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Seeing Red: Characterizing Historic Bricks at Sylvester Manor, Long Island, NY 1652-1735

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SEEING RED: CHARACTERIZING HISTORIC BRICKS AT SYLVESTER MANOR, SHELTER ISLAND, NEW YORK 1652-1735

A Thesis Presented

by

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ABSTRACT

SEEING RED: CHARACTERIZING HISTORIC BRICKS AT SYLVESTER MANOR, SHELTER ISLAND, NEW YORK 1652-1735

December 2014

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The goal of this project is to develop a basic material characterization of the bricks excavated at the site of Sylvester Manor on Shelter Island, New York. In the early Manor period of 1650-1690, this early Northern provisioning plantation supplied Barbadian sugar operations and pursued mercantile interests independent of state control. Accounting for the range of production defects and material properties of the bricks suggests on-site or local manufacture as a regional ceramic industry developed. Qualitative visual analysis and petrographic thin-sections were used to characterize the internal composition, variation and production evidence in the bricks. Interpreting the results of this analysis offers alternatives to the assumptions about building materials on the site, using material properties to assess the role of building materials as the landscape changed.

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS v

LIST OF FIGURES viii

LIST OF TABLES x

CHAPTER Page

I. INTRODUCTION 1
Research Questions 2

II. SITE OVERVIEW 8
Historical Context 8
Field Excavations 11
Brick Technology and Clamp Burning 14

III. SAMPLING 17

IV. ANALYSIS 28
Methodology: Visual Analysis and Microscopy 29
Initial Grouping 33
Dimensional Analysis 35
Group 1 Analysis 37
Subgroup 1A 37
Handsamples and Binocular Microscopy 37
Subgroup 1A Thin-Section Observations 42
Subgroup 1B 49
Handsamples and Binocular Microscopy 49
Subgroup 1B Thin-Section Observations 50
Subgroup 1C 53
Handsamples and Binocular Microscopy 53
Subgroup 1C Thin-Section Observations 61
Group 2 Analysis 62

CHAPTER Page

Handsamples and Binocular Microscopy 62
Group 2 Thin-Section Observations 68
Group 3 Analysis: Yellow Bricks 69
Handsamples and Binocular Microscopy 69
Group 3 Thin-Section Observations 77

V. DISCUSSION 80
Comparative Dimensions 80
Processing Bricks: Clay and Fabric Components 86
Firing 93
Bricks as Artifacts: Summary of Red Brick Groups 97
Group 3: Yellow Bricks 104
Note on Mortar 108
Possible Uses of Brick on the Site 109
Bricks in the Industrial Landscape of Sylvester Manor 114
Clamp Firing 117
Local and Regional Industry 119
Note on Ballast 122

VI. CONCLUSION 125
Afterword 129

BIBLIOGRAPHY 131

LIST OF FIGURES

Figure Page

1a. Site Overview of Sylvester Manor as of the 2005 excavation season 3

1b. Core excavations at Sylvester Manor, South Lawn 4

1c. Brick concentrations by weight.. 4

1d. Brick concentrations as scatterpoints.. 4

2a. Presentation of the four whole bats recovered from the A-Block........... 12

2b. Details of Sylvester Manor brick rubble and debris 18

2c. Details of brick features mentioned in text 26

3. Scatterplot of brick dimensions in the A-Block without analytical group assignments 36

4a. Group 1 Reduction Core Subgroup 1A Cross Section Profile Sample #43... 38

4b. #107 Subgroup 1A Rubble... 40

4c. #108 Subgroup 1B Rubble 40

4d. #101 Subgroup 1A Thin Section.. 43

4e. #101 Subgroup 1A Thin Section 43

4f. #101 1A Thin Section 44

Figure Page

4g. #101 1A Thin Section 44

5a. Group 1 Type 1B Cross Section Profile Sample #19 46

5b. Group 1 Reduction Core Subgroup 1B Cross Section Profile
Sample#3.. 47

5c. #118 Subgroup 1A Rubble 45

5d. #119 Subgroup 1B Rubble 45

5e. #102 1B Subgroup Thin Section 51

5f. #103 1B Subgroup Thin Section 51

5g. #102 1B Subgroup Thin Section 52

5h. #103 1B Subgroup Thin Section 52

6a. Subgroup 1C Cross Section Profile Sample #43 54

6b. Subgroup 1C Cross Section Profile Sample #55 55

6c. #34 Subgroup 1C 56

6d. #109 Subgroup 1C Rubble 56

6e. #100 Subgroup 1C Thin Section 59

6f. #99 Subgroup 1C Thin Section 59

6g. #99 Subgroup 1C Thin Section 60

Figure Page

6h. #100 Subgroup 1C Thin Section 60

7a. Group 2 Cross-Section Profile Sample #21 63

7b. #4 Group 2 64

7c. #114 Subgroup 1C Rubble 64

7d. #104 Group 2 Thin Section 66

7e. #104 Group 2 Thin Section 66

7f. #104 Group 2 Thin Section 67

7g. #105 Group 2 Thin Section 67

8a. Group Yellow Brick Group Cross-Section Sample #84 70

8b. #110 Yellow Group Rubble 71

8c. #111 Yellow Group Rubble 71

8d. #113 Subgroup 1A Rubble 72

8e. #112 Yellow Group Rubble 72

8f. #114 1B Fabric Cross Section 73

8g. #110 Yellow Fabric Cross Section 73

8h. #106 Yellow Brick Thin Section 75

Figure Page

8i. #106 Yellow Brick Thin Section 75

8j. #106 Yellow Group Thin Section 76

8k. #74 Yellow Group Cross Section 76

9. Scatterplot of A-Block brick bat dimensions reflecting group assignments after analysis 81

LIST OF TABLES

Table Page

1.Study population list 20

2. List of analytical products from study population 22

3. Brick artifacts in South Lawn A-Block units 24

4. Schematic representation of observational criteria 30

5. Overview: Brick Observations.. ?

6. Summary of proposed clay fractions 88

CHAPTER I

INTRODUCTION

This thesis investigates historic bricks from Sylvester Manor, a historic estate on Shelter Island, NY, in the eastern fork of Long Island (fig. 1a). The property was established in the mid-17th century by Nathaniel Sylvester, an Anglo-Dutch planter with stakes in Barbadian sugar operations, and is now an educational organic farm. It is one of the earliest Euro-American residences in the region and a rare surviving example of a northern plantation involved in the Caribbean trade as well as local commerce. It took its current shape in the 1730s after a major landscaping effort in the Georgian style , and the changing economic landscape has created a rich archaeological and documentary record which reflects the complex multi-cultural interactions and activities of native peoples, enslaved Africans, laborers and merchants over several centuries (fig. 1b-d).

The plantation landscape and its host of characters are well-studied, yet the building materials that actually shaped the environment are less perfectly understood. The site provides an opportunity to study building materials from controlled archaeological contexts as a dynamic component of a working plantation landscape. Self-sufficient manufacture was a central function of the expanding plantation during a century of

Sylvester ownership. Architectural ceramics such as bricks are well preserved and they can complement our understanding of material acquisition and production at Sylvester Manor. Bricks are made with fairly simple technologies, so accounting for structural materials sheds light on basic industrial requirements of the plantation. The built environment incorporates industrial processing as well as structures themselves (e.g. Moser et. al. 2003), and bricks are a good example of this intersection of landscape and labor. Different brick sizes, qualities and defects are represented in the excavations, including raw clay and defects associated with brick production This thesis specifically investigates a large sample of bricks from the site using optical microscopy. It organizes the recovered brick by characterizing and comparing selected material attributes and analyzes them as an example of an industrial product used at the site and in the region (Howe 2007; Scarlett, Rahn and Scott 2006; Armitage, Mink, Hill and Hurry 2006).

Research Questions

The goal of this project is to establish a basic material characterization of the bricks, and bring some order to this material which is the best preserved component of the built environment. Industrial products like brick must be understood in the technological context of their time and cannot always be compared directly. Understanding the manufacturing traces, defects and other variations in the properties of

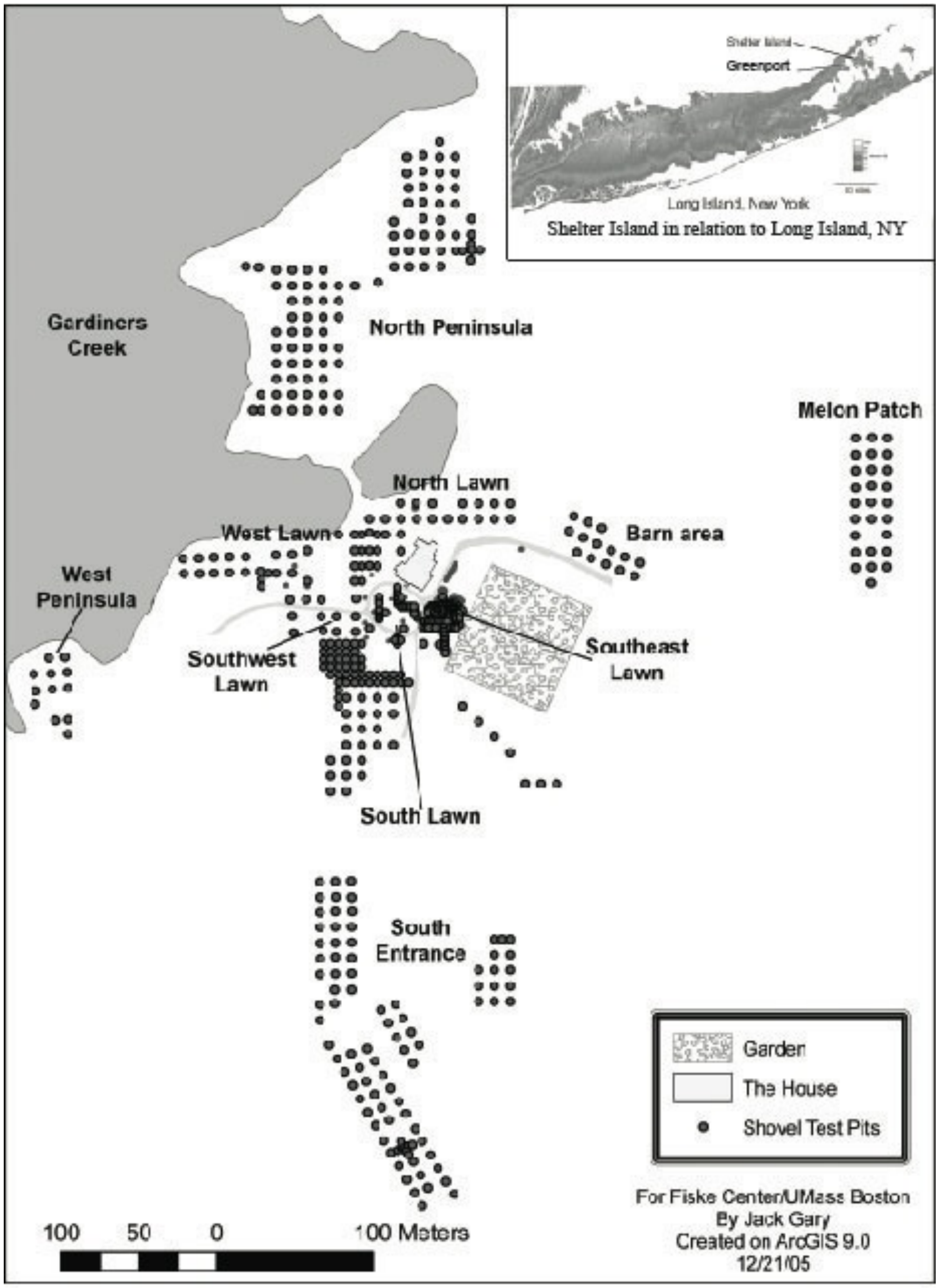


Fig. 1a: Site overview of Sylvester Manor as of 2005 excavation season, showing main areas of study mentioned in the text and geographical location of Shelter Island. Core excavations of the South Lawn midden are shown in fig. 1b), overleaf. Figs. 1c) and 1d) show previously plotted concentrations of architectural material including brick and pan-tiles, coral mortar and post-holes.

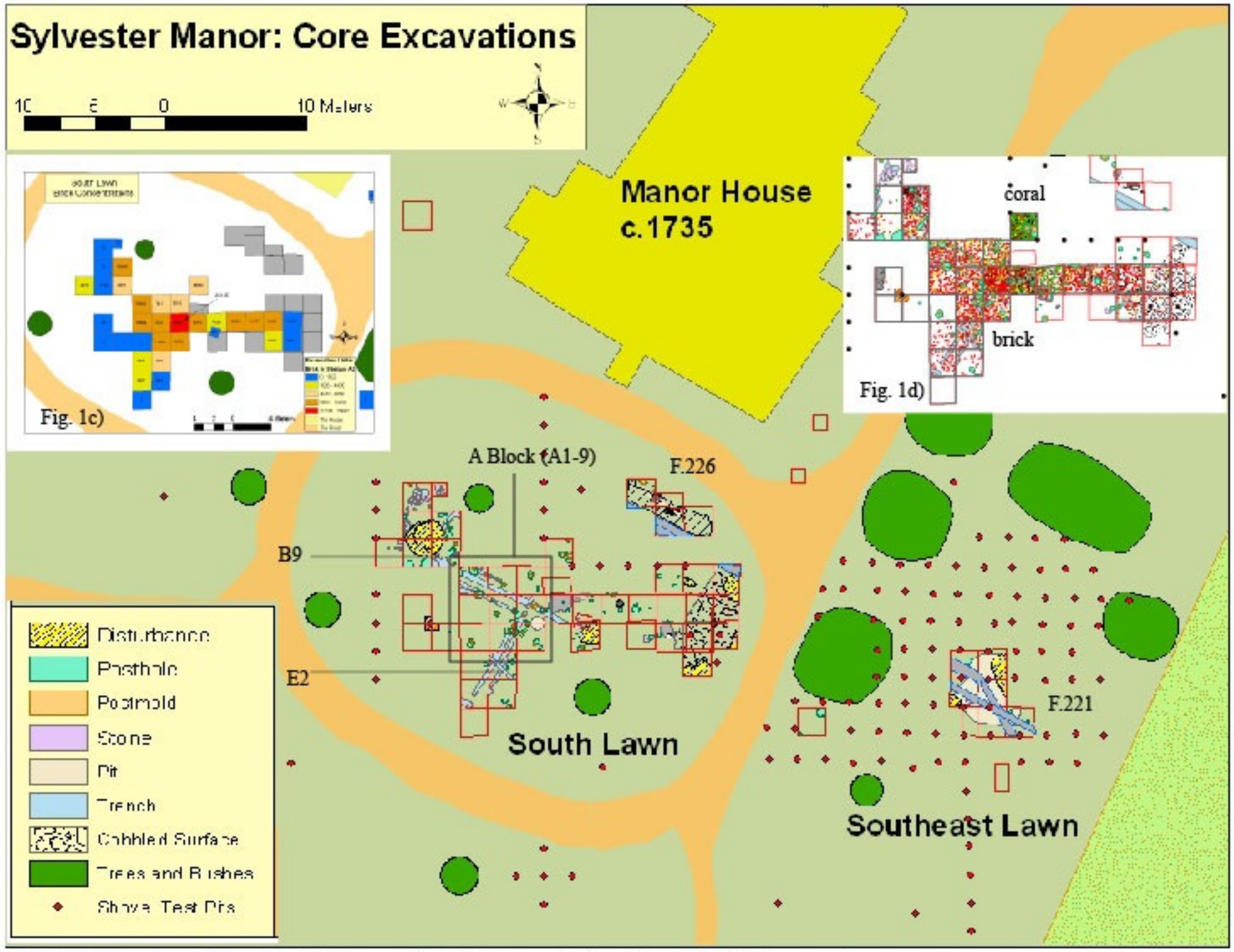


Fig. 1b) Core Excavations at Sylvester Manor, South Lawn; top left 1c) brick concentrations by weight; top right 1d) brick concentrations as scatterpoints ©Jack Gary, Fiske Center UMass Boston 2006

the brick and related construction materials such as pan-tile and mortar can support a broader discussion of the possible manufacturing activities at the site. At Sylvester Manor one assumption has been that concentrations of bricks, mortar and pan-tiles represent the remains of previous structures or elements in the vicinity, possibly the initial Manor house (Howlett 2007; Proebsting 2007). This thesis will develop alternatives to that assumption.

The shaping and firing of bricks both leave traces in the archaeological record and on the bricks as artifacts, so the focus of this study is a basic characterization of those factors by resolving the brick fabric components with qualitative descriptions and microscopic views of their interiors. This will contribute to an understanding of production methods used to create the Sylvester Manor bricks. The fabric components, surfaces and production traces of bricks (inclusions, temper, voids etc.) have specific qualities that can be analyzed, providing information about how bricks were fired and how firing affected the components. An analysis of these qualities will show that bricks which appear visually dissimilar may in fact be industrially related and suggest whether it is likely they are products made by a similar process and with similar materials. Accounting for this variation is also important because brick studies in historical archaeology have largely focused on manufacturing characteristics that emerge *after* the mid-19th century. Mechanized production, bulk freight networks and industry subsidies

have enabled detailed classifications of types, sizes and makers that resemble extensive systems for other ceramics like domestic wares; this makes it easier to place modern bricks in a documentary as well an archaeological context (Scarlett et. al. 2006; Gurke 1987). The Sylvester Manor bricks by contrast represent a range of handmade bricks from the 17th to 18th centuries which are materially undercharacterized and cannot benefit from such typologies (figs. 2a-c).

The excavated materials lack the geochemical references and spatial data to source the bricks directly, but laboratory methods and material characterization can be combined on a scale relevant to interpreting the role of bricks and construction at the site. Bricks are a good example of the real challenge of using laboratory analysis to understand the use-lives of artifacts. At what point does modern analytical evidence of damage, for example, translate into a past observed reality that was acted upon by a bricklayer? All bricks are small rectangular blocks of dried or fired clay with various additives. Yet beyond that, we can't presume on the criteria and parameters different uses bricks may have had, or exactly why they were used. Optical tools and methods are effective, low-cost techniques to enable a better understanding of bricks and other building materials as artifacts from the ground up. Comparing different visual scales can help account for overlooked variability or continuity in this material. In turn, this is relevant to the material experience of the site as a whole.

Landscape resources and formation processes influence the material complexity of sites (Hayes 2008; Woodward 2002; Lucas 2001; Gilbert et. al. 1993); the Sylvester Manor bricks represent just one possible way of converting raw materials in the landscape into resources used at the plantation. Clay deposits, sands, shells and coarser aggregates like river pebbles and rocks were all immediately available in the vicinity, along with marine water sources, a freshwater aquifer, abundant timber and a diverse labor force. Whether or not bricks were produced at Sylvester Manor, various businesses and industries in the region have taken advantage of such resources, and the material experience of plantations is important for understanding the role and development of such industries in the colonial Atlantic trade.

CHAPTER II

SITE OVERVIEW

Historical Context

Sylvester Manor functioned as a provisioning plantation for two sugar plantations on Barbados during the last half of the 17th century (figure 1a). Along with three business partners, including his brother Constant, Nathaniel Sylvester originally purchased and held Shelter Island in joint ownership. He took residence there in 1652 and oversaw commercial operations encompassing local trade, Caribbean supply and the manufacture of various provisions and foodstuffs. The joint business venture did not last long and in the early years of the plantation he had already gained control of a full half of the joint interest. His diverse business interests and partners extended his reach well beyond Shelter Island, and he showed political and financial finesse which culminated in his consolidating the entirety of Shelter Island as sole proprietor by 1672; no other partners ever took residence on Shelter Island. Unlike several Dutch sites in the region and the Hudson valley, it was not under external corporate or state supervision; the Anglo-Dutch heritage of the Sylvesters facilitated interactions between African, European, Native American and Afro-Carribean nationalities. Nathaniel Sylvester had a known sympathy

for Quakers and other Friends, even though this sometimes caused tensions where he did business, for example in New Haven Colony (Calder 1970). He was bred of both English and Dutch culture yet he seemingly owed no great allegiance to either government, always maneuvering to keep his interests independent. The Sylvesters were obviously shrewd business people, and they were not operating in an isolated environment: there was constant traffic across Long Island Sound and several critical nodes of the Atlantic circuit were just days by sail. Small holdings off Shelter Island are documented even in the mid-17th century in nearby Southold, including commercial operations like grain-mills, an orchard and most importantly, an interest in “brickyards and brickmakers at Hashamomac” (Calder 1970: 97; Town of Southold and Case 1882).

These holdings and interests operationally extended Sylvester Manor’s influence to these areas. As a business partner, Nathaniel Sylvester was party to rules of agreement drawn up in 1652, which regulated his economic behavior as the only business partner who took residence on Shelter Island. In particular, it set forth a formal corporate business structure: these rules established a general purse funding the venture and set restrictions for Nathaniel’s domicile and dealings, in the interest of turning a profit for the plantation. Personal trade was allowed but had to be reported along with annual accounts. Livestock was to be carefully managed and all lands and materials were to be held in common. Concerning construction, nothing was to be done “except for conveniency sake” (Priddy 2007:12). It is assumed that these articles influenced financial choices and

purchases as Nathaniel established the plantation, and that this includes the acquisition and use of building materials. One assumption that follows is that anything which could be produced rather than purchased would have been preferable under these articles, including bricks, mortar and plaster. If purchases were made, the cheapest and easiest options might have been preferable, although cultivating ties with local businesses would also be financially sound.

Complying with the articles, the current manor house was preceded by an initial two-story dwelling of “six or seven convenient rooms” (Priddy 2007:12), but it is unclear where exactly this house was, when and how it was demolished and what it looked like. The grounds also encompassed an entrance drive from the south, outbuildings such as a barn and dairy, a small wharf and planting areas over the years. These elements were connected by a network of roads, tracks and paths, all of which would have required materials and maintenance (Kvamme 2007). The Anglo-Dutch heritage of the Sylvesters is clearly captured in a mixed cultural aesthetic and cosmopolitan residential wares, with the assumption that this could extend to architectural preferences as well. A diapered cobblestone paving on the eastern edge of the south lawn is a good example of these preferences and the expression of identity and status through building materials (Howlett 2007).

Field Excavations

The excavations at Sylvester Manor from 1999-2005 identified two major concentrations of brick, one on the North Peninsula and one in the South Lawn midden (fig. 1b-d). These areas have been thoroughly investigated and yielded by far the highest number of bats and rubble, although only the South Lawn yielded intact bricks. This study concentrates on the A-Block of the South Lawn midden because it contained the densest area of brick concentrations and is interpreted as the core of the plantation workspace.

The South Lawn midden (field designation “A2”) is a single archaeological layer comprising several overlapping deposits of material, including postholes and molds revealed underneath the stratum (Howlett 2007). It covers the area extensively, and various features within it and in the vicinity have been interpreted as the best evidence of the previous built environment, possibly related to an original house or structures in the vicinity. The micromorphology of the midden soils was skillfully examined and yielded some important conclusions. First, the midden was likely open for several years and was capped in a rapidly layered episode coinciding with the ca. 1735 Manor house construction. Second,some architectural material was burned while the soil was not, which promotes the idea that the debris represents parts of previously demolished or burned structures from the South Lawn or another area (Howlett 2007; Proebsting 2007). Numerous features are scattered in the South and Southeast Lawns which intersect the

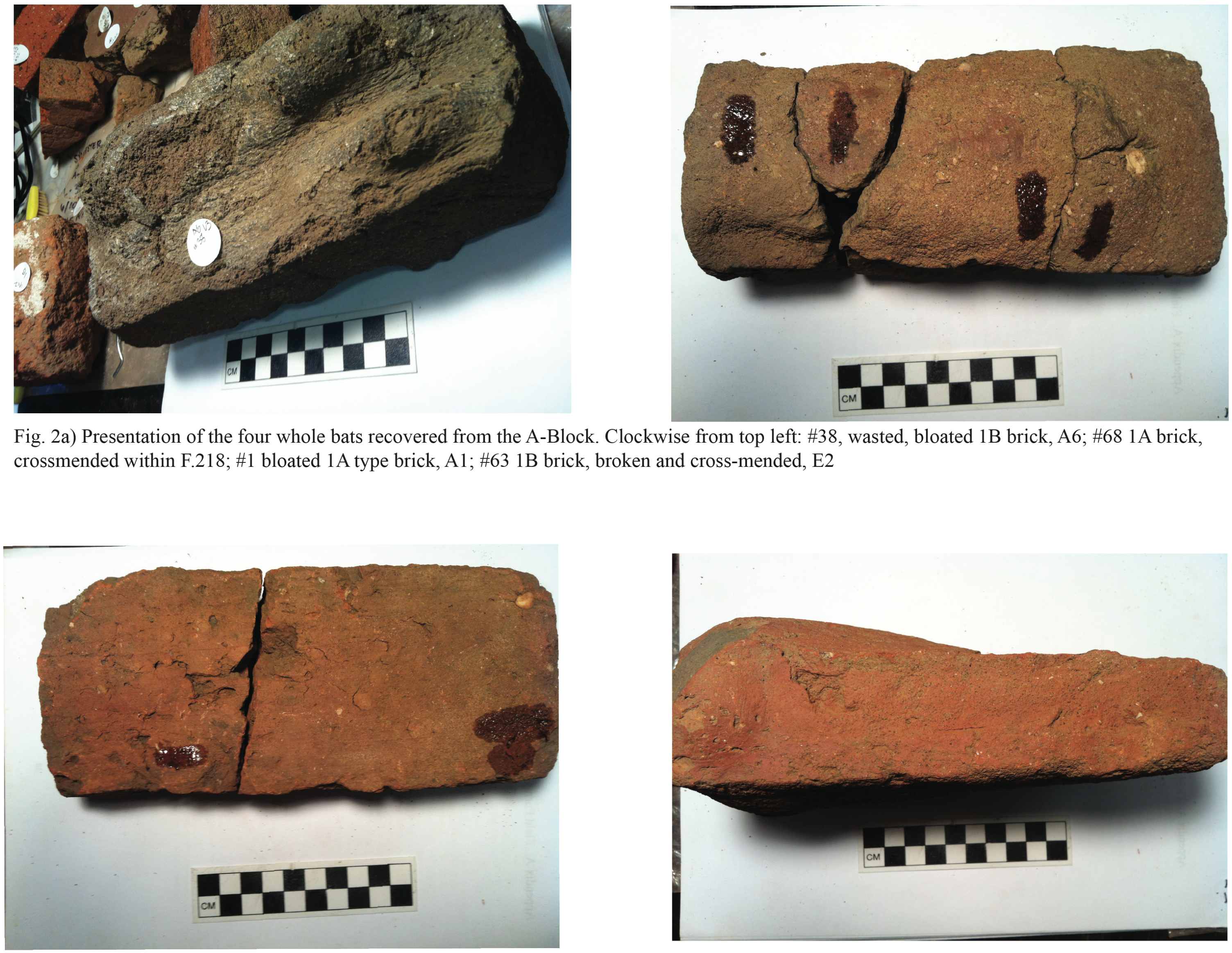


Fig. 2a) Presentation of the four whole bats recovered from the A-Block. Clockwise from top left: #38, wasted, bloated 1B brick, A6; #68 1A brick, crossmended within F.218; #1 bloated 1A type brick, A1; #63 1B brick, broken and cross-mended, E2

midden stratigraphy. Because the goal of this study is clarifying the technical origin and organization of bricks at Sylvester Manor, it is worth reviewing the following observations of brick and industrial activity in the midden area (figures 1b-d):

a) The South Lawn midden shows *separate* concentrations of brick and mortar. Brick is particularly abundant in unit A6, while a dense coral/mortar deposit in unit I7 with little brick contrasts sharply with adjacent units that contained high brick concentrations. The brick concentrations have distinct boundaries in the midden layer, notably a sharp decrease in unit A7 and lower concentrations across the other South Lawn units. Very few bats were recovered outside the A-block core area, and the volume of brick and pan-tile from underlying strata is negligible. Concentrations for the A-Block clearly show that the A2 midden layer is distinct in the density and diversity of its brick material within the South Lawn area.

b) Extensive landscape transformations at Sylvester Manor were a major focus of the excavation. Various phases of leveling, grading, filling and capping were recorded that scattered materials across the landscape (Howlett 2007). Construction materials are a constant theme in archaeological interpretation of deposits in the South Lawn and often appear in disturbed contexts. In particular, features 221 and 226 are complex records related to building activity, slaughter and labor tasks. Besides brick, high concentrations of mortar, raw coral, window glass, calcined shell and animal bone give these features an industrial character (Howlett 2007) and help distinguish them as distinct episodes. Like

the other material types the brick components in these features can be expected to reflect variation and change over time.

c) The Sylvester Manor bricks appear as weathered spall, rubble and bats in various conditions: the industrial “palette” is very wide (figures 2a-c). As with other structural materials and facings, this reflects different architectural “rhythms” of repair, maintenance and re-purposing that create distinctive taphonomic patterns for building materials and structural decay on archaeological sites (Leech 2005; Antonelli, Cancelliere and Lazzarini 2002; Bolvin 2000; Hinks 1997).

d) Mortar and plaster can be distinguished. Plaster traces incorporate hair to provide structure for thin layers, which the mortar does not, and it preserves relief patterns associated with *facing* bricks rather than coursing them. An analysis of the mortar concluded that sand is the only insoluble in an otherwise fairly pure carbonate body with no trace of gypsum commonly associated with smoother “fat-lime” plaster mixtures (Piechota 1999). This highlights the idea that the subtle variations in architectural materials can be appreciated but must be approached cautiously.

Brick Technology and Clamp Burning

The midden deposits date through the mid-18th century, so the technical assumption is that the brick evidence is consistent with the contemporary practice of “clamp” burning (O’Neill 2001; Finney and Snow 1991; Dobson 1850). With this

technique, “green” bricks (dried but unfired) are stacked into a closed mound of variable dimensions and so form their own kiln. This structure is undercut by fire channels and internal vents to conduct heat. It rests upon a fuel bed and/or a refractory surface of brick and sand. The mound is then sealed with clay and debris and fired from within, generally over a period of several days. During this time, bricks are constantly moved and flipped on the peripheries to promote an even exposure to the internal furnace. For large mounds, scaffolds and ladders were common. This technique produces a range of brick grades depending on how hot they get and how long they maintain that temperature. Clamps and drying bricks were generally covered with boards to secure against the elements and control air flow to some degree (Brown 1902; Morrison and Reep 1890).

On one hand, this is a very simple technology that requires little material investment beyond the bricks themselves and only a small measure of technical guidance. It can accommodate any required volume with little to dismantle (Smith 2001; Garvin 1994). On the other hand, it requires large amounts of labor and offers poor control of the firing atmosphere. A portion of lost product was understood as an inherent trade-off using the clamp method, although nearly every end product could be used for something, however defective. There is more preparation involved in a brick clamp than an open ceramic firing, but less infrastructure and maintenance than a kiln. Bricks are the only architectural ceramic that can fire themselves this way, so it is predictable what evidence of production will look like. Clamp activity is generally identified in archaeological

stratigraphy by soil staining due to high heat and slight depressions indicating fire channels, as well as a heterogenous mixture of wasted, cracked and otherwise defective bricks and daub reflecting margins of error and expedient use of debris (e.g. O'Neill 2001; Finney and Snow 1991). Kilns generally have smaller footprints where production evidence is better contained, while clamps tend to scatter evidence over a much wider area. Brick-making from 17th century Massachusetts, New Haven and New York to 1780s New Hampshire has produced evidence combining traces of production with both *acute* stresses (chimneys, structure fires, clamp burning) and *cumulative* stresses (for example, progressive frost and salt damage or abrasion) (Garvin 2002, 1994; Caroll 1979). This creates patterns of friable brick, spalls and chips, alongside larger rubble pieces due to stresses such as shear forces and shattering. Both stresses can occur both before and after deposition which can make a very complicated material record. This study focuses on the internal and external manufacturing traces of brick bats, supplemented by additional internal evidence from selected rubble cuts. Defects and wasters are very informative because they are caused both by heat stress during firing and by handling errors in a plastic state. This range of production circumstances is under-characterized yet very indicative of changes in technology and uses of brick in the landscape.

CHAPTER III

SAMPLING

The analysis sample was assembled from the area of highest brick concentrations on the site, namely excavation block A in the South Lawn (fig. 1b). The sample consists of brick bats and selected pieces of rubble from this area. Block A has nine 2m x 2m units ($36m^2$ total) which formed the core of the sample. Units B9 and E2 directly articulate with this block and also yielded bats, so bricks from those units were examined as well (hereafter, "A-Block" assumes these extensions are included). The total bat count comprised 98 brick bats, comprising all the recovered bats from this area, and the rubble pieces number 18. In total, this is a study population of 116 brick artifacts representing a range of production circumstances in the A-Block brick material (tables 1 and 2). Red and yellow bricks are visually distinct, but otherwise carried no further descriptive attributes in field recovery. For the red brick, 67 bats were identified in the A-Block, which includes four bats deemed characteristic enough for sampling but lacking intact dimensions; these areincluded in the sample data but were excluded from dimension measurements. Only four of the red brick bats are intact, of which two were cross-

Fig. 2b) Details of Sylvester Manor brick rubble and debris. Clockwise from bottom left:
1) Brick recovered from current Manor House (#72)

2) Brick bearing ‘SAGE’ mark from 19th brickyard at Greenport, recovered in surf (#74)

3) Underfired rubble incorporating the two base clays identified visually (CTX 1872)

4) Example of diagnostic (right) vs. undiagnostic (left) rubble (CTX 119)

5) Yellow brick rubble with incorporated shell fragment (CTX 106)

6) Brick fragment with mortar traces, possibly used as bricklaying tool (CTX 143)

7) Plaster fragment bearing contours reflecting brick facing (CTX 2032)

mended (fig. 2a). Additionally, four bat samples were identified from adjacent areas ofthe South Lawn for comparative purposes, bringing the total bat sample to 71. No other bats were identified in the south lawn, and no bats were sampled outside the south lawn. Yellow brick was also recorded for the A-Block units, yielding a total of 27 bats.

The eighteen brick rubble pieces of diagnostic interest were assigned sample numbers. This material was integrated into the micro-analysis of the brick fabrics and facilitated a minimum of invasive sampling on the bats themselves. The rest of the amorphous red brick rubble was not comprehensively analyzed, but was labeled as diagnostic or un-diagnostic according to whether individual pieces showed distinctive color, shaping traces, inclusions or surface features that could be resolved by eye and matched with larger brick pieces and bats. This diagnostic potential in the rubble was indicated according to represented groups or abundance of distinguishing features or surface finishes: high (~50% or at least two groups "+++"), medium (~30% or at least one group "++") or low (<20% or no apparent groups "+"). The context rubble piles total roughly 60kg, about half of the total material (table 3), Since pan-tile material was mixed into most of the excavated debris, it was separated as best as possible and the resulting rubble, excluding the non-dimensional bats and the rubble designated for analysis, was weighed by A-Block context to supply a revised figure for the brick material. A different focus was taken for the yellow brick rubble: pieces with visible shell inclusions were

Table 1: Study population list

Sample Number	SylManor CTX	Unit	Stratum	Group	width (cm)	height (cm)	width (in)	height (in)	ratio width/ height	projected length: width (cm) x2	length
1	106	A1	A2, L3	1	9.5	4.0	3 6/8	1 4/8	2.41	19.1	19.5
2	106	A1	A2, L3	1	10.3	4.6	4	1 6/8	2.24	20.7	
3	106	A1	A2, L3	1		4.3	0	1 5/8	0.00	0	
4	106	A1	A2, L3	2	10.2	5.3	4	2 1/8	1.90	20.3	
5	106	A1	A2, L3	1	10.3	5.1	4	2	2.02	20.5	
6	167	A1	A2, L4	1	8.9	5.1	3 4/8	2	1.74	17.8	
7	167	A1	A2, L4	1	10.0	5.4	3 7/8	2 1/8	1.84	20.1	
8	167	A1	A2, L4	1	9.4	4.9	3 5/8	1 7/8	1.93	18.8	
9	109	A1	A/B, L5	1	10.3	4.6	4	1 6/8	2.23	20.5	
10	109	A1	A/B, L5	1		4.7	0	1 7/8	0.00	0	
11	109	A1	A/B, L5	1		4.8	0	1 7/8	0.00	0	
12	109	A1	A/B, L5	1	10.1	5.1	4	2	1.99	20.2	
13	119	A2	A2, L3	1	10.2	5.0	4	2	2.05	20.4	
14	119	A2	A2, L3	1	9.9	5.1	3 7/8	2	1.94	19.7	
15	119	A2	A2, L3	1	10.7	4.1	4 1/8	1 5/8	2.60	21.3	
16	119	A2	A2, L3	2	10.1	4.4	4	1 6/8	2.28	20.2	
17	119	A2	A2, L3	1	9.7	4.2	3 6/8	1 5/8	2.30	19.3	
18	130	A3	A2, L3	1	11.2	5.7	4 3/8	2 2/8	1.96	22.4	
19	130	A3	A2, L3	1	9.6	4.4	3 6/8	1 6/8	2.19	19.1	
20	143	A4	A2, L3	1	10.6	4.9	4 1/8	1 7/8	2.15	21.2	
21	143	A4	A2, L3	2	9.9	4.6	3 7/8	1 6/8	2.16	19.9	
22	143	A4	A2, L3	1	9.8	4.4	3 7/8	1 6/8	2.21	19.6	
23	143	A4	A2, L3	1	10.1	4.4	4	1 6/8	2.32	20.3	
24	143	A4	A2, L3	1	10.3	4.4	4	1 6/8	2.33	20.6	
25	143	A4	A2, L3	2	9.9	4.9	3 7/8	1 7/8	2.02	19.8	
26	143	A4	A2, L3	1	10.2	5.3	4	2 1/8	1.91	20.3	
27	143	A4	A2, L3	1	9.8	5.0	3 7/8	2	1.97	19.6	
28	143	A4	A2, L3	2	9.6	5.0	3 6/8	2	1.93	19.2	
29	143	A4	A2, L3	2		4.4	0	1 6/8	0.00	0	
30	144	A4	A2, L4	1	10.3	5.3	4	2	1.96	20.6	
31	151	A5	A2, L3	1	10.4	5.4	4	2 1/8	1.92	20.8	
32	151	A5	A2, L3	1	9.9	5.4	3 7/8	2 1/8	1.83	19.8	
33	151	A5	A2, L3	2	9.3	4.7	3 5/8	1 7/8	1.99	18.6	
34	152	A5	A2, L4	1	9.8	5.1	3 7/8	2	1.93	19.7	
35	164	A6	A2, L3	1	10.2	4.8	4	1 7/8	2.15	20.4	
36	164	A6	A2, L3	1	10.8	5.1	4 2/8	2	2.10	21.5	
37	164	A6	A2, L3	1	9.5	3.9	3 6/8	1 4/8	2.44	19.0	21.0
38	164	A6	A2, L3	1	8.9	4.4	3 4/8	1 6/8	2.04	17.8	20.5
39	164	A6	A2, L3	1	9.8	4.0	3 6/8	1 5/8	2.43	19.5	
40	164	A6	A2, L3	1	10.1	5.4	3 7/8	2 1/8	1.86	20.1	
41	202	A6	A2, L4	1	11.4	5.1	4 4/8	2	2.22	22.8	
42	164	A6	A2, L3	1	10.3	5.2	4	2	1.96	20.5	
43	164	A6	A2, L3	1	9.3	4.8	3 5/8	1 7/8	1.93	18.6	
44	165	A6	A2, L5	1	9.7	4.4	3 6/8	1 6/8	2.22	19.4	
45	165	A6	A2, L5	2	9.7	4.4	3 6/8	1 6/8	2.21	19.3	
46	165	A6	A2, L5	1	9.1	4.4	3 4/8	1 6/8	2.08	18.2	
47	188	A8	A2, L3	1	10.9	3.8	4 2/8	1 4/8	2.91	21.9	
48	202	A9	A2, L3	2	8.8	4.4	3 4/8	1 6/8	2.02	17.7	
49	427	B9	A2, L3	2	10.3	5.1	4	2	2.02	20.7	
50	427	B9	A2, L3	1	9.7	4.5	3 6/8	1 6/8	2.18	19.4	
51	427	B9	A2, L3	1	10.1	5.18	4	2	1.95	20.2	
52	427	B9	A2, L3	2	9.8	4.5	3 6/8	1 6/8	2.18	19.5	
53	427	B9	A2, L3	1	9.2	4.6	3 5/8	1 6/8	2.00	18.5	
54	427	B9	A2, L3	1	10.0	5.1	3 7/8	2	1.96	20.1	
55	427	B9	A2, L3	1	9.8	5.0	3 6/8	2	1.95	19.5	
56	427	B9	A2, L3	1	10.0	5.2	3 7/8	2	1.93	20.0	
57	427	B9	A2, L3	1	10.2	5.3	4	2 1/8	1.92	20.4	
58	427	B9	A2, L3	1	9.2	4.5	3 5/8	1 6/8	2.05	18.3	18.5
59	217	E2	A2, L3	1	9.8	4.8	3 7/8	1 7/8	2.03	19.7	
60	217	E2	A2, L3	1	10.4	5.0	4 1/8	2	2.10	20.8	
61	217	E2	A2, L3	1	10.8	4.8	4 2/8	1 7/8	2.26	21.7	
62	217	E2	A2, L3	1	9.4	5.2	3 5/8	2	1.82	18.9	

Table 1: Study population list (cont.)

63	217	E2	A2, L3	1	9.0	4.2	3 4/8	1 5/8	2.16	18.0	
64	217	E2	A2, L4	2	9.4	4.5	3 5/8	1 6/8	2.08	18.9	
65	241	T26:1	A2, L3	1	10.2	4.2	4	1 5/8	2.44	20.3	
66	2032	CC1	L5	1	11.2	5.3	4 3/8	2 1/8	2.10	22.3	
67	2023	CC1	L4	1	10.2	4.6	4	1 6/8	2.20	20.4	
68	2152	A2	F.218	1	9.7	5.4	3 6/8	2 1/8	1.80	19.4	
69	130	A3	A2, L3	2	10.1	4.7	4	1 7/8	2.16	20.3	
70	86	S.Lawn	Plant Pit	1	9.7	4.6	3 6/8	1 6/8	2.10	19.3	
71	53	B3	A2, L3	1	9.3	4.9	3 5/8	1 7/8	1.91	18.5	
72	106	A1	A2, L3	3	6.7	3.8	2 5/8	1 4/8	1.76	13.4	17.0
73	106	**A1**	**A2, L3**	3	7.1	3.8	2 6/8	1 4/8	1.86	14.2	
74	106	**A1**	**A2, L3**	3	6.9	3.4	2 6/8	1 3/8	2.03	13.8	
75	167	**A1**	A2, L4	3	7.1	3.4	2 6/8	1 3/8	2.09	14.2	
76	167	**A1**	**A2, L4**	3	7.8	3.1	3	1 2/8	2.52	15.6	
77	167	**A1**	**A2, L4**	3	8.1	3.3	3 1/8	1 2/8	2.45	16.2	
78	119	A2	A2, L3	3	7.6	4.0	3	1 4/8	1.90	15.2	
79	119	A2	**A2, L3**	3	7.4	3.2	2 7/8	1 2/8	2.31	14.8	
80	119	A2	**A2, L3**	3	6.8	3.2	2 5/8	1 2/8	2.13	13.6	
81	130	A3	**A2, L3**	3	7.2	3.7	2 6/8	1 4/8	1.95	14.4	
82	143	A4	**A2, L3**	3	7.5	3.4	2 7/8	1 3/8	2.21	15.0	
83	143	A4	**A2, L3**	3	7.0	3.4	2 6/8	1 3/8	2.06	14.0	
84	151	A5	A2, L3	3	6.8	3.7	2 5/8	1 4/8	1.84	13.6	
85	151	**A5**	**A2, L3**	3	7.5	3.3	2 7/8	1 2/8	2.27	15.0	
86	151	**A5**	**A2, L3**	3	7.6	3.2	3	1 2/8	2.38	15.2	
87	152	**A5**	A2, L4	3	7.5	3.2	2 7/8	1 2/8	2.34	15.0	
88	164	A6	A2, L3	3	7.9	3.2	3 1/8	1 2/8	2.47	15.8	
89	164	**A6**	**A2, L3**	3	8.1	3.7	3 1/8	1 4/8	2.19	16.2	
90	164	**A6**	**A2, L3**	3	7.1	3.3	2 6/8	1 2/8	2.15	14.2	
91	188	A8	A2, L3	3	8.2	3.7	3 2/8	1 4/8	2.22	16.4	
92	188	**A8**	**A2, L3**	3	6.8	3.6	2 5/8	1 3/8	1.89	13.6	
93	188	**A8**	**A2, L3**	3	7.3	3.5	2 7/8	1 3/8	2.09	14.6	
94	427	B9	A2, L3	3	8.2	3.4	3 2/8	1 3/8	2.41	16.4	
95	427	**B9**	**A2, L3**	3	7.7	3.9	3	1 4/8	1.97	15.4	
96	427	**B9**	**A2, L3**	3	7.5	3.4	2 7/8	1 3/8	2.21	15.0	17.6
97	427	**B9**	**A2, L3**	3	7.9	3.2	3 1/8	1 2/8	2.47	15.8	
98	427	**B9**	**A2, L3**	3	6.9	3.2	2 6/8	1 2/8	2.16	13.8	
99	106	A1	A2, L3	Rubble			N/A				
100	130	A3	A2, L3	Rubble							
101	151	A5	A2, L3	Rubble							
102	164	A6	A2, L3	Rubble							
103	427	B9	A2, L3	Rubble							
104	143	A4	A2, L3	Rubble							
105	151	A5	A2, L3	Rubble							
106	164	A6	A2, L3	Rubble							
107	151	A5	**A2, L3**	Rubble							
108	151	A5	**A2, L3**	Rubble							
109	103	South Drive	A/B, L3	Rubble							
110	143	A4	**A2, L3**	Rubble							
111	164	A6	**A2, L3**	Rubble							
112	426	B9	**A2, L3**	Rubble							
113	151	A5	**A2, L3**	Rubble							
114	164	A6	**A2, L3**	Rubble							
115	188	A8	**A2, L3**	Rubble							
116	164	A6	**A2, L3**	Rubble							
									avg. 2.1		

Table 2: List of analytical products from study population

Sample Number	Cut Type	Location/ Condition	External Firing	External Shaping	Internal Firing	Internal Shaping	Brick Subgroup	
2	Cross Section	Interior	Reduction Spots	Abrasion	Sintered	Soft Fabric	1B	
3	Cross Section	Interior	Even	Length Strike, Light Mold Sand	Reduced Core, Bloat	Poorly Mixed	1B	
8	Cross Section	Interior	Reduction Spots	Coarse Mold Sands	Sintered	Large Voids	1C	
9	Cross Section	Interior	Vitrification	Smoothed Sides	Underfired	Soft, Poorly Mixed	1B	
19	Cross Section	Interior	Vitrification	Smoothed Sides	Sintered	Coarse Inclusions	1B	
21	Cross Section	Interior	Even	Wet Strike, Fine Sand	Sintered	Dried Clay Chips	2	
32	Cross Section	Interior	Even	Coarse Mold Sands	Sintered	Voids, Coarse Inclusions	1C	
34	Cross Section	Interior	Even	Coarse, Dry Fabric	Underfired	Dried Clay Chips	1C	
53	Cross Section	Interior	Vitrification	N/A (Ruptured)	Bloating	Soft, Poorly Mixed	1A	
54	Cross Section	Interior	Even	Coarse Mold Sands	Sintered	Coarse Inclusions	1C	
55	Cross Section	Interior	Heavy Reduction	Coarse Mold Sands	Red Core	Coarse Inclusions	1C	
56	Cross Section	Interior	Reduction Spots	Coarse Mold Sands	Marbling, Reduced Pockets	Coarse Inclusions, Voids	1C	
64	Cross Section	Interior	Even	Abrasion, Smooth Sides	Sintered	Well-Mixed	2	
74	Cross Section	Interior	Vitrification	Severe Deformation	Vitrified	Clay Inclusions	3	
84	Cross Section	Interior	Even	Abrasion, Beveling	Dark Vitrified Phase	Marbling	3	
98	Cross Section	Interior	Even	Abrasion, Beveling	Vitrified, Even	Marbling	3	
99	Thin Section	Interior/ Sintered					1B	
100	Thin Section	Reducing Pocket/ Underfired					1B	
101	Thin Section	Surface/ Offgassing Core					1A	
102	Thin Section	Surface/ Vitrified					1C	
103	Thin Section	Interior/Fused					1C	

Table 2: List of analytical products from study population (cont.)

104	Thin Section	Edge/Sintered					2	
105	Thin Section	Interior/ Sintered					2	
106	Thin Section	Interior/Lightly vitrified					3	
107	Cross Section	Rubble/ Vitrified Edge	Vitrified Exterior, Gaseous Core	N/A	Bloating	Poorly Mixed	1A	
108	Cross Section	Rubble/ Vitrified Interior	N/A	N/A	Sintered	Nodules, Voids	1B	
109	Cross Section	Rubble/ Interior	N/A	N/A	Sintered	Dry Fabric, Dried Clay Chips	1C	
110	Cross Section	Rubble/ Vitrified Edge	Thin Vitrification Layer	N/A	Marbling	Vitrified Clay Pockets, Crusts	3	
111	Cross Section	Rubble/ Vitrified Interior	N/A	N/A	Marbling	Reduced Clay Marbling	3	
112	Cross Section	Rubble/ Vitrified Interior	N/A	N/A	Marbling	Clay Pockets, Crusts	3	
113	Cross Section	Rubble/ Vitrified Edge	Vitrified Exterior, Gaseous Core	N/A	Bloating	Poorly Mixed	1A	
114	Cross Section	Rubble/ Sintered Interior	N/A	N/A	Sintered	Dark Nodules, Dried Clay Chips	1C	
115	Cross Section	Rubble/ Vitrified Interior	N/A	N/A	Marbling, Vitrification	Voids, Cracks	1A	
116	Cross Section	Rubble/ Sintered Interior	N/A	N/A	Sintered	Grog, Shrinkage Rims	1B	

Table 3: Brick artifacts in South Lawn A-Block units

A-Block	A1	A2	A3	A4	A5	A6	A7	A8	A9	B9	E2	Other CTX	Total
n (bats) Red Brick	12	6	3	11	4	12	0	1	1	10	6	**5**	**71**
Diagnostic Potential, Red Brick Rubble	++	+	+	+	+++	+++	++	+++	+	++	+	-	average ++
Rubble, red (kg)	7.52	7.67	4.65	3.07	4.5	13.15	1.85	8.79	6.59	2.27	1.48	**-**	**61.54**
n (bats) Yellow Brick	6	3	1	2	4	3	0	3	0	4	1	**0**	**27**
n (shell frag rubble), yellow	3	0	0	0	1	0	0	1	0	0	0	**0**	**5**

recorded since the fabric showed very little variation compared with the red brick rubble. The shell components of the yellow brick were of analytical interest, however, since they do not appear in the red bricks and indicate a distinct technology, clay source and/or processing method. This selection recognized a need for a different analytical focus to contrast them with the red bricks and develop an alternative to the previously held assumption that they were imported. In North American contexts, the term “Dutch” is widely and loosely used to describe these yellow bricks, which are generally considered as imported Dutch products (e.g. Smith 2001).

This sampling split the material into red and yellow brick, and then separated it into two classes of brick artifacts: brick bats (pieces with at least two intact dimensions) and rubble (with zero to one intact dimensions). Brick bats were defined as having a measurable height and width, since only four bats have an intact length. The width and height were both defined by shaping marks: mold edges (height and width) or striking surface to reverse surface (height only). Dimensions of the brick bats were recorded with calipers in centimeters and rounded to one decimal (table 1). This initial review showed significant fabric variation in the sample: two different red brick groups comprising 71 bats and 14 rubble pieces (Group 1 and Group 2, 73.3% of the brick sample) were recorded alongside the distinctive yellow bricks with shell components, Group 3, totaling 27 bats and 4 rubble pieces represents 26.7%.

Fig. 2c) Details of brick features mentioned in text.
Clockwise from top left:

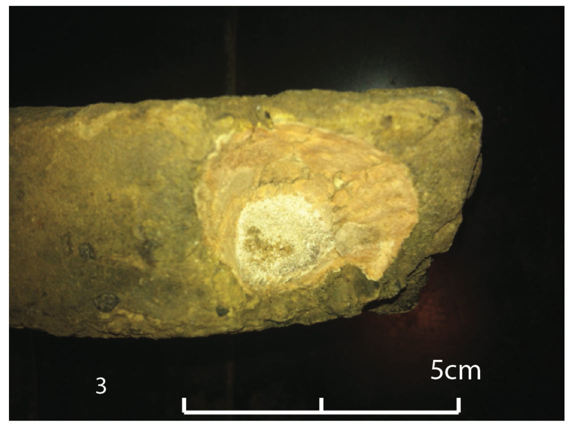
1) Mechanical deformation by handling (”pinching”, #65)

2) Broken, fused debris, 1B subgroup CTX 169

3) Yellow brick with embedded shell (#75)

4) Molding striae and “lip” (1B subgroup, #71)

5) Internal appearance of oxidized clay (red) and with components of carbon/iron rich clay (black), recorded as “burned” brick (1C subgroup, #117)



The separation of the red brick groups was based on external evidence of shaping and fabric quality: Group 1 bricks are struck lengthwise and show rough, poorly processed fabrics, while Group 2 bricks are struck across the width with water and have smoother, more homogenous fabrics. Apart from their yellow color, Group 3 bricks were also distinguished by a lack of obvious production traces seen in the red bricks, notably coring and molding traces. This suggests technical production differences underscored by their distinctive coloring. These basic differences were noted during the sampling phase and formed the basis for further analysis.

CHAPTER IV

ANALYSIS

This chapter draws together different lines of evidence regarding the manufacture and processing of the Sylvester Manor bricks, demonstrating how they are industrially and mineralogically related. The analysis is aimed at material characteristics since it cannot yet benefit from elemental sourcing of clays in an industrial region (Monette, Richer-LaFlèche, Mousette and Dufournier, 2007; Pavia 2006; Armitage et. al. 2006; Gilbert et. al. 1993). Whether or not the bricks were made locally, they were obviously used at Sylvester Manor, so recording characteristics of bricks and other industrial materials will enhance the understanding of basic structural needs and maintenance processes at the plantation.

Ceramics are extremely complex systems with interacting chemical and structural behaviors in the clays, inclusions (non-plastic components) and temper (deliberately added non-plastics). Brick and other aggregate studies rely on a combination of methods to provide complementary data, since the strengths of each are suited to different chemical and mineralogical observations. Frost, salt, acidic and mechanical damage can also be distinguished within bricks in hand-sample and microscopically (Larbi 2004;

Hinks 1997; Renk 1969). Thus, architectural ceramics can generate unique qualitative data regarding taphonomic appearances, firing behaviors and weathering. At Sylvester Manor, the quantitative brick data consists of total weights, which provides a rough idea of concentrations for different contexts but does not account for material differences within them. To contribute qualitative data on the bricks as well, analytical methods were used that reflect similar work done on aggregate characterization with low-cost optical methods yielding high returns of information. The sampling phase measured the dimensions of the brick bats in the A-Block, and organized them into groups based on visual surface characteristics of bricks and rubble. In this phase, low-power microscopy, cross-sections of brick and thin-section petrography were used to refine and describe those groupings with standard references (Nesse 2012; Rice 2005). Thin-section analysis was chosen to microscopically investigate characteristics observed in hand-samples, with particular reference to defective firing behavior since this manifests as easily discerned differences resolved by eye in brick bats. These methods characterize the basic composition and production technology of the bricks, contributing to an understanding of the industrial landscape of Sylvester Manor which is discussed after the analysis.

Methodology: Visual Analysis and Microscopy

In this phase, rubble and brick bats were examined to observe internal composition and firing behavior (table 2). Fifteen brick bats and ten pieces of the selected

Table 4: Schematic representation of observational criteria used in the analysis of Sylvester Manor brick sample. The table is divided into external and internal features related to both shaping and firing. These criteria were resolved with the unaided eye, microscopy and thin-sections.

	SHAPING	FIRING
EXTERNAL Group 1 and 2 criteria	Dimensions (width, height and/or length) Mechanical Deformations Tearing, Pinching (common hand-molding defects) Surface Features Strike Marks (length or width) Molding marks Edge Retouch (smoothing or brush marks) Corners (if intact: sharp or worn) Molding sands (coarse or fine; faces and/or sides)	Fractures (sharp, clean=well fired, homogenous fabric; friable, rough= poorly mixed or low fired fabric) Surface Color(s) (ranges in reference to Munsell Color Charts) Deformations Bloating (rapid gaseous development), Slumping/Fusing (distortion by intense heat) Surface Features Localized fluxing or vitrification (extensive or partial, color and texture of glassy phases) Capillary action Extraction of organics through pores (thin, dark rinds) Extraction of interior salts (white "scum")
INTERNAL Group 1 Subgroups Details (all bricks)	Processing of clays (brick texture) Homogeneity of fabric (coarse vs. fine fraction), Mixing of clay components Distinct bands or layers (different colors due to different firing behaviors) Added aplastic grog, clay waste material (dried spall and chips), indurated clay components (dried nodules with elemental/mineral differences) Shaping Whorls Voids and air pockets indicating shaping method as loops or layers, often confirmed by inclusions and fabric marbling Size, shape, details of inclusions (>0.1mm)	Porosity Void shapes, sizes and alignments Development of sintering (solid particle fusing) or internal vitrification (melting), Firing temp estimates Coring Black (inide out: reducing atmosphere, incomplete carbon displacement) or Red (outside in: previously oxidized and reduced again); sources of bloating and offgassing Internal Color(s), Munsell ranges Streaks, Plumes, Marbling Offgassing and vitrification developing erratically along fault lines or boundaries of fabric components

analytical flow

rubble sample were cut across the width with a Raytech saw, thus exposing a flat surface. Photomicrographs were taken of these cross-sectioned pieces with a Celestron 44302 digital microscope between 10x-50x and processed with Mac OS X and Adobe CS5. These images allowed a closer inspection of the fabric components and details on a scale between petrographic analysis and hand-sample observations. From the rubble sample set aside for analysis, eight pieces were selected for thin sectioning according to the following criteria: a) representing a range of firing processes: vitrified, defective and mid-range fabrics that could mechanically withstand the procedure; b) a representation of all identified brick fabrics; c) lending themselves to minimally invasive sampling by fitting onto a standard petrographic slide with a single cut. Thus, eight thin sections were prepared according to the standard protocol at the Center for Material Testing in Archaeology and Ethnology at MIT (table 3). These were cut with a Raytech saw and impregnated with Epotek 301 compound optical resin. These samples were then mounted on petrographic slides with additional Epotek 301. These samples were then ground to 30µm on an Isomet Petrothin system, polished with 1000 grit silicon carbide powder, cover-slipped, and studied with an Olympus BH-2 polarizing microscope fitted with a Leica DC-300 image capture package. Table 4 is a schematic representation of the observational criteria used to evaluate brick groups and subgroups. It summarizes external and internal observations related to both shaping and firing. This is important because brick analysis must account for a range of appearances and features generated by

both shaping and firing even within the range of a single type of brick. The visual analysis progressed in four observation areas: identifying external and internal evidence of both shaping and firing. By systematically comparing these areas, the 98 brick bats were organized into groups and subgroups. On the visual level, important criteria include: size/dimension, color, large inclusions visible to the eye (>2mm), shaping traces, surface features and evidence of firing conditions such as the formation of cores, vitrification and defects (Nesse 2012; Rice 2005; Smith 2004; fig. 2c). Illumination of thin-sections in plane polarized (PPL) or cross-polarized light (XPL) allows identification of microscopic criteria for distinguishing the fabric groups. These encompass microstructure (size and shape of pores and voids), fine fraction (clay ground mass composed of very fine "colloidal" particles) and coarse fraction (mineral and non-mineral particles within the resolution of the polarizing microscope used). Size, shape and frequency of inclusions and temper was determined by reference to standard abundance charts common in geomorphological studies. In particular, the identification of a "bi-modal" size range of mineral inclusions is important and generally indicates a deliberate addition of mineral or rock components (notably quartz) not found in the clay source itself, for example quartz sand or crushed quartzite rocks (e.g. Rice 2005). In this analysis, "bi-modal" refers to this disparate size range and not to a bi-modal distribution of different minerals. Although sand is often largely composed of quartz particles, crushed quartz components which concurrently appear in the fabric in size ranges larger than 3mm are designated as a type

of deliberately added“temper”. Together, the combination of microscopic and macroscopic scales of observation provide information that can account for the range of industrial production traces which characterize architectural ceramics in general and bricks in particular; unlike conventional ceramic typologies, the interest is in ranges of variation, rather than reference to specific types. For example, a group of similar bricks might have very different colors if some were underfired (trending towards lighter colors), overfired/vitrified (darker colors and glassy phases) or exposed to a reducing atmosphere (very dark to blackish hues). The bricks are labeled as “groups” rather than “types” to reflect the comparative nature of the analysis. The comprehensive results of these analytical methods are summarized in Table 5.

Initial Grouping

Observational criteria of the bats were collated (table 4) as observations of the bats progressed in several passes to distinguish basic characteristics not recorded in field excavations and initial processing. Group 1 is composed of rough, poorly processed bricks and wasters and includes three subgroups that were divided based on the basis of internal and external firing and shaping criteria. Group 2 by contrast contains technologically superior bricks with better processing and shaping methods. Including Group 3, the distinctive yellow bricks, this creates a total of five kinds of bricks represented in the Sylvester Manor A-Block. Exterior criteria were sufficient to

distinguish the basic division of Groups 1 and 2, while the yellow Group 3 was easily distinguished by color and did not show significant fabric variation. While internal shaping and firing details allowed further analytical insights into Group 2 and the yellow Group 3, they also enabled the division of Group 1 into three subgroups. Group 1 consists of three distinct sub-types: 1A, 1B and 1C (figures 4a through 6). These bricks were all produced with soft-mud methods and contain highly bi-modal coarse fractions which include riverine post-glacial gravels and iron-bearing sands. The internal appearance of these bricks is inconsistent, which suggests a lack of thorough preparation and mixing. Variability is also introduced by defective shaping techniques and an erratic range of behaviors as the clay bricks are fired. The three subgroups share heavy mold sanding and highly plastic fabrics which retain surface features well, such as the striae which consistently run header to header along the length on the striking face. Shaping whorls create temper domains inside the fabric and often work surface sand mixtures into the brick (figures 4a-b). The pore system formation is elongated along the width of the brick rather the length. There are no prominent surface marks or stamps of any kind**,** nor indentations to retain mortar in hand-molded bricks (*"keys"* or "*frogs*"; Gurke 1987; Searle 1921; Morrison and Reep 1890). The striking striae can be used to distinguish bricks groups, however: Group 1 is struck along the length, and the striae in this assemblage should have retained mortar traces but with rare exceptions do not. Some brick pieces and rubble show impressions suggestive of drying and stacking on open

ground, as well as mechanical and vegetal traces (grass, leaves, twigs; tools, nails, handling). These are all indications of raw clay processing since impression occurred in a plastic state.

Dimensional Analysis

Do the measured brick dimensions illustrate size consistency in the midden material? Can dimensions distinguish bricks that are similar in composition? Figure 3 shows a plotting of the measured bat dimensions without reference to analytical groups. A line indicating a 2:1 shape ratio for w:h. was added to visually gauge shaping consistency of the brick bats. Reference points are included that reflect three non-archaeological comparisons: 1) a 19th century brick representing the regional Sage brickyard (width 8.7cm, height 5.5cm, length 19.8cm) , 2) the size regulated by Mass Bay Colony in 1679 (width 11.4cm, height 5.7cm, length 22.8cm), and 3) a brick recovered from the current Manor house (width 9, height 4.2cm, length 18cm). Despite widely different sizes, the total average of dimension ratios (w:h) for the entire brick sample is 2.08, which confirms that they roughly strive towards the same shape. If a 4:2:1 shape ratio is assumed as a model, then a length can be projected for them and compared with a measured width or height. Length measurements for the four intact bricks in the A-Block suggest this ratio is roughly consistent.Since consistent brick sizes and shapes will influence the stability of any structure, controlling dimensions is important to brick industries. This sets practical limits for bricks as units of construction: they should roughly agree in size to be both

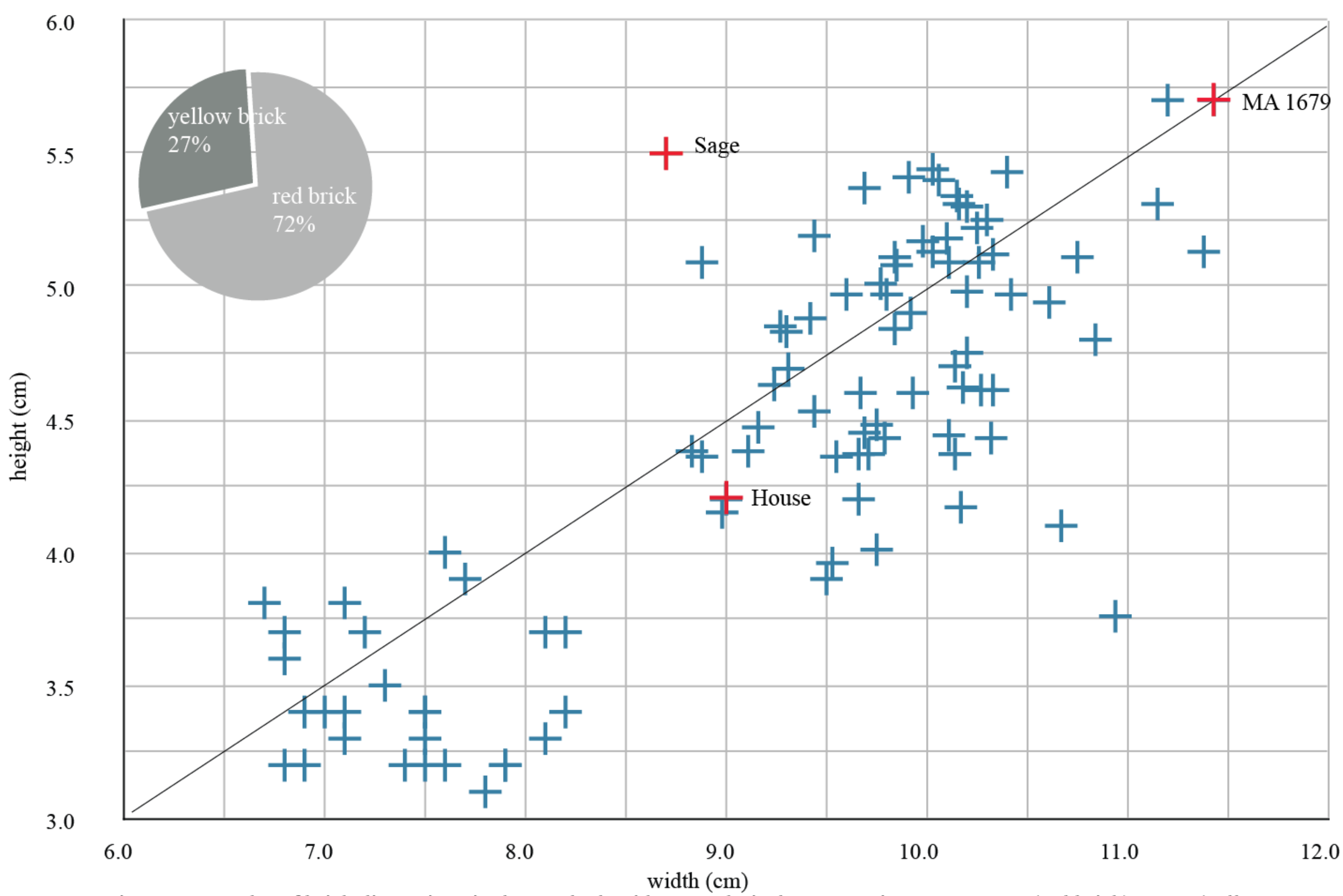


Fig. 3: Scatterplot of brick dimensions in the A-Block without analytical group assignments. n=67 (red brick), n=27 (yellow brick).Additional reference points are mentioned in the text and include a) a 19th century brick from the Sage brickyard at Greenport, NY; b) a brick recovered from the current Manor; c) the brick size prescribed by Massachusetts Bay Colony law in 1679.

within the practical grasp of a hand and overlap at predictable intervals to allow reinforcing patterns. Coursing bricks are commonly just under twice as long and half as high as they are wide, roughly conforming to a shaping ratio of 4:2:1. (e.g. Gurke 1987,Shaw 1846). Measurement ratios are a simple way to compare brick sizes and shrinkage, as they emphasize shape as given by more than one dimension.

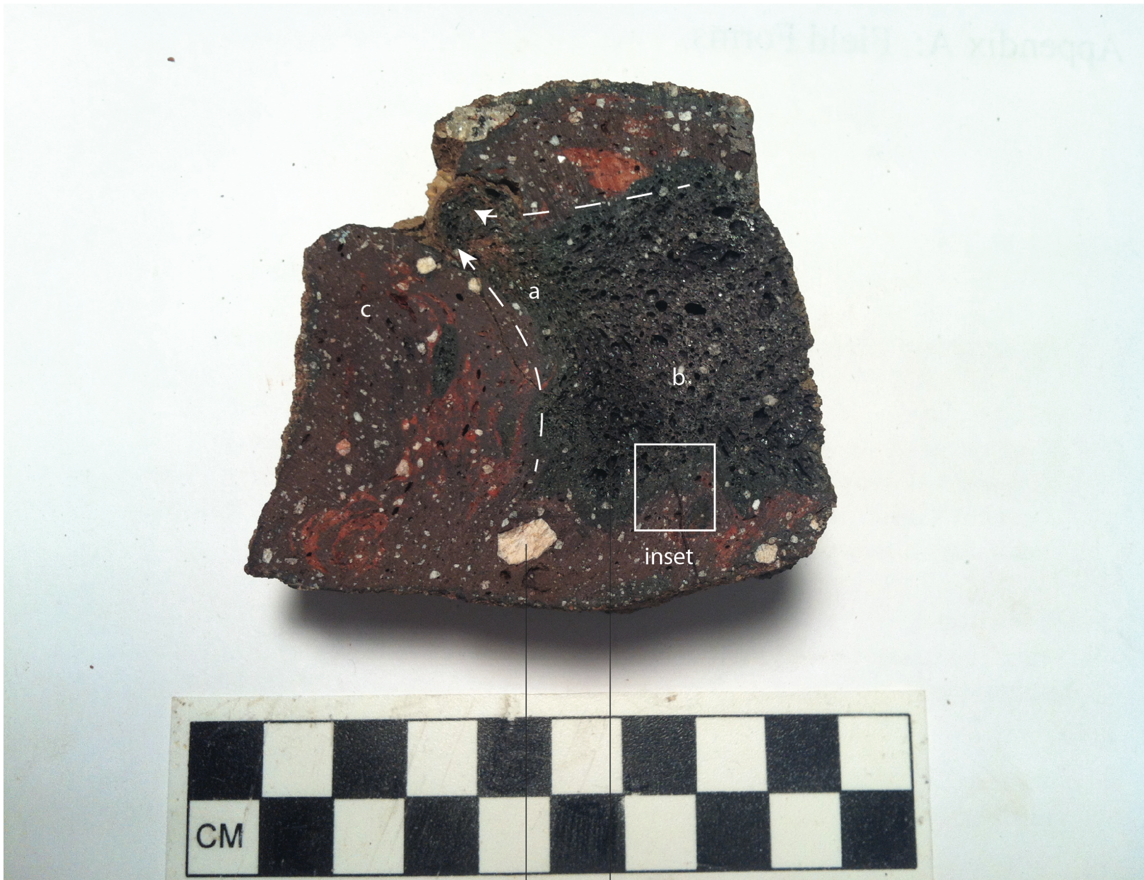
Group 1 Analysis

Subgroup 1A

Handsamples and Binocular Microscopy

Subgroup1A consists of five bats, 5% of the total bat sample (fig. 4a). It comprises erupted, marbled bats associated with the highest rate of deformations and uneven temperature exposures, often termed *clinkers* (ref. figure 2b). This group represents the most defective element in the A-Block bricks. This is apparent in the extensive bloating seen in these pieces, as their manufacturing inconsistencies exposed various rents and cracks to unequal atmospheres, causing irreparable flaws in the fired products and highly distorting dimensions. The defects can also resemble black marbling or "smearing" as well as remnants of incompletely oxidized clays and grog particles. Further, the unequal heat exposure causes the bloating and puffing characteristic of this group. Both spectacular examples of articulated breakage and failure as well as subtler internal evidence of incomplete oxidation combined with gaseous release are commonly f

Fig. 4a) Group 1 Reduction Core
Subgroup 1A Cross Section Profile   Sample #53 South Lawn Midden B9



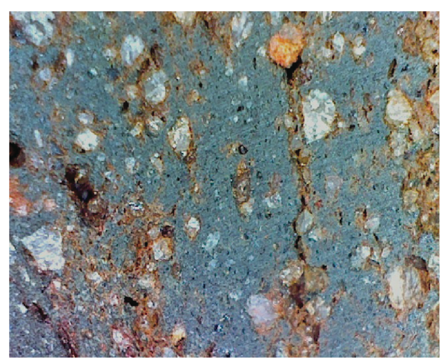
Inclusions (% of coarse fraction)
Quartz and Rock (as temper) 40%
Grog or Dried Clay <5%
Feldspars 20%
Hornblende/Mica (trace sand components)
Sand 35%

Voids/Pores: vitrified surface with internal pocket voids,
extensive gaseous matrix, vitrified marbling
Surface Strike: Length

Coarse:Fine:Void ratio 30:40:30

Bi-Modal quartz distribution

Areas: a) expansion fault lines b) reduction core c) fully vitrified



Detail of #53 vitrified interior with closed voids, width of field 1cm

found in this group. Evidence of the gaseous release mainly appears as pockets or bubbles with a highly brittle internal structure caused by expanding bubbles trapped in a vitrified matrix. It is particularly evident in the bloating of larger bats and is associated with the crucial firing variables of time and temperature as well as internal chemistry; this group demonstrates a rapid firing environment in which carbon could not completely oxidize and the bat most likely bloated as a result of a quickly vitrified exterior (figures 4c-d). This behavior can appear internally causing only slight deformations, as well as a severe bloating due to rapidly expanding gas pockets. The voids formed by this process can be arranged tightly packed and very small, or fairly large and spaced apart depending how rapidly gas was formed due to the brick's placement in the clamp; small localized nodules generally show a fine-grained gaseous matrix while severely defective fabrics have large expansion, open pores and a brittle lattice structure. Smaller patches of darker material can be discerned at the core of bloating pockets.

The vitrification seen in these bricks forms as a continuous "skin," typically of sodium silicate associated with reduced conditions as read from underlying clay layers. All defective bricks in this type show some indication of vitrifying conditions, often unevenly distributed across the surfaces and in the internal fabric, as would occur if clay batches were processed unevenly or with fluxes introduced by seawater, for example. The whitish-grey glassy phases are formed by the extraction of salts, with yellow-green components representing contamination by organic oxidation compounds such as sulfides

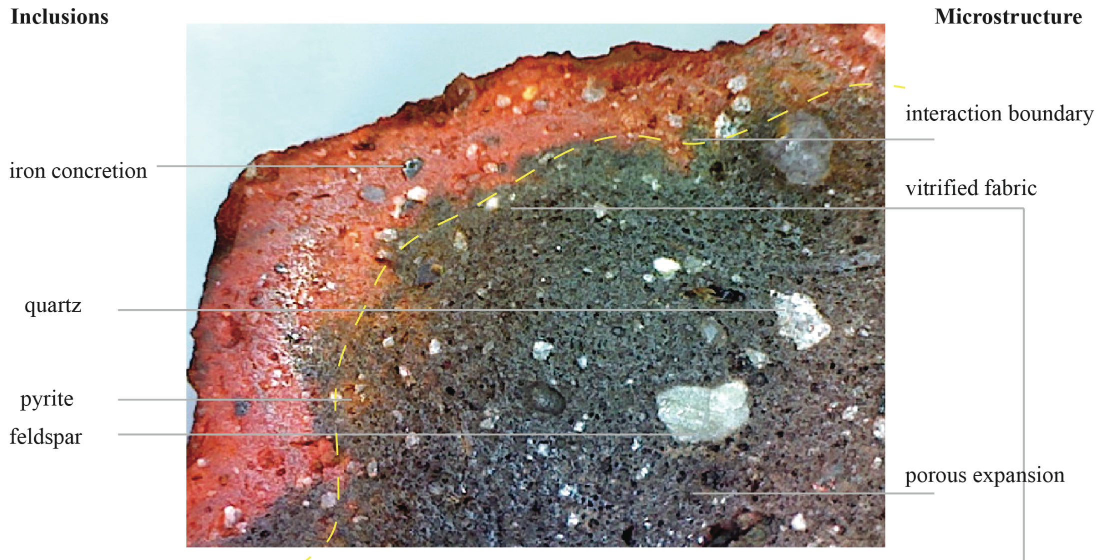


Fig. 4b) #107 Subgroup 1A Rubble: Detail of gaseous 1A fabric under a rapidly vitrified and fully oxidized layer plastic enough to deform. The interaction boundary is a sintered phase showing micropore development. Width of field 2cm.

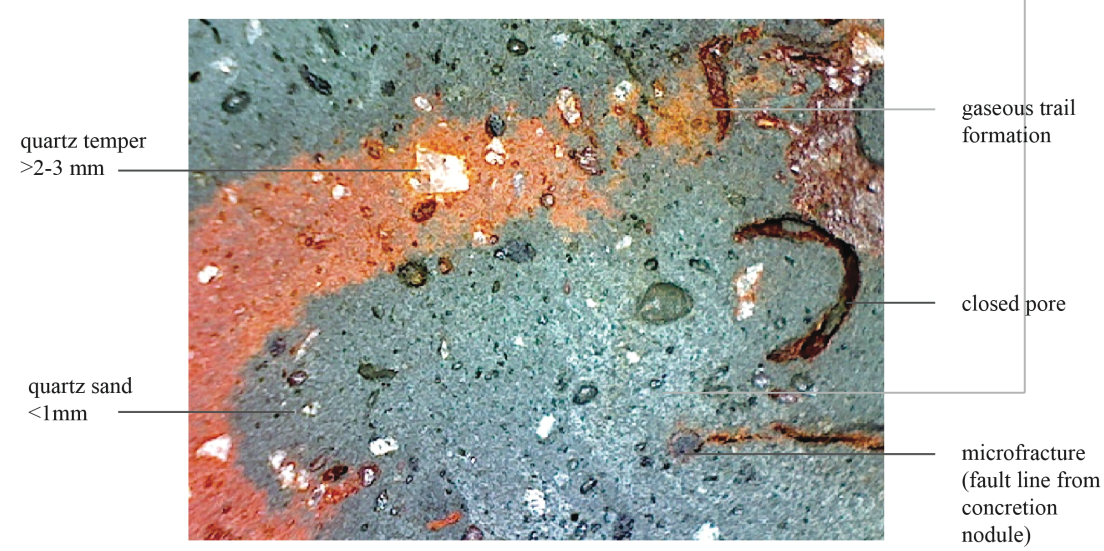


Fig. 4c) #108, Subgroup 1B Rubble: 1B marbled fabric showing gaseous movement through the brick fabric. Both face porosity and internal gaseous pressure cause this marbling associated with erratically vitrified fabric. The crescent shaped closed pore indicates burn-out of an organic inclusion. Width of field 2cm.

which can form in depositional environments. A combination of impurities in the ingredients and poor processing and firing can easily create such highly unequal and defective areas even within a single brick. A dark burgundy fabric color is reached at total vitrification that includes a dissolving of all but the highest melting inclusions in the fabric. The resulting permeability of these bricks is very low below these vitrified surfaces, and as a consequence, gasses are trapped in the extensively bloated phases, which are characterized by sub-spherical voids and burnouts with extensive micropore formation (figures 4b-c). The microstructures characteristic of type 1A show that the initial mixing and preparation of brick clays have long-reaching consequences and that these bricks were particularly sensitive to initial shaping.

This severe deformation and bloating was caused by a firing temperature exceeding 900º C and rapid complex volatilizing of organics and carbonate materials in the brick (Rice 2005). This creates very hard exterior surfaces highly resistant to both chemical and mechanical damage, yet 1A bricks are brittle and fracture sharply into large rubble that can sometimes be cross-mended. These bricks are the most mechanically inconsistent group as well, often showing traces of tearing, over-pinching and warping common in poor molding, striking and stacking; this group is clearly associated with manual failings rather than firing defects alone. Also characteristic of sub-type 1A bricks are very large inclusions in the form of both angular pebbles and rounded gravels of iron-stained quartz, which promote internal breakage and disrupt cohesive domains in the fine

fraction. These are in stark contrast to other major components of the coarse fraction, which include crushed micaceous rocks along with bi-modal quartz sands which account for ca. 80% of inclusions.The K-feldspars in particular are identified by cleavage planes; larger pieces can be present when alkali feldspars are generally absent, which suggests a firing temperature in the range of 1200º C to vitrify and deform the clay fraction (Rice 2005) Bloating is induced by a sealing of the brick surface and thus blocking the porous exchange of water vapor and gases. This melting consistently appears as an expansion of interior clay pockets, some large enough to cause tears, rents and bulges with a clearly defined interaction layer as the gases expand in the brick.

Subgroup 1A Thin-Section Observations

The single thin section of a group 1A brick contains the typical aplastic inclusions and the differential shrinkage of the clay fraction common to the Group 1 bricks (figures 4e-h). The high iron content of the clay in the vitrified areas is visible in thin section: the fabric is opaque in plane polarized light due to the glassy, melted clay particles and the presence of reduced iron oxides acting as fluxes; hematite phenocrysts are common in mono- and polycrystalline quartz. The microstructure also exhibits the gaseous void structure, which presumably developed rapidly at high firing temperatures in the presence of these fluxes and possibly salt. Some quartz particles seem to have been displaced by the rapid expansion and appear crowded against the interaction boundary of fully

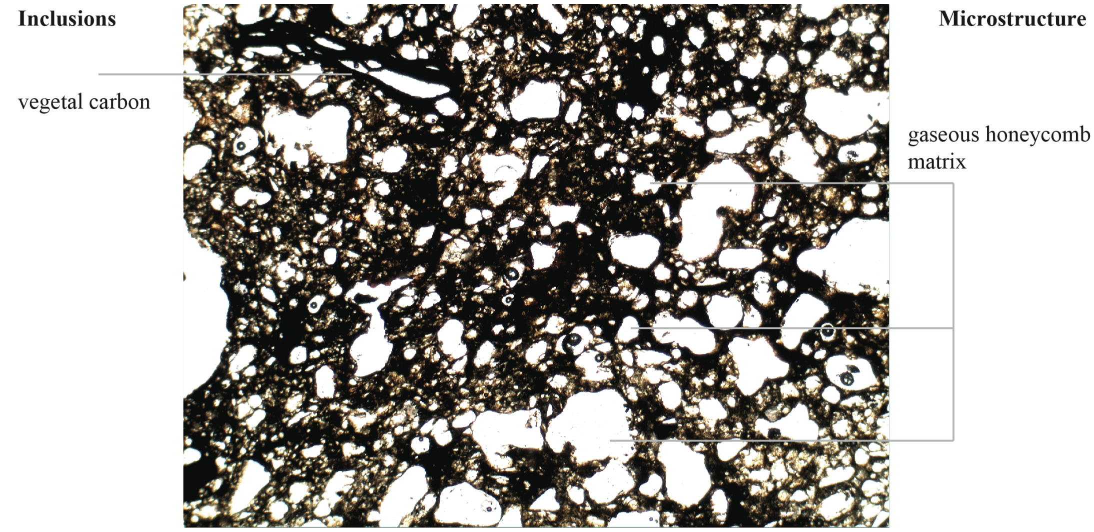


Fig. 4d) #101, Subgroup 1A Thin Section: Thin section of bloated, porous 1A matrix as a dark glassy honeycomb scattered with quartz sands. A vegetal carbon inclusion at top left indicates organic materials in the raw clay deposit which was left over from minimal processing. Width of field 5mm, PPL

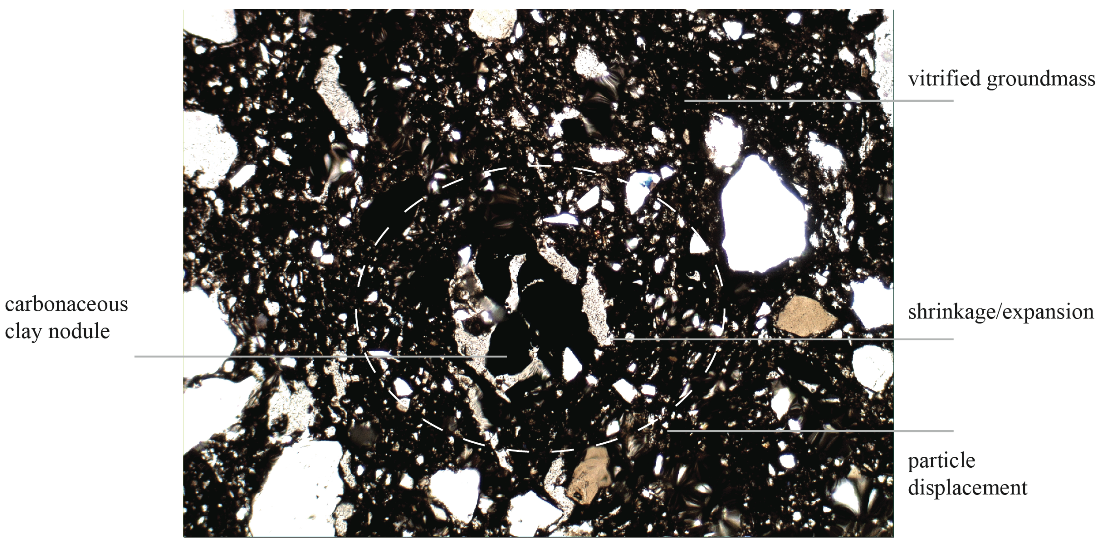


Fig. 4e) #101, Subgroup 1A Thin Section: Clay nodule showing expansion and shrinkage due to its iron and carbon content. The larger quartz sand particles are being displaced in radial arrangments around the offgassing, shrinking and cracking nodules which are clearly distinct from the fine fraction. Width of field 5mm, XPL

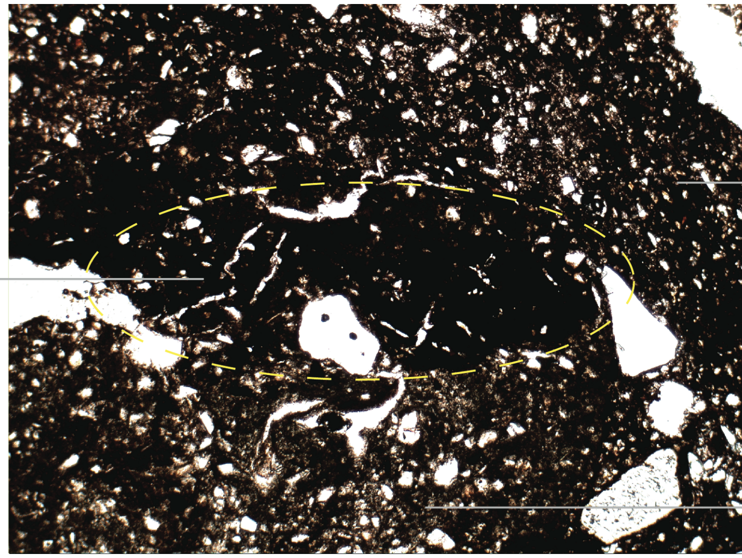


Fig. 4f) #101, 1A Thin Section: Detail of vitrified reaction layer. A large clay nodule is incorporated which shows small internal cracks created by offgassing carbon. Poor mixing of inclusions and an uneven firing of the fabric is evident. Field of width 5mm, PPL.

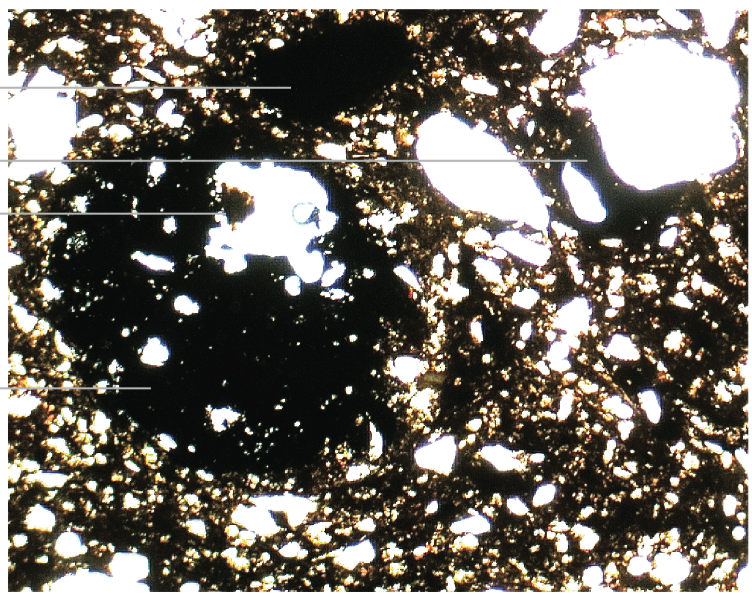
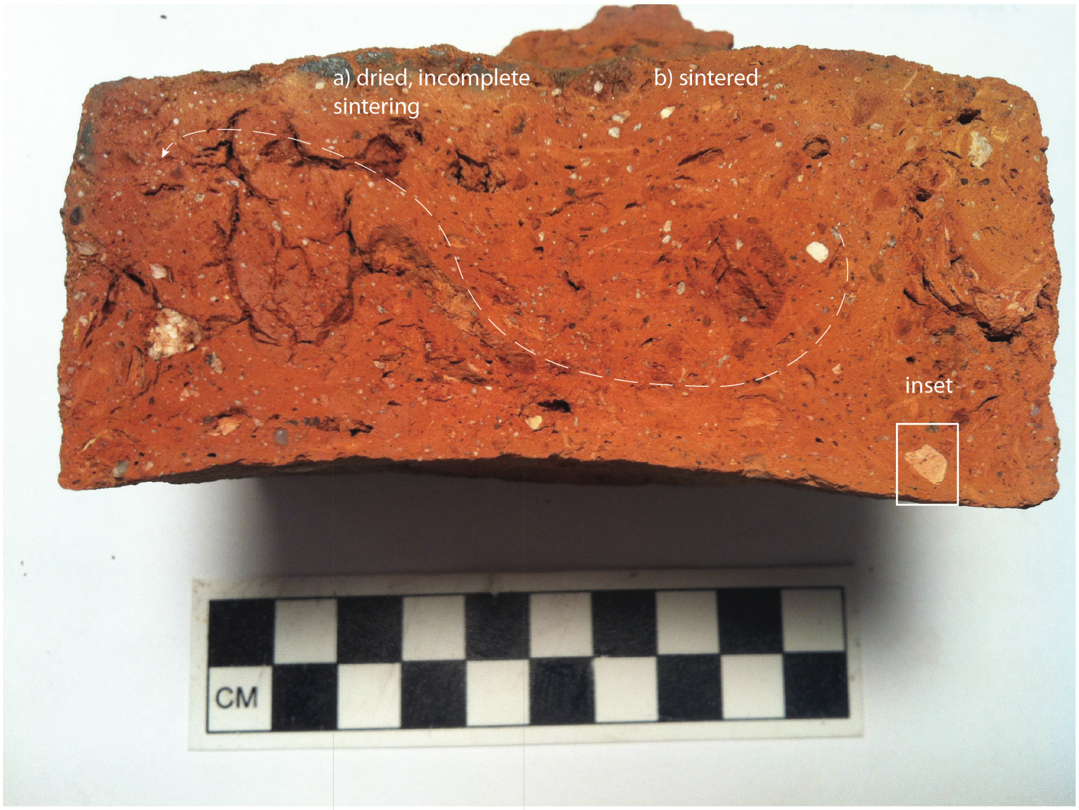


Fig 4g) #101, 1A Thin Section: Detail of large and small ferrous clay nodules embedded in fabric with distinct inclusions. A lozenge is rich in opaque hematite is also visible. The nodules are resisting the oxidation demonstrated by the clay groundmass but have not yet developed cracks and offgassing voids. Field of width 2mm, XPL.

oxidized and vitrified clay; other inclusions are melted into the very dense void structure and opaque vitrified fabric. A residual carbon component is apparent as remnant vegetal fragments in the gaseous fabric characterizing the 1A subgroup as well as carbon burnout voids not visible in hand-sample. These voids are associated with dark reduction rims as well as pronounced bloating due to expanding core formation clearly visible in the hand samples. Since carbon burns out around 600ºC in the presence of oxygen, remnant organic material in the reduced and bloated matrix can be explained by the displacement and restriction of oxygen in these areas. Distinct components appear in the fine fraction, most importantly the black clay nodules of differential shrinkage with minute amounts of mineral inclusions (fig. 4f-g). This difference in composition promotes rapid drying and sintering of the nodules with a distinct coloring which can be easily discerned at the domain boundaries as a blackish-red, probably hematite staining. This staining suggests a rich source of iron oxide in the clay which formed the bricks. These nodules are consistently highly rounded and appear together with lozenge or sub-rounded opaques, roughly 0.3-1mm across, with a reddish tint in cross-polarized light. They do not contain mineral inclusions and are sometimes cracked due to thermal expansion. The appearance of acicular-platy pleochroic micas (mainly biotite), pyrite/ iron impurities and sub-angular potassium and plagioclase feldspars including perthite intergrowths link the sands to a terrestrial origin from crushed and weathered rocks which is shared with the other Group 1 bricks. Sub-rounded quartz sand components also reflect

Fig. 5a) Group 1
Type 1B Cross Section Profile   Sample # 19 South Lawn Midden A3



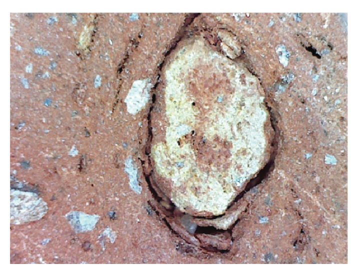
Inclusions (% of coarse fraction)
Quartz and Rock (as temper) 30%
Grog or Dried Clay 5%
Feldspars 20%
Hornblende/Mica 5%
Sand 30-35%
Limestone or marl <10%

Voids/Pores: closed, tunnel, pocket, burn-outs
Surface Strike: Length

Coarse:Fine:Void ratio 30:60:10

Bi-Modal Quartz distribution

Areas: a) dried, b) sintered



Detail of #19 feldspar (top), #9 limestone/marl (bottom); widths of field 1cm

Fig. 5b) Group 1, Reduction Core
Subgroup 1B Cross Section Profile   Sample #3 South Lawn Midden A1

Inclusions (% of coarse fraction)
Quartz and Rocks (as temper) 40%
Grog or Dried Clay 10%
Feldspars 20%
Hornblende/Mica (as sand)
Sand 30%

Voids/Pores: closed, tunnel , carbon burnouts
Surface Strike: Length
Coarse:Fine:Void ratio 40:50:10

Bi-Modal Quartz distribution with irregular Felsic inclusions

Areas: a) offgassing nodules b) reduction core c) fully oxidized

Detail of #3 vitrifying exterior incorporating sintered nodule, width of field 8mm

Inclusions **Microstructure**

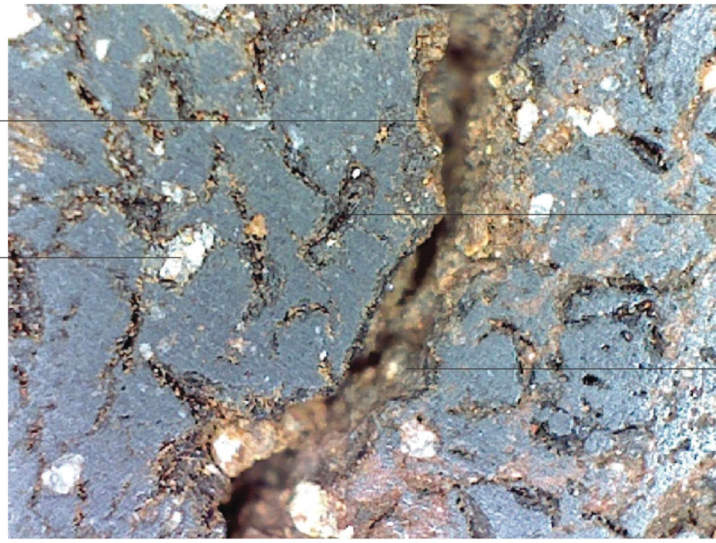


Fig. 5c) #118, Subgroup 1A Rubble: Fully vitrified 1A fabric. The clay groundmass is dissolved into a glassy phase. Microfractures and a larger crack due to bloating are maintained. This shows the fabric was unevenly fluxed and attained vitrification temperature rapidly, though not for an extended period. Width of field 8mm.

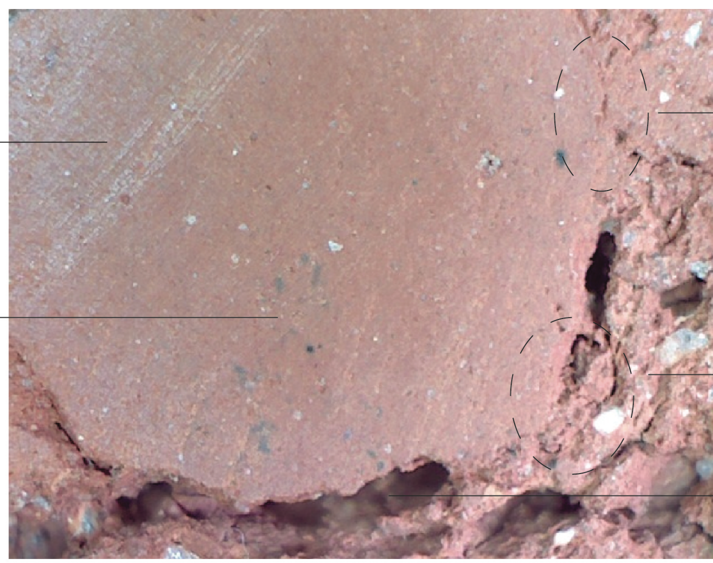


Fig. 5d) #119, Subgroup 1B Rubble: Sintering clay particle in 1C brick fabric. The shrinkage rim demonstrates the fabric contracted more than the particle under firing temperature, so the particle was previously fired to a higher temperature. The mineral inclusions are minimal compared with the surrounding matrix. Width of field 8mm.

a water-worn component or glacial till in the primary clay source alongside the large and highly angular temper.

Subgroup 1B

Handsamples and Binocular Microscopy

The 1B subgroup contains 21 bats, 21% of the total sample. It consists of flat, hard bricks with sanded reverse faces and smoothed sides, struck length-wise (figs. 5a-b). Their small thermal mass and highly plastic body caused a wide range of temperature effects and marbling due to gaseous movement through the fabric in a highly variable firing atmosphere. It is a counterpart to the extensive vitrification and sintered (solid-state particle fusing) phases observed in Type 1A, though a more diverse range of inclusions can be identified since the fine fraction is not extensively deformed and obscured by air pockets (figures 6a-b). These bricks are unequally vitrified and sintered with extensive continuous glassy vitrification on exposed surfaces and porous interiors. Reduced and oxidized colors are often layered or marbled especially where vitrification and heat exposure was unequal in some cases showing capillary organic extraction (Rice 2005). The fine fraction is generally a dark red with a clean, well-sorted quartz sand and a bi-modal crushed quartz component which consists of rough, highly angular pieces. Associated rubble is usually vitrified: flat, sharp and quite hard and the rubble retains edge features very well. 1B bricks can also show the black coring common to handmade

bricks, in which case the fabric is marbled or bloated (as seen in the 1A subgroup due to off-gassing clay components which are sealed in by differentially hardened surfaces). Some of the 1B bricks are fired hot enough to lose plastic integrity and completely fuor slump (see figure 2); these have a greasy luster and a finely crazed crust of minerals formed at high temperatures.

Subgroup 1B Thin-Section Observations

The thin sections from this subgroup show a distinct clay component in the form of rounded, dark off-gassing nodules which show neither extinction nor birefringence but have clearly defined shrinkage rims. On the whole they resemble the 1A thin-sections, with poorly sorted bi-modal quartz sands encompassing highly weathered polycrystalline quartz and felsic rocks, acicular-platy biotite mica (commonly altering to other minerals) and opaque sub-rounded to sub-angular specks (figures 5d-g). Clay mixing is evident in the various domains that form distinct boundaries within the matrix and react differently to firing conditions, though none show birefringence and appear to be extensively sintered. Aplastic inclusions extend to spall and chips of previously baked clay with clear boundaries within the matrix. A unique inclusion type is sandstone, however, which appears as a fine-grained rock fragment cemented by clay minerals and incorporating some opaque organic in its matrix. This is the only such appearance among the prepared sections of red brick (figure 6c). The presence of this sedimentary rock is consistent with

Inclusions **Microstructure**

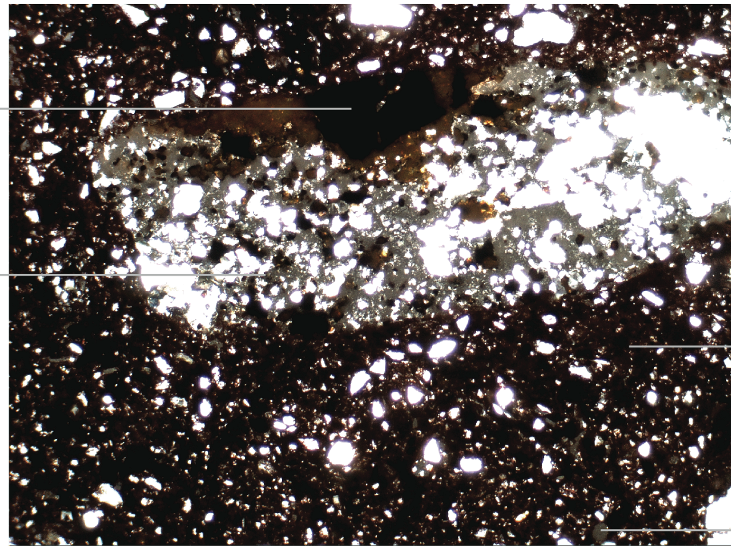


Fig. 5e) #102, 1B Subgroup Thin Section: Detail of very fine sands cemented with clay minerals in a vitrified 1C fabric with low porosity and high temperature mineral formation. This section captures an opaque inclusion intergrown with biotite in a sandstone or silicious wacke from the source of brick clay. Width of field 5mm, XPL

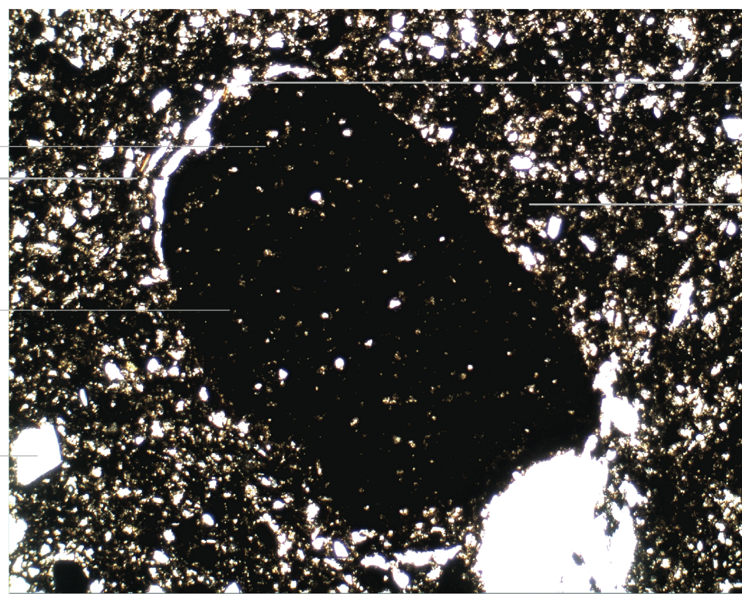


Fig. 5f) #103, 1B Subgroup Thin Section: Detail of clay nodule with a clear shrinkage rim and very fine sands. These sand grains are highly spherical in constrast to the coarse fraction composed of subangular, bi-modal quartz and a pleochroic micaceous component not found in these nodules. Width of field 5mm, PPL

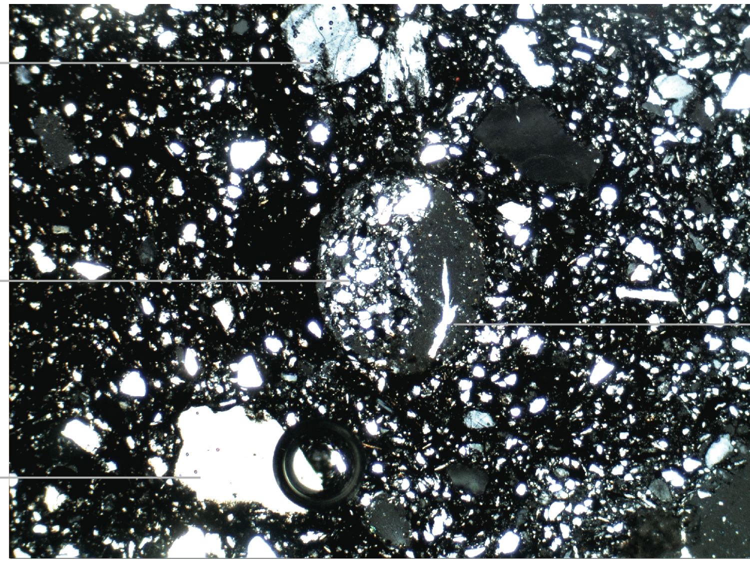


Fig. 5g) #102, 1B Subgroup Thin Section
Detail of indurated, highly spherical nodule in fabric. The distinct composition of quartz sand grains within the nodule demonstrates a separate component distinct from the surrounding matrix. It shows a developing crack due to differential offgassing and temperature stress. Field of width 5mm, PPL.

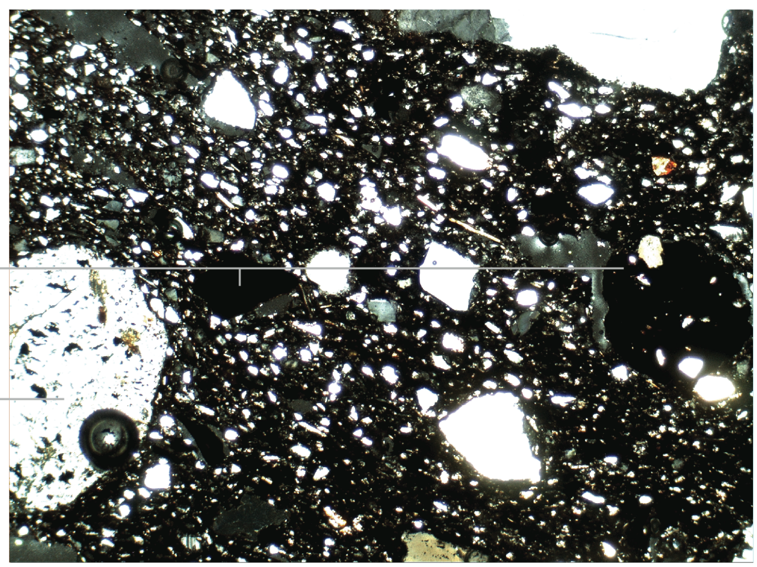


Fig. 5h) #103, 1B Subgroup Thin Section
Detail of fabric showing reaction boundary within the fabric between vitrifying phase (right), where pores are closing, and a sintering phase (left), where pores remain open. Ferruginous nodules with lower density of incorporated sand have created voids in the surrounding fabrics by offgassing. Field of width 5mm, XPL

shoreline or lacustrine clay sources. As with the 1A section, loose vegetal carbon is also consistent with such sources; although the temperatures needed to burn off carbon were obtained and induced sintering in the surrounding fabric (roughly 600ºC), a localized reducing atmosphere depriving the area of oxygen limited complete combustion.These sources typically contain the redox precipitated iron nodules found in the 1B subgroup. As 1B bricks contain highly vitrified phases and extensive internal reduction, there is little optical activity in the clay groundmass since glass phases can be opacified by dissolved elements such as reduced iron in thin-section allowing very little light transmission. The microstructure does not reflect the rapidly forming gaseous phases of the 1A subgroup, however, suggesting that vitrification was attained more gradually or under more consistent temperature. 1B bricks did not develop large, open voids and show only slight bloating in core formation. Because of this, interaction boundaries and inclusions are easier to discern in the surrounding matrix and these indicate poor preparation of the fabric. In consequence, unequal firing conditions experienced by different areas of the bricks are easy to discern.

Subgroup 1C

Handsamples and Binocular Microscopy

1C as a subgroup makes up the highest proportion of the bat sample, with 32 bats or 32% of the total sample. It shows a marked increase in bat sizes versus sub-types 1A

Fig. 6a Group 1
Subgroup 1C Cross Section Profile   Sample #43 South Lawn Midden A4

Inclusions (% of coarse fraction)
Quartz and Rock (as temper) 30%
Grog or Nodules 5%
Feldspars 20%
Hornblende/Mica 15%
Sand 30%

Voids/Pores: closed, tunnel

Coarse:Fine:Void ratio   30:60:10

Bi-Modal Quartz distribution with irregular Felsic inclusions

Areas: a) reduced nodules, b) underfired, c) oxidized

detail of #43 indurated clay nodule and hematite stain, width of field 1cm

Fig. 6b) Group 1
Subgroup 1C Cross Section Profile   Sample #55 South Lawn Midden A9

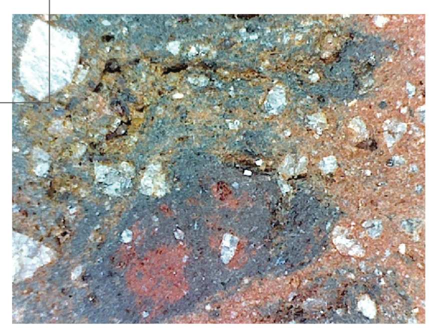
Inclusions (% of coarse fraction)
Quartz and Rocks (as temper) 40%
Grog or Dried Clay 5%
Feldspars 20%
Hornblende/Mica 5%
Sand 30%

Voids/Pores: closed, tunnel, carbon voids
Surface Strike: Length

Coarse:Fine:Void ratio 30:60:10

Bi-Modal Quartz distribution with irregular Felsics

Areas: a) oxidized core, b)reduction, vitrification of of sintered exterior



Detail of #55, reduction/oxidation boundary within brick, width of field 8mm

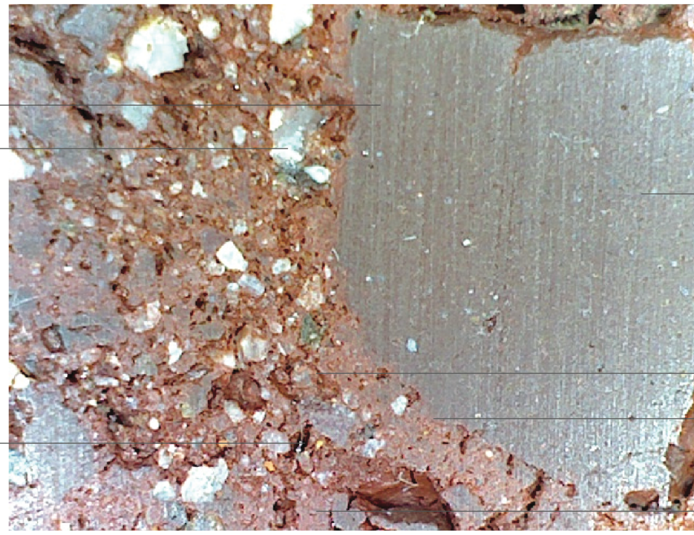


Fig. 6c) #34, Subgroup 1C: Angular clay fragment which is melding with the coarse fraction as it sinters in a solid state reaction. On the left, a vitrifying phase can be distinguished from the sintered phase. Width of field 1cm.

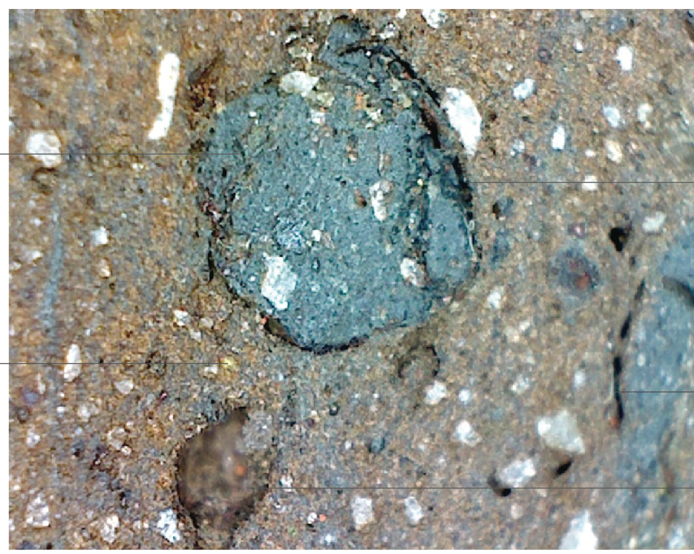


Fig. 6d) #109, Subgroup 1C Rubble:This dark nodule incorporates some crushed quartz sand with micaceous fragments. The shrinkage rim indicates a distinct clay higher in iron oxides resisting the oxidizing environment affecting the surrounding fabric. Width of field 1cm.

and 1B, and overall heftier pieces with a large thermal mass. It is a brick with heavily sanded faces (figures 6a-b), rough, weathered fractures and highly abraded surfaces. It is characterized by distinct black core formations that occur internally as a result of incompletely oxidized interiors, and by the incorporation of dried clay chips and grog, which can be distinguished from the matrix, especially in under-fired pieces. It is worked from a stiff clay mixture with a low moisture content, resulting in a rough fabric in which air pockets are easily trapped. Yet it sinters together and can leave little trace of incorporated dried clay once the chemically combined water is driven off. Vitrified examples show little structural deformation and have no counterpart to the 1A/B vitrification which warped extensively (Figure 2b shows bat #38, an exception which illustrates a deliberate stacking method or support structure that suppressed severe bloating). The under-fired internal matrix is generally rough and dry with poor sintering of the fine fraction; the bloating shown by the reduction cores is slight, and defects are more closely linked to unequal distributions of coarse fractions and temper additions than fabric defects. Mid-range examples have weathered heavily and reveal a craggy fracture, with pitted surfaces not hard enough to spall but which instead crumble into rough, friable rubble. The 1C subgroup does not suffer severe bloating and vitrified deformation, but it does show a “red” coring unique among the subgroups, caused when an oxidized fabric reduces again, which indicates a more open, porous structure in the brick (fig. 6b).

It generally retains fewer of the diagnostic surface faces due to weathering and abrasion loss of adhered sand; where the 1A/B subgroups have cleaner edges and clear striae, 1C has consistently worn, sanded faces. It is also struck along the length with a lightly serrated edge tool.Evenly fired examples are a bright orange-red and rarely display the high temperature color and deformation range evident in 1A/B cross-sections. Extensive vitrification is not evident. Aggregate inclusions range from quartzite sands to highly rounded pebbles, with unique and highly distinct pieces of grog, chips and rocks not observed in the 1A/B subgroups. Pore alignments can best be seen following shaping loops which are less fluid than the 1A/B and tend to incorporate air pockets. The sands used to temper this brick are consistent with the 1A/B subgroups, including carbonized vegetable matter in association with the carbon/iron clay nodules. These clay nodules are easy to distinguish and appear together with irregularly shaped hematite surrounded by hematite-stained clays and rounded glassy fragments. They also appear as un-sanded components in a consistently spherical range and visibly melt together into a domain when enough material is stuck together and temperatures are high enough (see figure 2a).

The dried clay/grog component in these bricks is distinct from these rounded dark clay domains since it sinters into the clay matrix in color as it destabilizes, and was incorporated as dried and lightly baked scatter and chips from the same clay source utilized for the bricks (figures 6c-d). 1C bricks are fairly soft with a developed porosity, promoting good insulating qualities on one hand, and extensive efflorescence, frost and

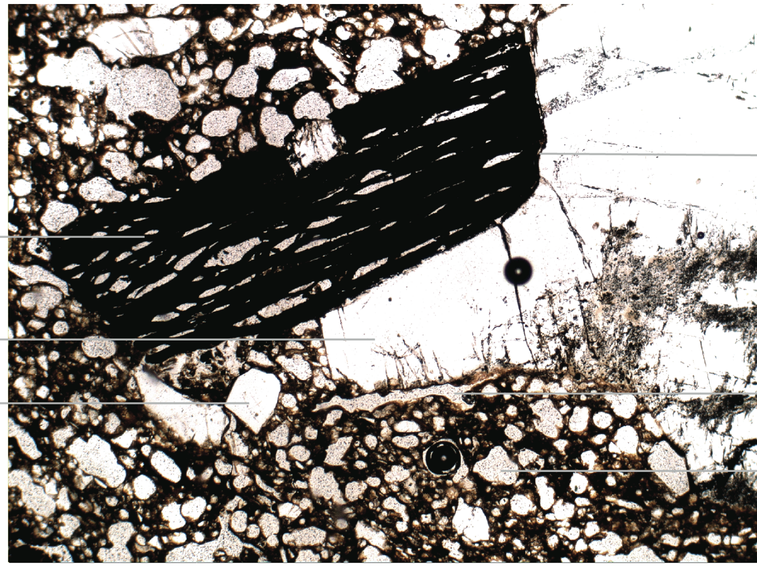


Fig. 6e) #100, 1C Subgroup Thin Section: Large vegetal carbon inclusion adhered to weathered orthoclase feldspar fragment in a porous 1B matrix formed by a lightly offgassing fraction. This weathering is indicative of mineral decomposition to colloidal clay which suggests it was not added as temper. Width of field 5mm, PPL

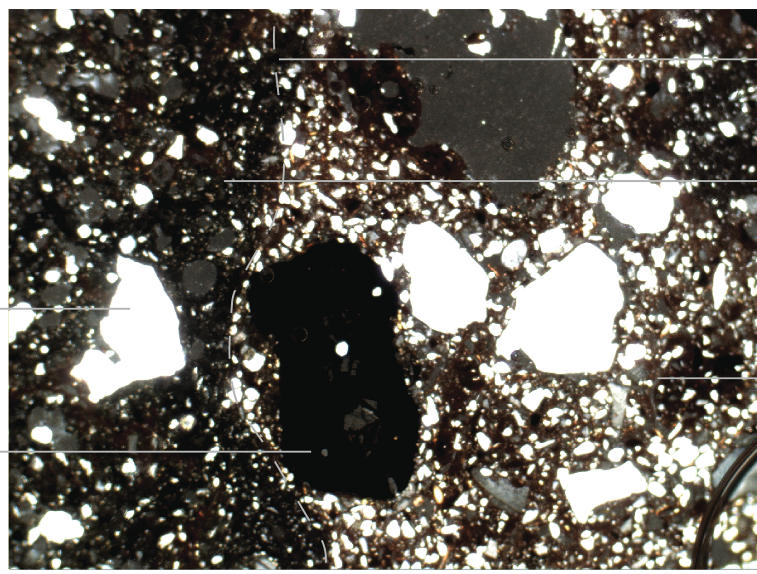


Fig. 6f) #99, 1C Subgroup Thin Section: Detail of carbonaceous/iron clay nodule at the boundary of vitrifying (left) and sintering (right) clay phases. A bi-modal quartz temper is clear in both, yet the proportions of fine-grained sand distinguishes them. Width of field 5mm, XPL

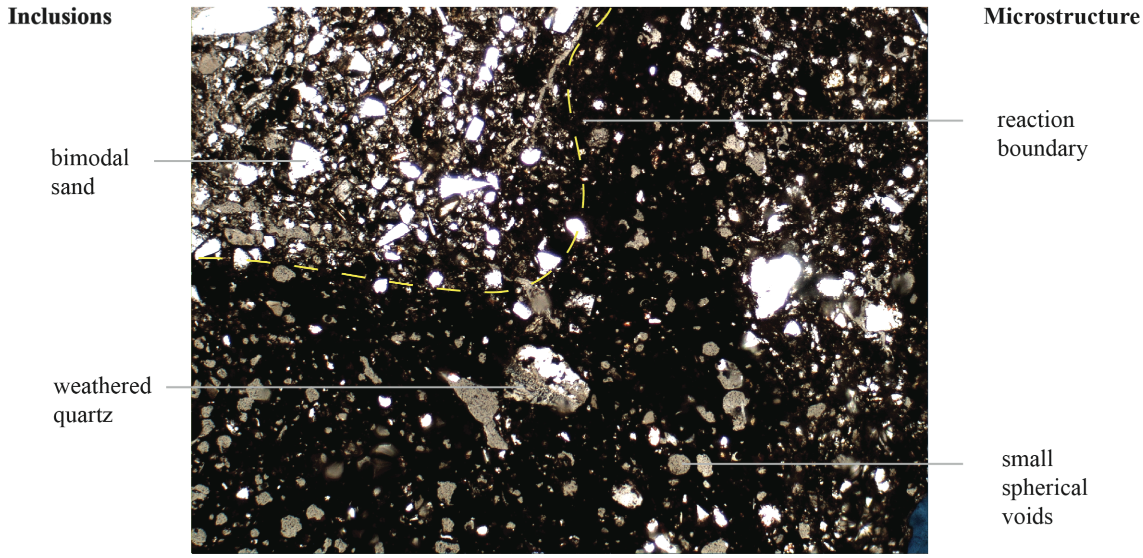


Fig. 6g) #99, 1C Subgroup Thin Section : Overview of vitrified fabric and boundary with sintering fabric. The gaseous voids in the former are small and spherical, suspended in a melting fabric in which the voids formed gradually. The vitrified area has dissovled sand components to an opaque glass. Field of width 5mm, XPL.

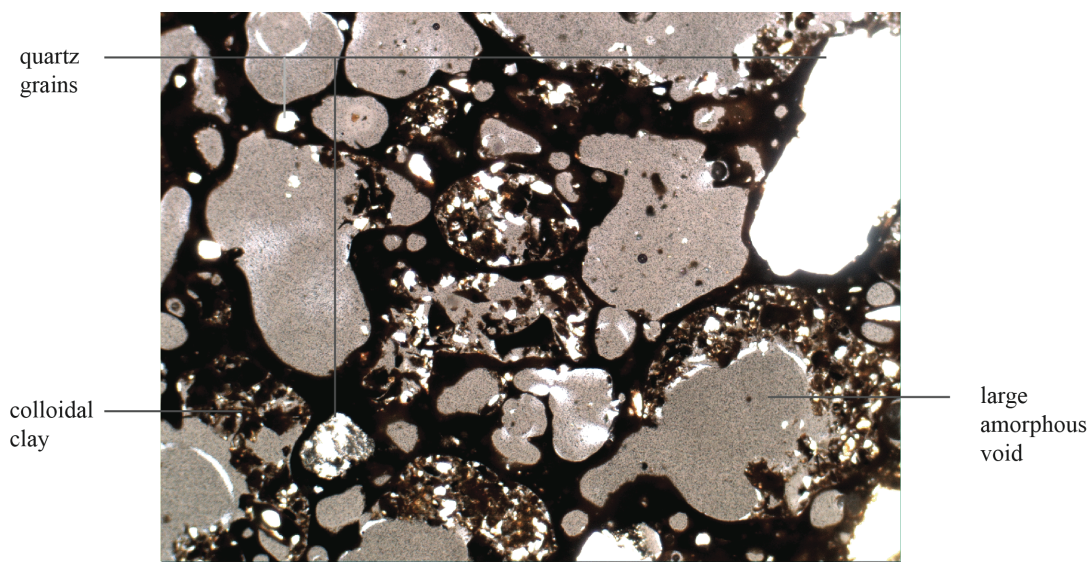


Fig. 6h) #100, 1C Subgroup Thin Section: Detail of developing offgassing core in brick interior. The large, amorphous voids demonstrate a rapid development and release of gasses as well as heated air pockets. This displaced inclusions to the peripheries of the voids and captured mineral grains in the connective fabric. Field of width 2mm, XPL.

water damage on the other. Efflorescence (salt-blooming) and a higher degree of post-firing breakage can also be attributed to capillary action and higher pore densities. Large pieces of crushed rock and pebbles that stretch and crack the brick fabric are still common in the 1C type yet the drier, stiffer fabric is less subject to deformation and failures based on these inclusions.

Subgroup 1C Thin-Section Observations

The firing behavior of subgroup 1C is characterized by porous, off-gassing pockets and a slightly birefringent groundmass (clay component of fabric). The quartz temper is distinctly bi-modal, and very large grains of parent rocks are assumed to be the source of observed minerals in the clay (gneiss, weathered granite: perthite, micas, hornblende etc.) that are up to 9mm across. The weathering of these components to altered forms (such as ‘sericite’mica) are indicative of alterations to clay (Rice 2005) and characterize the clay source. Larger quartz fragments clearly show shrinkage rims and cracks associated with the ß-quartz inversion around 600ºC allowing a good estimate of the firing range. The 1C fabric shares characteristic inclusions with the 1A/B fabric, including identical redox nodules that shrink and expand (figures 5c-d). One area shows developing vitrification with a lesser degree of sintering and higher porosity, while the other shows the distinct behavior of the nodule in a less vitrified area: differential

shrinkage, lower mineral amounts, off-gassing and void pockets of carbon burn-outs. The larger thermal mass of the 1C Group promotes more even firing conditions and porosity and fairly homogenous colors in handsample although the darker carbonaceous fraction is distinct. The violent ruptures of the 1A/B are not experienced yet the same mechanic can be observed as expansion causes micro-fractures within the brick due to concentrations of nodules with a higher content of iron oxide and carbon, as well as aplastic clay chips and grog.

Group 2 Analysis

Handsamples and Binocular Microscopy

Group 2 bricks total 13 bats, or 13% of the total sample. The key characteristics for these bricks are a smooth, well-fused fabric with consistent exterior shaping and dimensions (figure 7a). The clays used for this brick were likely very finely ground or separated by flotation (“elutriated”) to create evenly sized particles and remove debris. As a result the fabric is visually homogenous. Subtle color changes within the fabric are not caused by defective firing conditions, rather they show mixed clay sources of similar consistency but slightly different tempers. Incorporated clay fragments in the fabrics can show marbling from previous exposure, but are usually visually identical with the base fabric once they have sintered , and so can be termed an aplastic grog. As the ceramic fires and sinters, these inclusions become visually indistinct or lost altogether, which

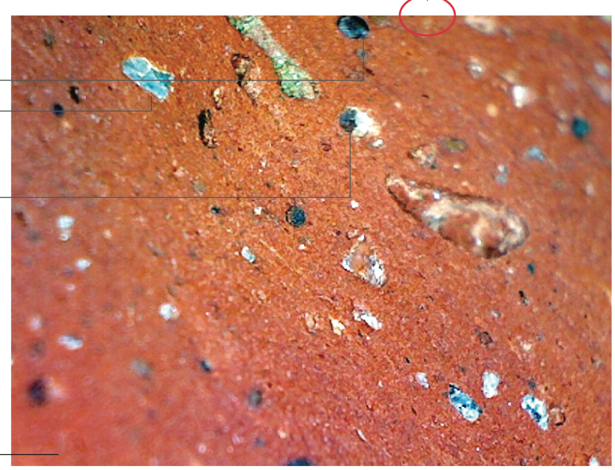
Fig. 7a) Group 2
Cross Section Profile   Sample #21 South Lawn Midden A4

Inclusions (% of coarse fraction)
Quartz (as temper) 5-10%
Grog or Dried Clay 20%
Feldspars <10%
Hornblende/Mica <5%
Sand 60%
Ash <5%

Voids/Pores: open, tunnel and closed pores
Surface Strike: Width

Coarse:Fine:Void ratio 15:75:10

No Bi-Modal distribution of temper



Detail of #21, microscopic coarse fraction, field of width 1cm

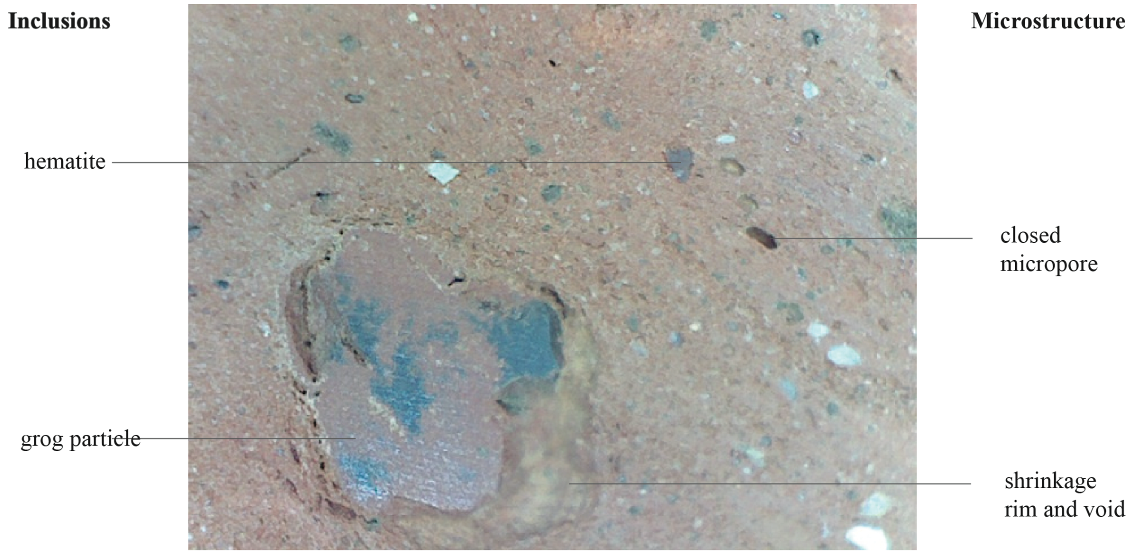


Fig. 7b) #4 Group 2: Detail of aplastic clay nodule (previously fired grog). The marbling of this inclusion demonstrates a distinct particle embedded in the surrounding brick fabric. A shrinkage rim with associated void shows the sintering temperature did not exceed previous firing temperature. Field of width 2cm.

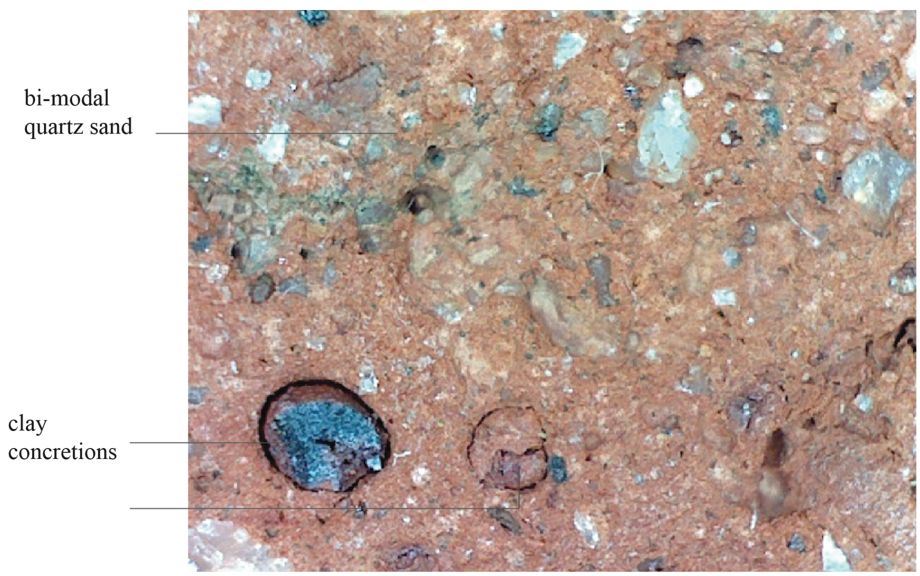


Fig. 7c) # 114 Subgroup 1C Rubble: Detail of indurated clay nodules within the heterogenous fabric. The fabric is sintering yet irregularities and fault lines due to processing and low water content are evident. Unlike fig. 7b this nodule is not previously fired, but is resisting resisting oxidation due to its higher iron content revealed in cross-section. Field of width 2cm.

highlights the importance of recognizing the range of industrial evidence which can be compared in ceramic production. Here, it appears that dried processing waste was incorporated into the fabric in the molding and shaping area. In stark contrast to the Group 1 bricks, this group is evenly fired with no glaring fabric defects.

The molding process for Group 2 bricks used water to smooth and wipe sides and faces, which are struck across the width of the brick rather than the length. A wet and plastic body formed lips, edges and runs of wet clay across faces as it was shaped. When mold sand was retained it is generally on the bottom face, and the side release striae indicate a lubricated mold, probably iron-shod. This exterior sand is very fine and well-sorted, as is the internal coarse fraction, and together this allows a fairly even distribution of heat within the bricks. The quartz particles generally included in this fabric are too small to show volume changes associated with the ß-quartz inversion around 600ºC visible in coarser fragments of the Group 1 bricks. Vitrified surfaces are thin and not extensive, and traces of surface finishes also survive. These include a thin reddish slip or paint retained in surface depressions, or as flaking remnants on bat ends. Whitewash or plaster traces can occur on Group 2 rubble and shards but none were observed on bats. A higher rate of water absorption is linked with a higher porosity within Group 2, because these bricks have produced copious amounts of spalled rubble consistent with frost and shattering damage. While there are fewer Group 2 bats in the A-Block assemblage than

Inclusions **Microstructure**

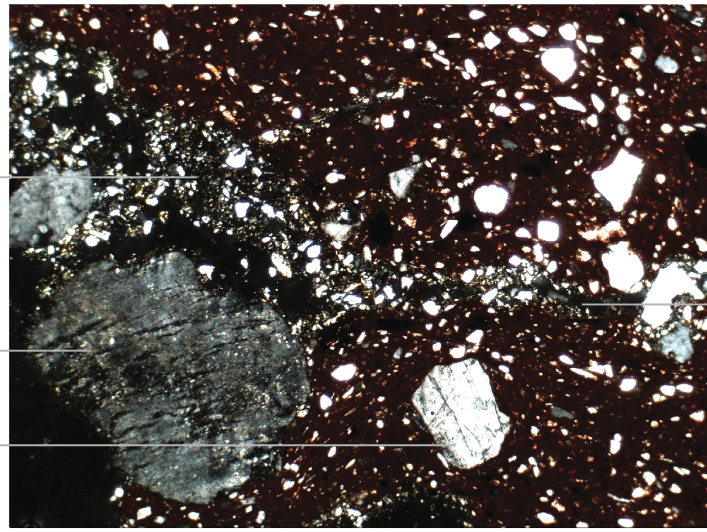


Fig. 7d) #104, Group 2 Thin Section: Detail of weathered mortar and calcite intruding into pore system of a group 2 fabric. This pore channel is not directly associated with a surface, yet large sub-angular quartz grains could indicate striking sands incorporated in fabric mixing and forming. Width of field 5mm, XPL

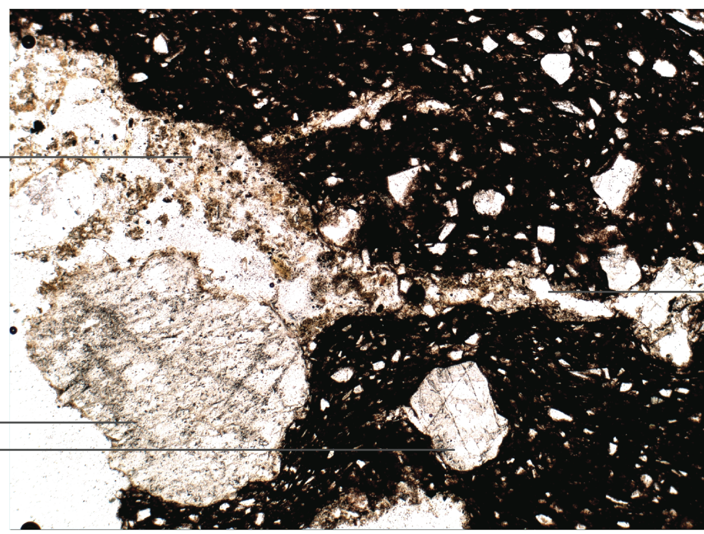


Fig. 7e) #104, Group 2 Thin Section: Detail of weathered mortar shown above, demonstrating a lack of colloidal clay groundmass. This trace material incorporates sand and is clearly distinguished from the clay in plane polarized light. Width of field 5mm, PPL

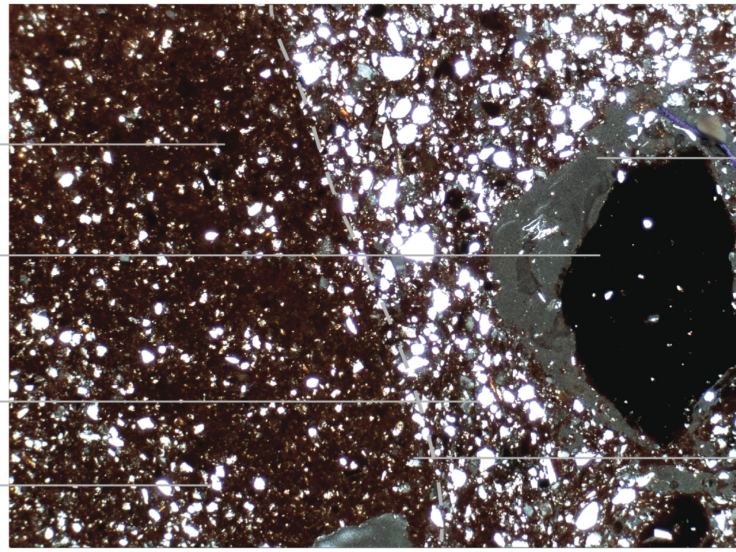


Fig. 7f) #104, Group 2 Thin Section: Detail of group 2 fabric showing distinct domains within the fairly smooth fine fraction. The carbonaceous nodules in other groups appear in one fraction with a bi-modal quartz distribution, while the other is tempered with very fine, well sorted sands.Width of field 5mm, XPL

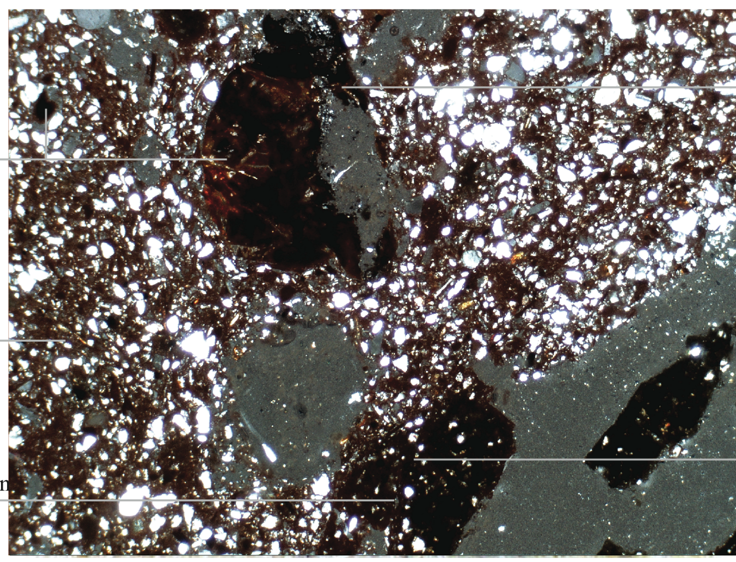


Fig. 7g) #105, Group 2 Thin Section: Overview of the bi-modal sintered clay fabric of group 2. At top, a hematite rich clay nodule shows strong birefringence Vitrified patches of iron rich clay are also visible. Carbonaceous content is demonstrated by the offgassing of nodules contributing to a high porosity. Width of field 5mm, XPL

other brick groups, it does contribute to very large volumes of rubble and sharp spall fragments almost identical with pan-tile.

Group 2 Thin-Section Observations

The sands in the Group 2 bricks are very fine and consistently well sorted, allowing an even sintering of the fine fraction with no large disruptions except the inclusion of unfired but previously dried clay fragments. Mineral inclusions are typically small, less than 2mm in diameter, indicating a sieved clay. Thermal expansion appears low as there is no evidence of internal rupture, bloating or fissures causing defects. There is also no indication of carbonaceous off-gassing in the fabrics although small dark nodules showing the same behavior as the Group 1 bricks are still evident microscopically (figs. 7f-g). In addition, small opaque specks of precipitate iron also appear in the fabric. In thin-section, a soft marbling of distinct clay phase colors visible to the unaided eye is confirmed and suggests some type of clay mixing: one phase contains very fine sand and is highly sintered, while the other has a higher birefringence and a fine sand dominating its coarse fraction with occasional sub-angular grains >.5mm, subhedral feldspars and finely textured polycrystalline quartz. The entire fabric is scattered with the hematite-bearing, carbonaceous component noted in Group 1 (figures 7f-g). Thus, the subtle differences of the clay components are preserved as visual differences in the fired product without noticeably affecting fabric quality.

Apart form minute traces of mortar, surface finish traces were not observed on other brick types, but in Group 2 they can include slip, pigment or plaster on rubble or bats. In one case, mortar has leached into microscopic surface pores. This can be clearly seen as a translucent mass of carbonate reaction products dense with sand adhered to the clay fabric in cross-polarized light (figures 7d-e). Under reflected light, opaque mineral inclusions (particularly hematite) can be distinguished from small vitrified clay nodules (<1mm) which can appear identical in plane polarized light. In hematite, a finely cryptocrystalline structure is revealed that does not appear in clay, while the vitrified clay nodules appear as both yellowish-green rather as well as orange-red under reflected light.

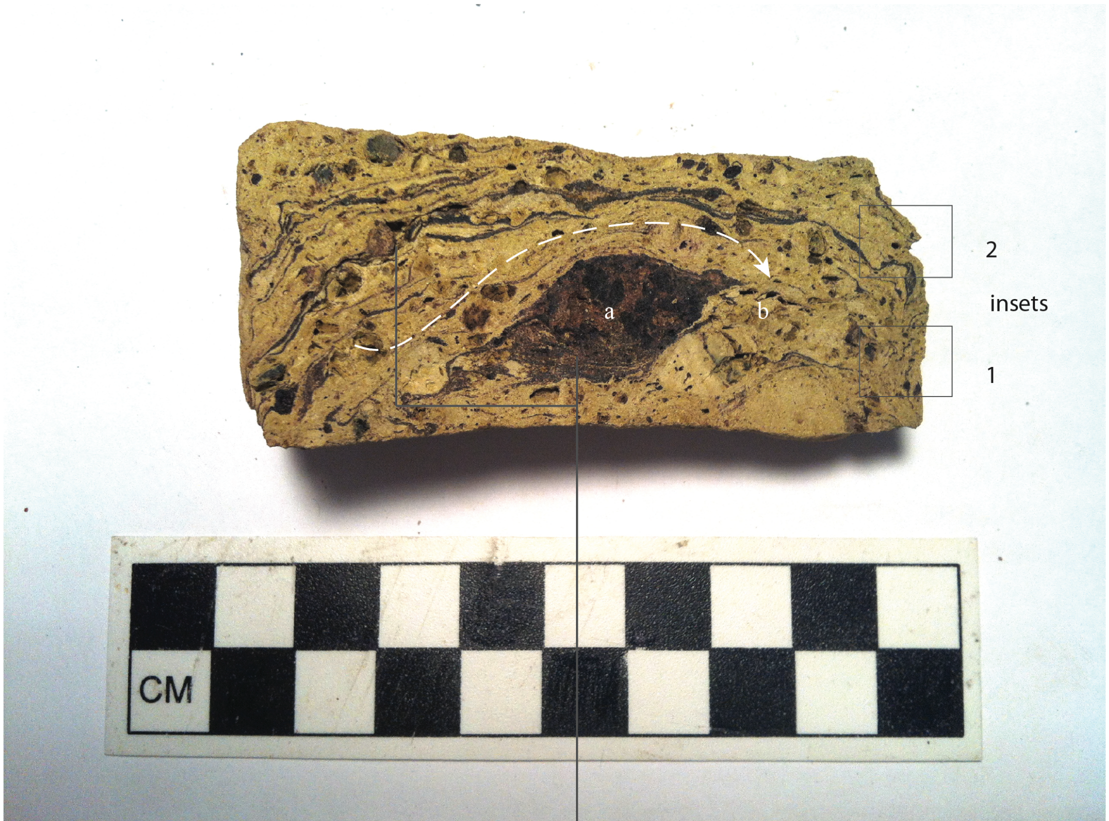
Group 3 Analysis: Yellow Bricks

Handsamples and Binocular Microscopy

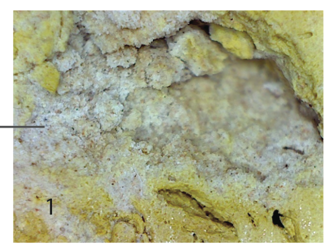
Unlike the red bricks, the yellow bricks in the A -Block appear to constitute a single fabric. They are easily distinguished by their range of yellowish, buff cream colors. 27 bats are in this group, 28% of the total sample. There is no indication of severe internal combustion or bloating and the best examples are quite hard and are resonant when struck together (figure 8a). They are fairly porous and slightly friable due to high proportion of sand in the fabric, however. Mechanical deformations are common, particularly slumping and pinching. They are made from a soft mixture of clays and sands with distinct components that appear either as dark or red nodules, marbles and

Fig. 8a) Group Yellow

Cross Section Profile   Sample #84 (Y13) South Lawn Midden A6



Inclusions (% of coarse fraction)
Quartz (as temper) n/a
Shell/Calcite 15%
Feldspars (as sand) 10%
Dried Clay/Nodules 5%
Sand 70%

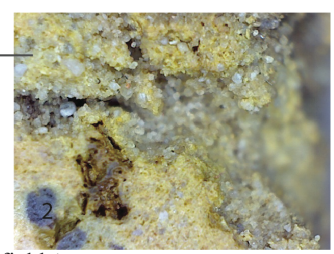


Voids/Pores: closed, tunnel, open, carbon burn-outs
Surface Strike: n/a (highly abraded)

Coarse:Fine:Void ratio 40:45:15

Bi-Modal Quartz distribution not observed

Domains: a) ferruginous clay/sand (iron oxide) b) marly clay



Details of #84 (Y13) showing 1) shell carbonate and 2) sandy matrix, widths of field 1cm

Inclusions **Microstructure**

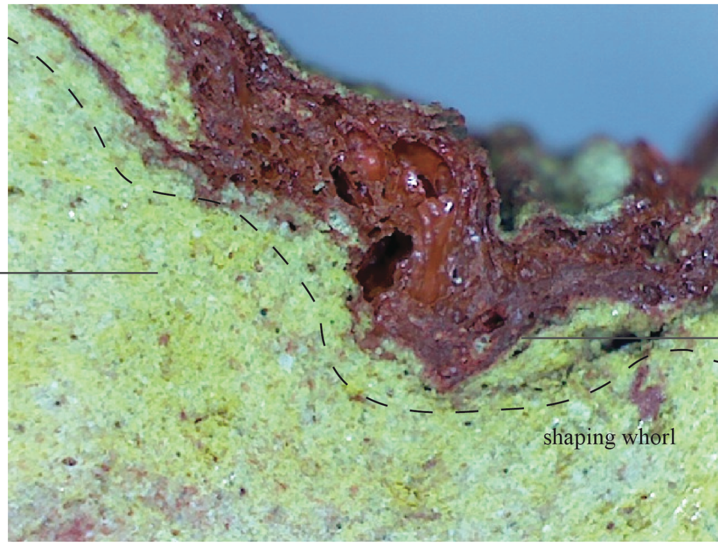


Fig. 8b) #110, Yellow Group Rubble: Detail of completely vitrified ferruginous sand as a glassy crust. It is mixed into a separate sandy clay phase cemented by a carbonate-lime reaction. This face was open to the exterior and a fully oxidizing atmosphere which affected this distinct phase. Width of field 2cm.

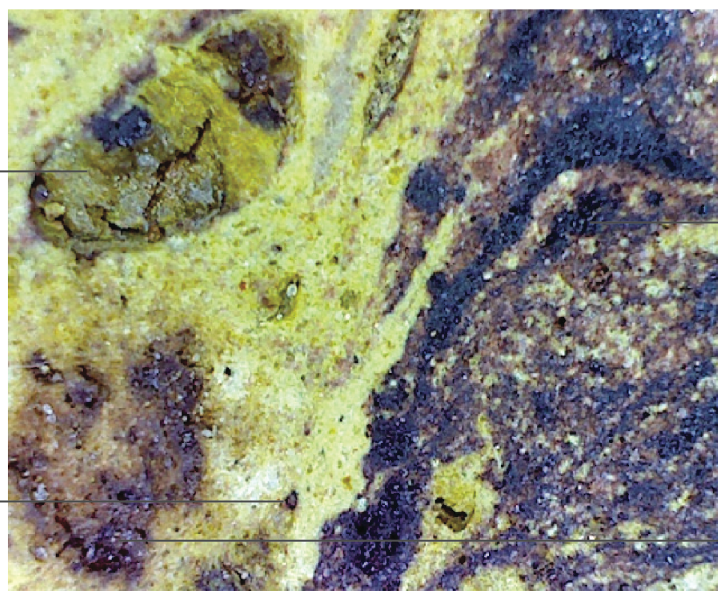


Fig. 8c) #111, Yellow Group Rubble: Detail of vitrified clay pocket and marbled, reduced black sand. As the clay component offgasses and forms micropores, associated sands in the fraction become clearer. Width of field 1cm.

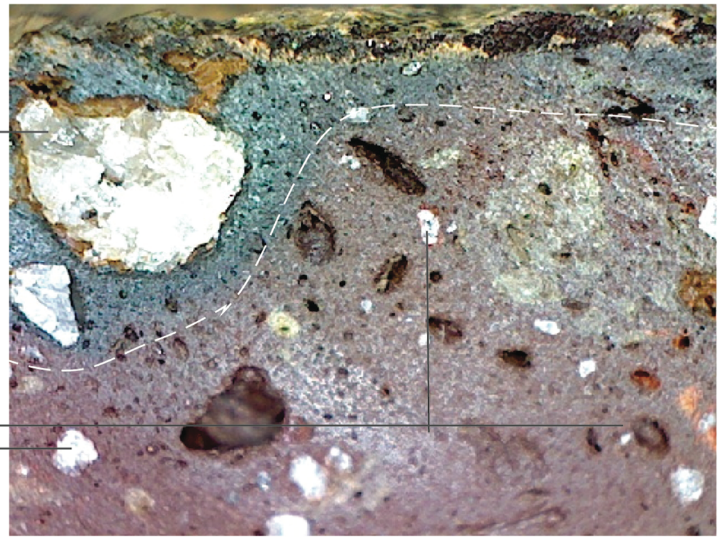


Fig. 8d) #113 Subgroup 1A Rubble: Detail of vitrified reaction layer: microporous structure formed in association with a reduced, salt-fluxed glassy phase on the surface; note the clear size difference of closed pores towards the interior. Width of field 2cm.

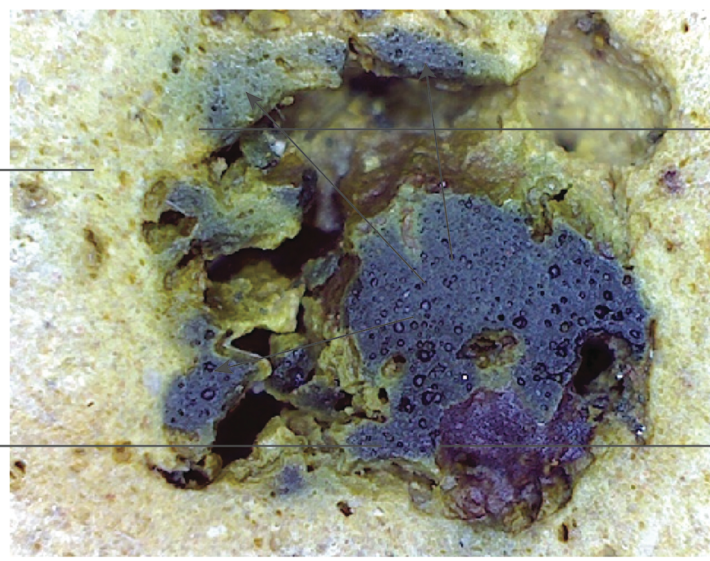


Fig. 8e) #112 Yellow Group Rubble: Expansion of clay nodule in yellow brick caused by offgassing in porous, sandy fabric.A system of micropores evolves as vitrification is approached, mirroring firing behavior of vitrified clay in the red brick. The clay phase of the yellow brick is unevenly distributed in the fabric and not part of a cohesive mixture. Width of field 8mm.

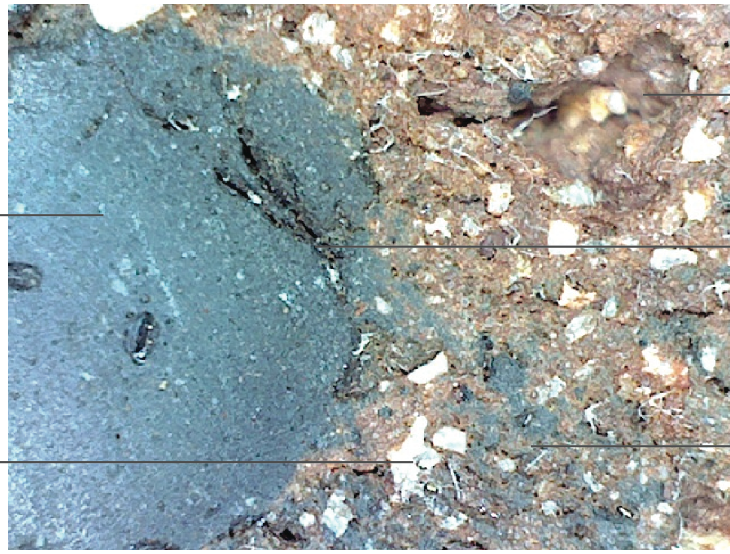


Fig. 8f) #114, 1B fabric cross-section: Detail of sintering clay nodule in sand heavy brick phase with developing shrinkage crack. This clay component appears rounded where the oxidized true grog is angular. These nodules incorporate fluxes but no temper and sinter readily. Width of field 1cm.

Fig. 8g) #110, Yellow fabric cross-section: Vitrified clay component in the yellow brick clay phases; shrinkage rims clearly separate it from the groundmass. The coloring is indicative of a manganese bearing clay which is incorporated into the lime heavy yellow fabric. Width of field 8mm.

crusts which can lose distinction as vitrification progresses (figures 8b-c). This is similar to the marbled appearance of the 1A/B fabrics, though none of the Group 3 bricks are bloated. To confirm the presence of carbonates in the body of the clay a simple chemical test was performed. Using a micro-pipette, a drop of dilute (3.8%) hydrochloric acid test solution was applied to the surface of freshly cut cross-sections of sample numbers #15 and #27. The presence or absence of strong effervescence, characteristic of carbonate bearing clay bodies, was observed with the unaided eye and recorded. All the yellow bricks effervesced strongly, which demonstrates that the whitish-yellow base clay for the yellow brick is highly calcareous; such clays are typically of marine and near-shore origin ("marl"). Most of the diagnostic surfaces are weathered off so that striking marks and vegetal impressions are difficult to discern, but shaping and lipping suggest perpendicular wedging and a length-wise strike as with the Group 1 bricks (fig. 8a). They lack the sub-angular, rounded and fractured rocks frequently responsible for fabric defects in the red bricks but they were subjected to firing deformation and poor handling. These are the only bricks with clear evidence of direct articulation with mortar, which is sometimes retained as very small patches. The yellow bricks incorporate dried, friable clay fragments (grog) as the red bricks do. These particles do not show interaction rims or internal marbling, indicating that dried base fabric was incorporated during processing; the incorporated clay appears to be of both the yellow and red variety, however (figures

Inclusions **Microstructure**

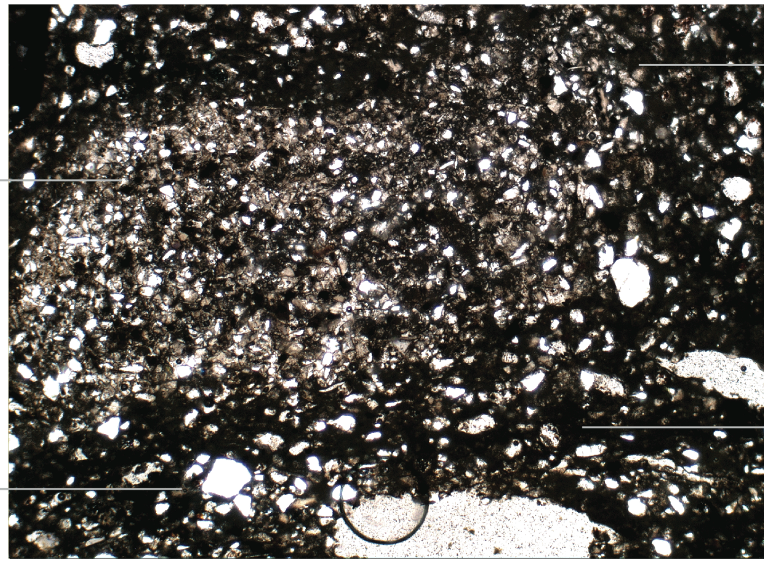


Fig. 8h) #106, Yellow Brick Thin Section: Sintered yellow brick incorporating sandstone fragment composed of very fine quartz grains cemented by clay minerals. It is distinguished from the matrix by the dense clustering of particles less than 50µm in size. Width of field 5mm, PPL

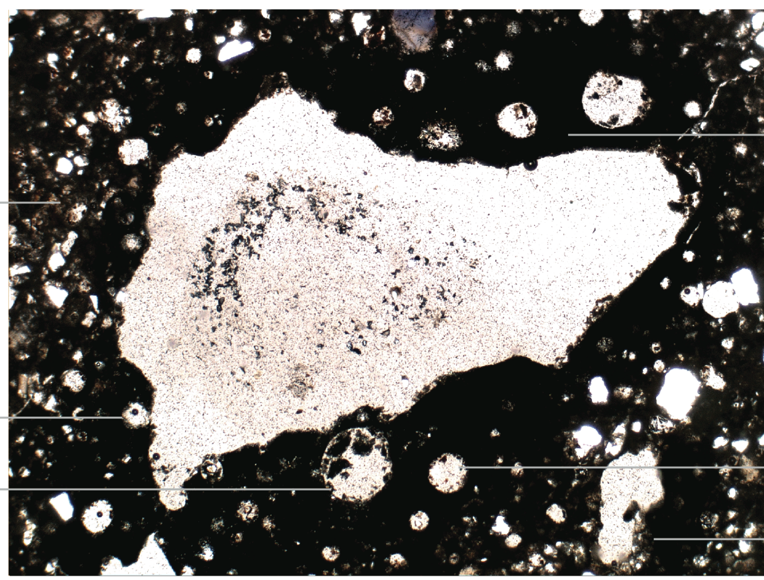


Fig. 8i) #106, Yellow Brick Thin Section: Detail of irregularly shaped carbon burnout void. It is surrounded by small, highly spherical voids indicating offgassing into the surrounding clay matrix. This behavior is replicated on a larger scale in the yellow bricks and indicates a carbonaceous clay component mixed into the highly calcareous clay. Width of field 5mm, PPL

Inclusions **Microstructure**

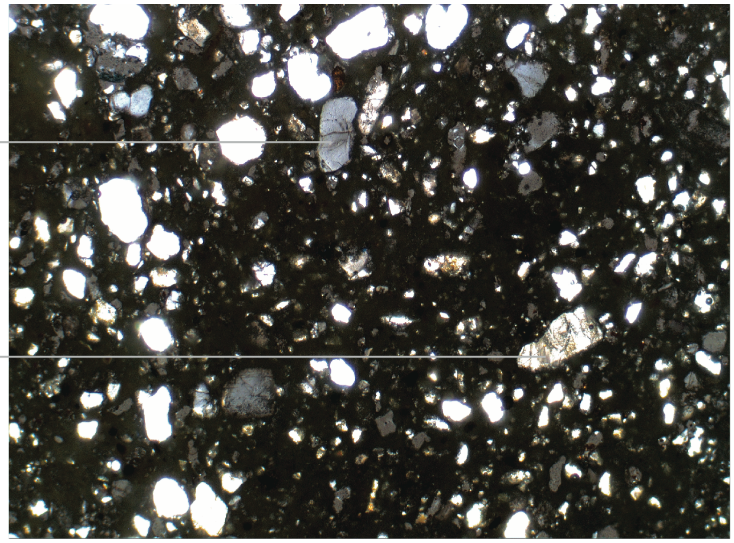


Fig. 8j) #106, Yellow Group Thin Section
Detail of sand composition which dominates the yellow brick fabric. The grains are consistently highly rounded, less than 50µm in size and very well sorted within the fabric. A small amount of weathered and iron-stained quartz grains are present. Field of width 5mm, XPL.

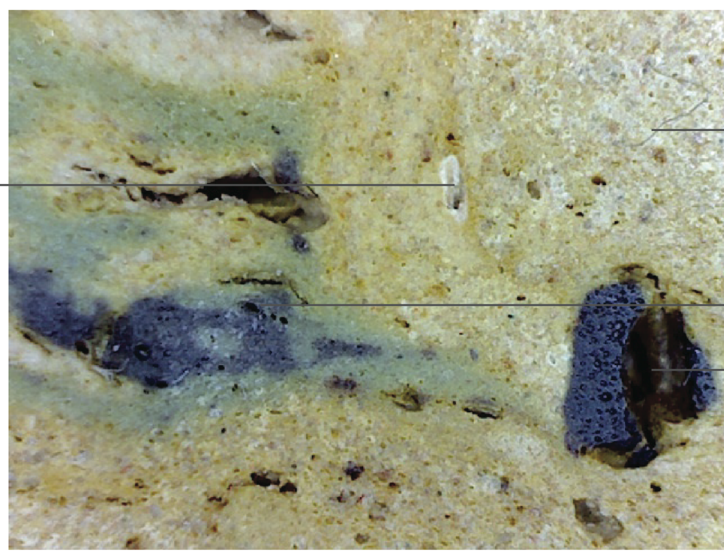


Fig. 8k) #74, Yellow Group Cross Section
Detail of vitrifying phase within the brick fabric. The mixing of a highly sandy marl with an additional clay creates localized concentrations of fluxed clay with distinct coloring and firing behavior. This in turn demonstrates how the brick was mixed and shaped. Field of width 2cm.

8d-g). A marine environment for the yellow clay is suggested by at least one example of scallop or clam shell impression previously fixed with a spot of mortar on sample #78, possibly indicating a decorative ornament or technical use as gauge of temperature. The clay surface underneath is a buff salmon pink color and is not fired to a yellow or greenish-gray. Shell exists as whole pieces and as impressions left by crushed material in the yellow brick fabric, sometimes inferred by a salmon-pink firing rim which is unique to this interface of clay and shell components in the yellow brick. Also, disintegrating shell appears as bands and nodes of pure calcium carbonate absorbed by the surrounding clay (fig. 8a inset). Broken shell pieces found intact within the fabric suggest a firitemperature between 650ºC and 800ºC kept some localized shell carbonates intact (Rice 2005). At least three mollusks are represented: oyster/clam, whelks, scallop and possible limpets, but no freshwater species were observed.

Group 3 Thin-Section Observations

These bricks are dominated by a very well sorted sand suggestive of marine environments, which is supported by the appearance of fine-grained sandstone captured in thin section and accounting for 5%-10% of the coarse fraction; calcic and potassium feldspars as well as mono-crystalline quartz dominate the fabric in a consistent size range of .3mm-1.2mm. The groundmass is generally dull with extensive localized vitrification. Carbon burn-out voids are clearly visible and are seen as dark reaction rims surrounded

by sub-spherical gaseous voids (figure 8h-i). The wedging patterns of clay and inclusions around these burnouts suggest a carbonaceous component, likely in the clay groundmass was incorporated by mixing with the sand fraction. The peripheries show a slighter higher amount of sand and more angular mineral grains due to the striking and mold-sanding techniques used in the 1B subgroup. An off-gassing microporous reduction with partial vitrification occurs in small clay pockets, with a purplish to black color. It is identical in appearance to vitrified Group 1 fabrics but does not cause bloating and coring in the yellow bricks since vitrification could not seal the clay on the surface and since the clay concentrations within the highly sandy matrix are localized. Fragments of a cemented sandstone were observed but the quartz sand size distribution is not bi-modal, and 70% of the coarse fraction is a well sorted sand. While opaque hematite is scattered throughout the fabric, it lacks pleochroic inclusions like biotite mica, which is likely due to a lack of parent rock material seen in the red bricks.

Marbling is caused by black, sandy clay incorporated by mixing (figs. 8a, 8k), As it vitrifies it shows a slightly increased porosity, exposing sand grains as its clay fraction melts. Red and purplish-black features are recognized in the bricks as hematite and magnetite components in this clay-bearing sand, which can completely fuse on surfaces exposed to the firing environment (figs. 8c, 8g); the marbled pattern of these clay phases demonstrate that they were incorporated into the brick in a plastic state and not added as dried grog. This clay component has a mechanical factor (shaping) as well as pyro-

chemical behavior (vitrification, offgassing) that can be distinguished as part of a heterogenous mixture in the yellow bricks.

CHAPTER V

DISCUSSION

Bricks illustrate the development of the early plantation and its changing industrial landscape. At Sylvester Manor, the brick evidence ranges from small weathered rubble and raw clay to coherent bats, which all demonstrate different exposures, destruction processes and weathering. Broken and wasted bricks can accumulate from a variety of bricklaying patterns, remnants, repairs, chinking and wall insulation which all contribute to material concentrations on site, particularly in the midden. To reflect this complexity of the material record, the discussion reviews the material evidence of the bricks from different perspectives as clay products, as building components and as archaeological material. A synthesized overview of identified brick types and criteria is presented in supplemental table 5.

Comparative Dimensions

Figure 9 illustrates the plotted dimensions of the A-Block brick sample which reflect the group characteristics assigned after analysis. It is now possible to see that the

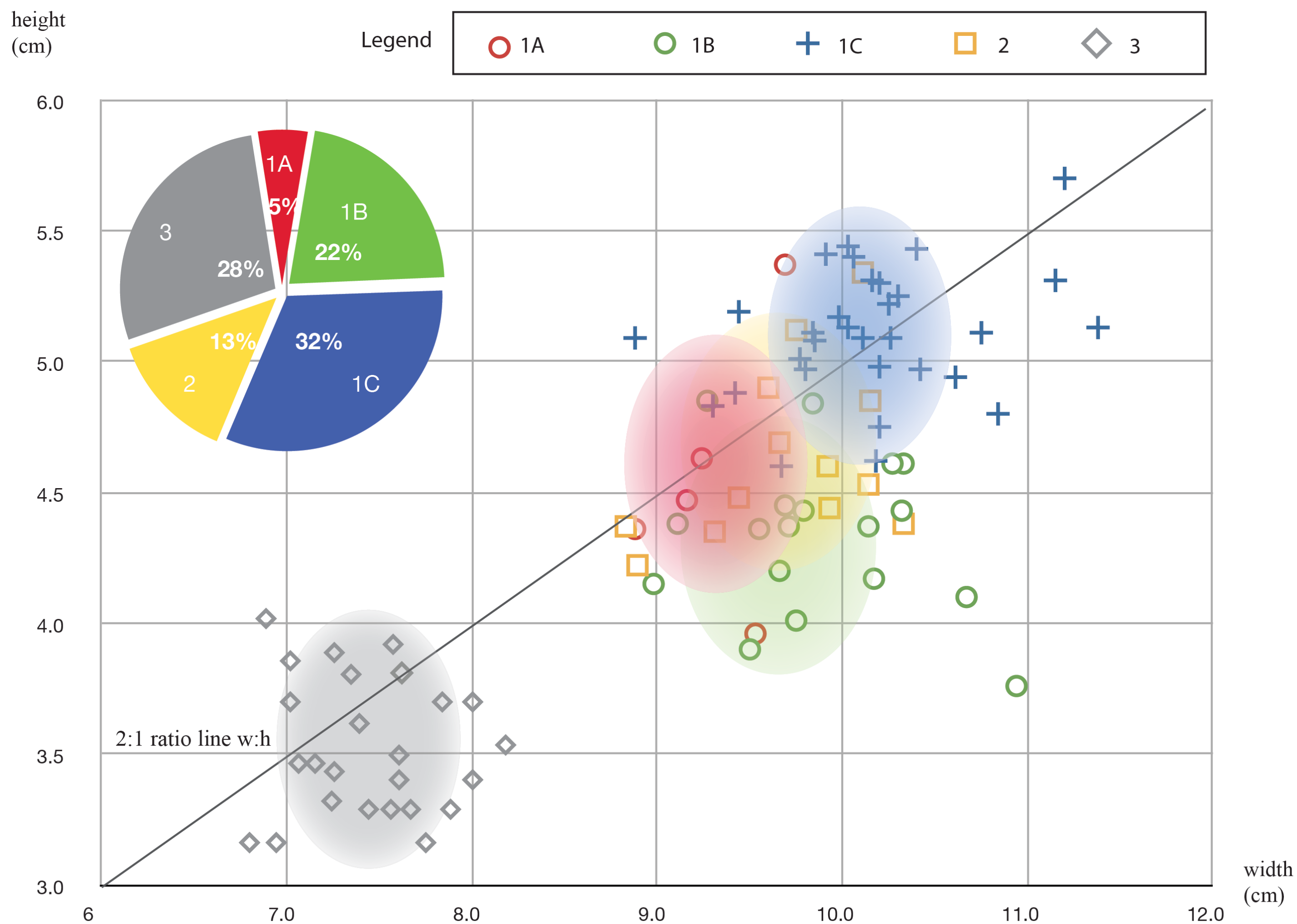


Fig. 9: Scatterplot of A-Block brick bat dimensions reflecting group assignments after analysis. A visual approximation of size range is given by a 1cm margin is centered on the averages of measured dimensions for each brick type. n (red brick)=67, n (yellow brick)=27

different brick fabrics seem to share a rough range of sizes. For each brick type, an average of the measured dimensions was calculated. Then, an arbitrary 1cm radius was overlaid to reflect production variability, uneven shaping and shrinkage rates. These factors can easily vary the dimensions of any given brick up to half an inch (1.3cm), and such distortions are quite common in handmade, soft-mud bricks (e.g. Gurke 1987, Harrington 1967). The clustering of these points in reference both to a common size margin and to the 2:1 ratio line can be interpreted as consistent shaping. In this regard, all the brick types show a slightly different distribution, which probably reflects similar but different processing for lots of bricks within the total sample and thus different brick groups. A number of points are outliers which can be interpreted as flaws or wasters contributing to a combination of bricks sorted for quality, bricks succumbing to wear and tear and defectively produced bricks representing all the identified brick types. A marked size difference suggests the red and yellow brick groups were not envisioned as being used together in structural elements. The decorative use of darkened *clinker* bricks mixed with yellow is well attested in the Dutch Atlantic (e.g. Garvin 2002; Smith 2001) but would be difficult to achieve with this material sample, as there is no evidence that the yellow fabric reduces and vitrifies this way, while the vitrified red bricks are nowhere near the yellow size range.

Technological shaping refinements increase structural stability; if bricks are the same size, the weight of a structure is borne evenly by the bonding patterns (e.g. Gurke

1987; Maginnis 1900). Thus, the size ranges of different bricks groups could reflect building preferences through time. For example, the refined Group 2 bricks cluster fairly tightly around the 2:1 ratio, while the Group 1 bricks show much more variation and account for most of the wasters; neither group suggests highly consistent shaping. A consistent w:h ratio allows cleaner, tighter bonds and less waste of mortar in vertical building. In practice, any size discrepancy can be overcome with broken bats and thick mortar beds, but this increasingly compromises aesthetically pleasing bonds and structural integrity as loads are unequally distributed. The interpretation of the dimensions is that the bricks used in successful construction are under-represented or missing entirely since they were far easier to recycle and salvage than the midden bricks under study. These dimensions support an interpretation of the bricks as construction debris, wear-and-tear discards and flawed pieces left over from production.

Continuous production of bricks produced at the site, or another designated area nearby, could have used shared equipment, methods and materials. There are several types of red bricks, suggesting they were used more extensively and/or for a longer period. The assumption is that the technological differences in the brick can be interpreted as a rough reflection of temporal sequence, with the Group 1 bricks being used earlier and the Group 2 bricks later. It is likely that many production characteristics overlap in successive lots of brick. Conversely, the yellow bricks were used for a short period and share very consistent dimensions but still incorporate defects and wasted

pieces, perhaps representing a small production run. Dimension changes are not arbitrary: making bricks wider creates a larger surface area which better resists compressive stresses and creates thicker walls, yet also requires more mortar to set. Brick dimensions also define surface areas. Vertical coursing exposes sides (stretchers and headers) and generally requires mortar, while horizontal plane arrangements expose top faces; bricks are laid dry and the interstices are packed with sand (Woodward 2011; Thomas 1998; Feister 1984). Therefore, roughly twice as many bricks are needed to cover area vertically than horizontally. The average surface area for the Sylvester Manor bricks is roughly $100cm^2$ for stretcher sides and about twice as much on surface faces for a standard 2:1 w:h ratio. This means that roughly 50 bricks would pave a flat $1m^2$ area with no mortar, while a wall or chimney would require 100 for the same surface area, excluding mortar lines. This estimate indicates that the volume of brick bats alone in the A-Block cannot represent a large amount of structural material; the author's modest patio of $9m^2$ is laid with over 500 bricks in a single herringbone plane weighing in at half a standard ton (roughly 450kg). This area is roughly equivalent to the diapered cobble paving in the South Lawn, for example. In any case, the variation in size, quality and production represented in the A-Block bricks makes it highly unlikely that any single building episode or structural element is represented. Moreover, the notable lack of articulated mortar also indicates a combination of discarded, trimmed and dry paved bricks that were

never used in vertical arrangements. In turn, estimates of surface area and weight concentrations cannot be applied equally to the diverse brick remains.

Regulated brick sizes in late 17th century Massachusetts Bay Colony were English derived and prescribed a fired 4:2:1 length:width:height ratio once mortar lines were applied (thus mold sizes were regulated slightly larger; Carrol 1979; Lefêvre 1900; Dobson 1850), while later standards in 1711 shift this to about 1.6:1 w:h as bricks became slightly thicker without changing their length. As noted in Chapter IV, the regulated 1679 size is indicated on the graph, and clearly the Sylvester Manor bricks fall short of that size range. Two examples of bricks outside the midden are also included in the graph for comparative purposes (one from the 1887 Sage brickyard at Greenport, NY, and one from the current Manor house, exact origin unknown). New York had similar brick laws enacted through the mid-17th to mid 18th centuries which also prescribed this basic shape, appointed inspectors and fines and regulated storage and handling (NY State, Lincoln, Johnson and Northrup 1894). These laws expressly deal with commercial transactions, however, so that imports and bricks burned for personal use were not subjected. Laws about the *use* of brick rather than specific dimensions probably had a more tangible effect on the growth of the industry, for example by prescribing brick chimneys and fireboxes in 1656 (Massachusetts State and Whitmore 1890). The dimensions of the Sylvester Manor bricks reflect production circumstances not subjected

to the kind of contemporary regulation that could be expected of commercial bricks made in cities nearby.

Processing Bricks: Clays and Fabric Components

Clay mixtures and treatments are responsible for a range of qualities in the red and yellow bricks in the midden. Although they lack diagnostic features relevant to this study, there are two types of debris clay in the assemblage. One is an orange-red associated with red bricks and pan-tiles, the second is a buff-cream clay associated with the yellow brick. These two clays appear as mixture components on the site in both raw form (lumps and spatter) and in fired bricks or debris as marbling and nodules. This suggests deliberate use and exposure of those clays to different mixing processes and firing atmospheres. These clays are the rawest products recovered from the site and are only lightly baked, highly friable and untempered. The two base clays are distinct and are worked together into brick mixtures, although they quickly lose distinction as fabric components once the bricks begin sintering (fig. 2c); the observation of small vitrified clay nodules of a yellowish-green clay under reflected light in the Group 2 thin-sections is another case in point.

Sources for clays could include shoreline marls, gleysols (anaerobic wetland soils) and surface clays. Clay and soil components could also be mixed together by digging through layers of surface deposits, in which case they would remain in the clay

fabric unless removed by processing and purification (Smith 2004). Clay sources in the region would most likely be mixed sedimentary deposits of kaolinite and other soil materials accumulating at interfaces of fluctuating water as a range of impure ball clays; these are highly plastic and provide unfired strength but are rarely pure (Rice 2005; Shepard 1956). Shoreline accumulation of calcareous marls incorporating shell carbonates is also a likely source. Yet, all sources would also vary widely in composition from one seam to the next, and therefore in the properties they contribute to ceramic products. If the makers of the Sylvester Manor bricks could identify basic differences in clays (for example, surface deposits with coarser inclusions and waterborne deposits built up of much finer sediments), then mixing them in various proportions could account forpoorly processed ceramic fabric that nonetheless created useable bricks. The color relationship of raw clay to fired ceramics is extremely complex and cannot be resolved in the current analysis, but some basic observations can be made.

The red and white clay represent two kinds of clay, or “fractions” (Clay fractions 2 and 3; table 6). Based on microscopic observations, another clay type is also proposed: the dark, sub-rounded nodules between 0.2mm and 2cm in size that consistently appear the brick fabric (table 5). These materials are likely shared between batches of brick because lots were made over time from similar sources and incorporated material from previous products.

Table 6: Summary of proposed clay fractions

	Oxidized Color	Reduced Color	Vitrified Color	Appearance in Bricks	Suspected Elements	Suspected Type
Fraction 1 "Black"	Dark Red/ Purple	Black	Black	offgassing cores and nodules	Fe, Mn, C	Precipitate redox iron; iron/carbon rich clay
Fraction 2 "Red"	"Brick" Reds	Brown-Black	Purple-Black	red fabric base, grog,chips	Mn, Fe, S	surface/ball clay
Fraction 3 "White"	(Salmon) Buff-Yellow	Olive-Yellow	Green-Gray	Fabric mixture, yellow brick binder	Ca, Fe	Marl, rich in carbonate and salt

The carbon content of clay fraction 1 is inferred from its extensive off-gassing observed microscopically and in hand samples and vegetal traces observed in the brick fabrics; vegetal carbon is most common in sedimentary surface clays and contributes to defective black coring; carbon dioxide and monoxide are formed as it burns off and internally raises the temperature of the brick (Shepard 1956). These clay nodules also resist oxidation and remain visibly dark in an otherwise oxidized fabric (fig. 5b). They are characterized by clear reaction and shrinkage rims as well as visible internal cracks due to rapid drying and water loss (fig. 2a, #117; fig. 5f; fig. 8f). They can develop into

off-gassing nodules and contribute to core formation and bloating, often remaining distinct in the fabric (fig. 6a). These nodules could represent components of parent clay incorporated as it was dug out and probably represent concentrations of iron and/or carbon within the clay source. They are visible to the eye in Group 1 bricks and occur microscopically in Group 2 bricks.

Clay fraction 2 is interpreted as the base for the red bricks, which demonstrate processing refinements over time and manifest in different brick products of similar origin and manufacturing. The ferruginous nature of the red brick base clay (fraction 2) is clear in the range of reddish-orange hues attained in firing the bricks, while a high manganese:iron ratio is the cause of a deep purple reduction in this fabric. Iron oxides cause complex interactions in the brick, particularly as hematite and magnetite, as well as limonite and other hydrated ferrous oxides commonly forming bog-iron and other waterlogged sediments. Unevenly distributed fluxes cause marbling and erratic vitrifcation in the Group 1 red bricks, a further indication that impurities from the clay sources were not processed out and carried over to the final products. In this sense, it is plausible that the fabrics of the Group 1 bricks were processed with seawater or brackish water drawn from wells. This would introduce impurities and an uneven distribution of fluxes manifesting in highly erratic firing behavior. The yellow bricks might suffer less from unpredictable fluxing if the proportion of clay in their fabrics is slightly lower, or because the salt concentrations are more evenly distributed in the fabric.

Clay fraction 3 has a distinctive cream-yellow color and is assumed as the base of the yellow bricks incorporating lime, sand and shell fragments from the original source. Calcareous marls are associated with sedimentary, silt-rich salt-water environments. Here, a high proportion of well-sorted sand accounts for a temper addition in the yellow brick fabric. At least two components contribute to differently colored phases in the yellow bricks: a) the yellow-white clay which can fire reddish-pink (seen at incorporated shell rims; fig. 2a), but here probably retains its light color in the presence of a complex mixture of salt, calcium, lime and magnesium which regulate the oxidation; b) distinct clay components worked into the plastic sand/clay mixture before it cemented in firing; these components appear as dark vitrified nodules and marbling as well as reddish, glassy crusts. If the yellow bricks utilized the same clay sources as the red bricks, this could reflect clay fractions 1 and 2 reacting distinctively to firing within the lime-rich yellow brick matrix, since it incorporates a clay component that vitrifies to a greenish-gray color (fraction 3; fig 8i). The incorporation of these different clays could be due to a work area or manufacturing scheme producing both red and yellow bricks, using different proportions for each. In the yellow bricks, the dark clay components appear as marbling and vitrified, off gassing nodules in cross-section. In the red bricks, dark components distinct from the matrix only appear as sub-spherical nodules associated with substantial voids created by off-gassing (both microscopically and as coring components; figs. 5b, 5g).

Both the red and yellow brick groups also incorporate grog and/or dried clay fragments. "True" ceramic grog is previously fired which can act as a suspended flux and aid the fusing of clay particles, thus increasing density, although it can also be chemically inert depending on parent material (Rice 2005; Shepard 1956). There are two variations of dried clay: one is a dried, untempered and highly angular in the Subgroup 1C and Group 2 bricks; since the material is the same, it only remains distinct in cross-section before it sinters. The other is a true grog (i.e. previously fired) often showing internal marbling not reflected in the surrounding fabric, as well as low amounts of very fine sands (fig. 7b). Both of these are interpreted as debris scatters of red clay material produced by successive cycles of brick production, which were incorporated into subsequent brick products during processing. Dried clay fragments can also be observed in the yellow bricks although they is not as common (fig. 8c).

The quartzite temper in the red clay base is identified by a distinctly bi-modal size distribution as well as highly angular pieces of felsic rock. This indicates mechanical processing and crushing, unlike the well-sorted sands indicative of sedimentary deposition and effluvial weathering. The red brick groups also incorporate rounded pebbles suggesting riverine gravels were also carried over into the brick fabrics due to a mixing of clays from different sources. Both rounded and sub-angular gravels and cobbles are responsible for tears, rents, cracks and other failings in the Group 1 bricks due to unequal fabric shrinkage as well as poor handling. This also contributes to internal

lines of weakness which evolving gasses can expand into (fig. 4c). The yellow bricks do not incorporate temper in the form of crushed surface rocks and rounded pebbles which are responsible for these mechanical failings in the red bricks. Instead, deformations in the yellow bricks can be attributed to handling errors and defective vitrification of the clay components.

As far as can be determined, the bricks are made from common iron-rich surface clays with carbonaceous components and at least one marly clay source. In the Group 1 and yellow bricks, processing of the clay mixtures seems minimal while the Group 2 bricks show some refinement. The abundant sands and gravels are consistent with regional geology and ecology of wetlands, brackish marshes, shorelines, estuaries and exposed cliff faces; the potential for precipitate redox iron at fluctuating water tables and in shoreline marls is especially high (Simmons 1986; Bokuniewicz and Gordon 1980; Mather 1843). In these bricks, the high iron content of the clay manifests as a range of reddish hues, as well as a buff yellow color as a consequence of high lime content in the yellow brick fabrics (Rice 2005; Smith 2004; Seger 1906). Crystalline quartz, gneiss, granite, possible andesite, hornblende, a range of feldspars, sandstone, lime, dried clay/grog, pyrites/iron impurities and tiny amounts of shell and calcite are identified in the Sylvester Manor bricks. Although they cannot be sourced, this is consistent with coastal, and lacustrine sands and gravels consistent with the general post-glacial terminal moraine geology reported in the region (Nelson, Pope and Voorhis 2012; Simmons 1986; Veatch

1906). Clays, water, shell and aggregates are all available in the immediate vicinity of the Manor from marine and terrestrial sources.

Firing

The heterogenous brick and mortar material in the midden is just one example of the many kinds of aggregate materials which could have been made on Shelter Island. Aggregate processing has a long history there and is supported by large shell middens on the North Peninsula as well as the attested use of lime mortar and plaster on the site (Hayes 2008; Howlett 2007). It also extends to the Native American ceramics which are low-fired and tempered with high amounts of calcined mussel shell. As architectural ceramics, bricks have the same basic material requirements as utilitarian and domestic wares, so they could have been made wherever such ceramics were produced, including Shelter Island itself. Temperatures of the brick firings were not high enough to melt larger feldspar fragments (<1200ºC; fig. 6a), but oxides of iron, salts and other fluxes enable extensive vitrification in the range of roughly 1000ºC (Rice 2005; Shepard 1956), Together with the range of differential heat exposure demonstrated in the bricks by marbled colors, gaseous fabric textures and defects, this suggests a closed environment. By contrast, the open firings proposed for calcinined shell for use in ceramic vessels are roughly 650º C (Hayes 2008; Rice 2005); carbon and carbonate shell matter also burn out in this temperature range. Overall, the evidence points to a poorly controlled firing

environment and unequal heat exposure in the bricks. Although enclosed firing temperatures can easily exceed those of open firings, they are difficult to control; this accounts for a wide range of brick qualities associated with clamp firing, especially if it is experimental or built with limited knowledge of the process.

The fabric darkening associated with reduction and vitrification can be distinguished from external traces of burning. “Blackened” or “burned” brick is sometimes described in field notes, when in fact this may be an internal mixture of darkened, marbled areas exposed in weathered fractures and cross-sections. The appearance of black reduction cores is an example of the complex chemical micro-environments within bricks created during firing. For example, black cores are not only caused by the incomplete oxidation of carbon, but also the reduction of hematite to magnetite; they further contribute to the internal formation of salts and other compounds at the interaction boundary of core formation (Gredmaier, Banks and Pearce 2011). Iron impurities are widely indicated in the clay, including the precipitate iron/carbonaceous nodules, hematite nodules (which can cause yellowish staining in quartz sands) and sulphur rich compounds such as pyrite (visible as small golden flecks at lower temperatures before losing organic sulfide components in firing); these could all contribute to uneven fluxing, erratic vitrification and offgassing,.

Although vitrification is not elementally diagnostic, it can indicate firing conditions of brick fabrics Although this process can yield desirable qualities in bricks

(notably water-tightness and durability), it can also easily destroy them if temperatures, firing time and fabric compositions are not carefully controlled. In a clamp firing, the process of vitrification is associated with reduced micro-atmospheres as the bricks get hotter than the surrounding air; the hottest spots are deprived of oxygen and airflow is only partially controlled. This explains the dark vesicular "rinds" formed at the edges of vitrified bricks, where carbon and other organics are incompletely burned out of the very hot, melting brick surface (fig. 8h). Vitrification occurs in temperature ranges upwards of 1000ºC as the silicates structures of clay begin to fall apart, but it can be encouraged chemically (for example with white oak potash; Loth 1974) or result unintentionally due to an enrichment of the brick fabrics with marine salts by way of seawater. Interestingly, laws governing brick size and quality often forbid brick-making with salty or brackish water (Carol 1976). As noted above, one likely reason is that enriching the interior or surface with impurities and salts (e.g. sodium, potassium and magnesium chlorides) adds an unpredictable fluxing element affecting brick quality and firing behavior, as is clear in the rapidly vitrified surfaces of the 1A/B bricks. The formation of hydrochloric acid, well known from salt-glazing techniques, is also dangerous and could be another factor in such laws.

Due to common firing technology, defective vitrification is represented in the assemblage for all Group 1 bricks including the calcareous yellow bricks. Vaporized salts deposit on brick surfaces and form hard glassy phases of sodium silicate; if formed

rapidly, this can seal a brick surface and trap internal gasses as with the 1A/B wasters (fig. 4a). Extracted salts from the interior can be incorporated into these phases or form a whitish “scum” at lower temperatures. An extensive terminology was used in the trades to describe the manufacturing range caused by clamp burning and corresponding uses for both wasted and under-fired brick (for example salmon or “sammels”, clinkers, rubbers, cutters, commons and seconds, e.g. Gurke 1987; Caroll 1976; Jamieson 1829). This made extensive sorting of bricks by masons commonplace: hard, vitrified bricks (clinkers) exposed to prolonged high heat were generally used for exteriors and wells, while softer bricks exposed to lower heats were used on interior facings and were often plastered. Vitrification appears on Group 2 bricks as a very thin layer, usually incomplete and more characteristic of ash dusting; overall, the color range indicates a fairly even firing. Group 1 bricks were exposed to high heats that were attained rapidly, and an uneven distribution of fluxing components caused erratic bloating and melting. In the yellow bricks, vitrification appears as a thin, greenish-yellow crust on the exterior and a greenish-grey fabric on the interior although deformations are very common. It is unclear whether the desirable qualities associated with vitrification were intentional despite its aesthetic shortcomings, especially in the Group 1 bricks. Clinkers would result with any clamp burning, however, and both brick and debris of every condition could be put to some kind of use (Morrison and Reep 1890; Brown 1902; Jamieson 1829)

Bricks as Artifacts: Summary of Red Brick Groups

Using the flow of external to internal observations of shaping and firing criteria noted in table 4, the bricks were refined into three groups: Group 1, Group 2 and Group 3 (Yellow). Group 1 is divided into three subgroups on the basis of firing behavior, inclusions and presence or absence of molding sands. The brick assemblage reflects a refinement of the aggregate mixtures and firing control as bricks were used and probably produced at the site or a nearby location over time. They range from ruptured and wasted 1As to the Group 2s with homogenous fabric and well-sorted inclusions. The 1A and 1B subgroup fabrics are visually distinct and are characterized by both reducing conditions and erratic temperature exposure. They are also thinner and longer than the subgroup 1C and Group 2 bricks, mirroring the general shape of the yellow bricks and probably used around the same time.

Commercially produced bricks should show consistent dimensions and this expectation is simply not met in the A-Block material (figure 9). The regulated dimensions and “sealed” molds (i.e. impressed with inspection marks, Caroll 1976) expected even of early commercial or municipal brickyards are not reflected in the bricks recovered from the midden A-Block. Mixing, curing, tempering, molding, drying and firing all influence the appearance and quality of the final product, and the Sylvester Manor bricks do not demonstrate consistency in this regard, either. Although the samples demonstrate some refinements of manufacturing techniques, they also suggest quality

sorting of bricks in construction or demolition as well as evidence of production debris and wasters. The wide range of preservation of the brick material is due to both acute manufacturing stresses in the bricks as well as surface and post-depositional weathering, especially in salty air and water. In terms of quality, it is likely that these bricks represent the lower end of productions which also made better bricks not represented in the midden A-Block.

Striking marks are consistent. Group 1 is rough, and always struck along the length of the brick, while Group 2 is struck along the width, yet often retaining a bottom strike as well, probably from a wet mold plate. In Group 1 cross-sections, the compression of shaping loops occurs across the width (fig. 6a). Together, this shaping evidence suggests molds were packed one at a time with the longest side facing the molder. Then they were given a quarter turn and struck lengthwise, drawing inward from top to bottom. This also accounts for a slight beveling observed in several cases where bricks were slightly compressed towards the short edge, leaving a characteristic raised lip as pressure increased and the strike pulled off the mold (fig. 2a). Meanwhile, Group 2 bricks often show two striking types on the same piece, lengthwise for the sanded bottom and a wet, width-wise strike on the top, perhaps indicating the multiple molds with removable panels commonly used in water-striking (Dobson 1850). Several bricks could be struck at once in wetted molds, then turned out onto a sanded surface. Retouching and brush marks on the sides sometimes appear on Group 1 bricks but there is consistent use

of molding sand for release. While the sides of subgroup 1A and 1B bricks are inconsistently smoothed, the 1C type always retains sanded faces and Group 2 bricks use very little molding sand. On the whole, the shaping methods of the bricks do not reflect consistent, regulated quality standards. Group 1 bricks are tempered with riverine sands and incorporate crushed, highly angular felsic rocks as well as large rounded river pebbles. This is probably due to inconsistent processing of the clay and unevenly distributed sand temper, which in turn causes the fabric to dry unevenly in firing, eventually rupturing as it shrinks around these large aggregate pieces. Dark nodules are also visible microscopically and in cross-section that are distinct from the matrix which also appear in the other group 1 bricks; these are noted as dried clay with a lower oxidation rate than the surrounding fabric.

The 1A and 1B fabrics began as soft clay mixtures readily absorbing water and subject to plastic deformation. They cover the widest range of glaring defects, which reflects both poorly processed bricks and exposure to a range of unequal firing conditions. The firing curve suggested by these brick groups is of short duration and high temperature. The erratic vitrification marbling in the 1A and 1B fabrics clearly reflects an enclosed clamp firing and poor clay processing. This unstable environment would only worsen with differential exposure to the peak temperatures of clamp firing or additions of salt fluxes. Whether intentionally added or introduced by processing batches of clay with seawater, various chlorides and other salts would contaminate the firing environment.

Sulfur, especially in the form of iron pyrite (FeS) and components of the fuel itself, was also commonly noted as a factor in effflurorescent salt leaching during firing; external and internal contamination contribute to gaseous formation within bricks as well as surface "kiln scum" and black reduction cores (Gredmaier, Banks and Pearce 2011; Shepard 1956; Jones 1908). Reduction often occurs in association with an end-stage of increased temperature as flues are sealed, any leftover fuels are burnt off and oxygen is totally displaced in the convection zones. In consequence, the fabric has a greasy luster with very low porosity due to extensive vitrification and high temperature mineral formation.

Because they are extremely alike in thin-section and cross-section, some of the 1A subgroup could be interpreted as variants of subgroup 1B bricks, in that they were exposed to uniquely defective conditions. While the 1A subgroup is internally deformed due to expansion pressure from extensive black coring and off-gassing, the 1B subgroup is heavily marbled, presumably because the brick surface did not seal fast enough to cause internal bloating but did experience erratic firing conditions. Together, these traits could indicate that these were part of an early lot of bricks that had a much larger wasted element overall than the other groups and the 1C subgroup. Vitrified material preserves very well compared to softer bricks since it is much harder and less prone to environmental damage and weathering. This is also precisely the reason such bricks were

often used in wells and drains where a need for durability was high and the aesthetic qualities were irrelevant.

Subgroup 1C is a dry, rough mixture of clay and grog which sinters at increasing temperatures to become an even mass with medium porosity. Extensive cracking in many bats and rubble pieces suggests a lack of proper clay preparation and prolonged drying promoting water loss in a “green” (unfired) state. Grog inclusions could be an attempt to correct that, but on the whole the dried clay inclusions in 1C bats appear to be the result of extensive re-working of those batches in the same work area and associated production debris of dried, scattered clay chips. 1C has heavily sanded faces and much sharper corners than the 1A/B subgroups. Wedging patterns attest a stiffer and stronger clay with a lower water content than the 1A/B bricks, allowing it to be packed tighter in the mold and retaining its shape better in drying and handling (fig. 6a). It forms reduced coring pockets associated with high carbon content and incomplete oxidation although they are far less pronounced than the 1A/B cores. This is partially explained by larger dimensions and thus a larger thermal mass than the other Group 1 subgroups and in turn a higher resistance to temperature stresses causing defects in other fabrics, such as bloating. The range of mineralogical inclusions is smaller than the 1A and 1B subgroups, mainly felsic rocks like gneiss and granite, but also occasional rounded pebbles. This indicates a combination of clay sources for the 1C brick mixtures although the shaping techniques are better than the rest of Group 1. 1C bats are also characterized by a high degree of

surface weathering and abrasion of the top faces inconsistent with the exposure bricks would have in a coursed wall; they are more in line with elemental exposure and foot traffic, such as in dry-laid paving. It would also be suitable for refractory and cooling purposes due to its porosity. It is plausible that this type was used as a basic building and paving brick at the site suitable for many different purposes, representing an increasing use of brick materials in an established plantation landscape. Thus, it is captured in a wide range of preservation and weathering states.

The Group 2 fabric is water-struck, with distinctly smooth tooling edges and striking surfaces. The slip-like texture of the clay is preserved in the firing after being tooled and molded when wet, often resulting in dried streaks on the surface. A very fine sand is still used for release, as with the recovered pan-tiles. Wiping usually removed this surface sand, however. These are lighter, homogenous fabrics characterized by even, controlled firings and minimal additions of a very fine, well-sorted sand which is evenly incorporated and only occasionally appearing in concentrated areas within the brick fabric. Apart from flecks of hematite and precipitate iron, scatters of sharp, opaque black specks could also represent sieved ash or coal, or iron finings from rollers and grinding wheels, although these are all generally seen as early 19th century innovations. Sieved coal and fly-ash introduce carbonaceous material and cause hot internal combustion, and if well-controlled this makes for hard, porous brick (these mixtures are known as "culm" or "breeze" e.g. Dobson 1850; Jamieson 1829).

Group 2 bricks have an average to high porosity and also contain dried clay chips that sinter readily with well defined boundaries in thin-section. As with the 1C bricks, this is likely a reworking of dried and fired clay waste from one batch to the next on a workbench. Molding sands are very fine while the fabrics contain very low amounts of coarse mineral tempering, so the Group 2 bricks are generally smooth except where poorly mixed. The evenly ground clay mixtures contain only microscopic carbon burn-outs and indicate consistent oxidizing atmospheres, allowing that these bricks could have been kiln-fired or prepared in a skillfully managed clamp variation (O'Neill 2001; Morrison and Reep 1890; Shaw 1846). Unlike the Group 1 bricks, incorporated nodules and particles within the clay were too small and the firing too even to cause disruptive failures.

Homogenous fabrics reflect technological innovation in clay industries, especially the chemical purification of clay sources and shaping treatments instead of relying on mechanical strengthening with a coarse fraction temper. The Group 2 bricks resemble bricks fluxed with alkaline liquids to promote an even, de-flocculated texture, for example with a powdered or liquefied chalky flux (Searle 1921; Lefêvre 1900). This was an early innovation in creating smooth, homogenous brick fabrics with even coloring. The volatile expansions and warping seen in Group 1 bricks are absent in the Group 2 bricks, and their clay fabric was probably engineered to ensure even particle sizes and distributions. Group 2 may represent later bricks (early-mid-18th century) made for

extensive interior use and clean, flat walls. This suggests a more refined approach to aggregate composition and a well-controlled firing which is demonstrated microscopically in the A-Block sample of this group. This could represent a better controlled process after initial experimentation as well as access to better products in the region.

Group 3: Yellow Bricks

The Group 3 bricks resemble "Hollandse IJsselstene" which are buff-yellow bricks made from calcareous river clays in the Netherlands (primarily Gouda, on the river IJssel); the A-Block samples roughly agree in size to a type of "geschifte stene" or half-brick, a common unit of Dutch building traditions in the 18th century Atlantic (Huey 2005, Smith 2001, Abelsma 1995, Gurke 1987, Becker 1977). They are commonly assumed as imported products from the Netherlands, although buff yellow bricks were made elsewhere from calcareous earths as mixtures of marl, ooze and dredged clay slime from riverbeds, including Scandinavia and the Baltic as well as New Netherlands and England (Smith 2001, Jamieson 1829). In the case of Sylvester Manor, this suggests they could have been made much closer to home. The yellow brick clearly indicates a unique clay composition, even though both yellow and red clay appear in the Sylvester Manor debris, sometimes in the same pieces. While the red bricks are more closely related as industrial permutations and seem to reflect a rough temporal sequence, the technologies used to produce both seem identical. The variation due to defects and handling errors is highly

consistent among the yellow bricks, so it is unlikely that they are of mixed origin or copies of “originals”. The construction aesthetic of the 17th century Anglo-Dutch Atlantic used these bricks extensively as firebricks in chimneys and ovens as well as walls, and they were known as durable pavers (Moser et. al. 2003; Abelsma 1995; Becker 1977). A distinctive dark surface vitrification attributed to “Dutch” bricks was the basis for contrasting patterns, but this is not evident in the A-Block yellow bricks; a dark color only appears internally as vitrified striations and nodules. Still, their size and color suggest a distinct product that could have appealed to a 17th century Anglo-Dutch aesthetic in the region. Contemporary techniques and expedient materials could have produced them in tandem with more basic red bricks.

The yellow color is both a clue and a puzzle but its exact nature cannot be resolved in this analysis. The high proportion of marine sand and shell carbonate are indicative of a near-shore clay source rich in salts which could significantly lighten the color of any fabric mixture. This could promote consistently lighter colors which would otherwise fire in reddish ranges at the high temperatures needed to vitrify brick. Although it is impossible to predict fired clay color from the color of a raw clay, it is reported that if the lime carbonate content is more than twice that of iron oxides in a brick clay, it will act to suppress and gradually lighten any burned reddish colors from heated iron oxides until a yellow range is reached at high temperature; carbonate contamination can promote a greenish-yellow fabric at high temperature (Rice 2005; Searle 1914; Seger 1906: 228).

This could explain amorphous, partially fired yellow clay lumps tinged green and pink, as the iron oxides did not reach high enough temperatures to fire the fabric completely yellow. Ferruginous clays can contain different mineral forms including limonite and hematite. Hematite manifests as a range of reds in an oxidizing environment, yet here they could be suppressed by a high concentrations of lime and salt while iron oxides act as a high temperature flux. High carbon contents can also mask the red coloration of heated iron oxides in a fully oxidizing atmosphere; limonite (a hydrated oxide of iron) is light in color but cannot be directly attributed to yellow colors in ceramics (Rice 2005; Shepard 1956). A lower proportion of clay in the yellow brick might promote lighter overall colors if it experienced higher temperatures than the red brick, however. Other clay components used in the mixture could manifest as isolated nodes of reddish vitrification and black internal marbling when exposed to vitrification temperatures due to a lower lime content and a separate firing behavior from the yellow fabric. The pale salmon color noted at some shell rims could also be interpreted as a slightly lower temperature at those rims where the clay could not burn quite hot enough to move beyond very pale red into yellow. As a calcareous marl enriched with decayed marine organisms and shell carbonate, this clay may have required little further processing to achieve a yellow color in firing; the rough nature of shell inclusions and the poor mixing shown in the fabrics demonstrates a lack of thorough preparation, however. Historically, rough mixtures of lime-rich material caused various failings in high-fired clays if the lime

sources were not properly treated; this was especially problematic if weather-proofing and refractory qualities were desired (Smith 2001; Seger 1906; Shaw 1846).

The yellow bricks are permeable, light and hard and are externally homogenous in appearance while internally marbled and scattered with off-gassing nodules. The porosity prevents the sharp spalling associated with rehydrated lime, yet the corners are not sharp and indicate that the bricks succumbed to chemical weathering, so it is unlikely that they were used in external applications. Reducing atmospheres and vitrifying conditions manifest in a greenish-gray color marbling visible in cross-section, although separate clay components are suspected for the vitrified red and black features scattered in the fabric (fig. 8k). Late 19th century clay industries made yellow sand-lime bricks from a sand/clay/lime mixture ground to 180µm which was praised as a superior brick since it formed a fairly pure hydrated calcium-silicate cement under steam pressure (Brown 1902). The yellow brick shows evidence for a cruder process of using a high lime content to create an internal cement. However, it incorporates more clay and relies on firing, much more akin to the production of early refractory "fire-clays" (e.g. Morrison and Reep 1890). Unless heated over 1000ºC, carbonate heavy clays can form extensive pore systems and spall heavily (Cultrone, Sebastián, Elert, de la Torre, Cazalla and Rogdriguez-Navarro 2004) yet these yellow bricks are not pure clays and contain large amounts of sand added to the marly base as well as salts and calcareous material of different origins (clay, shell, limestone). It is possible that the yellow bricks represent an effort to create a refractory

clay with a process and materials very similar to that used in the production of "Dutch" bricks. Although not all the yellow bricks were successfully fired, the vitrifying effect of the clay components made many bricks highly durable.

Note on Mortar

Lime mortar and plaster were prepared and used in some quantity in temporally distinct episodes on the site (Piechota 2007). The bricks from the A-Block units lack discernible traces of coursing mortar, however. There is no evidence of mechanical chipping damage on brick faces to remove mortar, and the molding striae of the bricks are clean and well-defined. Unless the mortar was of very low quality, this is highly unlikely because coursing bricks requires lots of mortar, and also because hydrated lime chemically hardens over time (Lounsberg 2013; Baronio, Binda and Lombardini 1997). Mortar removal also cannot fully explain the abrupt boundaries of mortar concentrations in the South Lawn midden, notably I7 and F.221 (ref. figure 1b-d). Acidic soils and moisture cannot fully account for the complete deterioration of mortar on all of the samples; in fact, chemical buffer zones are formed within the midden by the extensive calcareous deposits as read from earthworm casts (Proebsting 2007). Some brick rubble shows minute traces of post-fired burning or sooty deposits, yet the mortar/plaster recovered from the site does show significant amounts of blackening. This might be

interpreted as chimney or oven coatings which would probably have needed more frequent maintenance than the bricks themselves.

Possible Uses of Brick on the Site

Although the A-Block and midden bricks are a closed sample from an extensive site, they point to a simple reality concerning the use of brick products: the Sylvester Manor bricks either came to Shelter Island by water or were made on-site. Commercial brick products should reflect quality standards as a result of good money paid and the inconvenience of shipping bricks. By contrast, local manufacture and transport of bricks as Sylvester property would account for debris and production waste appearing in large amounts in the record as industrial trash. Archaeological sites that yield 17th brick material generally show some degree of in-situ articulation of bricks with mortar, as in fireboxes, chimney stacks, walls and wells (e.g. Pavia 2006; Moser, Luckenbach, Marsh and Ware 2003; Luckenbach 1994; Becker 1977). Yet apart from a brick floor in the dairy structure in the North Lawn, none of the brick in the Sylvester Manor assemblage shows such articulation nor do the voluminous field notes record any during the midden strata excavations. The South Lawn midden showed evidence of a layered soil burn and extensive mottling just underneath the A2 midden stratum, as well as thick layers of sand and clay lenses recorded throughout the excavation; units in the B-Block and feature 226 also record burn mottling (Howlett 2007). Slag pieces, coal and charcoal in primary and

re-deposited soils would result from brick firings and other industrial kilns. A number of subsurface channels and trenches were identified but not associated with cuts made for modern pipes (Piechota 2007; Howlett 2007). Those cuts went through the midden material, and brick excavated from these contexts was exclusively wasted.

Group 1 represents an early phase of local brick use and/or production. 1A and 1B bricks in particular constitute a distinct aesthetic and rudimentary technology, and probably contributed to features like a chimney, wells or drains in an early building phase. Coursing walls with flat, hard bricks despite irregularities is in line with 17th century building traditions, although high quality examples are largely missing in the A-Block material; it is unlikely the extant bricks were used to build walls and they carry no conclusive traces of coursing mortar. The clamp production method allows a wide range of brick qualities to be sorted for different purposes based on firing effects; this is represented by the diversity and variations seen in the midden material. 1C represents a basic building material extensively used for site needs across a larger area including paving and possibly drainage in later construction episodes; it constitutes a large part of the assemblage and is widely distributed outside the midden. These bricks were likely used in later construction episodes linked to an expanding mid-late 17th century plantation landscape comprised of permanent features and outbuildings as commerce intensified at the site. Although brick technology was largely unchanged from earlier production, it was probably better controlled, more efficient and made use of both skilled and un-skilled

labor. Traces of quality testing on 1C bricks include punctures with sharp, rectangular edges quite unlike marks from vegetal components like twigs. Punctured bricks could account for a way to "pin" bricks together with nails or tacks, contributing to the high concentrations of nails in the area. This could also be a method for testing drying or green brick not unlike checking a cake, and fired brick is commonly tested mechanically (e.g. struck with hammers). Environmental exposure and waterlogging created large amounts of 1C rubble that is characteristically rough, dry, and saturated with salt.

Based on the quantitative relationship to the red bricks, the yellow Group 3 bricks most likely contributed to single elements, probably chimneys or ovens, which could take advantage of the inferred refractory qualities of this fabric. They show the same range of production qualities and defects as the 1A and 1B subgroup red bricks, and for this reason are interpreted as roughly contemporary products. Group 3 bricks could represent a small, early production run made for specific purposes within a domicile and not widely used elsewhere on the site. Unlike the red bricks, there is no in-situ evidence for articulation as paving, although that would be consistent with highly abraded surfaces. Also unlike the red bricks, the yellow bricks are associated with a distinct aesthetic that was outmoded by the early 18th century in North America (Huey 2005; Luckenbach 1994). While brick can still serve various uses and accumulate in the landscape long after its structural use is over, yellow brick might have been "swept under the rug" even before the current Manor

house was built. Since there is far better evidence for mortar on the yellow bricks, they probably represent dismantled elements as well as outright discards.

Group 2 bricks reflect production practices that seem to reflect the increasing sophistication of clay product industries in the region. A lower amount of mineral inclusions and source impurities indicates more effective sieving treatments of the clay to produce more evenly sized particles from a natural deposit. These smooth, finely sized fabrics closely resemble pan-tiles and were possibly used in association with them to create a cohesive material landscape; the pan-tiles recovered at Sylvester Manor would have been impossible to produce with the materials and methods observed in the Group 1 bricks. Pan-tiles form chips and spall easily since they are brittle and homogenous, accounting for a mass of rubble obscuring the relationship to brick debris with similar qualities, notably the Group 2 bricks.

Sylvester Manor could take advantage of a productive clay industry developing in the region for more than half a century, so it is plausible that these bricks were made or acquired specifically for the construction of the 1735 manor house, probably together with the first pick of salvaged bricks from earlier elements or structures. This fabric and associated debris may reflect a later wave of materials and maintenance of an expansive, materially homogenous landscape where several buildings incorporate pan-tiles and bricks of consistent, commercial quality that take advantage of advances in mortar, plaster and contemporary surface finishes such as color washes, sealants and paints.

Building articulation and weathering leave material traces that are not always captured in hand-samples. Figures 7d-e show a Group 2 rubble piece with evidence of mortar. Since this sample does not have a face, this mortar should be interpreted as building spatter or weathering products intruding through surface pores, probably mixed with depositional calcite.

In this analysis, these bricks are best understood as architectural materials in two forms: a) previous components of un-coursed structural elements such as paving and floors (notably subgroup 1C and yellow bricks) and b) leftovers, wasters and debris representing production and experimentation waste representative of other bricks in better condition which could have been articulated with mortar and which were recycled or salvaged (mainly subgroups 1A/B and Group 2 bricks). It is likely that at least a portion were used in the construction of the current Manor house, although brick use must have continued in other ways. Iron wall "ties" were commonly used from the mid 19th century to strengthen brick wall courses but have not been recovered to date at the site. Other bricks were probably dumped, sold or salvaged according to preferences which are often reflected in the archaeological record; at Fort Orange, for example, 18th century looting from nearby Beverwijk intentionally left behind outmoded yellow bricks (e.g. Huey 2005).

Bricks in the Industrial Landscape of Sylvester Manor

Both Sylvester Manor and the mainland would have had interdependent functions in a commercial brick venture whether the bricks were produced at the site nearby or the immediate vicinity. If the Sylvester interest at the contemporary brickyards noted in Greenport and Hashamomac (Calder 1970; Southold NY and Case 1882) had a commercial dimension it could represent a source of wasters and debris at Sylvester Manor (keeping the mid-range to inferior bricks for personal uses while selling the best ones), and it would also enable easier distribution of fired products to the mainland. The brick assemblage at Sylvester Manor reflects efforts using similar resources and technology to produce and/or acquire different brick types; a commercial venture would likely have included an experimental phase of producing bricks to test local clay and aggregate sources to create a consistent product, including the distinctive yellow bricks. If initiative was taken at Sylvester Manor to produce bricks on-site, then the range of industrial remains can be interpreted as brickmaking conducted by variously skilled laborers and overseers using resources that were expedient but not ideal for creating good products.

The physical process of making brick is fairly straightforward (e.g. Garvin 2002, 1994; Gurke 1987; Dobson 1850). All the phases involve physical labor comparable to harvesting, carpentry and similar jobs consistently documented at Sylvester Manor with a mixed free, enslaved and indentured labor base (Priddy 2007; Chiarappa 1991). Although

no accounts of construction, repair, maintenance or acquiring architectural materials survive at Sylvester Manor from the plantation period, such records become very common, and quite detailed, by the mid-18th century (e.g. Arryl House, NY; Wentworth 1979). The material evidence at Sylvester Manor reflects rushed and/or unskilled processing stages, particularly regarding the drying and mixing of clay and bricks; poorly processed aggregates create inferior products. In early industrial accounts, sun-drying is discussed as a cheap and effective method for preparing bricks. But problems arose as atmospheric moisture and precipitation caused bricks to deteriorate quickly if not closely watched and treated (Brown 1902; Morrisson and Reep 1890). Most brick-making activity was carried out in late spring/summer, since dug clay was allowed to cure over the winter in repeated frost/thaw cycles (Rice 2005; Garvin 1994; Shaw 1846; Jamieson 1829). In addition, using the most expedient water sources might not have been ideal; salt-water would introduce impurities and fluxes, while fresh water would depend on local topography and proximity to clay processing.

In the South Lawn midden, excavated brick material spanning from the A-Block to the cobbled surface is highly varied, which does not suggest the articulated, load-bearing brick walls or foundations. The evidence from this analysis does not suggest structures since different defects, sizes and types are represented in a single archaeological layer and there is little uniformity within A-Block units (table 1). It would be difficult to build load-bearing walls with this material, though a mix of demolished

structural elements is possible. It is more likely that this range reflects industrial manufacturing of the time; even a single lot of bricks can generate a highly varied appearance in an unstable firing such as a clamp (Pavia 2006; O'Neill 2001; Finney and Snow 1991). The bricks likely represent an accumulation of disused brick, wasters and debris that succumbed to structural or production stresses spanning different periods of Manor occupation, including construction and maintenance episodes over time. Yet overall, based on the incoherent stratigraphy of the South Lawn midden, the direct evidence for temporal sequence is weak. In this analysis, the assumption is that industrial refinements in the bricks are representative of sophistication of clay industries generally, both in the vicinity of the site and elsewhere; clay products rapidly became exacting, competitive and prolific industries through the 18th and 19th centuries, and bricks became the predominant building material for explosive urban growth. For this reason, it is easier to interpret the differences in production in the Sylvester Manor bricks as an increase, rather than a regression, in quality through time.

In terms of structures, the lack of articulated brick remains, foundations and whole bricks at Sylvester Manor has been interpreted as a reflection of re-used materials in the current house which is indirectly supported by this analysis. Recycling and salvage could have left these un-mortared bricks behind as the unused remains of construction or as production wasters. Among the structural uses, both basic coursing and surface paving are probably represented by different products at different times. Social and spatial

distinctions are often manifested in building materials, reinforcing order and discipline in a structured landscape, for example in corporate or military environments (e.g. Singleton 2001; Feister 1984). In turn, this helps explain why different building material concentrations on the site show distinctive taphonomic patterns in different areas.

Clamp Firing

The rich and diverse A2 midden layer as a work space/clamp site can be interpreted as a reflection of the material and maintenance needs of a working farm or plantation. If the midden was exposed for a number of years (Proebsting 2007), then this central space would have combined industrial labor activities and refuse. Small and large scale episodes of repair, acquisition and production of brick (and any other building materials: mortars, pan-tiles etc.) would accumulate there. This industrial character is strengthened by discrete mortar concentrations and high and diverse brick concentrations in the sheet midden. Bats are most commonly broken across the width, which is characteristic of half-brick bonding in simple patterns which probably accounts for discarded brick bats that are otherwise sound, and for whole bricks which are wasted and discarded.

Although some post-holes in the midden have been interpreted as remnants of palisades and fencing, others are noted as being “partially burned in situ” and backfilled with contemporary soil and often contain brick (Hayes 2008; Howlett 2007:46); work-

yards, saw-pits, clamps and brick stockpiles would be seasonally shaded or covered, however, perhaps accounting for some of the post-holes. At least one of the midden trenches exclusively contains defective brick (Unit A2, pipe trench) perhaps representing a subsurface use of these features not yet considered, such as a drain. These perpendicular trench lines coincide with dense brick concentrations in unit A6 but revealed no structural associations. The relationship between the channels, postholes and stone foundation remnants is still unclear but it is likely that they represent multiple episodes, since the evidence demonstrates that the midden accumulated over time.

Geophysics has ruled out brick as an architectural foundation and indicates no resistivity hotspots which would result from a high intensity soil burn (Kvamme 2007). But due to intensive landscaping disturbances, soil evidence from a clamp firing in the midden is probably lost to GPR except as a material proxy like brick. Also, burning traces would appear at subsurface interfaces, however, not the landscaping cap of the A stratum. Although wells, drains and similar sub-surface uses of brick have not been identified, bricks can also be used as bed edging, paving and refractory or insulating surfaces (Kvamme 2007); these would not require coursing with mortar and could have low aesthetic requirements. Outbuildings, jetties and other commercial infrastructure in the plantation core taskscape could have incorporated bricks in ways not necessarily reflected in the midden material (Ingold 2009).

Local and Regional Industry

The eastern fork of Long Island has a long tradition of making bricks from extensive clay deposits through at least the 19th century. Greenport was the seat of the Sage brickworks established by Clinton DeWitt Sage in 1887, followed in turn by the Long Island Brick Co. (Booth and Monsell 2003). A Sage brick was recovered from the region during early field seasons. In addition, Robins Island, Fishers Island, Plum Island and Southold all ran brickyards of some importance in the 19th century and supplied bricks in the millions to New York and the mainland (Booth and Terry 2009; Newland 1905). The mid- 20th century saw the gradual decline of such works due to consolidation and catastrophic weather episodes, such as the 1938 hurricane which inundated the rich clay banks at Southold and bankrupted the Sage Brick Co.; precautions for flooding were common in clay industries because related damages could be catastrophic (Morrison and Reep 1890). Brick and aggregate industries are a tradition of the region that developed as highly localized markets before the mid-19th century and afterwards proliferated exponentially due to mechanized production and distribution; distinctive product branding also became widespread at this time (e.g. Stuart 2005; Gurke 1987). By 1850, hundreds of brickyards are documented in the Hudson valley and Long Island Sound (Booth and Terry 2009; Gilbert et. al. 1993), although the rich clay deposits at Arshamomaque, Hashamomac and other industrial sources on the north fork of eastern Long Island must have been known and used well before the 19th century, as is clear from

the colonial records of Southold and other sources (e.g. Calder 1970, Town of Southold and Case 1882, Mather 1843). Some are still in use and others have long since been exhausted. Shoreline brick-making occurred all along the Sound wherever clay deposits are found; there are several historically productive clay sources in the region including white clays (kaolin) known on Shelter Island, for example at the White Hills on the western extent (e.g. Mather 1843).

Clay strata are ubiquitous on Long Island. Many are discussed by locality in the 19th century professional and amateur geology of the region and attest a wide range of brick-making activities and aggregate sourcing, as well as a dynamic hydrologic environment which has changed the face of industrially used shorelines though the centuries. These early field observations were generally made when observing soils while digging wells or observing shoreline cliffs stripped by storms. This information does not allow sourcing but it generally agrees with the mineralogy of the Sylvester Manor bricks, making specific mention of hematite nodules, limonite, lignite, indurated clay balls and pyrites (Nelson, Pope and Voorhis 2012; Mather 1843). They reflect terminal glacial moraines and a ferrous wetland chemistry that characterize Long Island Sound's extensive coasts and salt marshes; both high and low power sediment transportation systems contribute to the shoreline formation of clay beds from mud and silt in the water column (Simmons 1986; Bokuniewicz and Gordon 1980).

It is possible that clay deposits on Shelter Island and the region are or were saturated with marine salts given the thin glacial aquifers and fluctuating seawater intrusion on the groundwater table causing extensive soil stains and iron leaching (Simmons 1986; Veatch 1906). Apart from small kettle ponds, Shelter Island does not maintain a freshwater circuit of streams and rivers, and its aquifer floats on the denser sea-water underlying deeper geological strata (Nelson, Pope and Voorhis 2012; Simmons 1986); like much of Long Island, this meant freshwater was generally tapped from wells. The complex microbiological environments of salt and seawater confluences were instrumental in creating the raw material used by the early industry of the region; vegetal trapping of riverine and marine sedimentation works in tandem with decomposition to create highly enriched carbonaceous deposits of clays and decayed material including lignite and peat layers (Shepard 1956). At Sylvester Manor, calcareous sandstone marl and waterlogged, carbonaceous subsurface clay rich in precipitate redox iron are identified as likely sources for brick mixtures which are combined with sands from marine and estuarine environments. The processing of bricks with saline water is also in line with a lack of circulating freshwater; despite extensive clay deposits, the complex soil chemistry of wetlands and estuaries would present challenges to brickmaking on Shelter Island and the region around it.

Aggregate processing on Shelter Island of shells, sands and crushed rock tempers by Native Americans pre-dates the mid-17th century Anglo-Dutch presence, but the

technologies appear to have influenced each other. For example, later Native American ceramics show an increased shell content that is better refined through the Sylvester occupation (Hayes 2008). Nearly all aggregate processing relies on some form of sustained heat, from baked shell temper in Native American ceramics to slaked oyster-lime mortars and bricks. On a regional scale, this large consumption of heat and natural resources spurred coastal fuel shipping industries but prompted ecological regulations as early as the 1650s (Williams 1989; Bishop, Freedly and Young 1861). Calcined shell and coral in early mortars on the site was prepared first, probably by burning a "lime-kiln" to then crush and process shell-lime into aggregate products; raw material processing may well have factored into initial site placement, as well as the lee harbor at Gardiner's Bay. Industrial remains at Sylvester Manor include refuse from charcoal- and lime-burning, glass and metal slags, and coarse redwares. These products are all related by similar requirements of processing labor and an industrial use of heat. Such remains reflect the multi-cultural production, self-sufficient farming and business activities carried out at Sylvester Manor which contributed to extensive Caribbean commerce, particularly with Barbados.

Note on Ballast

One alternative explanation to on-site manufacture of the bricks is that they were produced elsewhere and floated to the island from a local, regional or foreign point of production, or that they formed part of a ballast load. Obviously, Nathaniel Sylvester's

commercial reach extended well into the New York mainland and across Long Island Sound, and in the abstract anything could be sourced there (Priddy 2007). At the same time, the expectation would be for less waste and defective bricks than exist on the site and which are clearly associated with industrial production activity, whether at Sylvester Manor or elsewhere. In this scenario, evidence of that handling should remain on the shoreline as lost and jettisoned bricks. Historical precedents for importing brick, for example at Fort Orange, are generally caused by lacking simple but essential components for brick-making, notably clay, space, labor, water and fuel (Smith 2001; Becker 1977; Bishop et. al.1861), yet Sylvester Manor met all of these requirements. Ballast is a problematic explanation for movements of brick because cargo space was at such a premium, especially in the lucrative 17th century West Indian circuit which Sylvester Manor took advantage of. Bricks are hygroscopic and can absorb atmospheric moisture, becoming both heavier and possibly damaged. Bracing cargo had an equally important role, if not more so, than “balancing” in a ships hold; this was accomplished with ropes, nets, and spare timber (“dunnage”). Further, cargo ships were generally ballasted for return journeys, once cargo had been discharged and profits were maximized. The small total volume of brick that ballast can reasonably account for, along with the diversity of the Sylvester Manor bricks, makes it difficult to interpret them as ballast (Becker 1977; Townsend 1904). Unless the source and type of ballast was consistent over time, it would not accumulate in the patterns found at Sylvester Manor. Only sustained local commerce

lends itself to this interpretation. From Southold and eastern Long Island, small vessels would have access to leeward Shelter Island anchorages like Sylvester Manor, while larger ships would have anchored offshore at Gardiners Bay. It is obviously much easier to produce and deal in bricks locally rather than dedicating a shipment by water. Thus, a connection with regional brick-making makes a ballast interpretation much more plausible, especially as Sylvester property involved in quotidian local commerce. Bricks were often *locally* transported by river barges but far less frequently in cargo holds over long distances, similar to lightered gravels and other dredged river ballast which can sometimes be sourced in its own right (Jones 1976). It is both good building practice and in line with the creation of a nucleated plantation landscape to consolidate construction, maintenance and surveillance as much as possible, so if clay sources and production were not on-site they were probably close.

CHAPTER VI

CONCLUSION

A succession of brick products was used at Sylvester Manor pre-dating the current manor house and spanning various occupation periods. The analysis of the Sylvester Manor bricks demonstrates the complexity of historical building materials and aggregates despite their archaeological reputation for being unremarkable. It is a successful test of unlocking diverse and interesting details in a ubiquitous and under-characterized material, and it was conducted with mutually informative visual methods which are inexpensive, accessible and relevant to both archaeological fieldwork and laboratory analysis. In turn, this study has enabled more questions about the various materials and agents shaping the built environment over time and contributing to the formation of the site and the developing industrial landscape of the region. On one hand, the Sylvester Manor bricks are more closely related than their varied appearance suggests. They capture the production and firing technology of the time and show a high degree of similarity in terms of fabric composition and the sorting and shape of shared mineralogical elements. The interaction layers and domains in the bricks reflect chemical firing processes affecting different bricks. Both oxidation and reduction occur internally and externally, so

these processes produce widely different appearances of similar products. On-site or regional production could account for different bricks being made over time and forming at least two groups of red clay bricks alongside the yellow bricks. On the other hand, visual analysis identified at least five different kinds of brick with reference to microscopic profiles, external features and ranges of bat dimension ratios. Technological refinements and weathering in the bricks attest a sustained use of bricks at the site over time.

All the brick types represent hand-made bricks from processed clays that were mixed, cured and tempered before being struck with molds. The fabrics exist in under-fired, defective and mid-range qualities, and seem to incorporate clay source material as they are processed. A lack of evidence for brands and mechanization (die-extrusion, wire-cutting, precision shaping etc.) indicate brick shaping technology predating the 19th century, while the firing technology lacks the sophistication expected of large-scale commercial ventures. A combination of brick qualities and maintenance cycles are reflected here and encompass industrial activities that could include on-site production, construction and demolition. This suggests an unappreciated contribution of brick manufacture and taphonomy to the sum of historic site materials at Sylvester Manor. Accumulated discards and debris, inconsistent spatter of construction binders and expedient use of bricks as nogging and chinking material also contribute to this pattern.

In the context of a region known for clay products, and for bricks in particular, the range of industrial evidence at Sylvester Manor makes on-site or local manufacture of bricks highly plausible. Diverse industrial activities occurred at the site over time and bricks represent a wide range of raw materials processed from the landscape. On a basic level, the requisite materials for ceramic and brick production were all available at Sylvester Manor, similar to other colonial plantations using brick extensively: clay, water, space, fuel and labor (e.g. Huey 2005; Singleton 2001; Thomas 1998). Interpreting these remains as industrial debris rather than the debris of articulated structures helps to explain the formation of the midden and the development of the site core throughout the plantation period. A variety of associated materials appear together and suggest continuous construction, maintenance and demolition from the earliest phases of the Manor's occupation. Further, interpreting the bricks as related permutations of the brick-making process suggests a rough temporal sequence based on technological refinements.

The production of different brick types reflects the industrial experience of early supply plantations: using expedient resources to capitalize on local needs, while also participating in a larger Atlantic network circulating lucrative finished goods. Bricks are good business in urbanizing environments since the consumption of building aggregates increases exponentially with residential density. They also reflect aesthetic and material demands. In the New Netherlands, urban development created consistent and lucrative markets for aggregate industries; notices of land sales often explicitly included reference

to the potential for making bricks and other industrial materials (e.g. Fort Orange 1654). The key was whether profit could be turned by producing bricks on a larger scale beyond personal use. Commercial brick production was already beginning to beconcentrated in large yards by the mid-18th century, making small scale production increasingly obsolete after Sylvester Manor had phased out the supply trade to Barbados and the region was entering into an age of urbanizing construction (Gilbert et. al. 1993; Gurke 1987). The bricks at Sylvester Manor seem to represent this shift from material self-sufficiency in a wide-reaching Atlantic trade network towards regional business and larger, nucleated centers of material production. Bricks and other building aggregates are an important material link between urban and rural residences in the urbanization of colonial holdings. Anyone living in the 17th and 18th century Atlantic world could be familiar with the basic process of bricking, maybe peppered with incomplete knowledge of trade tricks and procedures. Whoever made the Sylvester Manor bricks had some knowledge and perseverance but inconsistent results. The material reflects some combination of poor oversight, unfamiliar materials, erratic firing and various degrees of professional skill. Sylvester Manor is situated on a rural island and it had to find independent solutions for its material needs; the bricks demonstrate that these choices were made over time and executed by different laborers, manifesting in a range of brick products and applications in the landscape.

Brick and aggregate products recovered from Sylvester Manor illustrate the dynamic role of building materials in a changing landscape over time, from the mid-17th century to at least the mid-18th century; they are entangled in an industrial cycle which links raw materials to production waste and debris, storage, weathering and collapse. Sylvester Manor was meant to be an efficient production engine and the Sylvester legacy proves that it was, yet it is not illustrated as a built environment beyond scraps of reference and the building materials revealed in the archaeological record.

Afterword

After 30 years of ownership, Nathaniel died in 1680 and his eight heirs variously stayed at the Manor or dispersed to nearby cities. The paper trail of his eldest son Giles Sylvester, who managed the plantation distinctly contrary to his father's image and broke most of the stipulations of his will, tapers off with a permanent move to Boston. As the Caribbean trade folded up, the property entered a tenancy period and was increasingly neglected until Nathaniel's grandson Brinley Sylvester inherited it after a long and difficult legal dispute around 1715. He revived operations at the recast estate and adopted a new architectural vogue for landscaping. The building material acquisitions for this project occurred in an industrial region that was nearly a century in the making, and in which the aesthetic role of yellow brick paving and chimneys, for example, had become distinctly outmoded. The Sylvester Manor bricks suggest that Brinley Sylvester's

ancestors were more self-sufficient in their material needs, contributing to an industrial landscape and a growing residential demand for building trades and materials.

Resolving debts and a keen political sensitivity had put Nathaniel Sylvester ahead in the fast-paced business of Caribbean supply, and Shelter Island was a large piece of land to be politically autonomous. The challenges he had faced in becoming the sole proprietor of Shelter Island were significant, which is underlined by his stipulation that the island *never* be divided by his heirs outside the family for any purpose, on pain of disownment (Priddy 2007). Yet within 15 years of his death the island starts to fragment into parcels and lots among the second generation, especially Giles, from about 1695 (who have since taken up residence in other cities, notably nearby Southold, Newport, RI and Boston, MA). As the land fragmented, more residents established themselves. In turn, they required more materials, and development rapidly nucleated on the island, culminating in a township by 1730 when Brinley Sylvester recast the property as a formal Georgian estate. This venture added a new cycle of building materials to the archaeological record that reflect a much more crowded island than his grandfather had known.

The material characteristics of these bricks can begin to account for an under-characterized experience written out of the record of Sylvester Manor and its architectural history through successive occupation periods. A range of broken, weathered and wasted bats illustrates this complexity far better than intact bricks that made the cut.

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