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UBIQUITOUS AND UNFAMILIAR:

EARTHENWARE POTTERY PRODUCTION TECHNIQUES AND THE BRADFORD FAMILY POTTERY OF KINGSTON, MA

A Thesis Presented

by

MARTHA L. SULYA

Submitted to the Office of Graduate Studies,
University of Massachusetts, Boston,
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

June 2015

Historical Archaeology Program

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UBIQUITOUS AND UNFAMILIAR: EARTHENWARE POTTERY PRODUCTION TECHNIQUES AND THE BRADFORD FAMILY POTTERY OF KINGSTON, MA

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Approved as to style and content by:

____
Christa M. Beranek, Research Scientist, Fiske Center for Archeaological Research
Chairperson of Committee

____
Stephen A. Mrozowski, Professor

____
John M. Steinberg, Senior Scientist, Fiske Center for Archaeological Research

____
Stephen W. Silliman, Program Director
Historical Archaeology Program

____
R. Timothy Sieber, Chairperson
Department of Anthropology

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ABSTRACT

UBIQUITOUS AND UNFAMILIAR: EARTHENWARE POTTERY PRODUCTION TECHNIQUES AND THE BRADFORD FAMILY POTTERY OF KINGSTON, MA

June 2015

Martha L. Sulya, B.A. Bates College
M.A., University of Massachusetts Boston

Directed by Christa Beranek, Research Scientist, Fiske Center for Archeaological Research

Redware ceramic sherds are frequently found in New England historical archaeological sites; however, detailed data has not always been published regarding excavated New England earthenware pottery production sites. The goal of this thesis is to contribute to the small body of research on New England redware production through the study of the life and ceramic production techniques of the Bradford family pottery. Their workshop operated in Kingston, Massachusetts, from the 1780s to the 1870s, a time when stoneware production and industrial scale ceramics manufacturing took hold in America. Documentary study of the Bradford family and the ceramics industry shows that they operated a small, family workshop very much in the traditions of redware potteries. A description of the chemical processes which affect lead-glazed redwares in a wood fired kiln provides insight to the physical appearance of excavated sherds. Analysis of the kiln

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furniture illuminates the technical aspects of pottery production, including methods and scales of production. Nearly 2,000 pieces of kiln furniture were examined and a selection of eight kiln furniture types was studied for function through use marks and color. The Bradford kiln furniture was also compared to those from the redware pottery workshops of two contemporaries: Hervey Brooks of Goshen, Connecticut and Joseph Hazeltine of Concord, New Hampshire. These archaeological remains can help us understand how the practices of a family business did or did not respond to changes in their trade and determine that the Bradford pottery was representative of the common experience of New England redware producers.

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CHAPTER ONE

INTRODUCTION

The goal of this thesis is to achieve a better understanding of the lives of potters and the production techniques of small New England potteries in the late 18^{th} and 19^{th} centuries, with a focus on the Bradford family pottery of Kingston, Massachusetts. This will be achieved through analysis of the kiln furniture from the Bradford pottery archeological excavation. The focus particularly upon kiln related artifacts illuminates the technical aspects of pottery production more than a study of the commercial products. A documentary study of the Bradford family and the ceramics industry at the time will provide context for the artifacts. The Bradfords started and ended their redware business in a time of transition within the ceramics industry. As a small, family workshop operating from the 1780s to the 1870s, the Bradford pottery resembles other redware potteries inasmuch as the documentary record can provide. By comparing the Bradford archaeological collection to those from contemporary pottery sites, this study will examine whether the Bradford pottery is representative of the common experience of redware potteries of this time. These archaeological remains can help us understand how the practices of the family business did or did not respond to changes in their trade. In particular the kiln related artifacts, even more than the vessel sherds, provide insight on their operations including their methods and scale of production.

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Kingston, incorporated in 1726, is a coastal community in southeast Massachusetts. The land route from Boston to Plymouth has run through Kingston since 1637, and the ease of transport by land and water has kept it an active community (Melville1976:75, 361-362). Governor William Bradford of Plymouth Colony received a parcel of land in this area and his descendants continued to live there long after many other colonial first-comers sold their allotments and moved away. Subsequent generations sold and transferred lands in the western areas of Kingston near the Jones River; some family members made bricks with the local red clay (Drew manuscript MC-29, Folder 19.1A:2), but it was Stephen Bradford (1771-1837), his son Stephen Bradford Junior (1807-1866), and grandson Orrin Bradford (1839-1890) who made earthenware pottery along Bridgewater Road (Kingston Annual Report 1867:36; Kingston Vital Records 1911:29, 30, 332; MA Deaths 1890). Stephen Senior is identified as a potter when he purchased land in 1798 from his father, John (1732-1811), who was known as a yeoman and brick maker (Kingston Vital Records 1911: 27; PCRD 1798:90-21). By the time John sold Stephen the rights to dig and transport clay from the family property in 1803, Stephen had also purchased adjoining lots from various relatives (PCRD 1800:87-99; 1800:87-127/128; 1801:91-140/141; 1803:94-261/262). Local historians surmise that Stephen built his red brick house (Figure 1) in 1804 around the time of his first marriage, near a curve in the Bridgewater Road (Drew manuscript MC-29, Folder 19.1A: 1).

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Figure 1. Bradford house in 1896 (Courtesy of Local History Room, Kingston Public Library).

Stephen Senior was well established as a potter by the time his father sold him the homestead farm in 1810 (PCRD 1810:114-166/167). Stephen Junior worked with his father and continued to produce pottery after his father's death in 1837. Most historians have surmised that the pottery closed during Stephen Junior's life; however, documentary evidence identifies Orrin as a potter before and after his father's death in 1867. Rather than being completely abandoned, the pottery may have been just one source of family income along with a saw mill, a grist mill and agriculture (MA State Census 1865, Kingston; PCRD 1835:180-234/235, 1837:94-58/59, 1862:311-198, 1873:400-22/23, 1875:415-81; US Federal Census: 1860, 1870, 1880).

Late in the summer of 1996 it became publicly known that the former Stephen Bradford house in Kingston had been torn down. Located on the north side of Wapping Road or Route 106 (the current names for Bridgewater Road), the surrounding land was to be converted into cranberry bogs. This property had been visited by New England ceramics scholar Lura Woodside Watkins in 1945 where she observed the brick house and adjoining property. Based on the abundance of sherds in the gardens west of the house, she surmised the pottery shop had been located there (Watkins 1950:46). Michael

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Burrey, a Plimoth Plantation Living History Museum employee who studied archaeology as an undergraduate student in Maryland, was the first to examine the site west of number 79 Wapping Road and some cranberry bogs. The house was gone and the topsoil had already been removed, revealing an abundant littering of stone, brick, and redware ceramic artifacts, including the pieces used to separate pottery in the kiln known as kiln furniture. He contacted professional archaeologists Connie Crosby and Steven Pendery who in turn notified the Massachusetts Historical Commission. The property owner gave permission for archaeological excavation in the area where the house had been but continued bog construction on other parts of the property. The goal of the excavation was to salvage as many artifacts possible, but to focus on the areas of pottery production in hope of finding a kiln and other related structures (Burrey 1996: field notes; Burrey personal communication 2012; Mason personal communication 2012; Pendery personal communication 2013).

Over the course of eight days between September 21st and November 2nd, 1996 Pendery and Burrey led the excavation with teams of volunteers, most of whom had previous experience in archaeological excavation. By November 12, new bog construction eliminated any further excavation of the site. In the end, five 1x 1 meter squares were excavated, two of which partially revealed a cellar hole. No kiln structure was found, but the cellar was filled with vessel sherds, raw clay, raw glaze, bricks and kiln furniture. The excavators removed a total of 120 three quart bags from the site. This resulted in 13,478 redware vessel sherds and 2,375 kiln furniture sherds. This latter category includes bricks with evidence of kiln use through glaze scars and pyro-plastic

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deformation as well as wedges, tripod stilts, setting tiles and glaze troughs (Burrey 1996: field notes; Burrey personal communication 2012; Goldstein personal communication 2012; Lathrop manuscript catalogue 1999; Mason personal communication 2012; Pendery personal communication 2013).

The Bradford pottery operated in a time when redware potters were challenged by changes within the ceramics industry. In the 18th century, imported tablewares flooded American markets, but the domestic redware potters continued production (Miller 1980:1-2, 20-22). It has been estimated that the number of redware potters working in New England doubled from roughly 250 to 500 in the years between 1800 and 1850 (Watkins 1950:2). Redware had long been negatively compared to stoneware because it could be porous, fragile, and was covered in a lead-based glaze which could leach out into a vessel's contents. Commentary decrying the dangers of lead was published in Pennsylvania journals as early as 1785 (Watkins 1950:80), yet people still purchased redware long after these objections were well understood (The Pittsburger 1836, 1838). One possible reason was that as long as stoneware was scarce and/or expensive, economics had a greater influence in consumer ceramics choice than quality and safety.

Significant changes did finally take hold in the latter half of the 19th century. There was an increase in the American production of stoneware household vessels which were comparable in function to the redwares. Combined with the industrial production of yellow ware, this competition had a significantly negative impact on the ability of redware potters to make a living in the craft (Barber 1893:109,117-118,178-179; Watkins 1950:86-91). Yet redware potters could not simply adapt their redware clays to stoneware

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techniques in order to meet the changing demand. The material and technical differences between stoneware and earthenware production were generally known but the subtleties were not publicly shared. Stoneware had to be fired hotter and salt was the best known glaze material but how to achieve those hotter temperatures and exactly when to apply the salt was less well known as were any alternatives to salt for glaze. Some potters tried to blend earthenware clays with stoneware, but it would have been difficult to achieve the temperatures necessary to determine if the mix was viable without firing up an entire kiln load. As it is, the elemental components of redware clay as it occurs in nature, prevents much variation in the ways it can be used and this was also true of the glaze materials. The redware potters may not have known the exact reasons why it would not work, but they were likely familiar with pots that were fired above the appropriate temperatures. Overfired pieces are found at most redware pottery sites. Yet learning what that appropriate temperature for a new material could be costly.

Some redware potters did convert to stoneware production with varying levels of success (Kelly 2013:48; Myers 1984:52; Warner 1985:174). The increased costs were significant for potters working in areas like New England where there were few local sources of stoneware clay. If there was enough money to hire someone who had already been trained in stoneware, there was a better chance of success, but it was still no guarantee (Watkins 1950:245-248) Furthermore, there was little published technical literature on pottery at this time which could help (Scientific American 1851:150). As a result, the trial and error method of learning could be ruinously expensive. In summation, the experiential method of learning the craft through a mentor/apprentice arrangement

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combined with material limitations and material costs to make it difficult for an older potter to make many changes.

Many redware potteries, including the Bradfords', were completely out of the business by the end of the 19th century. The archaeological study of their workshop site can provide clues as to if or how these potters might have changed their practices. The types of clay, glazes and vessels provide information about material and technological changes. If the Bradfords had tried to make stoneware, pieces of the kiln, its furniture, and glaze residues on these would be visibly different as well. The circumstances of the excavation did not create stratigraphic data for understanding what pot styles might have been made when, but the wasters from the site can answer many of these other questions.

Additional significance can be attached to the Bradford family pottery because of what its remains may reveal about the nature of New England redware production more generally. Attention has been given to earthenwares in New York, Pennsylvania, and the Southern States, but New England is still less well known (Barber and Hamell 1971:18-37; Barka 2004:15-47; Dickinson 1985:189-206; Horvath and Duez 2004: 100-129; Kelso and Chappell 1974:53-63; Rochester Museum and Science Center 1974:4-37). In 1949, Lura Woodside Watkins first published her definitive study, *Early New England Potters and Their Wares.* She scoured archives, public and private collections, and traveled to sites all over New England to compile a tremendous body of evidence on both redware and stoneware in the six New England states. Watkins also surveyed and excavated a great number of pottery sites. A portion of her collection was donated to the Smithsonian Museum but more remains in private hands; unfortunately her methods were

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not documented as well as would be desired today (Watkins 1950:52-58; Burrey 2012 personal communication). Watkins herself pointedly observed that studies of American ceramics rarely addressed the smaller redware and stoneware producers (Watkins 1950:2).

Watkins herself did not do any excavating at the Bradford site and no known professional excavations had been done there until 1996 (Watkins 1950:46). Former UMASS Boston graduate student, Hazel Lathrop, drew upon the Bradford excavation data which was available in 2000 for her Historical Archaeology MA thesis, focusing on the flowerpots and data from two units (Lathrop 2000:87-93, 105-107, 125-131). The Jones River Village Historical Society of Kingston issued a pamphlet about the pottery in their collection which is attributed to the Bradford pottery. It also focuses on the flowerpots and does not include any of the archaeological excavation data (Tucker 2008; 1-11; Tucker personal communication 2013).

Domestic Pottery of the Northeastern United States 1625-1850 (edited by Sarah Peabody Turbaugh) was published in 1985 and presents an extensive body of research on New England earthenware pottery. Yet the majority of redware pottery studies focus on collections compiled from the consumer perspective (Chase 1985:49-65, Gibble 2005:33-62; Turnbaugh 1985:209-228). As recently as 2006, Barker and Majewski noted that studies on American coarse earthenware and redware were still rare, remarking, "Scholars shy away from the study of these wares because they are often difficult to identify and classify" a possible result of the less distinctive features or markings on utilitarian earthenware vessels (Barker and Majewski 2006:208, 230). Overall, when

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compared to the studies of imported ceramics, the entire body of published work on domestic earthenware and New England in particular is still very small. The increased availability of research through electronic collections and databases is improving matters and the digitization of UMB graduate theses will make this study available more widely than was previously possible.

As rare as studies of New England redware potters are, those with details on the kiln furniture are even rarer. *Domestic Pottery of the Northeastern United States 1625-1850* presented research from archaeologically excavated New England pottery sites, and Fred Warner's article about the Goodwin Pottery of West Hartford, Connecticut contains a small section on the kiln furniture (Warner 1985:178, 180). It is more common for kiln studies to mention finding parts of kilns and the related furniture or include photographs. Published accounts of archaeological excavations of kiln sites lack details regarding the kiln furniture and the photographs lack precise explanations (Barber and Hamell1971:24, 35; Hunter 2001:240, 243; Pendery 1985:113-114; Rochester Museum Science Center 1974:15; Starbuck and Dupré 1985:150; Starbuck 2006:129-133; Watkins 1950: Figures 6, 7). A further but uncontrollable difficulty in the study of kiln sites is with the storage of these collections; many studies were written so long ago that the collection's current location is hard to determine.

My personal experience with ceramics is an additional resource towards understanding the production process of handmade pottery and interpreting the physical characteristics of sherds found in historical New England sites. I made wheel-thrown pottery for 17 years. At the afore-mentioned Plimoth Plantation Museum I studied

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historic English pottery as a staff potter for nine years and as the Curator of English Colonial Reproduction Collections for five years. In 2001 I was part of the team that built an updraft, wood-fired kiln based on 17^{th} C North Devon English kiln remains from Barnstaple, England, fired the kiln 12 times and repaired the kiln between firings. I experienced the process of firing earthenware and saw the difference between intention and outcome. As much as my personal study has been of an earlier time and location, the physical and chemical processes involved in firing lead glazed earthenware were limited. There were fewer technological differences between 17^{th} and 19^{th} century redware potters than between contemporaries who worked in different materials and/or larger production settings.

Chapter Outline

The first part of Chapter Two will examine the documentary history of the Bradford family members who were involved in the ceramics trade and the archaeological excavation which took place on their property. This is to determine who may have been involved at the Bradford home lot: what sort of people were they and what might they have been doing to make their living? There are no surviving Bradford family account books or diaries, which is typical for the craft. The few account books which have been found tantalizingly suggest that the record keeping may have been more common than the survival rate implies. Fortunately, other documents illustrate how brick and pottery making was one of several ways the Bradfords supported their families. Land deeds between the immediate and extended family members provide references to clay sources, brick kilns and wooded land. Additionally, the Bradford family owned rights to

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build mills, called water privileges, on the Jones River. As the largest source for water-powered industry, the river was an important feature in Kingston's economic and industrial development through the 18th and 19th centuries (Drew 1926:43-46). The Bradford family's involvement in the sale and purchase of these mills and water rights, along with associated litigation, produced additional historical evidence about their economic activities. Surviving tax assessment records increased in detail over the century and provide detail on assessable property and its value. The appellation of "potter" as the means of employment in many of these documents gives us the names of Stephen Bradford Senior, Stephen Bradford Junior, Orrin Bradford and Peleg Simmons as the men most likely to be working at the pottery. This combination of sources provides a broader perspective of the Bradford family economy than has been addressed in other studies.

The latter half of Chapter Two provides an account of the 1996 excavation of the Bradford site and its subsequent processing. The participants knew that they were on private property that had already been approved for agricultural use for cranberry bogs. They were there solely through the good will of the property owner. Leaders Stephen Pendry and Michael Burrey conducted the excavation in the most professional manner possible under the constraints of an experienced but all-volunteer crew and the construction deadlines. The team's knowledge of historic pottery and the understanding of the rarity of excavating a pottery site added to their desire to preserve and record as much evidence as possible (Burrey 1996: field notes; Burrey personal communication 2012; Mason personal communication 2012; Pendery personal communication 2013).

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Chapter Three presents a summary of the American ceramics industry to address the economic circumstances facing the Bradford family. It follows with a more detailed account of earthenware production techniques, using details from documentary studies to confirm them as practices by late 18th and 19th century American potters. A modern description addresses the elemental components of clay and glazes, the environmental changes inside a wood fueled kiln during a firing and how these factors affect one another. This discussion is provided to explain the visual features seen particularly on red earthenware and why variations in color and density are not necessarily indications of different materials.

Chapter Four is a description and examination of the Bradford collection itself. The first part will describe the condition of the collection at the time of the author's examination. When the excavation ended in November 1996, all the artifacts were brought to Plimoth Plantation, a living history museum in the neighboring town of Plymouth, to be processed and curated. It is also a state approved facility with a legacy of archeological inquiry stemming from the administration of museum founder Henry Hornblower and historic archaeologist Dr. James Deetz (Goldstein personal communication 2012). A brief discussion of the types of pottery which were produced at the pottery provides a broader perspective upon the intended function for the kiln furniture.

The remainder of Chapter Four is a detailed analysis of eight types of kiln furniture pieces, including deformed or glaze scarred bricks; from a total of 1,979 pieces, 164 samples were removed for measuring and color assessment. A great many vessel

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sherds found near a kiln site are from rejected pots, now called wasters, because they were likely damaged during the firing or broken shortly thereafter. A few wasters were selected to compare to the kiln furniture. The glaze scars on both the furniture and wasters indicate how the pottery was stacked inside the kiln (Pendery 1985:113). The elemental components of the clay are affected by the oxygen levels and temperature within the kiln. Deformation and color changes are a visual indicator of these conditions. The sample pieces were laid against the Munsell color chart to create a record of the paste and glaze colors. Even without glaze scars the color variations on a piece can provide a map of exposure of one piece by another, again indicating the arrangement, environment and temperature fluctuations within the kiln. These details illuminate the technical aspects of pottery production more than a study of the commercial products.

The final chapter presents data and descriptions from two collections of contemporary earthenware pottery kiln sites. A documentary study of Hervey Brooks and the archaeologically excavated artifacts from his pottery of Goshen, Connecticut, provide data from a redware kiln which was likely used from 1818-1827 (Worrell 1982:50-53). Joseph Hazeltine was also making redware pottery in Concord, New Hampshire from 1842-1880 and two kilns, the associated furniture, and wasters were excavated from his workshop site (Starbuck and Dupré 1985:145-149). The bricks from these sites, with definite connections to pottery kilns, can indicate the function of the disassociated bricks found at the Bradford site by their similar or differing qualities. The comparison of the kiln furniture can as well corroborate common aspects of kiln furniture types and their functions. The subsequent discussion will address how well the Bradford kiln furniture

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data answered the questions of firing techniques as conducted by the pottery staff. Did the data confirm an adherence to traditional methods or indicate any attempts at change? What differences between the Bradford and comparative collections might indicate if or how each pottery tried to make changes in their practices?

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CHAPTER TWO

THE HISTORY OF THE BRADFORD FAMILYAND THE 1996 EXCAVATION

The Bradfords of Wapping Road

The members of the Bradford family who inform our study had some involvement with clay working on Wapping Road (Figure 2), for at least five generations: Robert (1704-1782), John (1732-1811), Stephen (1771-1837), Stephen (1807-1866), and Orrin W. (1839-1890) (Kingston Annual Report 1867:36; Kingston Vital Records 1911:29-30, 320-322; MA Deaths 1890). Even without the personal narrative provided by diaries, letters or wills, it has been possible to piece together details of their lives from deeds, vital records, and other civic documents. The occupations listed in these documents can provide insight as to whether individuals were actively practicing that craft even if not on an exclusive basis. Robert Bradford (1704-1782) owned property including land called the "Brickiln Farm" and parceled out the land to his children (Hall1951:46; PCRD1789:69-60/61, 1792:75-244). His son, John Bradford (1732-1811) was known as a brick maker as well as a yeoman (Kingston Vital Records1911:27). John purchased several pieces of this property from his father and brothers which included the "Brickiln Lot" and a clay pit, although he already had use of the clay before 1786 (PCRD 1789:75-245, 1789:90-20/21). John, a widower, had sons with both his first wife Ruth and his

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second wife, Hannah. Stephen (1771-1837) was his eldest son with Hannah (Hall 1951:168-169; Vital records 1911:30).

Figure 2. Bradford neighborhood on Bridgewater Road, Kingston (detail extracted from Walling *Map of the County of Plymouth, Massachusetts*), 1857 (Courtesy of Beverly Booth, Plymouth Public Library).

It is not known where Stephen received his training, and as there are no historic references to John as a potter, it should not be presumed that John knew pottery as well as brick making. Neither is it known when Stephen started as a potter; there is supposition that he may have started as early as 1795 (Lathrop 2000:88). The first documented reference to Stephen as a potter is in 1798 when he was twenty-seven years old (PCRD 1798:90-21). The majority of deeds refer to him as a potter, although he is called a yeoman in at least two, (PCRD 1817:138-166, 1829:169-85). Many potters needed to make a living by trades other than pottery; it is curious that he seems to have never identified with his saw and grist mills in the manner of his son and grandson.

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At the beginning of the 19th century Stephen had sufficient money and family connections to establish himself in the mercantile community of Kingston. He purchased three lots from various relatives in 1800 and 1801 which were very near his father's property. In 1803 John sold his son, Stephen Senior, all the clay on the land known as "the Brickiln" and all rights enabling Stephen to dig and transport the clay at any time of year necessary. These stipulations imply that the land around the clay pits was also used for other purposes by others in the family and that clay digging and transportation might be counter to those uses (PCRD 1800:87-99, 1800:87- 127/128, 1801:91-140/141, 1803:94-261).

Stephen Senior was married three times, first to Polly Tupper in 1804 (Vital Records 1811:182) and local historian, Emily Drew, believed that it was around this year that he built the brick house (Drew manuscript, MC-29, Folder 19.1A:1). Drew also believed that 1804 was when the family operated a water powered mill for processing clay for the brickyard and the pottery. Whether this was for grinding or mixing the clay is unknown, and it is currently unknown if this was also connected to the grist mill that John's sister, Orpha, inherited from her father, Robert (Drew 1926:45; Drew manuscript MC-16 Folder 2.9; PCRD 1789:69-60/61). The year 1807 was eventful: his only son, Stephen Junior was born in June, his daughter Mary Ann died in September and his wife Polly died in December. Stephen married a second time to Ruth Cushing in 1809 with whom he had a daughter, Mary, in February of 1810 (Vital Records 1911: 30, 182, 320-321).

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On November 15, 1810 John sold to Stephen the home farm with all the land and buildings that he had not already sold to either Stephen or his eldest son, Sylvanus. No mills were specifically mentioned but they may have been part of the included land and buildings (PCRD 1810:114-166/167). John died two months later of dropsy and asthma, (Vital Records 1911:320, 322). It is not known if the family continued making bricks for sale after John's death. Local historians presume that Stephen at least made bricks with his father and for his own use (Burrey personal communication 2012; Drew manuscript, MC-29, Folder 19.1A:1-3).

Stephen Bradford diversified his sources of revenue and invested in a number of different businesses. Around 1808 he built a trip hammer shop on his dam; local historian, Emily Drew, inferred that the trip hammer shop was for metal working and was separate from the clay mill. Trip hammers are simply a mechanism used to pulverize many things and could have ground clay; however, most of the other local trip hammer mills were used for iron working (Drew manuscript, MC-29, Folder 19.1A:2-3).

In 1812 Stephen sold his trip hammer shop, the land it was on, and the water use rights for $300 (PCRD1812:117-120). If this sale also included the clay mill, Bradford did have a number of alternatives for clay processing which will be discussed later in the chapter. In the decades before and during the war of 1812, trade with England and Europe was hindered if not completely prohibited by federal embargoes. It culminated in the spring of 1814 when British warships, some of which were stationed in Provincetown Harbor, blocked the port of Boston. The blockade was short-lived, but Kingston would have been affected by the blockade as Provincetown is very close by sea and most of the

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nearby communities were dependent upon Boston commerce. Pottery sales could have been good while competition was limited (Melville 1976:97-99, 103; Urdang 1996:152, 164-172).

Some Kingston merchants benefited from the increased production in local shipbuilding during the war (Melville 1976:97-99,103). Between 1816 and 1818 Stephen bought meadow land in Duxbury and two separate woodland lots in Kingston; the latter purchases could have been for any number of purposes, not just kiln fuel (PCRD 1816:139-59, 1817:138-166, 1818:138-167). Meanwhile, the former trip hammer property changed ownership a number of times and in 1819 Stephen bought back the privilege, now with a grist mill upon it, for $556 (PCRD 1819:139-60).

At some time in 1820 Stephen installed a shingle mill along with the grist mill. In May of that year, his second wife, Ruth died and the following year he married Martha Morton (Drew 1926:45; Vital records 1911:182, 321). In 1822 Stephen bought a small lot of land from Jedediah Holmes that was adjacent to land he already owned (PCRD 1822: 147-251). In 1824 Stephen contracted with two other men, Jeremiah Sampson and Lenas Cushman, to share his home and the land around it. Steven kept use of a portion of land on the west side but Sampson got 1/3 of the house and some land on the west side and Cushman got the remaining 2/3 of the house on the east side and some land (PCRD1829:169-85). In 1825 Bradford bought meadow land on either side of the Jones River upstream from his property with the right to flow all the creeks down to his dam. Whether he lived in his own house as a tenant or lived elsewhere is unknown as is when and how he got his property back (PCRD1825:154-207/208).

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In 1828 Stephen started a lawsuit against Jedediah Holmes, a neighbor and owner of the downstream water privilege and mills. Bradford wanted financial compensation for his loss of income, claiming alterations to the Holmes' dam hindered the river flow and frequently prevented his mill from operating. The Jones River and mill ponds are evident on one Kingston map from 1879 (Figure 3). Lawsuit testimony repeatedly referred to the clay mill on the water privilege but it is not clear when it was in operation. They went to court in 1828, 1829, 1830, and 1832, finally settling in October of 1835. Over the years Bradford spent over $300 for court expenses and received very little in damages (Drew manuscript MC-16 folder 2.9:9, 19, 23, 26, 92-93; MC-29 folder 19.1A:3, 5).

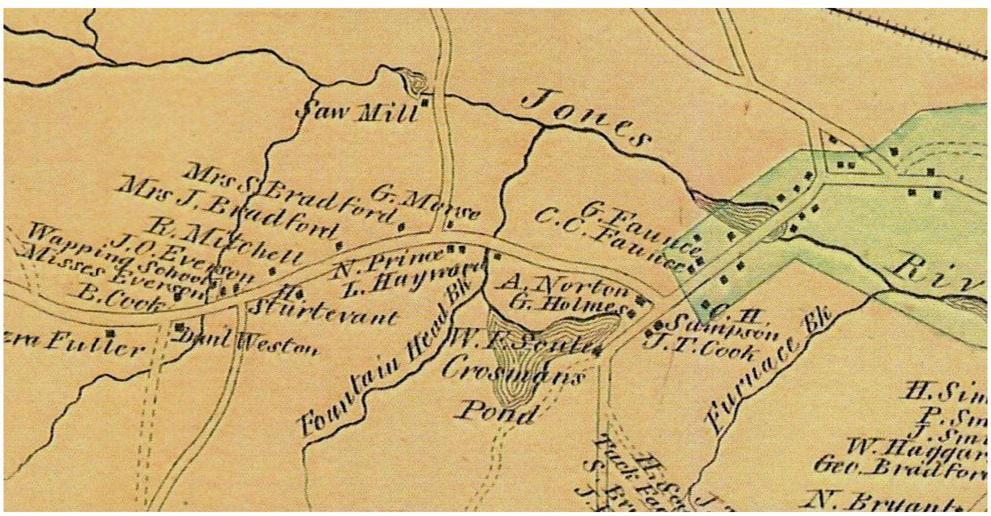

Figure 3. Bradford neighborhood on Bridgewater Road (detail extracted from Walker *Map of Kingston, Mass.*), 1879

Between May 7th and June 2nd 1835, an expedited land transfer was arranged in the family. Joseph Holmes (cousin), sold to Otis Waterman (nephew), his share of the Brick kiln land who in turn sold it to Stephen Bradford, who in turn sold it to his son, Stephen Bradford Junior. This property had been part of the division of lands between

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John and his siblings (Vital records 1911:157; PCRD 1835:180-234a, 1835:180-234b, 1835:180-234b/235). Fortunately for Stephen, he eventually received $700 from Jedediah Holmes on October 31, 1835. In return Holmes received full use of the river, free of any further litigation from the Bradford family providing he did not flood it above a certain level (PCRD 1835:180-139/140). Stephen died in April of 1837 of "palsy" and it took several years for Stephen Senior's estate to be settled, (Kingston Estate Bills 1840:2; Vital Records 1911:322).

Stephen Junior had already been working with his father in the pottery and was identified as a potter on the 1835 deed with his father. He married Rebecca Hayward in 1834 and their oldest son, Orrin (1839-1890), was the last member of the family to be involved with the pottery (PCRD 1873:400-23, 1875:415-81; US Federal Census 1860; Vital Records 1911:26, 28, 29, 182). After Stephen Senior died, an unusual arrangement was made between Stephen Junior and his stepmother, Martha. He received the land that would have been her dower right and all the "apparatus" belonging to the mills and clay shop, but she received the clay already dug, the ware already produced, and seventy dollars a year (PCRD 1837:94-58/59). It cannot be determined if Martha continued to be involved in the pottery. She was still living within the Bradford household in 1850, but moved to Plymouth by 1855 (MA State Census 1855; US Federal Census 1850). She was living in Kingston when she died in 1865, and money was drawn from the Kingston Almshouse accounts for her relief (Assessor's Valuation Lists 1865; Kingston Annual Report 1866:15, 20).

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Watkins theorized that the pottery was running in 1851 but ceased by 1855, but did not state her sources for this opinion (Watkins 1950:47). Based on deeds, census data, tax assessments and other civil records, it seems likely that the pottery operated at least until Stephen Junior's death in 1866 and possibly later. Stephen Junior is most often identified as a potter as well as occasionally farmer and box board manufacturer. In the US Census of 1850 he was listed as a potter and as a farmer and potter in the MA State Census of 1855 with 16 year old Orrin as a laborer (MA State Census 1855 Kingston; US Federal Census 1850, MA Deaths 1866). Other potters of the same time did not always self-identify as a potter; the younger Bradfords seem to have fluctuated more in their identities than did earlier generations of the family (Worrell 1985:162-163).

Stephen Junior was financially stable, buying small parcels of land, holding mortgages for neighbors, trusted by relatives to dispose of estates (PCRD 1841:257-67/68, 1862:311-173, 1862:311-198/199). He was, however, accused of flooding two neighbors' lands with his dam. He settled in 1856 by agreeing to maintain different water heights according to the time of year (PCRD 1862: 310-72/73).

Orrin seems to have worked in the family businesses for most of his father's life. Orrin was identified as a potter in most documents until 1868 (MA Births 1861; MA Marriages 1861; US Federal Census 1860). However, in May of 1865 Orrin was living in a separate household in Kingston with his wife, three young children and his mother-in-law, Nancy T Everson. In the state census of that year Stephen Jr was described as a box board manufacturer and Orrin as a sawyer (MA State Census 1865, Kingston Vital Records 1911:217). It is possible that the war had made the saw mill more profitable than

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the pottery. By October of that same year, Stephen Junior sold the west side of the Brick house to Mrs. Everson for $600 and she was to share it with Orrin and his family who would live in the east side (PCRD 1865:330-263/264).

Stephen Junior died in December of 1866 and was listed as a potter on his death record (Kingston Annual Report 1867:36; MA Deaths 1866). Earlier in the year his property assessment included a house, a barn, a pottery, a grist mill, a saw mill, 80 ½ acres of wood lots worth $1600, and a half acre mill lot with water power worth $200. The pottery was valued for $200, the grist mill for $75, and the saw mill for $100. By 1868 it seems the estate was settled and Stephen Junior's widow, Rebecca, was named on the tax assessment. As the valuation for the pottery dropped that year to $50 it seems likely that the pottery was inoperative and workshop emptied. Also in 1868 the assessor changed the listing from "pottery" to "pottery house", and in 1871 it is simply listed as a "shop," still worth $50. The language change could be irrelevant or it could mean the building was no longer associated with pottery production (Assessor's Valuation Lists: annually from 1866-1875).

Orrin was called a potter on his child's birth record in 1867 and in the US Federal Census of 1870, but on no other records after this time. His taxes from 1868 onward assessed his ownership in the saw and grist mills which he shared with his younger brother, Charles (Assessor's Valuation List 1870; MA Births 1867, 1870; US Federal Census 1870). Based on tax records and deeds, Orrin moved to East Bridgewater sometime after July of 1873. He lived there until his death in 1890 and does not appear to have worked in any clay related industries (Assessor's Valuation List 1873, 1874; MA

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Deaths 1890; PCRD 1873:400-23, 1875:415-81; US Federal Census 1880). By 1873 Charles had moved to Irondale, Ohio, close to East Liverpool. Stephen Junior's widow, Rebecca, remained in Kingston and continued to be taxed for the unspecified shop for several more years, although Orrin sold his remaining share of the Kingston house and property to his mother-in-law, Nancy Everson (Assessor's Valuation List 1875; PCRD 1873:400-23, 1875:415-81; Atlas of Plymouth County, MA 1879).

Other Family Members at the Pottery

Peleg Simmons, a neighbor and relative through birth and marriage, may have been an employee at the Bradford pottery from at least 1850 to 1862. His first wife was a Julia Bradford and he and his family lived with his mother's Everson relatives on Bridgewater Road. Simmons was identified as a potter in state and federal census records and MA State marriage and birth records (MA Births 1862; MA Marriages 1861; MA State Census 1855; US Federal Census 1850). Like Stephen Jr and Orrin, he was not identified as a potter on the 1865 State census but was listed as a laborer; at an unknown date Simmons moved to Middleborough, MA (MA State Census 1865; US Federal Census 1880).

Watkins believed the potter Noah Bradford of Barnstable, MA was Stephen Senior's brother. Examination of deeds showed that he was a nephew, the son of Sylvanus Bradford, Stephen Senior's brother. He could have trained and worked with his uncle. He later bought and sold land in Kingston while a resident of Barnstable and these documents refer to deeds between his grandfather, John and his father, Sylvanus Bradford. One lot of land was sold to Stephen Senior; the other lot was sold to Daniel

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Parker, the man who took over the Barnstable pottery after his death around 1832. Little is known of the elder Noah, other than that he died in the Kingston almshouse in 1841 (PCRD 1820:139-236, 1821:147-250, 1823:149-74; Vital Records Kingston 1911: 29, 321; Watkins 1950:47).

The Excavation

The Bradford Pottery excavation was conducted as an emergency salvage project in the autumn of 1996. Michael Burrey, a Plimoth Plantation employee and carpenter, learned that a brick house on the site of the former Steven Bradford home had been demolished in order to create cranberry bogs on the property (Figure 4). The house was on the north side of Route 106 and Wapping Road, the current names for Bridgewater Road, and was located on lot # 83 (Aerial Online GIS Map of Kingston 2014).

Figure 4. Kingston GIS Aerial Map of Bradford Site 2014

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When Burrey viewed the property, the house was gone and the topsoil had already been removed revealing an abundant littering of stone, brick, and ceramic artifacts including kiln furniture (Figure 5). Professional archaeologists Connie Crosby and Steven Pendery were contacted. They in turn notified the Massachusetts Historical Commission. The property owner gave permission for archaeological excavation in the area where the house had been but continued bog building on other parts of the property.

Figure 5. Bradford house lot, September 1996 (Courtesy of Plimoth Plantation).

Many archeologists are accustomed to alterations created by agriculture, but modern cranberry farming differs from other crops. It typically involves the large scale removal of top soil to create the bog pits and the building up of earth to create dykes and roadways between the pits. Further excavation is done for drainage ditches and pipes running to nearby water sources for irrigation and flooding. Knowing that the property was going to be extensively altered created a sense of urgency on the site. By the time Burrey was aware of the demolition and subsequent construction, there was no time for legal recourse to historic preservation legislation. The land was privately owned and had been approved for cranberry agriculture for many years. This resulted in a crew of

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volunteers who conducted the excavation in a professional manner; however, the varying skills and schedules of the volunteers combined with the rapidity of the project and led to some clerical errors (Burrey 1996: field notes, 2012: personal communication; Goldstein 2012: personal communication).

Pendery obtained a site number from the MHC and acted as Principal Investigator for a volunteer crew. The crew was comprised primarily of Plimoth Plantation staff and associates, most of whom had experience in field excavation or ceramics. Steven Pendery and Michael Burrey took field notes (Burrey 1996: field notes, personal communication 2012; Goldstein personal communication 2012; Mason personal communication 2012; Pendery 1996: field notes).

Initial surveys were conducted in early September, but the primary excavation started September 21st. It took place over eight days with the last being on November 2nd. The landscape was already completely disrupted by large machinery. The location of excavation (Figure 6) was determined by rubble from the demolished house, brick, clay and stone concentrations, sherd concentrations, and soil stains (Burrey personal communication 2012; Mason personal communication 2012; Pendery 1996: field notes, personal communication 2013). On September 21st a datum was established and stakes were initially laid out along a north/south axis. Units were laid out north and east of this line. The plan was to excavate 1 x1 meter squares in arbitrary depths of 20cm and the names of the units were founded on the units' North/East coordinates. The units that were labeled and excavated were: N0/E23, N1/E15, N6/E4, N4/E2, and N8/E2 (Burrey 1996: field notes, personal communication 2012; Pendery 1996: field notes, personal

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communication 2013). The site was also oriented to a house on the same side of Wapping Road at # 79 and water hydrant lying across the road on the South side (Pendery 1996: field notes).

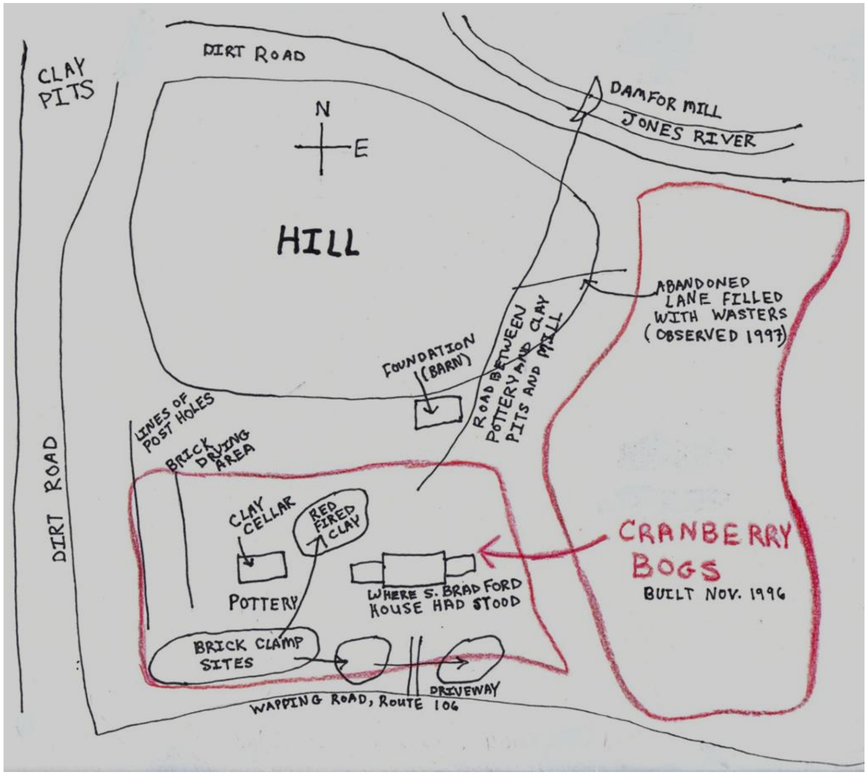

Figure 6. Hand-drawn map of Bradford Pottery Site, 1996 (Courtesy of Michael Burrey).

The intention was to excavate at consistent measured levels, but due to inconsistencies in crew method and artifact concentrations, the actual depth of the levels varied. Unit N4/E2 was only cleaned on the surface, filling one bag. Unit N1/E15 was excavated to 60 cm producing in two bags of artifacts. Unit N0/E23 was excavated in five levels to a depth of 110 cm, producing 27 bags. Unit N8/E2 was excavated in four levels to a depth of 110 cm, producing 19 bags. Unit N6/E4 was excavated in five levels to a depth of 110 cm and produced 55 bags. Due to the vast quantities of brick on the site, it

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was determined that only brick pieces with distinctive marks should be retrieved, although more brick was identified in the lab once sherds were washed. One centimeter mesh screens were used to sift the soil. Other finds included refined earthenware, stoneware, glass, and a bone handled knife. Wood, nails, mortar, slate and a large flat stone were retrieved as well as charcoal, coal, and slag. Artifacts were placed in three gallon bags, with a total yield of 120 bags. By November 12th bog construction eliminated any further examination of the site. A number of surface pieces were subsequently removed from bulldozer piles but have not been included in this paper, as they lack context (Burrey: 1996: field notes, personal communication 2012; Goldstein personal communication 2012; Mason personal communication 2012). The property still contains a significant number of sherds on the work roads around the bogs.

A surface arrangement of stone and brick in the area between N4 and N8 indicated a possible feature in this area. As Units N8/E2 and N6/E4 were excavated, the feature was believed by excavators to be the stone foundation or cellar hole of a work structure. N8/E2 contained the corner of a wall and a brick floor. A section of the presumed brick floor was removed from N8/E2 and underneath this was a mix of clay and rotted wood fragments and nails. Samples of timber and wood were also saved. Both units contained concentrated layers of sherds and bricks. Many bricks had glaze marks and attached sherds indicating they could have been used in a kiln. In Unit N6/E4, excavators found finished pots which were also coated with raw glaze. These were found at level 4, the lowest point excavated within this unit. A number of them were sufficiently intact to contain functional quantities of glaze indicating they may have been storage

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containers for the glaze itself. A lens of raw glaze was layered in the western wall of the unit. Because of the manner in which the glaze coated surrounding sherds, not just the storage pots, the excavators surmised that the pots containing glaze were being discarded rather than stored in the cellar. As compared to clay, dried glaze is easy to reconstitute and does not need to be stored in a moist condition (Mason personal communication 2012). The majority of the kiln furniture wedges and tripods were also found in this unit. While the entire site was littered with sherds, the volume, variety, and quality of artifacts within the feature led investigators to believe it was a cellar for storing clay which was eventually used as a dump. The location of this cellar corresponds to Watkins' 1945 supposition that the workshop was located west of the house (Burrey 1996: field notes, personal communication 2012; Goldstein personal communication 2012; Lathrop 2000: 127, Mason personal communication 2012, 2013; Watkins 1950:46). There was insufficient evidence to determine that the pottery workshop was directly above this cellar.

Unit N8/E2 (Figure 7) contained a deposit of clay which rested on a paving of bricks. It was highest where it abutted the stone wall and tapered out along the floor. This clay was believed to be deliberately placed here at the time the cellar was used because it contained no other artifacts; it was internally free of soil, stones and other debris. At the time of excavation it was damp enough to be malleable and held its shape. The refined quality and density of the clay in the cellar, compared to clay bits found elsewhere around the site, indicated that it could have been prepared for making pots. Samples of clay and glaze from Units N8/E2 and N6/E4 were bagged separately. Debbie Mason reconstituted

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portions of the clay and glaze samples and fired them in electric kilns to approximately 1800˚F. The results will be discussed in Chapter Four (Burrey 1996: field notes, Mason personal communication 2012).

Figure 7. Unit N8/ E2, Cellar Feature (Courtesy of Plimoth Plantation).

Following the excavation, the bags of artifacts were transported to Plimoth Plantation under the care of Dr. Karin Goldstein, Curator of Original and Archaeological Collections. Further details on the subsequent processing will be discussed at length in Chapter Four.

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CHAPTER THREE

POTTERY PRODUCTION: HISTORY AND TECHNOLOGY

As previously stated, the Bradford pottery was in operation from the late 18^{th} century to the third quarter of the 19^{th} century. This was a time of transition in the American pottery industry where redware potters faced competition from not only imported ceramics but also domestically produced goods made of stoneware clays. Many aspects of redware production followed traditional practices and techniques which had been accepted for centuries and had been sufficiently understood to accommodate American clays and materials. Redware workshops were also traditionally small in their scale of production. Throughout the first half of the 19^{th} century, both large and small stoneware potteries increased in number. The large scale manufacturers tended to produce goods to compete with the imported ceramics such as tablewares and decorative pieces, but they also made forms in yellow ware and lighter colored earthenwares which were directly comparable to redwares such as large bowls, cooking vessels, milkpans, jugs, storage vessels and chamber pots (Barber 1893:178; Stradling and Stradling 2001:165; Watkins 1950:151). The redware potters might have been able to continue in the face of industrialized imports but not against the additional pressure of domestic competitors who produced stoneware in comparable forms.

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In New England, pottery was taught in the traditional manner where the methods were passed from one practitioner to another, a practice that was carried over from England and Europe. English potters did not have an official company or guild, but they did have a similar contractual apprenticeship process. The terms of who would work for whom, for how many years, and in what trade were documented, as well as who would provide the apprentice clothing and other necessities (Jackson R., Jackson P. and Price 1982:70-71). This procedure continued in America even after the colonies became independent. The contracts were sufficiently binding that even heirs were required to fulfill the terms, as when Charlestown, MA potter, Phillip Drinker, stated in his 1647 will that John Gouldsmith should finish his “Indenture” with his son Edward (Watkins 1950:16). While we do not know if fathers and sons had formal contracts, these documents did exist between nephews and cousins, as in the case of Elizabeth States contracting her son, Adam, in Norwich, CT, with her husband’s relative, Peter States, from the date of contract until the boy was 21 (Watkins 1950:180). Even if less official, the financial significance of the agreement between a father and son was real. Hervey Brooks’ son, Isaac, ran away from their home in Goshen, CT and Hervey assessed his son’s debt for the apprenticeship at $133.00 (Watkins 1950:175; Worrell 1982:30).

It is likely that Stephen Bradford Senior apprenticed with a trained potter rather than being self taught while working with his father, John, to make bricks. Even with a good understanding of brick production he would have needed to learn throwing, glazing and firing techniques. Who he learned from is unknown but in the 1780s to 1790s Stephen could have apprenticed at many workshops in addition to those in Charlestown.

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There were pottery workshops south of Boston in Mattapan, Abington, Taunton and the Dighton/Somerset area (Watkins 1950:42, 45-46, 77-79, 255).

Another feature of traditional craft instruction was for trained men who were still landless to temporarily work for others; this was called the 'journeyman' phase. In other trades this had been to improve the journeyman's skills and control the number of practitioners. Although there is no evidence of formal journeyman contracts, there is ample evidence of individual potters as transient laborers and it has been suggested that some of these temporary potters were working as journeymen. This transience could also be a consequence of the insecure financial situation of potters within the trade and the lack of a strict guild structure in America (Kelly 2013:50-51; Watkins 1950:30-33; Worrell 1982:20-30).

The general practice for redware production was as small workshops, staffed by a few people who were often family members by birth or marriage; the numerous accounts in Watkins' book are further supported by documentary evidence of family businesses in other studies (Starbuck and Dupré 1985:140-144; Warner 1985:172-173). Many potters did not or could not restrict themselves to pottery as their sole source of income. The Bradfords had agriculture, timber, a saw mill, and a grist mill to support them and Hervey Brooks, of Goshen, Connecticut did much the same. In addition to pottery he worked in metal, agriculture, bought and sold merchandise from other producers and wrote local history books. The Goodwins of Hartford, Connecticut had diverse financial interests, including agriculture (Warner 1985:172,187; Worrell1982:9-10, 30; 1985:155). Some large production facilities did start as a small family workshop, although these instances

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are rare and the workshops were generally close to an urban market (Myer 1984:52). The Hews family pottery of Weston, MA was an exceptional case of a small family redware business which grew to an industrial level in three generations (Teller 1985:249-263).

The Processes: Clay

In the simplest terms, clay is made of decayed volcanic material that remained deep underground. The main ingredients are aluminum and silica. Primary clays remain in their place of origin; secondary clays were eroded and transported by water or ice. In the process, they also chemically and physically combined with other minerals and metals which can both help and hinder their functionality. Both earthenware and stoneware clays are secondary clays; the differences lie in the type and proportion of the additions and/or impurities. Redware is one form of earthenware that contains a large amount of iron oxide which produces its red color (Hamer and Hamer 1999:281). Earthenwares generally cannot be heated above certain temperatures so they remain porous; stonewares fire hotter and are more durable and impervious than earthenwares. Naturally occurring earthenware clays are generally more abundant and accessible to humans without extensive excavation than stoneware clays (Hamer and Hamer 1999:17-18, 56-59). Further details on the differences in the two clays and their uses will be discussed later in this chapter.

Traditionally, most potteries were built at or near the clay source which avoided the cost of shipping a heavy, cumbersome material. Early in his career, Hervey Brooks of Connecticut paid for clay and his costs in 1818 were $3.00 for the clay and $25.50 for transporting the clay by cart (Worrell 1985:158). Although the process is not described,

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digging the clay was an important enough activity to be documented in account books and journals (Starbuck and Dupré 1985:140-142; Watkins 1950:124). Clay can occasionally be removed from the ground in a workable condition, but most of the time it needs to be processed to improve its plasticity, or the ability to be shaped and hold the shape (Hamer and Hamer 1999:253). There are many references to clay mills which were used to break up the larger clay lumps, sometimes mixing it with water. In some mills the clay was ground with a stone possibly in the manner of a grain mill (Watkins 1950: 28, 29, 125). Other references simply refer to a stone or a stone and floor for grinding clay (Watkins 1950:50, 67). In 1805 Berkley, MA one brother sold to the other the privilege of grinding clay in the cellar of the house they inherited (Watkins 1950:76) implying that the clay grinding mechanism could not be very large. As early as 1779 a potter in Northampton had a horse powering the clay grinding mill (Watkins 1950:99) but horse powered mills were used far into the 20th century (Watkins 1950:157, 295; Wigginton and Bennet 1984:225). Mills which also compressed and pushed the clay through an extruder are now called pug mills, but this may be a more modern addition to the mill or a change in terminology (Watkins 1950:125; Wigginton and Bennet 1984:125-126). Depending on the quality of the clay and its intended use, temper could be added during the mixing stage at the mill. It helps in shaping the pot and allows the clay to dry and fire more uniformly. Some clay naturally has enough temper so no further additions are necessary. The added tempers most commonly used in redware are fine and coarse sands, or grog, a powder made from pots already fired and ground (Hamer and Hamer 1999:161, 335; Rice 1987:406-410).

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Clay improves with a resting period after the grinding, known today as aging and souring. Aging is simply allowing recently mixed clay to settle so the water can better disperse around the clay particles. Souring is the process where bacteria decompose small organic material, producing byproducts which further disperse the clay particles and making it even more plastic (Hamer and Hamer 1999:2, 322; McGarva 2000:126). Depending upon the climate, this could be done outdoors or in a separate space. In New England, the environment of a cellar would be an effective storage area to maintain dampness and protect the clay from freezing at this stage of the process. Ice crystals disrupt the clay particle layers, sometimes requiring the entire mixing process to be repeated. A cellar was found at the Brooks site. Along the walls were several courses of brick and within were rolled balls of clay sitting on a "huge" prepared stone. Hervey Brooks recorded the purchase of "a stone for a clay cellar" in 1827 (Worrell 1985:87-88). Depending upon its surface and texture, it is possible that the stone was used for a clay preparation surface, not as part of the cellar foundation.

The next step is for the clay to be kneaded and/or wedged by hand to improve texture and remove air pockets. Wedging involves more cutting and slamming of clay and kneading utilizes more rolling (McGarva 2000:40). Air pockets contribute to breaking during the firing process; it is not uncommon to find waster pots or bricks with pockets in the broken surface. If individual pieces require more temper, it can be added at this stage although it would not be efficient in a commercial production setting. The last step is to pat the clay into a rough ball to the size needed for the individual pot.

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Making a Pot: Tools and Methods

Potters in the late 18th and early 19th centuries had a number of different pottery wheel styles to choose from. The most likely style for a small workshop was the kick wheel. Its basic composition is a shaft attached to two discs. The lower disc is made of a heavy material, usually wood although it may be reinforced with metal. The shaft can either protrude below the bottom or else there is a second pointed rod attached beneath, allowing it to spin. The potter initially pushes the bottom wheel with their foot; this lower wheel is heavy enough to continue spinning for some time so that the potter can work the clay on the spinning upper disc or wheel head. The shaft is usually supported at the base or within a frame below the wheel head to prevent the mechanism from falling over (Rice:133-135; Watkins 1950:6). By the 18th century there were also gear modified wheels which had a foot or hand powered treadle attached to the lower wheel. This was also followed by wheels where a belt connected the shaft to an external device moved by a second person by hand (Holland 1958:7-8; McGarva 2000:47-49). Two potters from north coastal Massachusetts communities had "turning wheels" listed in their probate inventories, but it is difficult to determine what type of wheel these may have been (Watkins 1950:67, 71).

The making of a pot on a wheel was called both throwing and turning. An issue of New York Gazette in 1771 advertises for "throwers or wheelmen" to work in Norwich, Connecticut (Watkins 1950:184). In the same state, Brooks was "turning" wares (Watkins 1950:67, 71, 126; Worrell1982:27). The clay is vigorously placed on the wheel head and while the wheel is spinning, the potter applied pressure with his fingers pushing

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inward, outward and upward at varying times to shape the pot. The potter alternately fights against and takes advantage of the centrifugal forces working on the clay while it spins. This is particularly true when shaping the rims which can be quite easily altered if too wet or thin at the time they are being formed. Subtle variations in rim shape or angle can be a product of a wheel spinning a bit too fast or the potter pressing too forcefully rather than an intentionally created style. The external profile and rims were sometimes shaped with a tool or the bare hands and/or smoothed with a piece of cloth or leather. Rectangular wood 'rib' tools and ferrous knives were found under the workshop floor at the Brooks' pottery site and they look similar to ones used by potters today (Kelleher personal communication 2013). Tools and leather tend to compress the clay so that a smoother external surface is an indication of their use and an irregular profile with a rougher texture is more likely to have been made with hands alone. However, hasty trimming with a tool at the edge of the base can leave a very rough surface. A potter may decorate the outside of the pot with a wheeled rouletting tool. A pattern is cut into the wheel's surface and is rolled across the wet clay. Sometimes one can tell how wet the clay was based on the texture of these decorations. If the pattern is deep, rough or distorted the pot was still quite wet and recently made. If the pattern is shallow and irregular the pot may have been left to dry to the point where to press harder might have risked breaking the vessel. When multiple incised lines are evenly spaced a comb tool was likely used, as opposed to a single pointed tool for a single incised line.

Vessels were removed from the wheel by cutting with a string or wire as is done today. Horizontal scrape marks on the bases indicate the pot was cut when the wheel was

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stopped and a spiral pattern indicates it was cut while the wheel was still turning. The absence of either of these marks likely means that more finishing work was done to the pot after a drying period. Usually the vessels are placed on wooden boards and these have been listed in pottery inventories (Watkins 1950:53). Pots are left to dry long enough to be handled without damage but still contain enough water for working, a stage currently called cheese hard and when a bit more dry, leather hard. At this time pots can be inverted back on the wheel for more trimming and smoothing. More wet clay can be applied in the form of handles or decoration. Pierced holes are often cut at this time. A hole with ragged edge or distorted shape may indicate the holes were punched when the clay was quite wet. The pots are then left to air dry until most of the physical water has evaporated. At this state they will still absorb moisture and are very fragile.

Glazing: Materials and Methods

Potters who were going to use a tin and lead glaze needed to fire the pots in their unglazed state to ensure the glaze would adhere to the clay, but this is not necessary for the other lead glazes (Hamer and Hamer 1999:24-25, 213-214). For most earthenware potters, when there are enough dry pots to fill a kiln, the pots are glazed. It is not practical to leave unfired pots to sit too long before firing because dust may not completely brush off of an air dried pot; the mineral composition of dust can interfere with the ingredients and ruin the pot's glazing. The functional purpose of glaze is to seal the pores, preventing the contents from being absorbed. Glaze can be put just on the interior or functional sides; a storage vessel does not need glaze on the outside to serve its purpose but a

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colander does. Utilitarian wares tended to be glazed just on the interior but some were glazed on the outside simply for decorative purposes.

For centuries lead based glazes were used on redware as well as lighter colored earthenware pottery. Throughout the 19th century there was an increasing public debate on the dangers of lead, but no real improvement was available to the common potter (Scientific American 1851:150). The process of fritting glaze materials was in development in the 19th century, but it was not perfected until the 20th century. To frit lead, it is melted with silica compounds and then finely ground; this renders the lead less soluble and is *safer* for both potters and consumers. In the 20th century lead-free, boron based, earthenware glazes were created but they have not eliminated the use of lead (Hamer and Hamer 1999:32-33, 90, 147-148, 198-199). Most potters produced their own glazes, most likely based on recipes they learned from their instructors. They would purchase the non-local ingredients and surviving inventories and account books provide some information on those materials and their prices. Lead is listed most often just as "lead" but sometimes "bar lead" and "litharge." A Northampton, MA pottery was sending to Boston in 1779 for lead and two months later paying someone to "calcine" it. Calcining is a technique of refining materials at temperatures far below their melting points; it does not produce the same result as fritting (Hamer and Hamer 1999:42, 199; Watkins 1950:67, 77, 98-99, 125). Hervey Brooks' accounts mention both burning and pulverizing lead, (Worrell 1982:13, 26). Brooks was probably doing his own calcining of the lead. The refined product may have been the "red lead" which also shows up in his

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transactions with another potter with whom he worked early in his career (Hamer and Hamer 1999:42, 147-148,197-199; Worrell 1982:22).

Common glaze ingredients at the time were copper oxide for greens and manganese for purples, blacks and browns. Sand was also purchased by potters as a source of silica for the glassy quality of glaze; however, it was also mixed with the clay in general and had other uses inside the kiln (Watkins1950:99; Worrell1982:65). The Northampton pottery sometimes bought antimony at the same time as the lead. Antimony oxide can act as an opacifier in a clear lead glaze as well as create a bright yellow color; larger amounts of iron oxide can darken the glaze from yellow to shades of orange. Antimony was the pigment in the yellow decoration on tin glazed earthenwares (Hamer and Hamer 1999:11, 213; Watkins 1950:98-99). It is unknown if it was commonly used.

Some potters ground the materials with a tool called a glaze mill (Watkins 1950: 69, 71, 98-99). A glaze mill generally had two basic parts: a flat-bottomed top stone which rested in a stone basin. The water and glaze ingredients could be funneled to the space between the stones through a central opening in the top stone or in the gap between the center stone and the basin wall. The upper stone was rotated with a separate handle placed in a central or side notch. The basin had a drain in the side base for the glaze to flow out (Watkins 1950: 6, Figure 4; Wigginton and Bennet 1984:141-143). This is very much like a quern, a two stone hand-mill which was more commonly used for grinding grain (Rawson 1935:85, 334). They might have used something smaller as well. Some small redware pottery shops in 20th century England still hand ground their glaze ingredients with a mortar and pestle (Holland 1958:16).

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Earthenware potters applied their glazes in liquid form to the pots. The glaze ingredients were mixed with water to a pourable consistency, described as cream both now and then (Scientific American 1851:150). When done by hand, it is poured into the pot to be glazed or the pot itself is used as the scoop. The liquid is swirled around the interior to coat the surface and tipped towards the glaze container so any excess can coat the edge of the pot as it flows out. If needed, the pot is inverted and the rim is plunged into the glaze to completely coat it. Pots that are glazed on the outside are plunged into the glaze. Rims are wiped at this time. While glaze had been applied in a dry form in earlier times, the markings on many 19th century redwares indicate that their glaze was applied as a liquid. It would be very difficult to apply dry glaze and get the residue and wiping patterns which are seen on the lip and outside walls of milkpans and storage pots. Dry materials pounced on a damp pot would likely produce wider exterior bands with less precise edges.

Kiln Types

The most common type of kilns for small earthenware potteries were updraft kilns (Figure 8 and Figure 9 top). They are primarily made of earthenware brick with a sandy clay mortar. Stone is sometimes used in cooler, exterior, locations for bracing, sheathing, or paving. The shapes of the base could be either round/oval or rectangular with walls that went straight up then curving in to create a roof over the structure. The draft is similar to a fireplace; the wood is placed in front and most of the heat is drafted upward towards a chimney or smoke hole. In kilns, however, fireboxes are slightly outside the body of the kiln at/or below the level of the base. They directly open to flue channels in

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between and around platforms for the pottery. Kilns could have one or more fireboxes sometimes next to each other, sometimes opposite or radially around the outer kiln wall. Instead of flues in between solid platforms, sometimes a "checkerboard" grid of bricks was laid across more narrow piers for stacking. This space with flues and channels is sometimes called the combustion chamber. The flames and heat are drawn upward around the flues, past the stacks of pottery in the part known as the ware or firing chamber, and out through the chimney or smoke holes. With rectangular kilns, the fire boxes are on one narrow end of the structure. The ware platforms are built on brick arches whose openings allow the heat to draft towards the back end of the kiln. The tops of the round kilns could be either a shallow dome with a central opening, beehive style, or an extended bottle-necked chimney. In general, the greater the diameter of a round kiln, the taller it should be to provide an adequate draft (Greer 1979:134-139; Dawson and Kent 2008:209-211). Updraft kilns, both round and rectangular, are the most common kiln type to be found in New England and northern New York (RMSC 1974:7-10, 24-27; Starbuck 2006:129-132; Warner 1985: 177-179; Worrell 1982: Kiln study photo B25443).

Not all earthenware kilns necessarily had permanent domed tops or chimneys like the beehive or bottle kilns. Evidence has survived in England of earthenware kilns which were built with completely straight walls and their substructures of fireboxes and flues were similar to the enclosed styles. Possible roofing materials of ceramic tiles, bricks or some other nonflammable material were laid upon the tops of the pottery stacks to create a temporary dome. Some potters in England continued to use this type into the 20th

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century (Dawson and Kent 2008:219-220; Holland 1958:24; McGarva 2000:90-93). This is not to say that the New England potters were using them, more to suggest that the possibility of open top kilns existed. Evidence one way or another is difficult to find when excavated kiln remains are mostly sub- structures of floors and fireboxes (Starbuck and Dupré 1985:146-148, Kelso and Chappell 1974:56-57; RMSC 1974: 8-10).

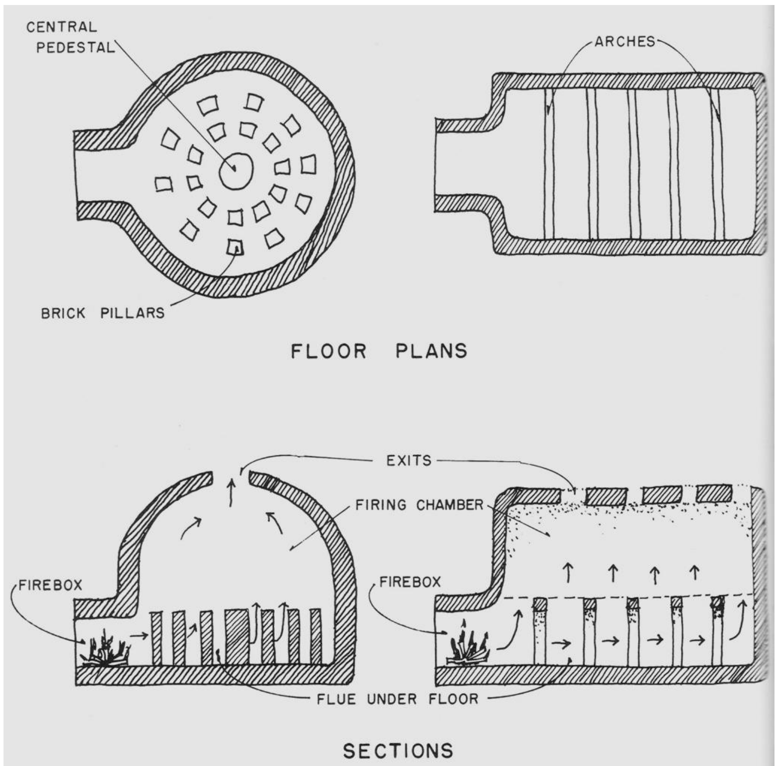

Figure 8. Round and Rectangular Simple Updraft Kilns (Greer 1979).

Round and rectangular down draft and muffle kilns did exist in the 19th century. Down draft kilns (Figure 9) had enclosed ware chambers and chimneys whose openings were lower than the fire boxes. This calls for extensive floor and flue systems that circulate the heat and flames down through the pots rather than simply upward. The chimneys can be inside, adjacent or completely outside the body of the kiln; the vast difference in the flue system and levels between up and down draft kilns makes them

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easier to differentiate if studying kiln floor remains. A cross draft kiln is a hybrid between the two. The structure is fairly shallow and the chimney is at the far end of the enclosed rectangular ware chamber. The fire box is lower than the ware chamber and the heat is drawn upwards by shielding baffle walls directly opposite the firebox and the opening to the chimney. Variations on the cross draft kilns are best known to have been used by small 20th century potteries in the Southeastern United States (Dawson and Kent 2008:203-206; Greer 1979: 138-143; McGarva 2000:91; Wigginton and Bennet 1984:148-155). Muffle kilns have extensive structures to prevent the flames from any contact with the pottery. This was more important to potters working in white clay to prevent discoloration; it is highly unlikely that New England potters would build muffle kilns as the structural changes would have been entirely unnecessary for redware production.

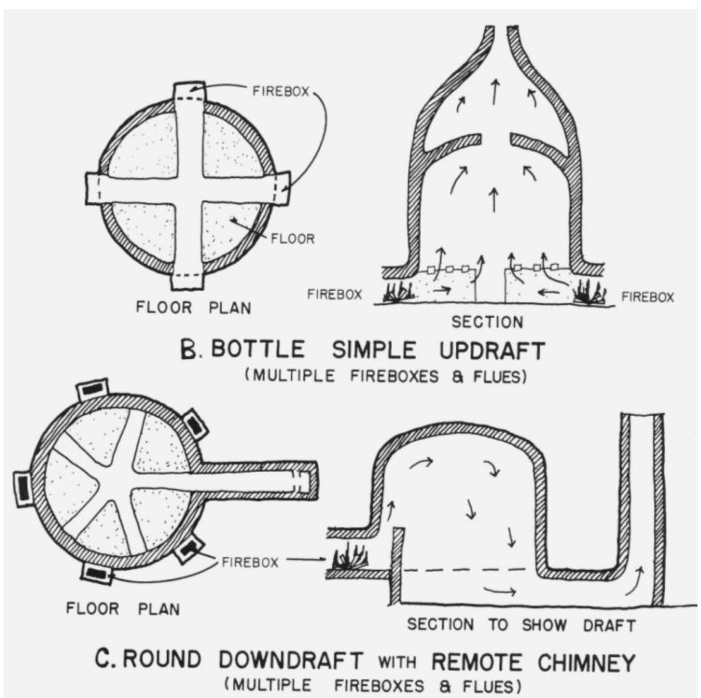

Figure 9 Bottle and downdraft kilns (Greer 1979).

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Kilns for brick making were also rectangular. They varied in width and length, according to the amount of bricks to be fired. The base, side walls, and top were made with older, finished bricks, and then filled in with the new, raw ones. The raw ones were also used in the arches that formed the fire tunnels. These acted as the fireboxes and flues and were the only openings within the brick kiln. The bigger the kiln, the more fire tunnels would be required to thoroughly heat the bricks. Under fired bricks could be corrected in a subsequent firing if necessary (Weldon 1990:19-24, 33). Because brick kilns were built and disassembled each time, the only likely remains to be found on sites would be severely heat-damaged or broken bricks. In light of the many uses of damaged bricks, including as non structural filler inside a pottery kiln, it is unlikely that very much would be abandoned (Worrell1982:61).

Kiln Setting: Overview

The earlier expression for putting the pottery in the kiln for a firing was called "setting." This terminology is found in account books and diaries from the 18th and 19th centuries throughout New England (Watkins 1950:30-31,120, 143; Worrell 1985:156). The amount of time this work required would depend upon the size of the kiln and the number of workers. Hervey Brooks itemized that he took one day or one and a half days to set his kiln, and did not always fire it the following day (Worrell 1982: Figure 5, 6, 7).

Most kilns had a door opening in the wall to load the kiln, although some may have been loaded through the fire boxes. Kilns with temporary domes could be loaded from the top (Dawson and Kent 2008:205, 210; McGarva 2008:94; Worrell 1982:67). It is easier if one person stood inside the kiln and the other(s) passed them the pots.

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Account books do not mention the apprentices who were handing the pots to the man in the kiln, but some assistance was common (Holland 1958:21, McGarva 2000:92-94, 100). Securely filling the kiln with as many pieces as possible required a comprehensive knowledge of the firing process and precision. Large spaces between the pots can waste fuel and create too great a draft in that area of the kiln. This can lead to over fired pots in that area. The opposite problem of making the spaces too narrow can hinder the air flow to the point the pots cannot be heated to the optimal firing temperatures.

If pots have unglazed or wiped rims, they can be stacked on top of one another rims to bases. Larger pots can be inverted over smaller ones. The kiln furniture would be used to separate pots and avoid the danger of glazed surfaces fusing to other pieces. Flat slabs or setting tiles of varying sizes and shapes could be placed between pots but small pieces of clay would be needed to separate the contact surfaces. Some of these pieces were made ahead of time and already dry before use; others were made of wet clay at the time of setting. While requiring more time, the pre-formed and dried separator pieces were more practical because the wet clay could compress under the weight of a stack. The possibility of collapsing stacks was great enough without risking an unbalanced stack at the start. Even wiped rims could have enough glaze residues to cause one pot to fuse to another. Clay wedges of varying sizes and form were shimmed between the pots to reduce contact. Some potters stacked wide mouthed pieces such as milkpans and plates on their rim edges so that they rested on the wiped or unglazed surface of their rims. These could be lined up in a row over the ridges of a trough so the contact points were small and any flowing glaze could be caught in the trough, rather like modern plates in a

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kitchen dish drainer. Some potters in the 19th century created thick triangular slab shelves with protruding ridges on the side. Stacks of these triangular shelves would be placed at the correct spacing and the milkpan rims would rest on the ridges. Tripod stilts could be used to separate layers of shallow pieces that had fully glazed rims. The points of the tripod would be in touch with the glazed surface and the flat bases rested against an unglazed base.

Watkins states that saggars were not used. Saggars are usually large, cylindrical, wheel thrown pots used during the firing to hold vessels that have unstable forms that do not stack well or cannot fit underneath another pot. They are placed upright so that any glaze would be caught by the bases. They are also useful for firing large numbers of small vessels that have fully glazed rims. Saggars are said to have been used at the Buckley pottery in England in the 18th century (McGarva 2000:105) and referred to in an article about glaze in the 1851 New England Farmer's Journal (Scientific American 1851:150). They are also sometimes used by modern potters to protect an individual pot or control the atmospheric conditions around it during a firing. They can be stacked upon each other or provide stability in a stack of mixed vessels. To maximize space, potters did function without saggars by placing irregularly shaped pieces on the top of stacks or carefully balanced in between. However, it is possible that other large pots were also used occasionally as saggars and their broken condition at kiln sites has disguised their function (McGarva 2000: 97-105; Watkins 1950:9; Worrell 1982:73-77).

If the loading doors were separate, they would be blocked up with bricks and often a clay mortar was applied to prevent the draft from pulling in cold air. This could be

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another source of mortar crusted bricks; however, the mortar was most often applied to the outside and so these bricks would not be as heat damaged as those from the fireboxes. Most kilns had an opening in the ware chamber wall to view the wares during the firing, but it would be filled with a loose brick or other material to be easily removed and replaced. It is possible that these opening were created in the bricked up loading door, so it is uncertain exactly how common they were from kiln remains (Watkins 1950:9).

Firing: Overview

Once the kilns were filled and the openings blocked up, the firing could start. The older expression "burning" was used in relation to both the wares and the kiln (Watkins 1950:157, 247-248; Worrell 1985:160). The length of firing would vary with the size of the kiln, the type of fuel used and other environmental conditions; working with an experienced person would help an inexperienced potter recognize the variety of situations. Watkins stated that the process took 30-36 hours. Hervey Brooks usually took "one day" or "one day & night" (Watkins 1950:9, Worrell1982: Figure 5,6, 7). A delay of a day or two between the setting and burning can allow the raw pots to absorb moisture from the atmosphere, especially if the delay is due to rain. A newly built or repaired kiln may also contain wet mortar. A potter may spend several hours at the beginning with smaller fires to slowly drive the moisture from the kiln and the pots. A rapid increase in temperature can vaporize the water in the clay to the point that the pressure bursts the pots. Once the steam is gone and there is only smoke, the burning can proceed in earnest.

The type of fuel can also help or hinder the process; slower burning hardwoods create coals that maintain temperatures, fast burning softwoods raise the temperature but

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create ash which can smother the coals. Potters may have not always had access to the assortment of woods they required; some even advertised for fuel in local newspapers. A Jaffrey, NH potter wanted split and dry hemlock, spruce and pine and a Norwich, CT potter sought ash, maple, birch, poplar, butternut, and a non-specific “white wood” (Watkins 1950:115, 185-186). The size of the pieces can also affect the speed of the firing, although optimal size would vary from one kiln to another. In general, large pieces take longer to completely catch fire than smaller ones, and too many large pieces at a time can slow down the process.

Experience taught the potter how often to add fuel and how to tell when the pots were finished. A glance through the viewing hole could tell the potter roughly how hot the kiln interior was getting by the colors of the flames but until the lead glaze turns from a matte finish to a glossy one, the pots were not finished. The scope of the viewing hole might be limited so that only a portion of the kiln was visible, leaving the remainder to be guessed at. Irregular spacing of the pots and/or windy weather can alter the draft and prevent a kiln from heating uniformly (McGarva 2000: 94-95; Watkins 1950:10).

Changes in the Pottery Industry: Basic Differences Between Stoneware and Earthenware Production

The appeal of stoneware is that when a piece is fired above 2192˚F or 1200˚C, the finished product is significantly more durable and less pervious than earthenware. Glaze, when used, is well bonded to the clay and both the clay and glaze resists chipping (Hamer and Hamer 1999:327). The greatest hindrance to stoneware production in Massachusetts and most of New England was the absence of the correct kind of clay. In the 1740’s the Parker family of Charlestown, MA initially tried to use the white clay from Martha’s

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Vineyard but it repeatedly failed, most likely because it did not contain all the components necessary in workable stoneware clay (Watkins 1950:35-36). By the latter half of the 18th century, stoneware pottery was being produced in New England but the nearest source of the clay was from New York and New Jersey and this remained the situation well into the next century (Barber 1893:65, 172-173; Watkins 1950:36, 84, 88). Potters who were located on the coast or a navigable river had the least expensive shipping costs, but it was still an additional expense which hindered success.

Although imported tablewares from England flooded the market, redware potters continued to supply their customers with basic forms for food serving, preparation and storage as well as other utilitarian pieces. Some late 18th century redware potters even made teawares (Gibble 2005:41-45, 56-57; Watkins 1950:54-56, 102-104, Figures 19, 20, 30, 63, 64). These potters may have been motivated by the hindered commerce with England and Europe. Even after American independence, war continued between Britain and France and both sides seized American ships, cargoes and/or crews. This worsened into the next century and led to numerous foreign trade embargoes and war. New England merchants strongly opposed the war with Britain from1812-1814. The port blockades during the war certainly hindered the shipping of stoneware clay from the New York area to New England, but it provided an opportunity for local redware potters to supply their neighbors while the shortages lasted (Melville 1976:97-99,103).

The relative abundance of redware clay had allowed potters to set up small workshops fairly near both the clay sources and their customers. An important change which occurred during the 19th century was the improvement in transportation, primarily

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through the expansion of the railroad system. It enabled heavy goods to be quickly transported to and from land-locked areas. This lowered the materials shipping costs for stoneware potteries so that they could afford to build in many more places and be able to ship the durable finished goods to more distant markets. One of the stoneware potteries in Bennington, Vermont used some local materials but also clay from New Jersey, North and South Carolina and minerals from Massachusetts and New Hampshire (Barber 1893:172-173). By the latter half of the century, the Bradfords' small shop might not only have been competing with stoneware potteries in Boston, Taunton and Somerset but potentially with the larger ones in Vermont, Connecticut, New York and Pennsylvania (Barber 1893:108, 116-117, 178, 251-252; Watkins 1950:82-89, 150-152, 213, 219-22). In November of 1845, the Old Colony Railroad line started running from South Boston to Plymouth with a depot in the center of Kingston (Melville 1976:109). This presented the Bradfords both opportunity and increased competition since goods coming from Boston could be more easily distributed in the same areas where they may have marketed their wares.

Stoneware workshops could also start as small family businesses, sometimes as an addition to a pre-existing redware shop. This was true for Elijah Cornell in New York after 1840, the Goodwins in Hartford, Connecticut after 1820 and William Seaver in Taunton, Massachusetts after 1790 (Kelly 2013:50-54; Warner 1985:172-177; Watkins 1950: 81-82). They sometimes hired an outsider to show them how to change over to the new materials, although this did not ensure success. Quite a number of these partners were recent immigrants from England or Europe but the assistant's background was no

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guarantee of success (Barber 1893:165-166; Kelly 2013:1-53; Watkins 1950: 34-38). These "potters for hire" may have been journeymen, or they could have been too poor in their former situations to afford their own shops. Perhaps they sought a position in a pottery in America to establish themselves until they could get a place of their own. The Bradfords do not seem to have been taken in outsiders to teach them any new ceramic techniques. Sampson and Cushman, the two men who became part owners of the house in 1824, were very likely from the Kingston area. Charles Bryant and his family lived with the Bradfords in 1855 but he was listed as a shoemaker in the Massachusetts state census (MA State Census 1855; PCRD1829:169-85).

Changing Materials

A period of experimentation would be necessary and as stated before, sometimes the transitioning shops attempted to blend the local and imported clays. Elijah Cornell attempted to blend redware and stoneware clays as did Thomas Goodwin, although it is likely that the Goodwins eventually switched over to all stoneware. When the site of their workshops was excavated in West Hartford, Connecticut sherds were found which appeared to be a blend of earthenware and stoneware clays as well as simply redware and solely gray stoneware. They also found kiln furniture in both sorts of clays and kiln bricks that had either lead or salt glaze melted upon them (Kelly 2013:52-55; Warner 1985:174-178, 183).

The kilns used in stoneware could be any of the previously discussed types and stoneware potters could and did use updraft kilns. The most important difference from the earthenware kilns was that the interior had to be made with the stoneware clay itself in

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order to withstand the higher temperatures (Russ 2004:165-167; Warner 1985:178). Downdraft and cross draft kilns kept the heat in somewhat more since the flames could not shoot straight up and out from where they entered the kiln. Stoneware kiln furniture was somewhat different in shape because the glaze types were less likely to fuse the pots to one another. At the Goodwin site, tripod stilts, glaze troughs and triangular milkpan slabs were found in earthenware and flat setting tiles, circles or "doughnut-shaped" and irregularly hand-formed pieces were made in stoneware (Warner 1985:178; Watkins 1950: Figures 6, 7, 8). The draft and airflow within a stoneware kiln was as important if not more so than for redware in order to achieve the necessary high temperatures to harden the clay and melt the glazes.

To change from lead to salt glazing would also present multiple challenges. When the stoneware is nearly finished being fired, the glaze is applied by flinging salt into the draft of flames and air. The draft brings the sodium chloride to the stacks of pots and can coat the interior of the kiln as much as the pots. The Cornell pottery was producing what they called "dingy" pottery and one family member thought too much salt was getting applied to the kiln instead of the pots. Sophia Kelly surmised that the Cornell staff could have had trouble with the multiple factors of how much salt to apply for how many times, when to apply it and how to stack the pots so the draft would pull the vapor around them completely (Kelly 2014:56). Lead had its dangers but salt glazing could also be hazardous to the potters. The breakdown of the sodium chloride produced varying amounts of hydrochloric acid and caustic soda which was released as fumes out the chimney (Hamer and Hamer 1999:296). This would be produced at intervals towards the

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end of the firing and be more problematic for those working in the larger facilities. There were other stoneware glazes in the 19th century in addition to salt. In New England, Albany slip made of redware clay from Albany, New York, was more commonly used than ash. These materials were applied before firing and presented their own challenges in adhesion and melting (Hamer and Hamer 1999: 360-362; Watkins 1950: 10,108, 146, 182, 189).

Scale of Production

The scale of production in some of the newer stoneware shops was significantly larger than production within the family potteries. In 1853, one of the potteries in Bennington, Vermont had 100 employees and six kilns (Barber 1893:64, 173). Also during the 1850s one stoneware pottery in Taunton, Massachusetts had 11 men, two ware kilns, one brick kiln, and three clay mills. There were two other stoneware potteries in Taunton around the same time with five to six men each (Watkins 1950:86-87). It is assumed that with the larger numbers of staff and equipment, these potteries produced more wares yearly than the smaller workshops. By 1892, the Hews Company was operating 24 hours a day (Lathrop 2000:60). This would have presented significant competition for a shop like the Bradfords' whose shop operated in a small combination of fathers, sons and cousins who may have simultaneously engaged in agriculture and other trades.

American potteries adopted many tools and machines on a large scale which reduced the hand work of pottery had been invented and used long before. Two-piece press molds for clay pipe making were used in the 17th century if not earlier. Simple

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turning lathes had been used to shape the outsides of pots since the early 1700s and the engine turned lathe came into use in the English factories in the 1760s. One of the difficulties of making thin-walled pots on a wheel is that the wet clay collapses easily; on a lathe, thick-walled leather hard pots can be trimmed down to thinner forms than if the same piece was returned to a wheel for trimming. Later refinements to the engine lathe allowed multiple patterns to be carved into leather hard forms held in the lathe on a mold. The initial tool production would be laborious but numerous pots could be made on the lathe (Rickard and Carpentier 2004:79, 92, 97). Jigger and Jolly machines mechanized the molding process in the 19th century to make hollowware and flatware, respectively. A piece of clay was pressed into a revolving mold and an arm was lowered into the mold, pressing the clay against the interior walls to make the form. The uniform shapes could be trimmed more easily as well (Barber 1893:5-9). The Linton machine was a variation on the jigger device because it could also make the hole in the bottom of the pot. The Hews Company, which acquired exclusive rights to this machine, benefited from this mechanization; previously a skilled worker made 1,000 wheel thrown flowerpots a day and with the Linton machine an unskilled worker made 3,000 (Lathrop 2000:59-60).

The other technological change that took hold in the 19th century was the use of hollow slip molds. Two part plaster molds were held very tightly together with straps while a liquid clay slip was poured in. The slip stayed there long enough for the plaster to absorb water and build up the vessel wall and then the surplus slip was poured out. Once the piece was dry enough for the clay to separate from the plaster wall, it could be removed. This allowed for very thin walls, delicate details, and numerous copies of the

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same form (Barber 1893:9-10). Larger stoneware producers who competed with the imported ceramics and decorative pieces took advantage of this technology more than producers of jugs, storage pots and flowerpots where thick walls were beneficial. Through the 19th century the technology eventually spread to the more utilitarian pieces (Watkins 1950: 211). The worker making the initial form had to be very skilled, but the men who reproduced it did not.

Chemical Processes in a Firing

The most common modern complaints about earthenware are its porosity and the health hazard posed by the lead in the glaze. The degree of which both could be dangerous varies piece to piece depending on the firing temperatures. If not brought to optimal fusing temperatures, the clay body is more porous and the lead less chemically bound with the other materials, so an under-fired pot was truly poisonous. Porosity also allows whatever material is being placed in the vessel to soak into the clay and potentially grow mold. For long term storage, a porous pot exposes the contents to air and hastens spoiling. Even if not under-fired, the acid in some foods can dissolve the lead in the glaze so that the lead can be absorbed by the food. It behooved the potter to try to fire his wares as high as possible, but in trying for higher temperatures many pieces can be ruined by too-rapid temperature increases or too high temperatures for earthenware. The results can be bloated, deformed, cracked and/or blackened redware pots; glazes can have melted off of the pots or have a blistered texture. Overfired earthenware is often more brittle than the same materials which were finished at lower temperatures. Such vessels

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are frequently found at pottery sites. The ease with which these results can happen is explained by the chemistry of the materials and the wood firing process.

Redware Clay in a Wood Kiln

The process of firing drives out water, burns away organic and non-organic materials, and melts the clay minerals into a ceramic material (Hamer and Hamer 1999: 129-132). Earthenware clays tend to melt at temperatures between 1652˚F and 2192˚F or 900˚C and 1200˚C (Hamer and Hamer 1999:281, 387, Rice 1987:91). Earthenware clays also can have varying amounts of naturally occurring oxide compounds that can act as a flux; fluxes reduce the melting temperatures of the clay minerals. Some fluxes start working at 1112˚F (600˚C) well within the firing range of earthenware clays. Red earthenware clays contain iron oxide and naturally contain between two to eight percent iron oxide (Hamer and Hamer 1999:36, 58).

The environment within a wood fueled kiln can vary during a firing; the oxygen levels in particular can repeatedly rise and fall. When fuel is added, the air source may be blocked and starve oxygen from the flames which are already further inside the kiln. As the flames travel around the pots, they chemically remove oxygen from the glaze and/or clay and change the materials' atomic structures. This creates what is called a reduction environment (Figure 10). The most obvious results of the reduction environment are color changes, which in red earthenware clays is the changing of red iron oxide to black iron oxide (Hamer and Hamer 1999:26). Black iron oxide is a flux at temperatures above 1652˚F (900˚C), causing the clay to melt further. The deliberate or accidental actions of the people fueling the kiln can change the air flow so that the

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environment is re-oxidized, but once above1652˚F (900˚C), no more than half of the iron can convert back to red iron oxide even if the kiln environment does change (Hamer and Hamer 1999:36-37, 129-132).

The naturally occurring carbon in the clay also contributes to this when the kiln temperature is above 1292˚F (700˚). It can take oxygen from both the atmosphere and the red iron oxide to become a gas and escape the clay. If the temperature rises to 1652˚F (900˚C) too quickly or if the potters are already starving the atmosphere of oxygen by how they add the fuel, carbon causes problems. It can convert more red iron to black and increase the amount of flux in the clay. Too much melting before the gases are released will trap the gases inside the clay walls. Carbon in particular can also prevent the black iron from re-oxidizing to the red. Sulfur also converts to a gas at around the same temperatures and can change the red iron oxide to black. These trapped gases are often seen as distortion, bloating, and/or a "cellular" frothy texture. It can also create cracks (Hamer and Hamer 1999:26-28, 36-37).

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Figure 10. Simple Updraft Kiln in Reduction (Courtesy of Kristen Peltonen and Plimoth Plantation).

These chemical, environmental and temperature changes during firing process are what produce the variations in color. Orange, red, brown, gray and black can be observed within a single piece of pottery. The fluxing action of iron is also why unglazed redware clay or bricks can appear glassy without a glaze ever having been applied; the glassy portions are usually a darker color from the black iron oxide.

Lead Glazes in a Wood Kiln

As previously stated, glazes were applied to earthenware clay because it was still porous even when fired to the optimal temperatures of 1652˚F (900˚C) and 2192˚F (1200˚C) (Hamer and Hamer 1999:281, 387; Rice: 1987:91). Most glazes also contained a certain amount of clay with naturally occurring and/or added metal oxides as well as the lead. Basically, the lead acted as a flux on the clay minerals to aid in their melting, the clay bonded to the pot and created a glassy surface coating, and the metal oxides

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provided the colors. According to modern observations, the optimal temperatures for lead to work as a flux are 1472˚F, (800˚C) and 2012˚F (1100˚C). Higher temperatures can cause the glaze melt too much and potentially run off of the pot. Bubbles in the glaze can either be the carbon or sulfur gases were trapped in the glaze or the lead itself was vaporizing (Hamer and Hamer 1999:27, 198-199).

The varying oxygen levels in the kiln can affect the metal oxides in the glazes and cause variations of color within a single glaze. Red iron oxide in oxidation creates yellow, tan and brown colors. If converted to black iron oxide, the glaze can be many shades of green, dark brown and black (Hamer and Hamer 1999:179). Copper oxides when combined with lead or iron oxide can produce glazes in shades of yellow-green in an oxidation environment. In reduction it can turn to shades of red with brown or purple tones (Hamer and Hamer 1999:76-77). Manganese oxides were also being used in glazes in this time period, which when combined with lead it can produce shades of purple and with iron or copper oxides browns and blacks (Burleson 2001:36; Hamer and Hamer 1999:216).

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CHAPTER FOUR

THE BRADFORD EXCAVATION: PROCESSING AND ANALYSIS

Initial Processing of the Bradford Collection

Once the property owner transferred ownership of the artifacts to the Jones River Village Historical Society, it was loaned by the JRVHS to Plimoth Plantation for long term storage and processing. Over four years Dr. Karin Goldstein, Curator of Original and Archaeological Collections, washed, labeled, and sorted the entire collection, with the assistance of many volunteers. These volunteers were some of the excavators, high school and college student interns, and other museum volunteers with varying backgrounds. Handwritten inventories of the all bags were made although some were later misplaced. A few bag numbers were changed to correspond more accurately to excavation levels. The process of just cleaning and numbering took approximately two years. Once the sherds were washed the amount of brick increased because when dirty, it closely resembled redware fragments. Because the site had been disturbed and the units could no longer be studied, all the brick fragments have been saved (Goldstein personal communication 2012).

Michael Burrey's field notes were transcribed and unit sketches copied. Lathrop created a chart with the existing bag inventory data. Refined earthenwares, yellow ware and stoneware sherds were recorded. The final total of non-redware ceramic was 1,264,

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12 of which were stoneware (Lathrop manuscript catalogue 1999; Lathrop 2000:128). No kiln furniture made of stoneware was found in the excavation. Based upon the proportion of redware sherds to stoneware, it is highly unlikely that any member of the Bradford family made stoneware pottery at this site. Approximately 13,478 redware vessel pieces and 2,375 kiln furniture pieces were recorded.

The next focus was upon vessel identification and mending. The redware ceramics were sorted by various physical features such as glaze and paste color, vessel part and type. Effort was made to mend as many pieces as possible to identify specific vessels. At the time, the archaeology workshop had no climate control and summer heat had a deleterious effect on the B72 adhesive. At the end of this process 183 'vessels' were catalogued and sketched. Volunteers were allowed to choose which pieces to catalogue. As much as these volunteers were encouraged to select common and/or typical pieces, their choices were sometimes idiosyncratic. Some sherds that were sketched as a vessel were smaller and less informative than others left in the remainder of the collection. As a result the vessel catalogue is not comprehensive when compared to the full collection. Some non-mending sherds that were similar in glaze or clay color were separately bagged as possible vessels with the goal that they might be mended if more of the pot was ever found. Some of those choices were also subjective (Goldstein personal communication 2012).

Preliminary typing was also done and some sherds which had not been categorized as vessels were separated into categories of rims, bases, and kiln furniture. This was partially subdivided into categories of possible vessel types: storage vessels,

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milkpans, flowerpots, flowerpot saucers, bowls, handles, and vessels yet to be identified. Some rims and bases of the milkpans and storage vessel types were further subdivided into profile categories but analysis was not completed. Around the year 2000 the collection was placed into 30 boxes and put into storage (Goldstein personal communication 2012).

Condition of the Collection

For this study, the 30 boxes were examined and were found to be arranged in the following categories: two boxes of 183 catalogued vessels, five boxes of partially mended vessels, three boxes of un-mended sherds bagged as vessels, four boxes of "typed" sherds, five boxes of rims, bases, and kiln furniture bagged together by context, and 11 boxes containing the original 120 excavation bags containing the non-redware finds and un-diagnostic redware body sherds. Due to the fact the original processing was done by volunteers, the 11 boxes of original bags were examined for misidentified sherds. The bag inventories were completed and transcribed with the Lathrop manuscript inventory in an Excel file. Among the body sherds, over 150 diagnostic rims, bases and kiln furniture sherds were found and placed with like parts sorted by context. When sorting through the five boxes of rims, bases and kiln furniture, an equal number of body sherds were found and were returned to their original excavation bags. Table 1 is a final count of glazed and unglazed redware sherds which based on glaze, texture, and throwing marks were likely from vessels and not kiln furniture. After sorting, the remaining 29 boxes were categorized by context, relabeled and numbered. Although an extensive

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typographical study for this thesis was ruled out, the following examination of pot types is included to better understand production methods.

Table 1. Redware Vessel Sherds

Redware Vessel Sherds	
Type	Number
Body pieces	10728
Rims	1424
Bases	1263
Handles	48
Lids & knobs	15
Total	**13415**

Hollowware Forms

The hollowware pieces in the collection are primarily comprised of storage pots, large milkpans, smaller pans and saucers, lids, jugs, chamber pots, flowerpots, and flowerpot saucers. These terms are based on functional period terminology as much as possible, but modern terms have been applied in the absence of 19th century sources (Beaudry et al. 2000:26-30; Hull and MacDonald 2008:8-10; Myers 1984:54-55; Warner 1985:179; Worrell 1982: Figures 4-7; Yentch 1990:28).

Rims, bases, and glazing were the features used to determine type. These were subdivided into rims or bases with either obtuse or vertical sides, which put them into rough categories of open mouthed vessels or straight-sided vessels. In the obtuse category are milkpans, pans, and saucers. In the vertical-walled category are storage pots,

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flowerpots and saucers, jugs, and chamber pots. There are also a number of lids and thin-walled body sherds with unique glazing that do not seem to fit in any of these categories and are in such small pieces as to prevent form identification.

Following Beaudry, the term milkpan is used for any obtuse-angled thick rimmed vessel that has a base of 8 or more inches and a rim diameter of 10 or more inches. Pan is used for obtuse angled vessels that have 5-8 inch bases and 7-10 inch rims (Beaudry et al. 2000:28). Saucers fall into both categories of wall angles. Their rims and bases are less than 7 inches in diameter, have both obtuse and vertical sides, and are both glazed and unglazed, with plain and decorated rims. The ones with interior glaze and obtuse walls are categorized as food related saucers, as their appearance resembles small pans and milkpans. The remainders are flowerpot saucers. These are both completely unglazed with obtuse angled walls, or glazed and unglazed with vertical walls.

Storage pots have both rims and bases diameters of 6 or more inches and are only glazed on the interior surface. Storage pots could have been placed rim-down over smaller pots because many do have glaze scars and ceramic accretions on the interior walls; however, they differ from saggar kiln furniture. Storage pots must be glazed to be functional and saggars are unglazed. Based on rim sherds, storage pots were the most common vessel found at the Bradford site. Few storage pots appeared to have handles; there were so few handles at all found at the site that handles do not seem to be used on much of anything. These large cylindrical forms could be any number of "pots" with function-related names, such as "butter pot" or "cream pot" but for the purposes of this

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study the more generic term of storage pot was chosen (Beaudry et al. 1983:29; Hull and MacDonald 2008:3-4, 8, photo 1; Worrell1985: Figures 4, 6-8).

Flowerpots vary tremendously in size, glaze colors, wall thickness and rim profiles. The walls vary in angle, although they are significantly straighter than the pans but more obtuse than the storage pots. They are primarily glazed on the exterior or not at all. Rims are straight, rolled, squared, and fluted and exterior surfaces bear incised or roulette decorations as well as plain. Some bases with holes were found. Flowerpot saucers are generally smaller than the obtuse walled saucers in size and have straighter wall angles. The rim profiles also vary and include fluting. Flowerpot saucers are glazed both inside and out or completely unglazed.

There are a number of distinctive sherds that were less typical but appeared in significant enough numbers to be noteworthy. There were no complete jug profiles but there was one mended rim and handle, some shoulders and distinctive bases with a black glaze inside and out. The bases have a round interior, and a curving rather than angular wall. The exterior feet flare outward. It has been suggested they could be bowls, but the trim angles on the bases are not typical of bowls of the time and resemble the bases of jugs and other bottle-like vessels (Beaudry et al. 2000:23-26). There is a small assortment of black glazed rims with handles. They are glazed on both sides, and their diameter and wall angles imply that they could be chamber pots, although there are no complete profiles of these vessels. Pudding pots are very similar in size and shape to plant pots, and without a complete base it is very hard to determine the difference. The rim is flat topped with a slight projection without a squaring off or decoration typical of the other plant

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pots. There are also a few lids, two of which have a central knob and one has an incised comb decoration similar to flowerpots.

There are a significant number of earthenware body sherds with an olive green glaze with a red or brown mottled streaking on the exterior surface and a red interior. The walls are significantly thinner than the majority of the collection and the body pieces have not been mended to any base or rim to indicate a profile. There are also thin-walled body sherds with an amber-orange glaze and black mottled streaks on the exterior. The close, small patterns of the mottling suggest that they are not part of the other mottled vessels with the color variation resulting from a reduction environment. As thin as they are, it would be a challenge to shatter redware in such precise pieces. They do not resemble any common refined earthenware, but they could be from another American pottery and part of the Bradford family's purchased vessels.

Observations of Production at the Bradford Pottery

Based on the concentric spiraling marks on the pots, the Bradford wares were being made on a wheel. Due to the texture on the edge of the bases, most of the Bradford pot bases were trimmed while still on the wheel at the time they were thrown. A rougher texture indicates that some were trimmed while the clay was still fairly wet. Some pieces bear the spiral marks from being cut from a moving wheel head. The smaller rough edge on some of the Bradford pot bases indicates that the pot was trimmed when made, but the cutting process left a clay burr which was never removed. These marks indicate that no further trimming work was done on the base and the pieces that are very smooth are likely to have been worked upon later when they were cheese or leather hard. There are

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no pieces with the uniform textures, vertical lines and scraping marks which would indicate mold or machine production methods.

Some of the Bradford pots have roulette decorations in the forms of floral swags, diagonal hash-marks and checkered stippling. More common are single and multiple incised lines. They appear on pots which have no outside glaze, which would have likely filled in the designs, but some are glazed on the inside. The incised lines are generally deeper than the roulette patterns, it is likely the clay was still quite wet and possibly still on the wheel after being formed.

The Kiln Furniture Study

The Bradford kiln furniture fell into the following varieties: bricks, wedges of two types, tripod stilts, glaze troughs, saggars and setting tiles of two different types: rectangular and circular slabs (Table 2). As stated previously, there were none found in materials other than redware. These pieces were made far enough in advance of kiln loading that they were used dry and do not show signs of wet compression from other pots. Their calculated manufacture separates them from irregularly shaped pieces of clay that were made with wet clay at the time of loading. Very few hand-molded wads were discerned from the other fragments within the collection so have been excluded from this study. With the exception of the circular slabs, for which there were only a total of four objects, study samples of 20 were selected from each furniture type for a total of 164 samples. They were chosen to represent the range of size, shape and color with most being representative of the category as a whole and some being exceptions. A selection of

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rim, base and body pieces bearing diagnostic scars were also selected to complement the furniture data.

Table 2. Kiln Furniture Sherds

Kiln Furniture Sherds		Count
Brick		876
Tripod stilts		447
Wedges Total		400
Type 1	225	
Type 2	175	
Saggars		171
Glaze Troughs		51
Flat setting tiles total		34
Rectangular	30	
Circular	4	
TOTAL		**1979**

The terminology was based on modern studies and function, as it is difficult to trace period terminology. Bricks and wedges are fairly straightforward, and the generic term of setting tiles allows for a variety of flat shapes (Pendery 1984:55, 1985:113-114; Watkins 1950:9; Worrell 1982:68). The term glaze trough follows Steven Pendery's use of the term. It was used to catch molten glaze during the firing, not for the application of raw glaze (Pendery 1985:114). Terminology for the triangular piece has greater variation; by the 20th century the comparable pieces were produced in a number of different shapes with varying numbers of points, so I have therefore chosen to use the term tripod stilt. Watkins uses the term "cockspurs" but this term is not found in any earlier references. Stilt is the common modern term for the piece and is also used in a number of kiln studies

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(Billington 1962:166; Pendery 1984:55, 1985:113-114; RMSC 1974:12, 15; Starbuck and Dupré 1985:150; Warner 1985:178-180; Watkins 1950:9 and Figure 6; Worrell1982:70).

Large, vertical walled, unglazed pots are likely saggars. They may have been initially made as storage pots but as they were used unglazed. They differ from the unglazed flowerpots because they bear glaze drips, scars, and clay accretions. There is the possibility that some ruined flowerpots may have been mistakenly attributed to the 171 saggar sherds. As there are no complete bases, it is difficult to tell the difference between a saggar base sherd and a flowerpot base sherd which does not include the area with the hole. There is also the possibility that unglazed flowerpots were sometimes used as saggars as some of them do have rims which would allow for stable stacking (Lathrop 2000:119, 130). However, a potter would know how running glaze could leave marks and/or flow through the center hole to drip onto something underneath. While not impossible, it seems unlikely a potter would routinely risk disfiguring pots that would otherwise be the easiest to fire. To keep the unglazed flowerpots away from glazed forms avoids the risk of more wasters.

Size, shape, materials, color, and damage details were recorded to provide insight as to how these items were used. All measurements were made with calipers in centimeters unless otherwise indicated. The terminology used to describe these details is modern and was chosen to express certain visual characteristics. While the furniture pieces vary in the proportions of clay and temper, most have a uniform coloration. Where discolorations exist in specific and repeated patterns and locations, it can be inferred that these changes are a result of external factors from use. The location of discoloration can

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show what surface a piece might have been supporting another glazed pot. Glaze drips are rounded patterns of glaze that appear to have fallen from another pot and mostly have a thick, smooth surface. Glaze scars are irregular shapes of shiny glaze that have a broken or chipped surface due to contact with another piece of pottery. The glaze could have been deliberately applied to the object or had run off of the adjoining pot. Clay accretions are pieces of clay from another piece of pottery that are now bonded to the study piece, usually with glaze.

Another means of surface discoloration is fuming; this can occur when vapor emitted from the glaze of an adjacent pot bonds to the unglazed surface of another pot. It is not unique to wood firing and can happen in a fully oxidized kiln environment. The fumed area is a different color than the clay body, but retains the matte texture of unglazed clay. It is possible for the clay in an unglazed pot to contain enough metal oxides to fume adjacent pieces, although this is less likely if they are all made of the same clay. Fuming is often found around glaze drips and clay accretions. Where there is no obvious glaze or clay but fuming exists, it is a likely point of contact between the furniture and a glazed pot. When the discoloration is in a discernible outline one can infer the possible shape and size of the pot.

As discussed in Chapter Three, the fluctuation between an oxidation and reduction environment in the kiln causes a variety of discolorations in redware. This also happens to the kiln furniture made of redware clay. It can appear as irregular surface patches, layers, and throughout entire pieces. Alteration in shape and texture is also common in sherds that were completely reduced and/or over-fired as the reduction

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environment caused some components to flux and melt the clay, creating distorted and glassy furniture. For the purpose of this study, areas in the following colors are categorized as reduction evidence on all sherds regardless of the clay texture: dusky reds, dark browns, grays and blacks. More on this will be addressed later in the chapter as part of the color study. To save space in the following tables, the term fuming has sometimes been abbreviated to "f" and reduction to "r".

Bricks

The site had so many bricks that the initial plan was to remove only a sample; most of the 876 pieces are small and were distinguished from the redware after washing. Among the larger brick pieces, many bear glaze marks and spatters which are unlikely to occur in the production of the brick itself and are more indicative of the brick being used in a kiln for glazed vessels (Table 3). Unfortunately very few of the ones with these marks were complete. There is a possibility that some had been overfired when initially produced and they could have been placed as filler in parts of the kiln where their weakness would have no structural impact (Worrell 1982:61-62). More likely their shapes and fragmented condition indicate that they were exposed more than once to intense heat post production. A brick maker might re-fire a 'soft' brick but not an overfired one (Weldon 1990:33). Some bricks were altered in shape by tools, but most were altered in shape and texture from over-heating. Some broken pieces possessed physical features worth including even if their measurements were uninformative.

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Table 3. Brick Dimensions and Description

Object #	Dimensions			Glaze details	Clay, molten bits attached	Part of object
	Length	Width	Height			
B1	18	9	5			entire
B2	18	9.6	4.8	end	clay & molten end	entire
B3	0	8.6	5.6	top, base, end	clay all surfaces	corner
B4				top, end	clay top, end	corner
B5	0	9.65	4.65			end
B6				3 sides		fragment
B7				top base 1 side		end
B8	0	8.6	4.4		all sides	end
B9				top, base 2 sides		end
B10	0	9.2		top, base	end	middle fragment
B11	0	8.6			all sides	end
B12	0	8.7			top, end base	end
B13	0	8.2		top base	top, base, end	end
B14	0	5.2			side, top	middle fragment
B15					nearly molten	corner
B16	10.2	9.6	4.75		sides, end	end
B17	0	0	4	top, base	top, side, end	corner
B18	0	0	5.4		end, side	corner
B19						middle fragment
B20	0	0	4.6		crusty top	corner

In spite of their fractured condition, some observations can be made as to the size of the bricks. The width and height measurements ranged from 8.2- 9.6cm wide and 4-5.6cm high. The averaged measurements were 18.55cm long, 8.97cm wide and 4.79cm high. They may have been a more uniform size when new. Some variations can be attributed to the shrinking that occurs during firing; clay becomes more compact even on a molecular level. Over firing could have shrunk some and bloating and coatings of molten materials (Figure 11) enlarged others.

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Figure 11. Bradford kiln bricks (Courtesy of Peter Follansbee).

Bricks 2, 3, 6, 7, 10, and 13 have shiny and thick coatings of a material that could be a heavy buildup of glaze. Brick 14 has a crust of porous molten material which extends past the edge of the brick surface. On 2, 10 and 14 the brick clay is darker in color at the contact point but gradually changes to oxidized red in the direction opposite the molten material. The other glazed bricks show varieties of color but with less banding. This will be discussed further in the section on paste color. Bricks 3, 8 and 11 are dark in color but with a thin patchy coating of oxidized clay on the surface. Brick 5, however is fully oxidized and has a dusting of white lime mortar. It has an impressed "X" mark on one surface which was made while the clay was still wet. It shows no sign of post-production alterations. The rough texture and uneven dimensions indicate that Brick 1 was altered after production to create a point on one end, perhaps to fit a curving or angled wall or flue channel. Another piece of evidence was glaze and clay bits attached with glaze to the bricks. As indicated in the third column of the above table, eight bricks had some amount of glaze, many on multiple surfaces. Bricks 4 and 9 also have pieces of

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broken clay embedded in the glaze surface, indicating either pots or other kiln furniture pieces were in contact with the brick during firing and fused to the brick surface. Brick 6 and Brick 15 have experienced such high temperatures that the clay has bloated and changed shape as well as color, although they are still recognizable as bricks.

Bricks with molten material on just one side may have been built flush into a kiln wall, more likely in locations of high to moderate heat, such as the fireboxes, flues or combustion chamber. The thicker molten crust might have been a red clay mortar coating which was not any more heat resistant than the brick clay, but at least protected the brick and preserved its structural integrity. Layers with thin or surface molten coatings may have not had a covering. Completely distorted and molten bricks were possibly in the bases of the fireboxes and flues and were exposed to such high temperatures that they cracked and distorted beyond use. Some of the bricks which had smaller spatters of glaze could have been on the floor of the ware chamber. There are no fuming rings as will be seen on other kiln furniture pieces. Either pots rims were not in direct contact with the bricks or the heat was too intense to leave such a mark. The beveled brick might have been cut for a rounded or arched part of the kiln, such as for a wall in an oval kiln or a firebox roof, but as it has no heat, glaze or clay damage whatsoever it appears to be unused.

Tripod Stilts

Tripod stilts are a highly useful stacking tool and the majority of the 441 pieces show evidence of use. Four were intact and two were mended, resulting in six complete tripods to be measured. As it was difficult to determine a common size, the primary

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characteristic for the selection was that they had the largest amount intact (Table 4). The smaller pieces were chosen for their proportions in order to document the range of styles and sizes. They had had unique point shapes or had they been intact they would have been the largest, smallest or tallest in the collection. It is difficult to determine if the tripod stilts were broken pre or post-deposition. The ones with glaze scars or broken points were likely bonded to pots so it is possible that the entire body broke when the stilt was forcibly removed. The points on most of the Bradford stilts were more of a narrow ridge than a round point. This longer contact surface area would increase stability but potentially increase the chance of bonding.

Table 4. Tripod Stilt Dimensions and Description

Object #	Completeness of body	Broken points	Length			Thickness	Glaze
			pt to pt 1	pt to pt 2	pt to pt 3		
T1	all but 1 point end	slightly	6.9	6.5	5.6	0.85	yes
T2	all but 1 point edge	yes	8	7.8	8.1	1.05	yes
T3	all but 1 point edge	slightly	8.1	8.6	8	0.80	yes
T4	all but 1 point edge	yes	6.7	7.3	6.6	0.65	no
T5	all	slightly	7.4	8.2	7.5	0.85	no
T6	all	yes	5.5	5.7	5.8	0.70	yes
T7	2 legs	grazed	8.7			1.05	no
T8	1 leg	yes, side				1.00	no
T9	1 leg	slightly				1.10	no
T10	1 leg	yes				0.50	yes
T11	2 legs, - 1 point edge	yes	10.9			1.00	yes
T12	1 leg	yes				0.80	yes
T13	2 legs, -1 point edge	yes	9.2			0.90	no
T14	2 legs, -1 point edge	yes	8.6			0.80	yes
T15	all but 1 point end	yes	7.4	7.6	9.1	0.90	yes
T16	1 leg	yes	7.1			0.95	yes
T17	2 legs	slightly	8.3			0.85	yes
T18	2 + legs	yes	9.9	6.9		0.91	yes
T19	1 leg	yes	4.2			0.75	no

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T20	1 leg	grazed	1.30	Yes

The tripod stilts usually have glaze scars of a single color on their points and occasionally drips on their bases; this was the case for 13 of the 20 selected although it did not directly correlate to the 13 of the 20 which had broken points. The variation in length and thickness implies that they were used with more than one type or size of vessel. A large vessel could be balanced on a small tripod stilt so long as it was in the very center, but it would have been risky if the stack became unbalanced. Most tripod stilts were .7 to 1cm thick in the middle of the body, although T10 was the smallest at approximately .5 cm thick. The average length between the ends of two points was 7.57 cm; T11 was the longest at 10.9 cm and T6 the shortest at 5.5 cm. There are no clay accretions on any of the tripod stilts, just broken points and/or surrounding glaze scars indicating the glaze or point broke rather than the pot. Glaze is rarely spattered over the top surface. This indicates that while the points were often in contact with a glazed surface, the tripod stilt was resting on top the glazed surface rather than below. Based on the breaking patterns and the lack of glaze accumulation it is appears repeat use was uncommon.

The tripod stilts were clearly made by hand and not in a mold (Figure 12). Tripods 13, 16 and 17 bear crease marks on the side of the flat part of the body. All were likely made by taking two fairly soft rolls of clay, overlapping them at one end then flattening down the overlap to blend the pieces together. Drier clay would require more blending and leave fewer fingerprints. The loose legs are then pulled apart and the ends of all are rolled back onto the top surface, pressed down and pinched to make the points. A crease

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where the ends were rolled back before pinching is visible on some. The majority of tripods overall bear fingerprints and finger-sized concave impressions in the sides of the points and Tripods 12 and 13 bear a handprint on the top surface.

Figure 12. Bradford tripod stilts (Courtesy of Peter Follansbee).

Wedges

Wedges are multi-purpose triangular pieces of clay. They were used to separate pots from each other or from setting tiles, so it is not surprising that they have glaze scars and accretions on both flat surfaces (McGarva 2000:105). There are 225 Type 1 wedges and 175 Type 2. Both were made by hand with of rolls of clay that were flattened lengthwise on one side. Type 1 was cut and/or scored to width with little additional alterations. This is evident by the abrupt change on the sides from a smooth flat surface to a rough and uneven surface. The potter most likely cut the roll with a knife and broke them apart when the clay was dry enough to break. An indication that the clay was quite soft on the Type 1 wedges when the roll was scored is the fact the knife dragged the clay

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just enough to pull out slight points at the top of the thick side. Both types were made in a variety of sizes (Tables 5 and 6), and some were left combined together. On these, the score marks for separation are clear on the top surface but non-existent on the base. The feature that most differentiates Type 2 is that they all have a rectangular furrow impressed into the top angled surface. The furrow is quite uniform in outline and possibly made with a tool. Type 2 wedges are also rolled and scored, and are generally more angular than Type 1. Some were cut on all sides and show no break marks.

The two main criteria for wedge sample selection was evidence of use and variety of sizes, as size could indicate the sizes of the pots they supported. Type 1 wedges were too irregular to measure for length due to the erratic shapes caused by the scoring and damaged ends (Figure 13). The asterisks in Tables 5 and 6 indicate that these are multiple wedges that were scored but not broken apart.

Table 5. Type 1 Wedge Dimensions and Description

Object #	Base front W	Base rear W	Front height	Rear height	Clay residue	Clay residue
WT1-1	5	4.95	0.2	1.1	no	no
WT1-2	4	3.9	0.9	2.2	yes	yes
WT1-3	4.1	4	0.22	1.6	yes	yes
WT1-4	3.1	4.2	0.7	1.9	no	no
WT1-5**	3.7	3.8	0.22	1.9	yes	no
WT1-6	3.9	3.95	0.4	1.7	no	no
WT1-7***	5.5	5.2	0.16	1.2	yes	no
WT1-8**	3.9	3.6	0.1	1.22	yes	no
WT1-9	2.8	2.2	0.12	0.9	no	no
WT1-10		1.4	0.12	0.6	no	no
WT1-11	2.32	2.4	0.05	0.5	no	no
WT1-12	2.2	2.3	0.3	0.8	yes	yes
WT1-13	1.95	1.9	0.1	0.55	no	no

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WT1-14	2.05	2.1	0.3	0.8	no	no
WT1-15	2.1	2	0.3	1.55	yes	yes
WT1-16	1.8	1.76	0.05	0.75	yes	no
WT1-17	3.2			1.6	yes	no
WT1-18	4.15	4.25	0.2	1.6	yes	no
WT1-19	2.75	2.7		1.3	yes	no
WT1-20	2.3	1.85	0.15	1.8	yes	yes

Table 6. Type 2 Wedges Dimensions and Description

Object #	Base front W	Base rear W	Front height	Rear height	Glaze residue	Clay residue
WT2-1	1.35	1.25	0.1	1.7	yes	yes
WT2-2	1.25	1.4	0.07	1.62	no	no
WT2-3**	2.5		0.1	1.9	yes	yes
WT2-4**	2.6	2.75	0.15	1.65	yes	yes
WT2-5	1.4	1.45	0.1	1.15	no	no
WT2-6	1.2	1.2	0.05	1.6	yes	yes
WT2-7	1.3	1.35	0.05	1.75	yes	yes
WT2-8	1.25	1.2	0.1	1.5	yes	yes
WT2-9	1	1.19	0.1	1.02	yes	yes
WT2-10	1	1.05	0.15	1.5	no	no
WT2-11	1.2	1.1	0.05	1.2	no	no
WT2-12	0.9		0.15	1.5	yes	yes
WT2-13	1.2	1.2	0.1	1.85	yes	yes
WT2-14	1.3	1.22	0.1	1.4	no	no
WT2-15	1.35	1.4	0.25	1.85	yes	yes
WT2-16	1.15	1.12	0.15	1.4	yes	yes
WT2-17					no	no
WT2-18	1.35	1.4		1.3	yes	yes
WT2-19	1.07	1.05	0.7	1.7	yes	yes
WT2-20				1.85	yes	no

Both wedge types are fairly regular in width but Type 2 is more uniform in size overall with an average length of 2.47 cm, an average width of 1.2 cm and the height range between 1 to 1.9 cm. Type 1 wedges varied in size and not just due to the selection criterion. Most of both wedge types were broken on the thinnest end and both have glaze

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drips and scars on the top surface which run parallel to the front edge with 60% of the Type 1 and 70% of Type 2 having glaze scars. They vary more in the amounts of clay accretions with 25% on Type 1 and 65% on Type 2; however only on Type 1 wedges do the clay accretions vary in color and texture, an indication that these were used more than once. The glaze and clay marks on Type 2 are opposite each other on both top edges of the furrow and are uniform in color (Figure 14). Length measurements were not relevant because the vast majority of wedges were broken at their thinnest edge; Type 1 wedges length measurements were not taken at all. It should be noted that the breaking did not happen along the lines where the glaze and clay stuck, it seems to be more of an issue due to shape, thickness or material rather than use.

The markings on both types indicate that they were used perpendicular to the pots' edges. The taller the wedge, the more likely it was to have glaze stuck to it. The shapes and centers of gravity of both wedges make them more stable on a flat surface with the vessel balanced above, rather than the wedges balanced on a rim edge. It is possible that Type 1 wedges were simply jammed in where needed. Type 2 wedges may have been used with specific pot forms and their more calculated shape was designed to come into contact with surfaces that were more likely to stick. The furrow would create a smaller contact surface area. Type 1 wedges had 5 out of 20 sherds with clay accretions; Type 2 had 13 out of 20 sherds with clay accretions.

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Figure 13. Bradford wedges type 1 (Courtesy of Peter Follansbee).

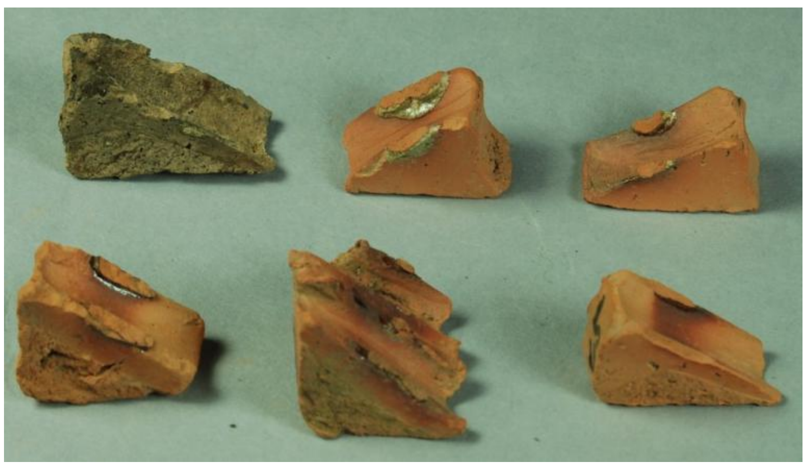

Figure 14. Bradford wedges type 2 (Courtesy of Peter Follansbee).

Glaze Troughs

The 51 trough sherds are from rectangular, shallow vessels. Their function is presumed to be a support for shallow vessels like milkpans; the vessels would balance vertically on their rims similar to modern dishes in a drying rack yet without the upright supports of the modern rack. None survived intact, although a few ends survived

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sufficiently intact to provide a width measurement (Table 7). Some troughs have patches of glaze which are less noticeable because the nearby unglazed surface has discolored in the firing.

Table 7. Glaze Trough Dimensions and Description

Object #	Base W max	Height max	Length	Glaze residue	Clay residue	Part of object
GT1	11.7	3.6	15.4	top, end, 2 sides, base	top	end
GT2	11.4	3.8	18.8	top, end, base	top, base	end
GT3			15.3	top, 1 side, end base	top, base	end
GT4	11.9	3.5		Top	top	middle
GT5				top, side, dripping from base	top, base	side
GT6		3.4		top, base	top, base	corner
GT7				top, partial side, end, base	top, base	corner
GT8		3.45		None		corner
GT9		3.7		top: minute flecks		corner
GT10		3.5		top: 1 small spot		corner
GT11				top: minute flecks		corner
GT12		2.8				side
GT13		3.25	15.5	base: minute flecks		side
GT14				top	top	side
GT15				top, end, base	top, base	side
GT16		3.45		top spatter		side
GT17		3.4		top edge thick	top	side
GT18		3.8		top, end	top, base	corner
GT19		3.7	17.3	top, side, fleck on base	top	side
GT20		3.65		spots top		end

A few measurements can provide an idea of size; the average height of the troughs is 3.5cm, the average width is 11.66cm wide and the longest fragment was 18.8 cm long. Many of the troughs are coated with glaze and have oval parallel ovals of clay stuck to the top ridges; others are lightly spattered (Figure 15). It is still difficult to imagine how a heavy vessel like a milkpan could truly balance on one of these. On the

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top of GT 7 and on the base of GT15 there are clay accretions which resemble wedges; perhaps the troughs were combined with other kiln furniture pieces.

The troughs which are not covered with glaze have a flat top edge and sometimes bear cut marks or finger smears along both interior and exterior surfaces. The ends are likely cut while wet and some have a slight fold where the wet clay edge was pushed towards the interior and many have glaze flowing down this surface. Judging from the multiple coated surfaces, it seems more likely that these pieces acted more as supports like the tripod stilts instead of basins to hold back excess glaze. Enough hand work was done to these so that the end edges could have been turned upward rather than smoothed flat.

Figure 15. Bradford glaze troughs (Courtesy of Peter Follansbee)

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Rectangular Slab Setting Tiles

These narrow pieces of flat clay were also likely to have been used to support and separate pots. None were found intact, but most of the 30 sherds had glaze drips, scars and/ or clay accretions. Added materials were avoided as much as possible when the measurements were taken, but the irregular surface textures and cut edges caused variations in the dimensions in a single sherd (Table 8). It is actually difficult to say which wide surface was the top or bottom or if the potter ever had a preference as to which surface was to be laid upright in the kiln. If one surface was smooth and the other rough, the smooth one deemed the top as it was likely made with tools and the rough receiving an impression of the work surface. Knife drag marks and gravitational glaze drips also determined top and bottom for this study's purposes.

Table 8. Rectangular Slab Setting Tile Dimensions and Description

Object #	Height			Length max	Width		Glaze & fuming	Clay	Part
	avg	min	max		min	max			
RS1	1.23	1.15	1.3	10.6	9.6	9.8	top & circ. f		end
RS2	1.73	1.65	1.8	10.2	7.9	8	top & circ. f		end
RS3	1.78	1.65	1.9	10.5	7		top & base circ.	top, base circ.	end
RS4	0.95	0.75	1.15	7	6.2	7.7	top		end
RS5	1.80	1.7	1.9	7.6	8.5		top, side, base, end	top, base	end
RS6	1.60	1.6	1.6				top, side, base	side, base	side
RS7	1.75	1.7	1.8	14.9	11		top & base circ. f	base circ.	corner
RS8	2.30	2.1	2.5				top circ., side, base	top circ., base	corner
RS9	1.40						top, side, base	top base	side
RS10	2.50						top, base	top circ.	side
RS11							top, side, base	top, side base	side
RS12	1.70	1.65	1.75				base	base	corner
RS13	2.30	2.2	2.4				base minute flecks		corner
RS14	1.30	1.2	1.4	7.3	6.5				end
RS15	2.90	2.8	3	9.6	9.3				end
RS16	2.95	2.8	3.1						corner
RS17	1.45	1.3	1.6				top f , side		corner
RS18	1.55								corner

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RS19	1.70	1.6	1.8			6.3	6.6	top f, side, end		end
RS20	2.85									side

The rectangular setting tiles varied in size, with an average height of 1.88 cm. RS4 had the smallest measurements of .75cm height and 6.2cm wide; however the remainder of the sample is disproportionate. RS16 is the tallest at 3.1cm and RS7 the widest at 11cm. Most rectangular slabs have cut edges and angular cut corners although RS3 has one section on a long side which is rounded and uncut. An oval piece of clay was likely rolled flat, then cut with a knife to size. There are no visible fingerprints or indentations. With the variety of vessel sizes, there was no more reason to have a uniform slab size than to have a uniform tripod stilt size.

The most interesting characteristic of the rectangular slabs are the patterns and residues left upon them by pots, some of which can be seen in Figure 16. RS3, RS7, RS8 and RS10 have rings of clay bonded to them with glaze. Based upon the thickness of these rings, they are likely the rims of pots which broke off when separated rather than base remnants. RS5 also has a piece that looks rather like a wedge, and five others have less recognizable clay accretions. Glaze drips, scars or flows are present on 14 of the 20 samples. It is likely that these vessel rested mouth down on the slab surface. RS1, RS2 and RS7 have distinct circular fuming marks left by pot rims which were in contact with the slabs and the spacing between the concentric rings indicates the rims were wiped of glaze. It was the glaze at the edge of rim which likely caused the marks. The incomplete ring outline and additional ring marks in opposite patterns indicates two possible arrangements: either more than one vessel rim was in contact with the slab during the

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firing and that the slab straddled the two different rims and/ or that the slab was used in several firings. RS5, RS6, RS8 and RS 11 have clay accretions with multiple shapes, colors and textures on different surfaces. The irregularity of location on these rectangular slabs implies that they were used multiple times and/or they caught the accretions in a stack collapse towards the end of the firing when the glaze was molten.

Figure 16. Bradford rectangular slab setting tiles (Courtesy of Peter Follansbee).

<u>Circular Slab Setting Tiles</u>

It is not definite if these pieces were actually made for kiln use. There are only four vessels, two of which are similar enough to possibly be from the same object although they do not mend (Table 9). They are flat, bearing vertical pierced holes which start from the top surface but do not continue in the same diameter to the base. The circular marks in the clay indicate they were thrown on the wheel, the edges wet trimmed and the slab cut with no further finishing on the bases (Figure 17). In spite of the fact the

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edges do have a bevel, their weight and lack of handles would make them rather unwieldy as lids. They may be a variation on a piece of kiln furniture known in England as a "piecrust" or "panbrim" (McGarva 2000:105, Holland 1958:21). Potter Andrew McGarva describes it as "a circular slab of fireclay, usually with a hole in the middle" which topped off a stack or "bung" of large pans and also served as the base for stacks of flowerpots, or separated individual pots (McGarva 2000:104-105). It is a common practice among potters today to pierce holes in thick, non-tempered clay pieces which will be used in the kiln. The holes allow steam to escape from the clay as it heats and prevents breaking.

Table 9. Circular Slab Dimensions and Description

Object #	Top diameter	Base diameter	Height		Glaze
			max	min	
CS1	26	23	1.9	2	minute flecks
CS2	26		2	2.3	
CS3	25	23	2.3	2.5	
CS4	28		1.7	1.8	

The flecks of glaze could have occurred if the slab supported a pot during the firing, although it could also have dripped from something above it in the kiln during the firing. In light of the fact these glaze marks are minimal and the pieces are broken, it is possible that they were not a successful form. To date, nothing fitting this description has been described as being found at other American kiln sites, although this may be due to the lack of detail on kiln furniture.

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Figure 17. Bradford circular slab setting tile (Courtesy of Peter Follansbee).

Saggars

The sherds categorized as saggars in this collection are large, vertical-walled and unglazed vessels. The size and form of the 171 sherds are so similar to the large storage pots that they may have been made as such but were set aside to be used as saggars when the others were glazed. As stated earlier in the chapter, they bear a large number of glaze scars and drips and clay accretions (Table 10) which are more likely to have been acquired through use as a stackable vessel to hold other pots rather than from firing mistakes. Based upon the discoloration in the clay body itself, they were likely fired around and near other glazed vessels; therefore, fuming and reduction data is included in the following table.

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Table 10. Saggar Dimensions and Description

Object #	Depth avg	Depth min	Depth max	Length/Height	Glaze residue	Clay residue	Fuming or reduction
S1	0.8			7.7	base	base	r wall
S2	1.15			5.3			f outside wall and base
S3	0.1				base	base	r all exposed surfaces
S4	0.9				base	base	r all & accretion
S5	0.6			8.6	base		r outer base surf
S6	0.8			6.8	base		r inner wall, base
S7	0.9			9.45			r all surf irregularly
S8	1			15.5	inner wall horizontal		f inside, r outside
S9	0.7				inside base		f inside base
S10	0.8				inside base		f inside base
S11	0.8			5	rim		f both sides at rim
S12	0.7			4.7	rim, very overfired		r rim & wall
S13	0.8			13.7			r wall outside
S14	1			12	base		f base
S15	1			3.25	inside wall		f outside
S16	1			2.9			
S17	0.8			8.15			r stripes wall
S18	1			8.3			r base, wall
S19	0.9	0.7	1.1	5.3	rim		
S20	0.8	0.75	1.1	6.4	base		f base, r outer wall

The depth measurements of the individual sherds varied because most of them are sections of bases or rims with a partial wall. The average thickness was .89 cm and a conclusion to be made from the measurement data is that they were sturdy, not delicate vessels. The length measurement is provided to demonstrate that the saggar attribution was made on observable-sized sherds, not tiny fragments. S8, seen on the lower left in Figure 18, is a body sherd but is notable in its size and has drips of glaze that run parallel to the throwing marks on the clay. As a cylindrical vessel, the throwing marks are horizontal to the wall of the upright vessel and the glaze drips usually run perpendicular to the throwing marks. Either the saggar fell over during the firing or was laid horizontally. Even if it had been broken previously and was used as a setting tile rather

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than a saggar, the direction of the glaze drip is unusual. With four of the twenty samples carrying internal glaze drips and the same proportion with internal fuming marks, it can be inferred that some saggars contained glazed vessels during a firing. External glaze drips, circular fuming marks, and glaze scars on both the rims and bases are more abundant and demonstrate that the saggars were used in between other glazed vessels, not just in stacks with other saggars. The circular fuming marks are very similar to those on the rectangular setting tiles.

Figure 18. Bradford saggars (Courtesy of Peter Follansbee).

Color Study

As previously stated, the colors on a piece of fired redware can be created from the naturally occurring metal oxides in the clay, metal oxides in the deliberately applied glazes, the accidentally applied glazes, and the effects that temperature and oxygen levels in the kiln can have on those metal oxides. The colors and the location of those colors (Figure 19) can indicate the juxtaposition of pot to kiln furniture and the conditions during a firing.

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Figure 19. Bradford wedges type 2 fuming detail (Courtesy of Peter Follansbee).

A color study of the selection of kiln furniture was made using the Munsell color chart (Table 11). A complete analysis of the correlation between color and location proved to be more exhaustive than this thesis required. However, a number of generalizations can be made from this data and further details are available in the Appendix 1 table.

Table 11. Color Variations in Munsell Notation

Clay exposure	Munsell page	Color names
Oxidized	2.5YR, 5YR	reddish yellow, red, light red
	10R	red, light red, weak red
Fumed	10R	reds, reddish grays
	2.5YR	dark reddish grays, dark reddish browns
Reduced	10R, 5YR, 2.5YR	dark reddish browns, reddish grays, gray browns
	GLEY1	N column, gray to black

The greatest color variations are in the glazes, but not in a manner to suggest that the Bradford pottery was using several different glaze formulas. The color ranges are similar enough to still be attributable to a few glaze mixes which altered according to the

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oxidation or reduction environment during firings. 5YR, 2.5YR and 10R are still the most common pages with the colors matching the darker red, reddish brown and reddish gray variations. Other glaze patches match 10YR and 7.5YR pages in browns and yellow browns. Without detailed testing, it suggests that iron was the most prevalent metal oxide in the glaze. The most notable difference was that when the glazes were green, they most often fit the GLEY1 page in the grayish greens and greenish gray variations and occasionally 10Y olive greens. When it was possible to match the tiny glaze spots on the ridges of the Type 2 wedges they matched GLEY1 greenish gray on an oxidized clay. However, the majority of the green glaze color was on heavily reduced clay; copper green glazes often turn 5R dark-dusky red or metallic copper colors when fired in a reduction environment.

The second purpose of the color study was to demonstrate how a single sherd could contain multiple colors even when made of the same clay and glaze. This was very obvious in some of the saggars. S1 has a wall of 'sandwiched' colors: GLEY1 very dark grey between a 10R red interior and a 2.5YR light red exterior. S7 is 10YR and GLEY1 dark gray and brown on the inside and 2.5YR light red on the outside with dark gray and brown streaks. S3 is 10R red on the interior and GLEY1 dark gray on the exterior. The glaze on the base exterior is 2.5YR and 10YR reddish and yellowish brown. The following bricks, which are seen in Figure 11, also show variations within a single object. Complete brick B2 is 10R red on the long surface, 2.5YR light red in the interior, 10R dark reddish on one short end and is a glassine 5GY light grayish green on the other. B13 is mostly GLEY1 in shades of greenish gray with interspersed pockets of 10YR dark

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yellowish brown. While the bricks could have been in contact with glaze, it seems less likely to have been a deliberate green glaze application. Unfortunately, the possibility that the kiln furniture could have been exposed to more than one firing makes the comparison of the furniture colors to a shard of a household vessel less informative. In one firing the pieces could have been set in a crowded space where the air flow hindered the flames and in a more open space where too much heat was pulled through in the next. The overall color variations indicate that some were in firings where the environment changed back and forth from oxidation to reduction multiple times; the 'sandwiched' color variations in the saggars can happen in a single firing.

This possibility for color variations in a single vessel should be kept in mind when using color to classify sherds or determine a minimum vessel count. A single broken redware vessel might have clay that is black, gray, and/or multiple shades of red with glaze that is green, black, brown and/or multiple shades of red. If the vessel broke in a manner where each color is only present on separate sherds, a single vessel might be misattributed to being several different vessels. This unfortunately complicates redware identification rather than simplifying it. With this factor in mind, it should be known that a coarse earthenware vessel count based on color is of questionable relevance.

It should be noted that excavator and potter Debbie Mason fired samples of the clay and glazes removed from Units N8/E2 and N/6E4 the cellar in electric kilns in full oxidation environments. The cellar clay is 5YR 7/6 reddish yellow. A lump of clay removed from the site but not from the cellar is 2.5YR 5/6 red and the glaze from the cellar upon it is a glassine 5YR 5/6 yellowish red where thin and 10R 3/6 dark red where

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thick. A piece of the cellar clay was put in a stoneware crucible and fired to roughly 2400˚F. It is a dull 2.5YR 3/3 dusky red. These colors match those seen in both the kiln furniture and vessel sherds.

The above data was compiled to provide an extensive description of the kiln furniture from the Bradford site. In the absence of documentary evidence, whether primary or secondary, these details should illustrate the types and their shapes and colors. It is hoped that the functional inferences made here can be used to understand kiln furniture at other redware production sites.

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CHAPTER FIVE

CONCLUSIONS

Comparative Collections

There are few New England earthenware pottery production sites with collections available for study, and fewer with compiled data which would allow for ready comparison. I selected my comparative sites on the basis of the following criteria: comparative dates of production to the Bradford site, available written research, and availability for collection examination. Two sites fit: the Brooks site of Goshen, Connecticut, and the Hazeltine site of Concord, New Hampshire. Some collections were available for study but were incompatible by date, some lacked solid provenience, others had published information but the collections were not readily available for study (PAL 1994: 19, 23-26, Pendry 1985: 70-71, Pendry 1984: 55-56; Warner 1985:171-187; Worrell1985:94). Not all kiln furniture collections had numerical data, and/or the categories differed sufficiently to not allow direct comparisons of type. Therefore, the comparative analysis is qualitative and descriptive rather than quantitative.

Hervey Brooks of Goshen, Connecticut

The Hervey Brooks collection at the Old Sturbridge Village Museum is an excellent source of artifacts relating to 19^{th} century earthenware pottery production for

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comparison to the Bradford site. Brooks lived in Goshen, Connecticut for most of his life and he recorded his business activities in several account and day books which date from 1802 to 1873. These provide exceptional data on the myriad of agricultural and mercantile transactions as well as the pottery (Worrell 1982:5, 11-13, 23). Brooks produced mostly utilitarian redware forms such as bowls, milkpans, platters, storage pots and stove pipes, using redware clay and lead glaze throughout his career (Worrell 1982:7, 77-78; 1985:156-158, 161).

In 1962 Old Sturbridge Village moved Brooks' workshop building from its original site in Goshen to the museum grounds in Sturbridge, MA. The kiln was found beneath the existing floor and Herbert Darbee led a limited archaeological excavation (Worrell: 1982:46). In 1978 John Worrell and a large team of OSV staff and archaeology students conducted a systematic excavation of the shop and kiln remains, followed by smaller excavations in 1980 and 1981 (Worrell 1982:47-48). An account of this process was detailed in Worrell's unpublished *Synergistic Report* and all materials are available for study upon request at Old Sturbridge Village.

The kiln was likely used by Brooks between 1818 and 1821-1827, based on the Brooks account books and the site (Worrell 1982:50, 52-53, 56-57). The remains were situated within the north bay of three stone foundation walls. It could not be determined if the kiln had always been used inside a wooden structure, but the stones were judged to have been in place at the same time the kiln was in use (Worrell 1982:43-44, Figure 12). The kiln was oval, measuring 3.75 m east-west and 3.4m north-south. The base was built in four layers: leveled earth, flat stones topped and chinked with a clay mortar, and

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radially-laid bricks. This brick layer was the base for the east and west firebox openings and the flue channels that ran around and between the semi-circular stacking platforms. The outer walls were two bricks thick, alternating in a header and stretcher courses, stopping at the fire box openings. The maximum height of the surviving wall was seven courses high (Worrell 1982:59-60 and Figure 10). The two semicircular stacking platforms were framed in whole bricks laid in alternating header and stretcher courses but were filled with partial, poor quality or heat-damaged bricks; the maximum height of these platforms was eight courses. The clay mortar which filled the spaces between all the structure bricks seemed slightly less sandy than the bricks themselves (Worrell 1982:61-62).

Brick surfaces in the firebox and flue channel showed the most pyro-plastic deformation. The exception to this was the floor and a 5cm level at the base of these inner bricks. There was a layer of sand on the floor of both fire boxes and the central flue channel which may have protected these surfaces from the heat (Worrell1982:65-66). Above this level, many bricks had surfaces which were rough, black, bubbly and appeared to have flowed. It looked to be an application of material, sometimes bonding courses together. In cross section the thick applied layer looked much more vitrified than the hardened mortar between the courses. As this molten material was not found throughout the entire inner heat flues or stacking platforms, it suggested that these bricks closest to the heat source were being deliberately protected with this applied layer. Other bricks looked like they had a thin layer of glaze or that just the brick had melted, indicating that either this covering had fallen off or was not uniformly applied at every

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firing (Worrell 1982:62-66). A section of the south west corner of the stacking platform and west firebox wall was removed for study (Worrell 1982:80, Figures 14, 15, 18).

A study of the Brooks kiln furniture was written in 1982 by Garth Dallman, a student working with Old Sturbridge Village. This document provides measurements, descriptions and counts of the kiln furniture and compares them to pieces from the James Moore Pottery site from Brimfield, MA. The types and amounts of kiln furniture which resembled those found at Bradford site were 312 flat setting tiles, 84 glaze troughs, and 39 tripod stilts. There were wedges which resembled both Bradford wedge types, but they were counted with other hand-formed separating pieces; the total of this category was 518. The pieces which differed were 21 triangular shelves, which Worrell called milkpan shelves (Dallman 1982:16-26).

Even as fragments it was evident that the setting tiles varied in length, thickness and shape, but most were roughly rectangular. Some had hand formed and rounded edges, some sharply cut and many had a texture on the flatter side that could have come from being pressed against a wood grained surface. One complete piece was a long trapezoid, (22.5 x 3.75 x 4.13x 2.5 cm) and all edges were cut. Most bore glaze drips and scars on the top surface and sides and a number of them were warped and no longer flat (Dallman 1982:17-18; Worrell 1982:68).

The glaze troughs were roughly rectangular with flat bases and cut ends. The walls of some were possibly created in a mold with smooth or wood textured surfaces and clean cut edges. Others showed clear finger marks on the outer surface when the wall was pushed up. Some had smeared indentations lengthwise down the trough that

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appeared to be made with fingers. One was significantly curved, but because its base was still quite flat it seemed to have been curved deliberately rather than distorted by the heat. Some bore glaze drips and some had both clay and glaze scars on the tops of the walls (Dallman 1982:20-22; Worrell 1982: Figure 21).

The tripod stilts were very similar to the Bradford pieces. They bore creases at the joint where the clay rolls were joined and bore hand and finger prints. Most of the points were broken off and/or bore glaze scars, making it difficult to tell if the points were more round or narrow blades, but the ends were definitely pushed up and pressed with the fingers to make the point. One had a circular rim scar on the base, but most had glaze drips on the upper surface (Dallman 1982:25; Worrell 1982:70, Figure 23). The clay and glaze on some were quite reduced to shades of black and brown while others were still quite orange-red.

There were wedges resembling both Bradford Type one and Type two. They do seem to have been made differently, although this would only have an effect on the speed of producing them, not their functionality. It would appear they were made by taking a roll of clay and beveling one end and cutting the opposite, because the rounded edges are along the sides and the cut along the back. The flattened end also tends to be wider than the cut end. There were a larger number of grooved wedges and they bore more glaze scars than the flat ones. Some of the indentations on the grooved wedges appeared to be made with the fingers as well as a tool (Dallman 1982:23; Worrell 1982:71-72, Figure 23).

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The milkpan shelves are an isosceles triangle with a protruding shelf at the base of the two shorter sides, approximately 20 x 13.5 x 4cm. They were made in a mold, based on the smooth texture and crease marks on the shaped side and scraped texture on the flat (Figure 20). As the glaze scars are on the flat side, this indicates the glazed pottery was stacked on the flat side (Figure 21) rather than the resting in the beveled ridge (Dallman 1982:16; Worrell 1982:69-70, Figure 21, 22a).

Worrell commented that while they did not find anything that was immediately identified as a saggar, they did find many pieces of completely unglazed pots that bore glaze drips. He does suggest that they might have been used in the manner of a saggar (Worrell 1982:73). There were also a large quantity of hand-molded wads of clay that bore glaze drips, scars, and impressions where they were pressed against other shelves or pots. These were not likely made ahead of time but formed as needed when the kiln was being loaded (Dallman 1982:23-24; Worrell 1982:72, Figure 23). Old Sturbridge Village recreated a kiln like Brooks' and it is still fired periodically. In the interest of experimental archaeology, it behooved them to retrieve and analyze more kiln furniture than most excavations.

Figure 20. Brooks triangular milkpan shelf profile

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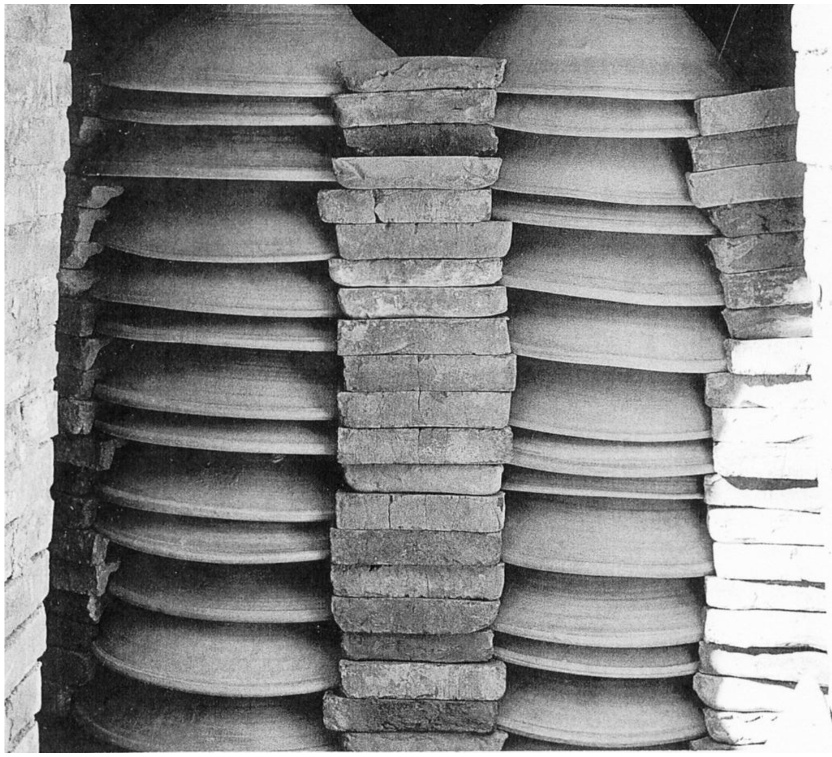

Figure 21. Reproduction kiln at Old SturbridgeVillage stacking milkpans with triangular shelves (Worrell 1982:Figure 29).

Joseph Hazeltine of Concord, New Hampshire

Joseph Hazeltine was one of a number of 19th century potters working in a community called Millville which was later brought into the city of Concord, New Hampshire. He was working from roughly 1842 to 1880, producing utilitarian redwares with the local clay (Starbuck 2006:129-130). From 1982 to 1984 David Starbuck and Mary Dupré led summer excavations at the Hazeltine site under the auspices of the New Hampshire State Conservation and Rescue Archaeology Program. The site location was known locally to be on the property of a private school (Starbuck 2006:129). Their research revealed two kiln bases surrounded by stone foundations, likely to support a shelter structure. They also found a waster dump 35 m south of the kilns containing

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sherds similar to those from the kiln areas (Starbuck and Dupré 1985:138, 149; Starbuck 2006:129). The artifacts are now housed at Plymouth State University and are available for research upon request.

Kiln I was oval, measuring 4.2 meters east-west and 3.4 meters north-south. The base was built of close-laid large granite stones, smaller stone and brick rubble, then a layer of clay that was fired and quite reddened in places which could suggest the location of the fireboxes. There was not enough upper structure remaining to determine any details about the rest of the kiln (Starbuck and Dupré 1985:147-148), although diagrams and photographs indicate some remains of a layer of set bricks on top of the hard-packed clay (Starbuck 2006:131-132.) The house foundation was dry-laid stone of two or three stones high and measured approximately 7 meters east-west and 4.9 meters north-south. The largest space between the wall and kiln base was on the west side, indicating an active working area (Starbuck and Dupré 1985:148).

Kiln House II was adjacent to the first with its south wall mostly abutting the north wall of Kiln House I. It could not be completely excavated due to a retaining wall built on top of the North-East corner of the house and kiln. The rectangular kiln base section which was excavated measured approximately 3.6 meters north-south and 3.6 meters east-west. The house foundation was also stone but was less intact, measuring approximately 5.9 meters north-south and 5.8 meters east-west. The kiln base was again large stone topped with smaller stone and brick rubble, but no clay layer or upper structure remained (Starbuck and Dupré 1985:148, Starbuck 2006:129, 131). The kilns were very different in shape, but the artifacts around them were similar so that they were

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both likely to have been used for earthenwares. The kiln furniture on the site was mixed with the other wasters within the kiln structures (Starbuck and Dupré 1985:147), but during processing in the lab they were separated from the other sherds. Led primarily by Mary Dupré, the furniture was divided into categories of bricks, wedges, stilts, stackers, setting bars and setting tiles (Starbuck personal communication February 12, 2014).

A sample of bricks was removed, but only those which were located from rubble around the kiln bases. Although most of the examined bricks were fragments, the largest one measures 16.3 x 4.4 x 8.8 cm. Many bricks have surfaces which were rough, black, bubbly and flowing. On some bricks it appears to be an application of material but on others bricks it seems as though just the brick had melted. This melted surface is usually on one side; on some it is the short end and others the long but narrow surface, indicating the bricks had likely been laid in layers of headers and stretchers. There is often a thick clay mortar and/or a gritty surface coating on the remaining surfaces which is hard but not melted. This suggests that the kiln bricks were held together with a clay and sand mortar and may have also been coated with a protective mortar coating on the interior surfaces, much like the Brooks kiln.

The wedges are very much like Bradford Type 1 wedges. They vary in size and seem cut from a roll of clay. Like the Brooks wedges, the cut surface is on the back and the sides are rounded so they may have been cut and shaped one at a time. The beveled end is broken off from most and the glaze drips and scars run parallel to that edge indicating they were used perpendicular to the pots which touched them.

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The tripod stilts appeared to have been used in the same way as those from other sites, but Hazeltine's were made in two ways. One type is very similar to Bradford's and Brooks' where two pieces of clay were hand rolled, blended together and the points folded up with the fingers. This type usually has a crease at the point where the two pieces overlap. The second Hazeltine type was likely made in a mold from a single piece of clay as these have three raised bars only on the base surface of the arms (Figure 22). The ridge is approximately .32 cm high and none with the ridge has a crease between or along the arms. Many were likely to have been made in the same mold because the ends of the raised bars were irregular in the same places. It is possible that the raised base was meant to serve in the same manner as the points: to prevent a glazed surface from bonding to another pot. At this time, however, it has not been determined if this functioned better than the flat-base tripod. As most of the points on both types of tripods are broken and bear glaze drips and scars, the upper surfaces seemed to have worked the same.

Figure 22. Hazeltine tripod stilt base

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The Hazeltine stackers are similar to the milkpan shelves from the Brooks site. They were made in molds, but with much sharper edges than the Brooks shelves and were formed in two different triangular shapes. The isosceles triangle ones have protruding shelves at the base of the shorter sides. The other is right triangle shaped and has a shelf only on one side. These may have been made by cutting the wider ones in half. Like the Brooks shelves, both types have more glaze drips, scars and fuming patterns on the flattened side than on the rounded. The two shapes may have been made to accommodate the different shaped kilns, but data is currently insufficient to confirm this theory.

Within the setting bar category, I found some which in my study I call glaze troughs. These are handmade with rounded edges and are approximately 7.5cm wide and 2 cm thick. One has a very slight concave surface but the parallel glaze scars and fuming indicate that a pot had rested upon the higher points on the edges. Others have pronounced ridges and smeared indentations down the length of the tile leaving grooves. On some finger prints were left in the clay where the sides had been pressed up by hand to create the ridge. Most of the observed pieces have glaze spots of varying sizes and scars; on one piece the glazed flowed down the outside surface to the base and bonded a piece of pottery underneath it.

The most common Hazeltine setting bars are narrow and pointed ovals. They appear to be hand-shaped clay rolls which were tapered, flattened then pinched and smoothed to a blunt point. The edges are mostly rounded and some bars have creases on the ends or interior cracks that can come from uneven hand pressure. These pieces bore

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many glaze drips, scars, rings of glaze, and clay accretions which had accumulated on all surfaces and in all directions. While neither the Bradford nor Brooks site had anything quite like these, Watkins illustrated pieces similar to these found at the 19th Century Corliss pottery from West Woolwich, Maine (Watkins 1950: Figure 7).

The Hazeltine pieces which were called setting tiles are thin, flat, unglazed sherds of clay which bore glaze drips and scars. As they did not have finished edges it was difficult to determine if they were from a flat-made shelf or a saggar. Some do have circular marks in the clay indicating they may have been part of a wheel-thrown pot. There are at least 100 of these pieces, but they could have also been re-used waster pots.

Discussion

The kiln furniture from all three pottery sites share many common types, as can be seen in Table 12.

Table 12. Kiln Furniture Types from Bradford, Brooks and Hazeltine Sites

Kiln furniture type	Bradford	Brooks	Hazeltine
Bricks with molten coatings	X	X	X
Glaze troughs	X	X	X
Rectangular setting tiles	X	X	X
Tripod stilts: hand made	X	X	X
Wedge type 1	X	X	X
Milkpan shelves		X	X
Wedge type 2	X	X	
Saggars	X		
Setting bars with pointed ends			X
Tripod stilts: mold made			X

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The majority of the kiln furniture types were found on all three sites, although there are some differences in specific shapes and/or manufacturing methods. The Hazeltine site did not have any Type 2 wedges but it did have three different styles of flat setting tiles and two types of tripod stilts; however, none seem to have functioned any differently. It was theorized that the Bradford glaze troughs were used to prop milkpans on their sides and all three sites have them. Yet the Brooks and Hazeltine sites have specialized milkpan shelves in addition to glaze troughs. It is possible that either or both of the two kiln furniture types had broader functions that are not yet understood. No saggars were identified at either the Brooks or Hazeltine site, although both have unglazed but spattered, wheel thrown sherds that could potentially be saggar sherds. It is also possible that any of these could have been waster vessels that were pulled to be impromptu shelving. The circular setting tiles from the Bradford site are unusual; as stated earlier, they may be a type of pan brim but their attribution as kiln furniture is not fully confirmed.

All three sites have bricks which bear frothy and molten coatings on relatively restrained surfaces. These are likely kiln bricks which had only one side facing the extreme heat and may have either lead glaze spatter, been smeared with a protective coating of clay mortar which melted or the brick itself started to melt. After reading Kelly's account of the Cornell salt glazing experiences, it was posited that the glossy coating on the bricks might be salt rather than lead glaze or over-fired redware materials (Kelly 2013:56). However, the Brooks pottery has exceptionally detailed written accounts of his earthenware production; if Hervey Brooks had tried to make stoneware, it is quite

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likely he would have written about it. None of the three sites had any evidence to suggest stoneware production: no significant numbers of stoneware waster sherds and no kiln furniture made of stoneware clay. There is nothing to suggest that any of the three potteries made any other ceramic type than earthenware.

It is noteworthy that the Bradfords did not use any molded kiln furniture. Press molds can be made with redware clay and may take time initially to make but would presumably take less time to use. Based on the cut edges of the rectangular slab setting tiles, the tooled indentations on type 2 wedges, the Bradfords were not concerned with spending less time on making kiln furniture. A slight upturning of the wet end edges on the glaze troughs would have made them hold back glaze better, but they did not seem to find that necessary. As there were few discernible hand-formed wads which are often pinches of wet clay shoved in place while the kiln is loaded, they may not have been concerned with loading times either.

The most significant difference between the furniture from the Brooks and Hazeltine potteries and the Bradford's is the use of the milkpan shelves. The large triangular pieces with their L-shaped edges permitted a stable method of stacking entire columns of the large milkpans rather than trying to balance the bottom-heavy form on its rim edge. The only drawback was that their shape implies they were to be used with two stacks at a time. It would be tremendously important to make sure the shelves were stacked straight and the spacing between the columns was close enough to sufficiently support the weight. 'Off balance' pieces can wreak havoc during the firing as materials expand in the heat. Pan rings are a modern kiln furniture piece that serves the same

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purpose but for only one stack at a time. The profile is still L shaped and is curved rather than triangular (McGarva 2000:102-103). Hazeltine's cut, halved triangles may have been an attempt to make the shelf smaller but retain its function.

The Bradfords had some method of milkpan stacking which they seemingly found adequate. A quick assessment of rims in the collection placed them as the second most common form after storage pots. A theory that the Bradfords used the type 2 wedges instead of milkpan shelves cannot be determined without further examinations of the Bradford milk pans, wedges, and other comparative collections.

One notable waster piece is pictured in Figure 23. These collapsed milkpans show evidence that the stack collapsed towards the end of the firing. The 'sandwiched' layer of reduced clay is mostly in the outside layer of the pans. A thin layer of clay started to re-oxide on the surface but while the glaze was still molten the stack collapsed, bonding them all together. This waster shows that the milkpans were somehow arranged together rather than singly, but does not show what initially kept them apart. If they were resting on their rims, the missing ones from one end of the row might have become so molten from the reduction environment that they became structurally unsound and toppled them all over. Unfortunately for the potters, a waster like this could be produced in many ways, including a collapse of a stack of Brooks or Hazeltine shelves.

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Figure 23 Bradford collapsed milkpan stack (Courtesy of Peter Follansbee).

Assessment

The initial question of this study was to determine if the Bradford pottery was typical of New England earthenware producers of the 19th century. The body of evidence from the excavation and documents confirms that they were, at least in their production methods. All the kiln furniture and residues upon them are consistent with lead glazed redware production. In spite of the fact the 1996 excavation could only investigate a small portion of the site, there is nothing there to suggest that the Bradford pottery made anything other than typical household earthenware vessels with lead glazes. They did vary their decorative styles; there were several different incised and roulette patterns as well as a few different rims on the flowerpot vessels. If they intended the glazed and texture-decorated flowerpots to be their innovative product, they were either so

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successful that they hardly lost any, or else they never made many. There were significantly fewer flowerpot sherds than the traditional storage pots and milk pans. They may have experimented with manganese streaking on thin walled vessels; the patterning is reminiscent of sponge decorated pottery and the streaky Rockingham glazes. As previously stated, there were unfortunately not enough sherds to determine if they were even made at the Bradford shop.

It would appear from the excavation sherds that the Bradfords did not attempt any manner of technological adaptation. Based upon the wheel, hand tool and finger marks in the clay, they do not seem to have tried to use time-saving devices such as molds, molding machines or lathes. Their product line was basic and limited. They put very few handles on their vessels and did not seem to even make lids for the storage vessels; admittedly handles can get in the way when loading a kiln and lids can be problematic. If a lid is fired separately from its vessel, it may warp out of shape or if not wiped thoroughly the glaze can melt it to the rim when fired within the pot. Hervey Brooks was more innovative than the Bradfords. He made butter churn lids, slip trailed dishes, water pipes and chimney parts. It can be posited that the Bradford excavation may have been so limited that much evidence was lost. Based on the similarity of the surface sherds still on the property to the excavated collection, the excavation seems to have retrieved an adequate sample of the Bradfords' products. They did not bring in an outsider to help them adapt. The ceramics industry was changing around them, but the Bradfords continued their traditional forms and methods.

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Documentary evidence can provide information that is missing from the material remains. Tax records also suggest that the pottery business was small in scale. The tax assessment of Stephen Junior in the years before and after his death priced the pottery at $200.00, which was more than the combined value of the saw and gristmill. Yet for many years they had money outside the property, assessed as "money at interest", varying over the years from $300 to $2,000 (Assessor's Valuation Lists of Kingston 1865- 1874). Perhaps because the pottery was not their sole source of income, it was unnecessary for the family to make changes. There was no need to greatly alter the materials or scale of production because they had an income from agriculture, the mills and investments. They could produce vessels that had a known local demand but did not need to expand their customer base. Once Stephen Senior's litigation secured the water power, the family was relatively sure of some income from the saw and gristmills. Rather than put all their money into expanding the one business, the family maintained a diversified income. They never even took over sole ownership of the brick house.

Hervey Brooks also had a diverse income. In addition to pottery he worked in metal, agriculture, bought and sold merchandise from other craftsmen and farmers and wrote local history books. He was presumably financially stable, yet his son was disenchanted enough with the lifestyle to run away from home (Worrell1982:9-10, 30; 1985:155).

After Stephen Junior died and his estate was settled in 1868, the value of the pottery dropped but Orrin seemed to have sufficient pride in the family business to still be identified as a potter in documents until 1870. Unfortunately the lack of a major river

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and the shallowness of the ocean harbor prevented Kingston and many of its neighboring communities from developing large-scale industrial or maritime industries. Kingston did not completely stagnate, but it hardly competed economically with Boston or any of the nearby communities which peaked economically in the late 19th century. This would have been evident to Orrin and his brother. Without a good river and even with the train line from Boston, it would not have been cost effective to try to transport stoneware clay into Kingston. The expansion of agriculture in the western states at the same time also made it impractical to support the family on just agriculture. It is not surprising then that Orrin and Charles Bradford did not just close the pottery, they left Kingston entirely. Yet when compared with the accounts of other New England brickyards and earthenware potteries, the Bradford family business did quite well, lasting nearly a century. The sherds which remain on the property, even after agricultural disruptions, are a testament to their activities.

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APPENDIX A

KILN FURNITURE COLORS

Munsell Notation of Colors from Most Common to Least Common

Bricks				
Clay Body	10 R: reddish black, red, dk reddish gray, dusky red	2.5YR: red, lt red, reddish brown, dusky red	GLEY 1: dk gray, v dk gray	5YR: reddish yellow
Accretion	2.5YR: lt red, reddish brown	5YR: reddish yellow	7.5YR: reddish yellow	10YR: v. dk gray
Reduction	10 R: dusky red, dk reddish gray	GLEY1: gray, dk gray, v dk gray	5YR: dk gray, dk reddish gray	10YR: dk yellowish brown, dk brown
Glaze	GLEY 1: lt gray, lt grayish green, grayish green, dk greenish gray, v dk greenish gray	5GY: lt greenish gray, grayish green	10Y: olive	
Tripod stilts				
Clay Body	2.5YR:red, reddish yellow, lt red	5YR: lt red, reddish yellow	10R: light red, weak red, red	
Accretion	7.5YR: strong brown	2.5YR: lt red	5YR: reddish yellow	
Fuming	10R weak red, dk reddish gray	7.5 R dusky red, weak red		
Reduction	10 R: weak red, dk reddish gray	GLEY1: black, v dk gray		
Glaze	10 R: dusky red, reddish gray	2.5YR:dk red, dk reddish brown,	5YR: yellowish red	GLEY 1: v dk grayish green

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Wedge Type 1				
Clay Body	5YR: reddish yellow	2.5YR: lt red, reddish yellow	10R: weak red, dk reddish gray	2.5YR: reddish black
Accretion	2.5YR: lt red, reddish yellow	5YR: reddish yellow	10YR: lt yellowish brown	
Fuming	10 R: red, weak red	2.5YR reddish brown	5 YR dk gray	
Reduction	5YR: dk gray			
Glaze	5YR: reddish brown, dk reddish brown, black	10Y: dk olive green, v dk grayish green	2.5YR red	10R: v dusky red
Wedge Type 2				
Clay Body	5YR: reddish yellow	2.5YR: lt red,	GLEY 1: gray	10YR: dk gray
Accretion	2.5YR: lt red	5YR: reddish yellow	2.5Y: gray, white	
Fuming	10R: weak red	7.5R: weak red	2.5YR: reddish brown, weak red	
Reduction	2.5YR: dk reddish gray			
Glaze	GLEY 1: greenish gray			
Glaze Troughs				
Clay Body	2.5YR: red, lt red, reddish yellow	5YR: reddish yellow	10R: lt red	2.5 YR: dk reddish brown, dk reddish gray
Accretion	2.5YR: reddish yellow	5YR: reddish yellow	10R: reddish gray, weak red	
Fuming	2.5YR: weak red, reddish brown	10R: reddish gray		
Reduction	5YR: black			
Glaze	5YR: reddish brown, dk reddish brown, yellowish red, reddish black	2.5YR: dk reddish brown, reddish gray	7.5YR: strong brown	2.5Y: olive brown
Circular setting tiles				
Clay Body	5YR: reddish yellow			
Fuming	10R: weak red			

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Rectangular setting tiles				
Clay Body	2.5YR: red, lt red, reddish yellow	10R: red, weak red	5YR: reddish yellow	7.5YR: lt brown,
Accretion	2.5YR: red, lt red, reddish yellow	5YR: reddish yellow, reddish brown		
Fuming	10R: weak red, red, dk reddish gray, dusky red	GLEY1 v dk gray		
Reduction	2.5YR: reddish gray, reddish brown, dk grayish brown	7.5YR: dk gray brown		
Glaze	2.5YR dk reddish brown, red, reddish brown	5YR: reddish brown, dk reddish brown, yellow brown	7.5YR: brown	10YR: dk yellow brown
Saggars				
Clay Body	2.5YR: lt red, lt reddish brown, red, reddish brown	10R: red		
Accretion	10R: lt red, reddish brown	10YR: v pale brown	5YR: gray	
Fuming	2.5YR dk reddish gray			
Reduction	GLEY1: dk gray, v dk gray	7.5YR: dk gray, v dk gray	2.5YR: dk reddish gray	10R: dk reddish gray
Glaze	2.5YR: dk reddish brown, reddish brown	10R: black	10YR: yellowish brown, black	7.5YR: v dk brown

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