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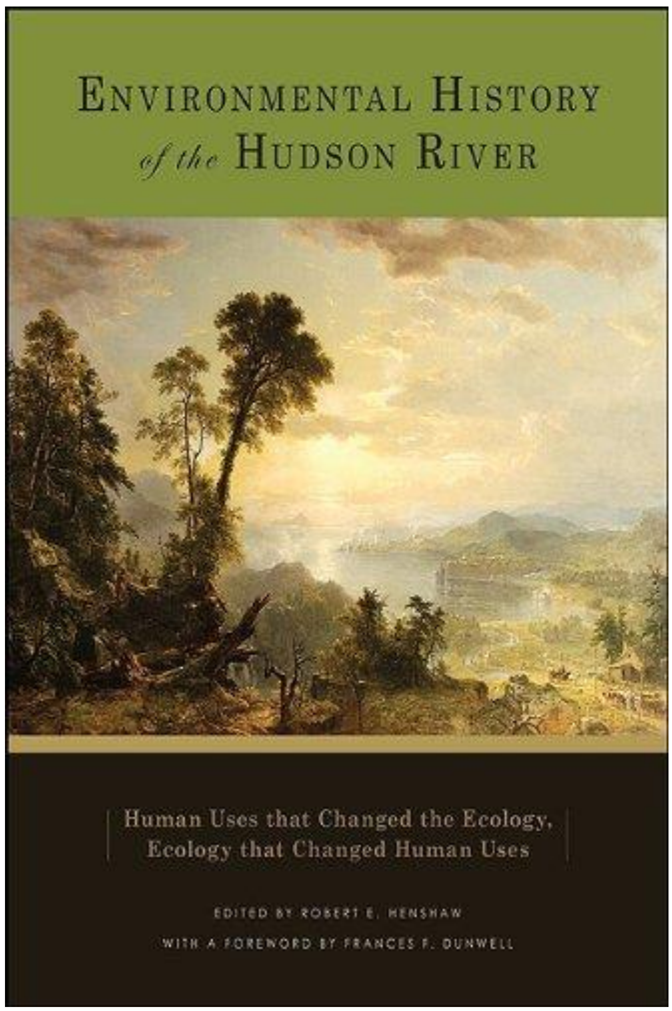

CHAPTER 8

ARCHAEOLOGICAL INDICES OF ENVIRONMENTAL CHANGE AND COLONIAL ETHNOBOTANY IN SEVENTEENTH-CENTURY DUTCH NEW AMSTERDAM

Joel W. Grossman

ABSTRACT

This chapter analyzes the environmental implications of seventeenth-century ethnobotanical data from the initial shoreline block of the Dutch West India Company (WIC) in Lower Manhattan. In addition to the structural remains of the colony's early inhabitants, the excavation yielded a well-preserved sequence of colonial plant remains spanning the periods of Dutch and early English rule. This analysis of the archaeological chronology and plants: (1) provides new understandings of the continuity and shifts in the relative prevalence of European and indigenous plants between the seventeenth and the eighteenth centuries; (2) presents new archaeological insights about the introduction and nature of early Dutch cultigens in New Amsterdam; (3) suggests that many of the archaeologically recovered early-seventeenth-century plants may have been maintained or collected as foods, dyes, or medicines, from both European and Native American sources; and finally (4) building from new research in Dutch botanical history, suggests mechanisms and institutionalized protocols in the exchange of medicinal plant knowledge between Native American herbalists and Dutch botanists in the seventeenth century.

INTRODUCTION

The study of environmental history has two ways to go. As brought to my attention by my Dutch colleague Jaap Jacobs, in 2008 Geoffrey Parker—a British-trained military historian of sixteenth and seventeenth-century Europe—defined the dilemma as follows: "Either we 'fast-forward' the tape of history and predict what might happen on the basis of current trends; or we 'rewind the tape' and learn from what happened during global catastrophes in the past. . . . [Many] experts . . . have tried the former, few have systematically attempted the latter" (Parker 2008, 1078).

Parker's work supported the notion that much of contemporary environmental modeling is too shallow in time-depth to provide reliable bases for projecting into the future. He also cited the work of two Norwegian scientists, Nordås and Gleditsch, who summarized a recent military intelligence assessment entitled, "National Security and the Threat of Climate Change: Report from the Panel of Retired Senior US Military Officers" (Military Advisory Board 2007). This crossover report between the disciplines of military threat assessment and the study of climate change is relevant because it criticized the: "failure of the International Panel on Climate Change (IPCC) to undertake systematic analysis of historical evidence to show how climate change acts as a threat multiplier for instability in some of the most volatile regions of the world" (Nordås and Geditsch 2007, 627–38; in Parker 2008, 1078).

This inadvertent validation of the need for time-depth in environmental reconstruction is music to an archaeologists ears . . . and an opera to environmental historians working on issues of habitat change in colonial New York. We have the best of both worlds: an unmatched material record of early Dutch settlement, coupled with a trove of seventeenth-century archival sources, in Manhattan, Albany, and The Netherlands. Accordingly, while most of our regional environmental modeling has relied heavily on relatively recent nineteenth, and rarely eighteenth, century sources, I will use archaeological and ethnobotanical evidence from New Amsterdam to push the record back to the mid-seventeenth century.

Accordingly, consistent with the focus of this volume, *Environmental History of the Hudson Valley*, and the four hundred-year anniversary of the arrival of Henry Hudson, I will use the archaeological record of seventeenth-century New Amsterdam to characterize the environmental conditions and consequences of human interaction within the confines of the Dutch West India Company (WIC) property in Lower Manhattan, which fronted on the waterfront at Pearl Street, then also referred to as the Strand (Fig. 8.1). The 1984 NYC Landmarks Commission–mandated excavation, eight to twelve feet below the modern city (protected by the rising sea and the thick brick basement floors of early-nineteenth-century row houses), documented the survival of the four hundred-year-old structural remains of the colony's first inhabitants (Grossman et. al. 1985; Grossman 1985; 2000; 2003; 2008). In addition to the recovery of 43,000 well-preserved Dutch, English, and Native American artifacts, foundations, and cisterns, the deep urban dig disclosed a number of

Fig. 8.1. The Seventeenth-Century Environment of New Amsterdam. Extruded from Viele's 1865 topographic map of Manhattan, this 3D terrain model shows the environmental context of the seventeenth-century Dutch West India Company colony (red outline) and excavated western end of the block at Pearl Street and Whitehall (red rectangle). The initial settlement was bounded to the north by a two-pronged escarpment which stepped down from a higher plateau at City Hall Park, and to the east by a spring-fed marsh (Blommaerts Vly) which drained into the East River through a ditch (the "Graft") under modern Broad Street. The predominantly "open" vegetation illustrates not a "pristine" or "primeval" canopy of continuous tree cover at European contact, but instead an "anthropogenic" landscape representing centuries of Native American seasonal clearing, burning, cultivation, and selective tree harvesting. As put forth by Hammett (2000) and others (cf. Day 1953; Cronon 1983; Denevan 1992), these activities suggest a patchwork for Lower Manhattan of upward to thirteen humanly altered habitats. In addition to major thoroughfares (e.g., Broadway), these probably included fields and gardens, residential and defensive sites, food (fish and shellfish) processing stations, edge areas and meadows, parklands and orchards, hunting areas, old fields, and landing sites.

undisturbed features and deposits, each containing dated, but previously unanalyzed and unreported, samples of colonial seeds, and each important as an "environmental time capsule." This reanalysis of the artifact and botanical evidence documents a refined three-phase, century-long sequence dating back to the second quarter of the seventeenth century. It also revealed significant, and previously unreported, order-of-magnitude changes in plant diversity between the seventeenth and eighteenth centuries; shifts that help refine the onset of the "Historic Horizon" in the environmental history of the Hudson drainage (see Peteet, ch. 9 in this volume for long-term prehistoric change; see Vispo and Vispo, ch. 12, and Teale, ch. 13 in this volume for cases of eighteenth and nineteenth-century change).

Using this archaeological chronology (and its associated 3D computerized database—see Grossman 2003), the following ethnohistorical study: (1) defines the context and time frame of the ethnobotanical data, (2) uses quantified seed data to highlight continuities and changes in plant diversity between the 1630s to the 1730s (Fig 8.2; Tables 8.4, 8.5, 8.6), (3) incorporates new data to argue the presence of European vegetables, (4) evaluates each of the identified plants from the multiple perspectives of sixteenth and seventeenth-century European herbalism and botanical history, North American prehistoric archaeology, and contact-period ethnobotany to suggest that many of the archaeologically recovered seeds may in fact represent previously underappreciated indigenous foods, or Native American and European medicinal plants in seventeenth-century New Amsterdam, (5) uses new research into the training of Dutch botanists, doctors, and officials to suggest potential mechanisms of cross-cultural information exchange between the Dutch and Native Americans. Finally, parallels in the naming, qualities, and uses of the medicinal plants also, it is argued, may reflect the existence of interregional and often long-distance, networks (e.g., Interior-Coastal, Intercoastal, Upper Hudson-Lower Hudson) between Native American ethnic groups, as well as between Dutch, English, and possibly French colonial botanists and medical practitioners.

THE ARCHAEOLOGICAL SEQUENCE AND HISTORICAL CONTEXT

The age and timing of historic environmental impacts in the Lower Hudson have often been based on a limited number of radiocarbon determinations (generally with a standard deviation of +/- one hundred years, or more), localized historical accounts and assumptions, or estimates based on the interpolation between earlier and later dates to fill gaps in sediment core time scales, especially for the seventeenth century. In contrast, this study uses two lines of archaeological and historical evidence to date and define changing patterns of plant diversity between the seventeenth and eighteenth centuries in Lower Manhattan: (1) the reanalysis of the archaeological chronology of the Pearl Street excavation based on the availability of new artifact dates from excavations in Europe and the Americas, and (2) a reevaluation of historical land-use records based on when the first residents of the block arrived in New Amsterdam, in contrast to using the date of the earliest recorded (or surviving), and significantly later, land grants by the Dutch West India Company to parcels within the block. Both approaches need to be explicitly addressed because they define the earliest concrete evidence of plant use in New Amsterdam, and because they date significant shifts in the environmental record between the seventeenth and eighteenth centuries.

The excavation resulted in the documentation and reconstruction of three major phases, or periods of occupation: the second quarter of the seventeenth century, the late seventeenth century, and the early eighteenth century:

1. Early to mid-seventeenth century (ca. the early 1630s to ca. early 1650) deposits and features all belong to the Dutch period;
2. Late-seventeenth-century, post-1680, deposits pertain to the culturally Dutch, but politically "English" Period of occupation at the site (as per Goodfriend 1991);
3. Early-eighteenth-century, post-1710 to ca. post-1730, complex of features and structural remains deposited some forty to fifty years after the English takeover of New Amsterdam.

Of these three periods and primary units of comparison, only the time frame of the earliest group has been revised, from the mid- or late seventeenth century, back to the second quarter of the seventeenth century. This chronological shift also provides a three-phase framework for comparing continuity and change in the nature and diversity of colonial plant remains over a one hundred year time span between the early seventeenth and early eighteenth centuries at the site (Table 8.1).

Chronological Revisions

As is the case for the Dutch West India Company site, archaeological chronologies (dating schemes) are moving targets, subject to change with each new discovery. While the relative placement of individual features and deposits is fixed at excavation by the natural stratigraphic sequence of deposition, the absolute dates of the artifacts within them can change significantly as new data become available. Over the last decade, new artifact dates from early-seventeenth-century excavations at Jamestown, Virginia, new finds in The Netherlands, and the deep-sea discovery of tightly dated shipwrecks, have redefined many of the original time markers originally used to date the artifacts of the Pearl Street block. This transatlantic progress in historic archaeology is important because it underscores the significance of multinational collaboration and because it suggests that the initial occupation of the site is significantly earlier, by at least two decades, than initially thought.

When the Broad Street excavation took place in the early 1980s, the early-seventeenth-century excavations at Jamestown had not yet taken place, and local comparative material was limited to ongoing excavations in Manhattan and to preliminary results from the work of Paul Huey at Fort Orange in Albany, New York. Previous excavations in Manhattan east of Broad Street had demonstrated the survival of late-seventeenth-century remains (post-1670) under nineteenth-century basements in Lower Manhattan, but these were still being analyzed (Rothschild, Wall, and Boesch 1987; Cantwell and Wall 2001, 170). At the time, it was generally assumed that the earliest Pearl Street artifacts were roughly conterminous with two periods identified in Albany dating to 1640–47, and 1648–1657, and specifically post-1653 based on a land grant to one of the occupants in the New Amsterdam block (Huey 1988, 598). Others thought they were later. One ceramic specialist reassigned new letter designations to the excavated deposits, grouped/mixed the earliest and latest deposits from the Pearl Street excavations together into one assemblage, and assigned it to a single broad late-seventeenth-century period between 1653 to 1685 (Janowitz 1993, 13, Table I). New data now suggest that these treatments are no longer reliable.

Over the last decade, new research with a focus on the date of introduction (T.P.Q., or *Terminus Post Quem*—"date after which") of a number of "generic" pottery types (e.g., "Eng/Dutch Tin-glazed" earthenware and several kinds of stoneware), formerly thought to have been indicative of the mid-seventeenth century (post-1640 or 1650), are now dated in Jamestown to post-1600 (Kelso and Staube 1997, 14, Tables 2 and 3; Mallios 2000, 50, Fig. 58). Furthermore, new archaeological sequences from well-dated, single-component (unmixed with later periods or occupations) house and farmstead sites near Jamestown have shown that many of the pottery types recovered from the Pearl Street site, formerly thought to be statically "most popular" in the mid-seventeenth century, were subsequently recovered in the Chesapeake area between 1630 and 1650, or to at least a decade, if not two decades, earlier (Mallios and Fesler 1999, 3, Fig. 60; Mallios 2000, 50, Fig. 58).

Likewise, from Holland, new chronologies for Delft tiles, developed by Dutch scholars, show that particular design elements on tiles (specifically, "ox-head" and "spider's head" corner motifs) thought in the 1980s to postdate 1650 (Grossman et al. 1985, Plates V-4, V-17) may have actually been introduced in the second quarter of the seventeenth century, if not as early as the 1620s (Pluis 1998, 537; Van Lemmen 1997) (Table 8.1). In addition, two important time markers, large sherds of Wan-Li–decorated pottery, from two different features (Components 38 and 62) at Pearl Street, both with seeds, previously thought to postdate 1670, or even 1690 (Wilcoxen 1990, pers. com. to Diana Wall at the South Street Seaport Museum 1990, in Dallal 1996, 220), are now dated by Dutch scholars to sometime between 1650 and 1660; a shift that in turn suggests that the basket feature it was found in predates the mid-seventeenth century (Jan Baart, pers. com. Dec. 4, 2009). Furthermore, the possibility exists that they may be somewhat earlier; Wan-Li pottery has been repeatedly recovered from late-sixteenth to early-seventeenth-century shipwrecks (Table 8.1). This chronological revision suggests that the basket (which I interpret as a probable drain at the outside corner drip-line of two walls of an early-seventeenth-century shell-limestone foundation), and the seeds it contained, was in use before 1650. Although the presence of post-1676 leaded glass kept the barrel fill of Component 62 in the late seventeenth century, this adjustment in the age of Wan-Li pottery is also important because the a basket/cask with seeds (Component 38) can now be reassigned to the early to-mid-, versus the late, seventeenth century, as was previously thought (Table 8.1).

Finally, Dutch experts in the history of clay smoking pipes have now established that one former, and widely used, dating tool, the measurement of pipe stem bore diameters (based on the assumption that the wider the bore diameter, the earlier the stem fragment), which supported the initial interpretation that the earliest deposits at Pearl Street postdated the 1640s and 1650s, appear now to be no longer useful. Research by Don Duco, of the Pijpenkabinet Museum of Amsterdam, has invalidated the utility of this technique for seventeenth-century artifact dating by showing that pipe stem bore measurements from a single pipe can vary considerably in diameter (Duco 1987, 135–36). This elimination of pipe stem dating for seventeenth-century contexts effectively removed four mid-seventeenth-century age time-markers from six early deposits, and from four with seeds (Components 2, 6, 8, 12); a change that reassigned their probable age of deposition to sometime in the early seventeenth century, instead of the mid-seventeenth century (Table 8.1).

These multiple lines of revised chronological time markers—a post-1630 pipe bowl, decorative tile motifs now understood to have been introduced as early as the 1620s, the recovery of post-1620–30 raised glass "prunts," (adornos in the form of raised molded berries on the stems of goblets) from three early deposits (Components 8, 12, 13), and the elimination of previously presumed mid-seventeenth-century "pipe stem mean dates" for six features (Components 2, 6, 8, 9, 13, 38)—now suggest that the earliest archaeological features postdate the 1630s, and were probably deposited within the decade of 1630 to 1640 (Table 8.1).

Historical Evidence of Early Occupation

These corrections of the material record are paralleled by historical shifts in archival interpretation which suggest that the first inhabitants of the block arrived earlier than initially thought. At the time of the original study (1983–85), the consensus of a number of New York archaeologists and historians was that the earliest surviving land grants and deeds, dating to the mid-seventeenth century (1647–1653), referenced by Stokes in his *Iconography of Manhattan Island* (1915–1925), represented the initial dates of occupation for the waterfront along Pearl Street in Manhattan. This interpretation overlooked the fact that all land was originally owned and controlled by the Dutch West India Company, and that its workers and officials resided and worked on "company land"; none of which was "deeded," or transferred, to private ownership until later.

In addition, other historical sources, both primary and secondary, suggest that the initial occupation of the excavated block may have begun as early as the 1630s. In 1902, J. H. Innes suggested that "within a few years after 1633 [and following the completion of Fort Amsterdam between 1626 and 1635, (Innes1902, 5)] . . . they had extended easterly along the north side of Pearl Street (which here ran along the shore of the East River) almost as far as the present Broad Street, where at this time the tide ebbed and flowed through a small salt-water creek. . . . [to become] the seat of trade for the town and the focus of early shoreline commercial activities" (Van Laer 1974, I: 111; Innes 1902, 5, 45).

Innes explicitly noted that "[t]hough the deeds or ground briefs for most of the parcels of land at this locality [western end of the Pearl Street and the area of the excavation] were made from 1645 to 1647, it is difficult to believe that they had not been in several instances built upon at an earlier date" (Innes 1902, 45). Five stone workshops along the western end of the block may have been the first

TABLE 8.1. Table of Revised Artifact Dates

This revised chronology used the recent availability of new artifact dates from Jamestown, Va., Holland, and tightly dated shipwrecks to suggest that the earliest seventeenth-century features and structural remains (components) from the Pearl Street site (the Broad Financial Site), were significantly earlier than initially thought when first studied in the 1980s. As detailed above and in the text (see chapter 8, Section II), contemporary time markers from other subsequently excavated sites now strongly suggest that the initial occupation along Pearl Street took place within a twenty-year period between 1630 and 1650; with the earliest features probably constructed in the decade of 1630 to 1640, or at least 10–20 years earlier than previously estimated.

General Time Period	*Component No.*	*Primary 17th Century Components (with seeds)*	*Revised Component TPQ Time Range (+/– 5 years)*	*Revised Ceramic TPQ*	*Original Component TPQ*	*Original Ceramic TPQ*	*Original Glass TPQ*	*Original Pipe TPQ*	*Original Pipe Mean Date (Note 8)*
EARLY-MID 17th CENTURY									
Early-Mid. 17th.c.	8	BT-Lot8-N-Bar	1633–1650	1600	1640	1640	nd	nd	1635 (na)
Early-Mid. 17th.c.	12	Pit/BT-Lot 8-N-Bar	1633–1650	1600	1640	1640	1630	1630	nd
Early-Mid. 17th.c.	9	BT-Lot8-S-Bar	1633–1650	1630	1650	1650	nd	nd	1664 (na)
Early-Mid. 17th.c.	22	BT-Rect-Yel Brk Feat	1633–1650	1600	1640	1640	nd	1630	nd
Early-Mid. 17th.c.	10	BT-Oval Yel-Cistern	1633–1650	1600	1640	1640	nd	nd	nd
Early-Mid. 17th.c.	61	BT-Lot 14-Bar-BT	1633–1650	1600	1640	1640	nd	nd	nd
Early-Mid. 17th.c.	2	Below-Bld A-Floor	1633–1650	1600	1640	1650	nd	17th c.	1649 (na)
Early-Mid. 17th.c.	6	Bld. A Floor - Heerman's Warehouse	1633–1650	1620	1640 - St. Group IA	1762?	1676 ?	1645?	1665 (na)
Early-Mid. 17th.c.	13	Lot 8-N Barrel Fill	1633–1650	1630	1650	1650	1630	1630	1645 (na)
Early-Mid. 17th.c.	5	BT - Hermans Warehouse	1633–1650	1580	1640?	1580	nd	nd	nd
Early-Mid. 17th.c. /Mid-Late 17th c.	38	Rope Basket-/ cask Drain-Fill	1650	1650–60	1670–80	1670–80	nd	nd	1616 (na)
LATE 17th CENTURY									
Late 17th c.	14	Lot 8-S Barrel Fill	Post-1680	1620	1680	1650	1678	1678	1697 (na)
Late 17th c.	16	1/2 cir YB Cist Fill	Post-1680						
Late 17th c.	62	Lot 14-Barrel-Fill	Post-1676	1630	1676	1680	1676	1664	1684 (na)

Diag. TPQ Data/Comments (See numbered footnotes 1–8)	*17th Century Occupants—Innes 1902*	*Arrival Date (van der Donck 1656; Innes 1902)*	*Deed/Ground Briefs from Dutsh West India Company (Innes 1902; Stokes 1915–1928)*
Delftware: Revised TPQ = 1600; Found in Post 1630 Contexts at Buck Site, Jamestown, Va. (2); Pipe MD from small sample and unreliable (Duco 1987)	Haie/ van Tienhoven?	1633	Ground brief July 16, 1645, pos. Jacob Haie (Stokes II, 266); van Tienhoven “Great House” or Warehouse, Post-1652 (Innes 1902, 57)
Delftware: Revised TPQ = 1600; Found in Post-1630 Contexts at Buck Site, Jamestown, Va.; Raspberry Glass Prunt TPQ = 1630 (1,2); Pipe date based on single stem frag 8/64"; not reliable (Note 8)	Haie/ van Tienhoven?	1633	Ground brief July 16, 1645, pos. Jacob Haie (Stokes II, 266); van Tienhoven “Great House” or Warehouse, Post-1652 (Innes 1902, 57)
Westerwald, Orig TPQ 1650 revised to Post 1630 based on Jamestown dates (4); Pipe MD from small sample and unreliable (Duco 1987); No Pb = pre-1676	Haie/ van Tienhoven?	1633	Ground brief July 16, 1645, pos. Jacob Haie (Stokes II, 266); van Tienhoven “Great House” or Warehouse, Post-1652 (Innes 1902, 57)
Delftware: Revised TPQ = 1600; Found in Post 1630 Contexts at Buck Site, Jamestown, Va.; “EB” Pipe bowl Post 1630 (1,2)	A. Heerman?	1633	Pre-1651 (Innes 1902); 1645 (Stokes 1915–1928)
Delftware: Revised TPQ = 1600; Found in Post 1630 Contexts at Buck Site, Jamestown, Va. (2)	A. Heerman?	1633	Pre-1651 (Innes 1902); 1645 (Stokes 1915–1928)
Delftware: Revised TPQ = 1600; Found in Post 1630 Contexts at Buck Site, Jamestown, Va. (2)	Kierstede/Steenwyck	1638	1646 (Innes 1902); 1647 (Stokes 1915–1928)
Delftware: Revised TPQ = 1600; Found in Post 1630 Contexts at Buck Site, Jamestown, Va. (Millios 1999); Pipe MD from small sample & unreliable (1,2,7) cf Duco 1987	A. Heerman?	1633	Pre-1651 (Innes 1902); 1645 (Stokes 1915–1928)
Component TPQ marked by Pb glass (pos intrusive); Two 18th century “post-1762 Creamware” sherds prob intrusive and excluded from sample; Ceramic TPQ = “Ox-head” dec on tile rev to 1620; 95 Pipe frags had MD of 1665, now rejected cf Duco 1987; “Rouletted” dec. bowl rims dated to ca 1645 cf (Hume 1976).	A. Heerman?	1633	Pre-1651 (Innes 1902); 1645 (Stokes 1915–1928)
Diag. Tile with “Ox-Head” motif Rev TPQ = 1620; Glass Raspberry Prunt, TPQ = 1630; Pipe MD = 1645 or pos. 1635 (1,5) invalid (Duco 1987); Pipe TPQ based on ca. EB = 1630–1683; bowl shape (ca 1645–1666) cf Duco 1981; Westerwald orig. dated to ca 1650, rev to 1630 cf. Jamestown dates	Haie/ van Tienhoven?	1633	Ground brief July 16, 1645, pos. Jacob Haie (Stokes II, 266); van Tienhoven “Great House” or Warehouse, Post-1652 (Innes 1902, 57)
Majolica: Ceramic TPQ = 1580 (1)	A. Heerman?	1633	Pre-1651 (Innes 1902); 1645 (Stokes 1915–1928)
WanLi design = Comp TPQ; Originally assigned TPQ of post-1670 in text & Plate III-C2 (Table I-A2 in Grossman et al. 1985 listing of “1664” is typo); Revised TPQ of 1650–1660 cf (Jan Baart-Pers. comm. 2009) TPQ for Comp38.; Note: General Wan-Li ca 1630–50 at site, Jamestown,Va. and post-1613 Shipwreck (Note 3); Tile w “spider’s head” corner tile dec. Rev TPQ = 1640 (Note ,5), but common in second half of 17th century.	Haie/ van Tienhoven?	1633	Ground brief July 16, 1645, pos. Jacob Haie (Stokes II, 266); van Tienhoven "Great House" or Warehouse, Post-1652 (Innes 1902, 57)
Component TPQ set by Pipes and Pb Glass: Post-1678 “RT” mark on English Pipe; Bowl forms = 1680–1690; Lead Glass = TPQ of 1676; Tile w “Ox-head” corner Motif-post 1620; (1,5)	van Tienhoven?	1633	1652? (Innes 1902); Stokes II, 266
		1638	
Originally dated to post-1680 “buff bodied slipware” questionable def. type; Wan-Li-TPQ: Originally ident. as post-1670, Rev to 1620; Manganese Purple: orig. TPQ of 1670–75 cf Ft. Orange contexts, rev. to post-1630 cf. Jamestown, Va. data; Comp. TPQ: Pipe Bowls (HG Mark) Post 1664; Pipe MD of 1684 unreliable (1,3); Comp 62 TPQ from Pb glass—post 1676	Kierstede/Steenwyck?	1638	1646 (Innes 1902); 1647 (Stokes 1915–1928)

TABLE 8.1. continued

General Time Period	*Component No.*	*Primary 17th Century Components (with seeds)*	*Revised Component TPQ Time Range (+/– 5 years)*	*Revised Ceramic TPQ*	*Original Component TPQ*	*Original Ceramic TPQ*	*Original Glass TPQ*	*Original Pipe TPQ*	*Original Pipe Mean Date (Note 8)*
Late 17th c.	76	Pearl St.-Matrix	Post-1680	1620	1680	1670	nd	1680	1698 (na)
Late 17th c.	17	Build. E BT	Post-1680	1620	1800	1800	1680	1678	1688 (na)
EARLY 18TH CENTURY									
Early 18th c	63(Cx 102.02-04)	Lot 14 R-BrkCistern-02-04	Post-1720	na	1720	1720	1710	1720–1727	1725
Early 18th c	53	Bld. D Lower Fill	Post-1720	na	1720	1675	1705	1678	1706
Early 18th c	54	Bld. D Upper Fill	Post-1720	na	1720	1700	1705	1678	1716
Early 18th c	63(Cx 102.01)	Lot 14 R-BrkCistern-Late 01 Cx	Post-1734	1734	1734	1734	1710	1690–1720	1699
EARLY-MID 19TH CENTURY									
Early-Mid. 19th. c.	28	Pit - Stone Pier Fill	Post-1830		1795	1795	1726	1730	1711
Early-Mid. 19th. c.	66	Pit Fill (N65 E25)	Post-1813		1813	1813	nd	1786	nd
Early-Mid. 19th. c.	33	Brick Drain-Fill	Post-1850		1850	1780	1750		
Early-Mid. 19th. c.	15	Oval YL Brk Cis Fill (reused brick)	Post-1844		1844	1844	1800	1738	1730
Early-Mid. 19th. c.	75	Interface w Floor??	Post-1857		1857	1780	1857		
EARLY 20th CENTURY									
Early-20th	35	StoneRubble-Bl Base	Post-1903		1903	1903	1903	1680	
Early-20th	68	Olive Silt-Lt 13-14?	Post-1903		1903	1903	1903	1832	

Footnotes: New TPQ Dates and Changes:

1. (Grossman et.al. 1985; Table I-A2); Pipe Mean and TPQ dates as per originally reported by D. Dallal (Chapter VII in Grossman et al., 1985); Glass Dates as originally reported by J. Diamond, Chap VI in Grossman et al., 1985); Revised Ceramic dates per Kelso and Stroub 2004 & Mallios 1999.
2. "Delftware": Originally dated to Post-1640 based on Mean Date at Fort Orange (Huey 1984 per. Com. in Grossman et al., 1985); Rev. to Post 1600 TPQ; Post-1630 at Buck Site, Va. Jamestown, Va.: (Mallios 1999, Fig. 60).
3. "Wan Li dec.": Orig TPQ 1670, Revised Date Range for Comp 14 and 62 TPQ examples = 1650–1660 (Pers. Comm. J. Baart Dec. 2009); Generic Wan-Li dec.; From 1630–1650 contexts at Buck Site, Va. (Mallios 1999, Fig 60, p. 48); Recovered from 1613 Shipwreck Witte Leeuw (van der Pijl-Ketel (ed) 1982; Sjostrand, 2007); See Dallal 1996 re earlier assessments that Comp 38 Wan Li charger post-dated 1670–1690 ; now disputed by Jan Baqart (pers. comm. 2009).
4. Westerwald post-1618 at Jamestown (Kelso & Straube 2004, 136); European Date Range of 1550–1775 (Mallios 1999, Fig 60, p 48; Hurst et al., 1986).
5. "Ox-Head" Tile Corner Motif: New TPQ 1620 vs. 1650 (Pluis 1998, 537; see Huey 1988, p. 436); "Spider's head corner motif on delft tile dated to post-1640 to ca. 1670 (Pluis 1998, 555)

6 "Buff bodied slipware" original dated to 1680 (cf.Huey pers. Com. in Grossman et al 1984, Pages, V-8, V-21) Revised to post 1588, cf. Huey 1988, 404); Assumed to be too generalize for site-specific TPQ.

7. Component 2 (Below cobble floor of building A) dateable only to early-mid 17th c.; Original Pipe TPQ of 1657 is typo (1659 rev down to 1649, cf McCashion, Dallal in Grossman et al.,1985). Orig. Glass TPQ of 1676 is error—no lead glass present (Grossman et al., 1985, vi–5, vii–14).
8. Pipe Bore Stem Mean Dates are now rejected as unreliable cf. (Duco 1987, 135–136).

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Diag. TPQ Data/Comments (See numbered footnotes 1–8)	17th Century Occupants—Innes 1902	Arrival Date (van der Donck 1656; Innes 1902)	Deed/Ground Briefs from Dutsh West India Company (Innes 1902; Stokes 1915–1928)
"EB" Pipe Mark 1630–1683; 10 Pipe bowls post-1680 forms; Latest dateable ceramic was tile with "Ox-head" motif, Rev. to post-1620; Orig. Ceramic TPQ based on 3 late sherds—Westerwald, Pearlware and Whiteware, prob. Intrusive; 99% (292/298) were Early-Mid 17th c.; Earliest Ceramic type was a Weser red-slipware platter (1570–1630), [No seeds recovered due to mixture](1,5)	Street Matrix @ Pearl	"Laid Out" ca 1630; Paved-cobbles ca. 1680	Singleton 1909
Post-1725 Glass TPQ in is data entry error in Table I-A2, Actual Glass TPQ for Component was ca. Post-1680 Wine Bottle finish& Pb Glass = Post 1676-80; Orig. Ceramic TPQ of 1800 based on a probably intrusive sherd of embossed Pearlware; Profile suggests mixture from cap of 18th rubble over Late 17th c. Builders Trenches (Grossman 1985, Plate IV-12Top); Comp. TPQ revised from Post-1800 to Post-1680 based on pipes & glass 1) Grossman 1985 et. al V29;VI-21); Ceramic TPQ based on "Ox-Head" tile motif, Rev. to Post-1620	Post-Warehouse Building E Wall BT	Building Earlier than thought; Rev. from Early 19th c. to Late 17th; Wall suggests pos correlation in time and space with first Stat Hays.	na
Note: Top context (102.01) Stratigraphically more recent with Ceramic TPQ (1734 Soft Past-Porc.) than lower contexts.	Kierstede/Steenwyck	1638	1646 (Innes 1902); 1647 (Stokes 1915–1928)
Pipe Mean Date = 1706; Pipe bowl TPQ's = 1678; Kiersted property until 1710 (Stokes 1915–1928); Crossmend w Comp. 54 w MD of 1716; Original and 2008 Component TPQ of 1720 is approximate cf. Glass and Pipe TPQ's.	Kierstede Rear Shed/Cookhouse?	1638	1646 (Innes 1902); 1647 (Stokes 1915–1928)
Pipe stem Mean date = 1716; Pipe bowl TPQ =1678 (crossmnd: Cmp53)	Kierstede Rear Shed/Cookhouse?	1638	1646 (Innes 1902); 1647 (Stokes 1915–1928)
Note: Top context (102.01) Stratigraphically more recent with Ceramic TPQ (1734 Soft Past-Porc.) than lower contexts.	Kierstede/Steenwyck	1638	1646 (Innes 1902); 1647 (Stokes 1915–1928)
Cx-29 TPQ=1830; Early 19th C. Stone Pier Pits, Cmps. 27,28,29,49 = Early 19th C - Contemp. Structural Group		1830–1850	Early 19th c. Features
		1830–1850	Early 19th c. Features
Doc and Structural Evidence of mid-19th Cent.; Assoc w Comp. 47-Brick Drain assoc. w post 1820 Ceram & post 1850 ceramic (St.Grp I).(Grossman et. al. Table I-A2)		1830–1850	Early 19th c. Features
Flow Blue Transprint Whiteware (1844)		1830–1850	Early 19th c. Features
Comp. TPQ = Glass- Snap case base, Post 1857		1830–1850	Early 19th c. Features
ABM (Automatic bottle Machine) 1903			
ABM (Automatic bottle Machine) 1903			

buildings erected (Innes 1902, 5–6). A tavern and a brewery were in place, apparently across the street to the north, by 1631, and a church—"a mean barn"—was erected along the Strand (Pearl Street) by 1633 (Innes 1902, 3, 58; Stokes 1915–1925, 267). A surviving letter, referring to the decade before 1639, also documented that this early 1630s commercial activity, in the western end of the block near Whitehall, was matched by a zone of boat repair and construction facilities fronting the eastern end of the block at the outlet of the ditch or "Graft," later renamed as Broad Street (Van Laer 1974, I: 111). In 1934 Poole also described this it as a landing place for small "country shallops" (Poole 1934, 52).

This 1639 affidavit before Secretary van Tienhoven by a carpenter seeking compensation for work done during the administration of Van Twiller, the director of New Netherland between 1633 and 1638, provides a glimpse of the extent of building activity in the 1630s. Specifically referring to work outside the fort, he listed a bake house, a church with house and stable in the rear, a large shed in which boats and yachts were built, a goat house, a small house for the midwife (the mother of Sara Roelofs Kierstede?), a number of houses, the repair of sawmills and a gristmill, and the buildup of the fort bastion (Van Laer 1974, I: 108–109).

Additionally, the excavation exposed the rectangular stone foundation of a single large building that was originally interpreted as the warehouse belonging to Agustijn Heerman (variously spelled as Augustyn Heermans and/or Augustine Heerman), who arrived in New Amsterdam in 1633 (Jameson 1909, 289). Heerman, in actuality, administered the warehouse as an agent for the firm of Pieter Gabry and Sons; Pieter Gabry was the son of Charles or Carel Gabry, merchant of Amsterdam and director of the West India Company (Jameson 1909, 375; pers. com. Jaap Jacobs 2009). When excavated, it was thought that the warehouse postdated these surviving records of land transfer, interpreted by different historians to have taken place either in 1647 (Innes 1902, 18) or after 1645 (Stokes 1915–1935). But Innes suggested that the warehouse appears to have been rebuilt several times before 1647 (Innes 1902, 18).

Finally, the block included the early home, or compound, of one of the settlement's first doctors, Dr. Hans Kierstede (built for him by the WIC), who arrived in 1638 and married Sara Roelofs in 1642 (Van Rensselaer 1898, 24). (As noted by Jaap Jacobs, Kierstede was in actuality a surgeon and would have been addressed and referred to as "meester," or Mister, instead of Doctor [pers. com. Jan. 24, 2010].) After a decade of service to the WIC, Dr. Kierstede was granted title to his parcel at the corner of Pearl and Whitehall streets in 1646 (Innes 1902, 18). But his home may have been built soon after his arrival in 1638 and possibly before his wedding. Innes described his company-built home as being "to the west of the Company's Warehouse on the Strand," which suggested (1) the absence of other residences in the intervening space, and (2) that both the warehouse and the Kierstede home may have been already built before 1642 (Fernow 1976; van Rensselaer 1898, 24; Innes 1902, 18).

Accordingly, when combined, the revised archaeological and archival evidence suggests that the earliest structural elements and ethnobotanical samples date to the second quarter of the seventeenth century. Given ambiguities over the date of introduction for different artifact types and the constantly evolving assessment of regional and international chronologies, it is safe to suggest that the early to mid-seventeenth-century components probably fall within a twenty-year time span between the 1630s and the 1650s. Of these, the earliest features appear, based on the historical references above, to have been constructed and deposited between 1633 and 1638, consistent with the above-referenced revised archaeological assignment to the decade of 1630. As detailed in Table 8.1, the earliest deposits and features were almost exclusively made up of the fill of builder's trenches for foundation walls, cisterns, and privies (denoted by "BT"). As such, these "BT" features, and their seeds, also reflect the earliest environmental conditions and plants when the site was initially occupied by the Dutch, prior to 1630 (Table 8.1).

ETHNOBOTANICAL CONTINUITY AND CHANGE

Using the artifact-based archaeological sequence for dating, this treatment will concentrate on the chronology and ethnobotanical significance of three primary topics: (1) Native American potherbs and starchy seed bearing plants, (2) identification of *Cruciferae/Brassica* or cabbage family vegetables, and (3) Native American and European medicinal plants, predominantly in the early seventeenth century.

While the archaeological record at Broad Street does not extend back to the decade of Henry Hudson's initial visit to the area in 1609, it documents several important trends in changing plant diversity that are otherwise not clearly in evidence from archival sources alone. As will be documented below, the stratigraphically sequenced, dated, and quantified plant remains suggest that the earliest Dutch settlers may have had access to, or actively exploited, a range of previously underappreciated indigenous plant foods and medicines; present new evidence for the appearance of European vegetables and fruits; and show a profound "dropoff" in plant diversity by the early eighteenth century.

The Botanical Flotation Samples

The basic units of ethnobotanical analysis were selected only from "hi-integrity," or unmixed, units of well-dated natural stratigraphic association and contemporaneity. These minimal units of association, the individual excavation "Contexts" (each distinguished by a unique computer number designation), were grouped in the stratigraphic reconstruction process into larger units of analysis and dating, called Components (each a discrete, and functionally distinct, feature—e.g., pit, cistern, builder's trench—with each comprised of one or more contexts). Botanical analysis was limited to only those reconstructed components that were both tightly dated and stratigraphically unmixed. Once the stratigraphic associations and relative age of each was defined based on the age of the most recent artifacts they contained, this subset of unmixed and dated deposits were subjected to archaeological "flotation," a technique that uses water suspension and jets of circular air streams to agitate and separate out fragile plant seeds, mostly charred, from their soil matrix.

With the exception of one large 8.5 liter sample from Component 38, and one two liter sample from Component 8, all other flotation samples were limited to one-liter volumes. A total of 32.5 liters from six components and fifteen stratigraphically distinct contexts were "floated," manually sorted, and prioritized for ethnobotanical identification. Additional specimens, especially the larger pumpkin and peach pits, were also recovered from the one-quarter-inch field screens during excavation from five additional components made up of eight contexts (Tables 8.2 and 8.3).

The resultant seed recovery was roughly comparable both in sample size and seed count for all three periods. Out of a total sample of 2,607 recovered seeds (1,148 unidentified), 1,458 seeds were identified to the genus level from twelve components and twenty-four contexts for all three periods. Out of twenty-four identified seed types, nineteen were identified from seven components and twelve contexts dating to the early-mid seventeenth century; thirteen varieties from three components and seven contexts were recorded for the late-seventeenth-century sample, and seven plant types were recovered from three components and five contexts for the early eighteenth century (Tables 8.2 and 8.3). See www.GeospatialArchaeology.com/BroadSeedData.html for a context-specific breakdown of seeds types by basic context-level units of association and contemporaneity.

These levels of recovery may be far from representative of the full range of plants once present. Samples from other historical sites have demonstrated that only between 8 to 32 percent of artificially introduced "control" seeds were recovered by flotation (Miller 1998, 65). Accordingly, the following analysis treats the recovered plants remains as gross, order of magnitude, indices of the changing diversity, and assumes that the actual range of variation may have been significantly broader for each period.

Continuity and Change in Plant Diversity

Despite these generic sampling issues, the quantified seed data suggests order of magnitude changes in plant diversity between the early seventeenth and early eighteenth centuries (Fig. 8.2).

In addition to these gross changes, the range of identified seed types were evaluated according to seven major ethnobotanical functional categories:

TABLE 8.2. Cross tabulation breakdown of seed counts per dated Components and Periods.

Seed Totals (Identified) per Dated Component and Period	Nicotiana sp. - tobacco	Galium sp. - bedstraw / "cheese rennet"	Polygonum sp. - knotweed / "Bistort"	Amaranthus sp. - amaranth	Chenopodium sp. - lambsquarters	Phytolacca sp. - pokeweed / pokeberry	Citrus sp. - citrus	Vitis sp. - (Lg. Seed 6.1 - 6.5mm)	Vitis sp. - (Sm. Seeds 4.5 - 5.5mm)	Portulaca sp. - purslane	Vaccinium sp. - blueberry	Cruciferae sp. - cabbage / mustard fam.	Cucurbita sp. - pumpkin / squash	Fragaria sp. - strawberry	Rubus sp. - brambles (raspberry / blackberry)	Prunus persica - peach	Trifolium sp. - clover	Cyperus sp. - sedge / nut grass	Acalypha sp. - copperleaf	Mollugo sp. - carpetweed	Linum sp. - flax	Stachys sp. - "woundwort" / "betony" / "heal-all"	Prunus sp. - cherry	Acacia sp. - an acacia	GRAND TOTAL
EARLY-MID 17TH C.																									
Comp 13 - Lot 8 - North Barrel fill	1	1	1	1	1		1			23	1		1	6	6	2		1	1						47
Comp 10 -BT - Oval Yellow brick cistern													12												12
Comp 61 - BT - Lot 14 Barrel																2									2
Comp 9 -BT - Lot 8 South Barrel																6									6
Comp 8 -BT - Lot 8 North Barrel										5				1											6
Comp 6 -Warehouse floor - Bld. A																		1							1
Comp 38 - Rope Basket / Cask - fill	1					5		4	4	7		1	1	10	9		1								43
EARLY-MID 17TH C. TOTAL	2	1	1	1	1	5	1	4	4	35	1	1	14	17	15	10	1	2	1						117
LATE 17TH C.																									
Comp 14 - Lot 8 - South Barrel fill										24	1	7		8	10	2		8	2	1	1	1			65
Comp 62 - Lot 14 - Barrel fill													2	2	2	1	1								8
LATE 17TH C. TOTAL										24	1	7	2	10	12	3	1	8	2	1	1	1			73
EARLY 18TH C.																									
Comp 53 - Building D - Lower fill									18				1	2	1173									1	1195
Comp 63 - Lot 14 - Red brick cistern / well -Cx.01													6												6
Comp 63 - Lot 14 - Red brick cistern / well -Cx.02																9									9
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-04													9												9
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-05													28												28
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-06																4									4
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-07																14									14
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-08																							2		2
EARLY 18TH C. TOTAL									18				44	2	1173	27							2	1	1267
GRAND TOTAL	2	1	1	1	1	5	1	4	22	59	2	8	60	29	1200	40	2	10	3	1	1	1	2	1	1457

Graphic: Joel Grossman, Ph.D. © 2010

(1) Native American potherbs, (2) indigenous starchy seed plants, (3) indigenous seasonably available fruits and berries, (4) Native American pumpkin or squash, (5) non-food plants (indigenous and European), (6) European fruits and vegetables, and (7) Native American and European medicinal plants. Each of these categories was further compared as a plot of continuity and change in three functional distribution tables designed to graphically show the shifting patterns of plant diversity between each period of the revised three-phase site chronology: early to mid-seventeenth century (Table 8.4), the late seventeenth century (Table 8.5), and early eighteenth century (Table 8.6). These comparisons also showed that some varieties continued to be represented in all three periods. Seeds of squash or pumpkins, strawberries, and brambles (as well as peaches and small-seeded

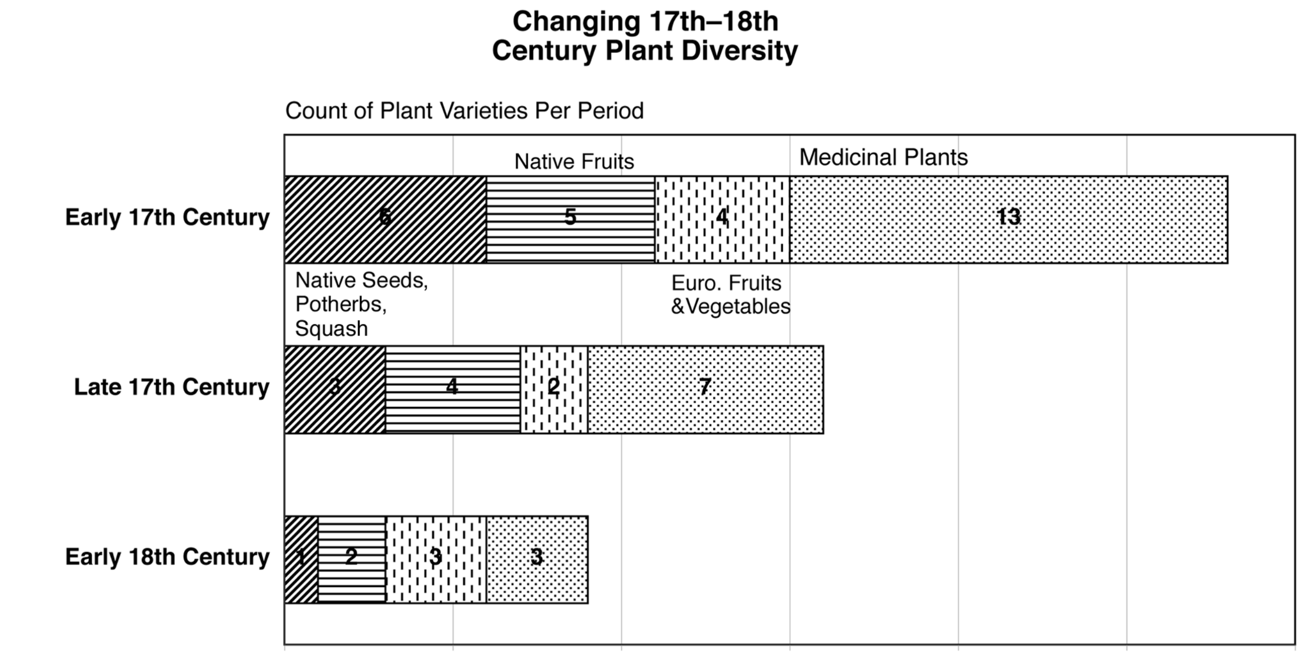
TABLE 8.3. Cross Tabulation Showing Number of Instances of Stratigraphically Distinct Deposits (Contexts) for Each Seed Type per Dated Component and Period.

Contexts per Component and Period	Nicotiana sp. - tobacco	Galium sp. - bedstraw / "cheese rennet"	Polygonum sp. - knotweed / "Bistort"	Amaranthus sp. - amaranth	Chenopodium sp. - lambsquarters	Phytolacca sp. - pokeweed / pokeberry	Citrus sp. - citrus	Vitis sp. -	Vitis sp. - (Lg. Seed 6.1 - 6.5mm)	Vitis sp. - (Sm. Seeds 4.5 - 5.5mm)	Portulaca sp. - purslane	Vaccinium sp. - blueberry	Cruciferae sp. - cabbage / mustard fam.	Cucurbita sp. - pumpkin / squash	Fragaria sp. - strawberry	Rubus sp. - Brambles (raspberry / blackberry)	Prunus persica - peach	Trifolium sp. - clover	Cyperus sp. - sedge / nut grass	Acalypha sp. - copperleaf	Mollugo sp. - carpetweed	Linum sp. - flax	Stachys sp. - "woundwort" / "betony" / "heal-all"	Prunus sp. - cherry	Acacia sp. - an acacia	GRAND TOTAL
EARLY-MID 17TH C.																									
Comp 13 - Lot 8 - North Barrel fill	1	1	1	1	1		1			4	1		1	2	3	1		1	1						20
Comp 10 -BT - Oval Yellow brick cistern													2												2
Comp 61 - BT - Lot 14 Barrel																1									1
Comp 9 -BT - Lot 8 South Barrel																1									1
Comp 8 -BT - Lot 8 North Barrel										1				1											2
Comp 6 -Warehouse floor - Bld. A																		1							1
Comp 38 - Rope Basket / Cask - fill	1					1		1	1	1		1	1	1	2		1								11
EARLY-MID 17TH C. TOTAL	2	1	1	1	1	1	1	1	1	6	1	1	4	4	5	3	1	2	1						38
LATE 17TH C.																									
Comp 14 - Lot 8 - South Barrel fill										4	1	3		4	3	2		5	1	1	1	1			26
Comp 62 - Lot 14 - Barrel fill													2	1	1	1	1								6
LATE 17TH C. TOTAL										4	1	3	2	5	4	3	1	5	1	1	1	1			32
EARLY 18TH C.																									
Comp 53 - Building D - Lower fill									2				1	2	2									1	8
Comp 63 - Lot 14 - Red brick cistern / well -Cx.01													1												1
Comp 63 - Lot 14 - Red brick cistern / well -Cx.02																1									1
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-04													1												1
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-05													1												1
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-06																1									1
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-07																1									1
Comp 63 Lot 14 - Red brick cistern / well - Cx. 02-08																							1		1
EARLY 18TH C. TOTAL									2				4	2	2	3							1	1	15
GRAND TOTAL	2	1	1	1	1	1	1	1	3	10	2	4	10	11	11	9	2	7	2	1	1	1	1	1	85

Graphic: Joel Grossman, Ph.D. © 2010

grapes) were recovered from a variety of deposits from all three periods. Blueberries were restricted to only the early and late-seventeenth-century samples.

As graphically depicted in Table 8.4, twelve (12) or ca. 60 percent, of the nineteen different plant types identified from the early-seventeenth-century sample could be linked to Native American food sources (potherbs and seed bearing plants) and potential medicinal uses. However, the early-seventeenth-century sample also included two European orchard fruits, represented by multiple instances of peach pits and a single citrus seed. Like blueberries, strawberries, and brambles (raspberries/blackberries), peach pits were recovered from multiple deposits from all three seventeenth and eighteenth-century sample periods. While peach was of



	Early 18th Century	Late 17th Century	Early 17th Century
Medicinal Plants *	3	7	13
European Fruits & Veg.	3	2	4
Native Fruits & Berries	2	4	5
Seeds, Potherbs, Squash	1	3	6

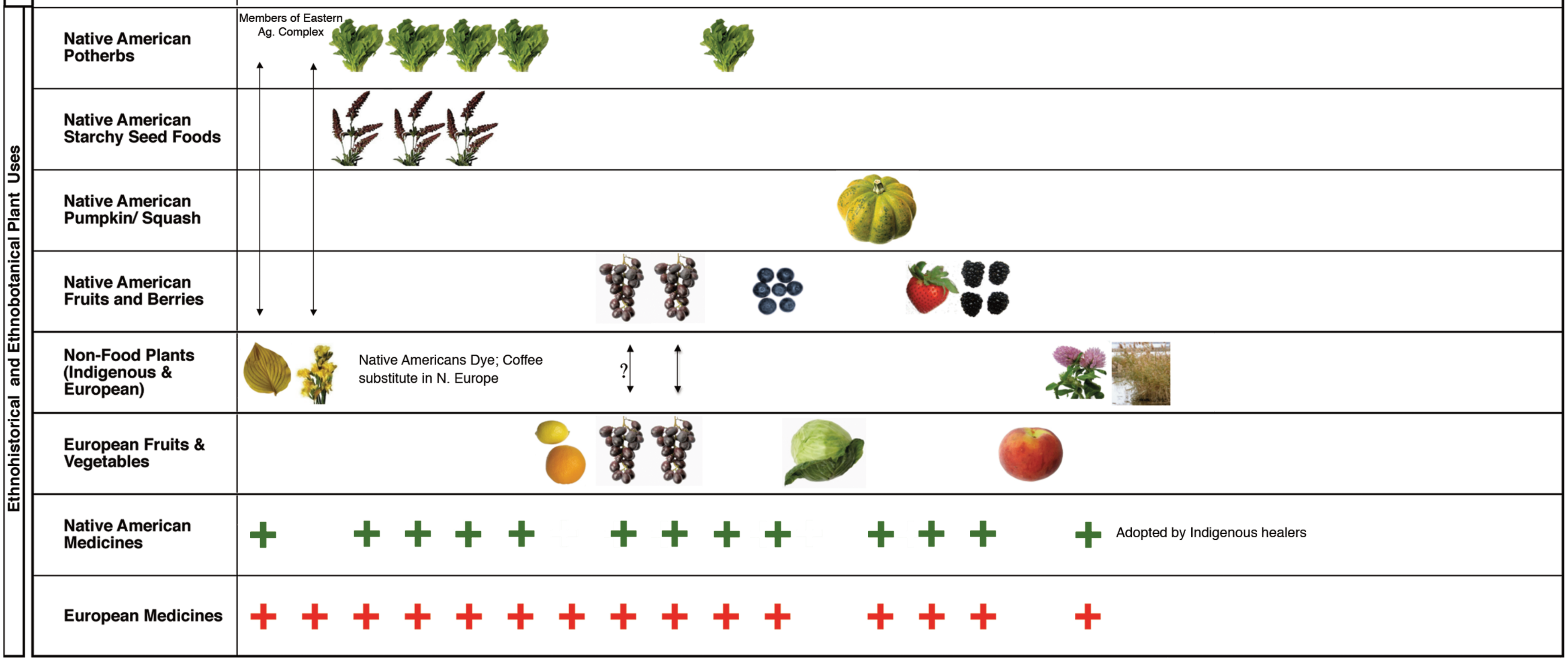
FIG. 8.2. Changes in Plant Diversity by Period.
This horizontal bar chart compares gross changes in the relative prevalence of major plant categories between each of the three main Periods. It illustrates an order of magnitude (ca. 50%) decrease in the number and diversity of plants between the early and late seventeenth centuries, with an even sharper reduction in plant diversity (ca. 80%) by the early eighteenth century (see Tables 8.4 to 8.6 for detailed plant-use breakdowns). These pronounced changes underscore the danger of relying on either contemporary or historical, eighteenth or nineteenth century, plant inventories to reconstruct conditions in the early seventeenth century.
*Medicinal plants include: tobacco, grapes, sedge, bedstraw, and squash as well as a number of indigenous and introduced potherbs and seed-bearing nutritional plants; exclude: citrus, clover, copperleaf, and cabbage family examples.
Graphic: Joel Grossman, Ph.D. © 2010

undisputed European origin, and peach orchards were documented in New Amsterdam by 1639 (Jacobs 2005, 107), the attribution of peaches to purely Dutch sources must be approached with caution. Peach orchards were cultivated by Cherokee farmers along the Gulf Coast, suggesting that peaches may have been introduced as early as the fifteenth century by Spanish conquistadors (Delcourt 2004, 107). Peach (as well as plum and cherry) pits were also among the seeds ordered by the Massachusetts Bay Colony to the north by 1629 (Hedrick 1919, 463).

The single citrus seed was recovered from the unmixed, single-component, interior fill of a double-barrel cistern that was abandoned in the second quarter of the seventeenth century (Component 13; Tables 8.2 and 8.3). The feature was undisturbed by later intrusions, and both its association and dating to the early seventeenth century appear reliable. No citrus seeds were recovered from later seventeenth and eighteenth-century deposits. However, its presence begs the question as to how it got into the site matrix. The native habitat of citrus is generally limited to tropical and subtropical environments; it does not tolerate temperatures below 47° to 57° F, and does not react well to frost or salty soils (Culture Sheet.org; www.culturesheet.org/rutaceae:citrus). Therefore, citrus trees probably could not have grown in New Amsterdam in the seventeenth century without the protection of a greenhouse-like structure against frost. One possibility is that the seed arrived in some form of preserve such as an early marmalade (a concentrate of boiled sugar and rinds) that was being made in Europe, origi-

Table 8.4. Early-Seventeenth-Century Plant Diversity

Period	Nicotiana sp. – tobacco	Galium sp. – bedstraw	Polygonum sp. – knotweed / "Bistort"	Amaranthus sp. – amaranth	Chenopodium sp. – lambsquarters	Phytolacca sp. – pokeweed / pokeberry	Citrus sp. – citrus	Vitis sp. – (Lg. Seed 6.1 – 6.5mm)	Vitis sp. – (Sm. Seeds 4.5 – 5.5mm)	Portulaca sp. – purslane	Vaccinium sp. – blueberry	Cruciferae sp. – cabbage fam.	Cucurbita sp. – pumpkin / squash	Fragaria sp. – strawberry	Rubus sp. – Brambles /raspberry	Prunus persica – peach	Trifolium sp. – clover	Cyperus sp. – sedge / nut grass	Acalypha sp. – copperleaf	Mollugo sp. – carpetweed	Linum sp. – toadflax	Stachys sp. – "betony" / "woundwort"	Prunus sp. – cherry	Acacia sp. – an acacia	Grand Total
Early-Mid 17th C.	2	1	1	1	1	1	1	1	1	6	1	1	4	4	5	3	1	2	1						38
Late 17th C.										4	1	3	2	5	4	4	1	5	1	1	1	1			33
Early 18th C.									2				4	2	2	3							1	1	15
Grand Total	2	1	1	1	1	1	1	1	3	10	2	4	10	11	11	10	2	7	2	1	1	1	1	1	86



This cross-tabulation table shows the early to mid-seventeenth-century distribution of recovered plant remains in relation to eight ethnobotanical and functional use categories: (1) Native American Potherbs, (2) Native American Starchy Seed Foods, (3) Native American Pumpkin/Squash, (4) Native American Fruits and Berries, (5) Non-food Plants, (6) European Fruits and Vegetables, and (7 & 8) Native American and European Medicinal Plants. In addition to the presence of traditionally recognized Native American foods (Squash/pumpkin and berries), this breakdown by function and origin illustrates the early availability of citrus, peach, and possibly grapes, as well as a number of European vegetables. Furthermore, ethnobotanical and archaeological sources strongly suggest that the range of foods available to the earliest Dutch settlers may have been significantly broader (through the addition of five indigenous potherbs, of which three were also seed-bearing plants) than traditionally thought. They also indicate that at least thirteen out of nineteen (or ca. 70%) of the early-seventeenth-century plants may have been exploited as Native American and European medicines. Graphic: Joel Grossman, Ph.D. © 2010

Table 8.5. Late-Seventeenth-Century Plant Diversity

Archaeological Plants		Nicotiana sp. – tobacco	Galium sp. – bedstraw	Polygonum sp. – knotweed / "Bistort"	Amaranthus sp. – amaranth	Chenopodium sp. – lambsquarters	Phytolacca sp. – pokeweed / pokeberry	Citrus sp. – citrus	Vitis sp. – (Lg. Seed 6.1 – 6.5mm)	Vitis sp. – (Sm. Seeds 4.5 – 5.5mm)	Portulaca sp. – purslane	Vaccinium sp. – blueberry	Cruciferae sp. – cabbage fam.	Cucurbita sp. – pumpkin / squash	Fragaria sp. – strawberry	Rubus sp. – Brambles /raspberry	Prunus persica – peach	Trifolium sp. – clover	Cyperus sp. – sedge / nut grass	Acalypha sp. – copperleaf	Mollugo sp. – carpetweed	Linum sp. – toadflax	Stachys sp. – "betony" / "woundwort"	Prunus sp. – cherry	Acacia sp. – an acacia	Grand Total
Period	Early-Mid 17th C.	2	1	1	1	1	1	1	1	1	6	1	1	4	4	5	3	1	2	1						38
	Late 17th C.										4	1	3	2	5	4	4	1	5	1	1	1	1			33 
	Early 18th C.									2				4	2	2	3							1	1	15
	Grand Total	2	1	1	1	1	1	1	1	3	10	2	4	10	11	11	10	2	7	2	1	1	1	1	1	86
Ethnohistorical and Ethnobotanical Plant Uses	Native American Potherbs																									
	Native American Starchy Seed Foods																									
	Native American Pumpkin/ Squash																									
	Native American Fruits and Berries																									
	Non-Food Plants (Indigenous & European)																									
	European Fruits & Vegetables																									
	Native American Medicines										+	+		+	+	+		+	Adopted by Indigenous healers							
	European Medicines										+	+		+	+	+		+				+	+			

This cross-tabulation table of late-seventeenth-century plant remains shows their distribution relative to the same eight ethnobotanical use categories as in the previous early-seventeenth-century breakdown (Table 8.4). In addition to an order of magnitude reduction in number and diversity of indigenous potherbs, nutritional seed sources, and potential indigenous medicinal plants (down from thirteen to five) by the late seventeenth century, it shows a continuity of indigenous squash/pumpkin, berries, and European fruits and vegetables. The late-seventeenth-century sample was also distinguished by the introduction of three (for a total of eight) plant types used in Europe as sixteenth and seventeenth-century medicines. Graphic: Joel Grossman, Ph.D. © 2010

TABLE 8.6. Early-Eighteenth-Century Plant Diversity

Archaeological Plants		Nicotiana sp. – tobacco	Galium sp. – bedstraw	Polygonum sp. – knotweed / "Bistort"	Amaranthus sp. – amaranth	Chenopodium sp. – lambsquarters	Phytolacca sp. – pokeweed / pokeberry	Citrus sp. – citrus	Vitis sp. – (Lg. Seed 6.1 – 6.5mm)	Vitis sp. – (Sm. Seeds 4.5 – 5.5mm)	Portulaca sp. – purslane	Vaccinium sp. – blueberry	Cruciferae sp. – cabbage fam.	Cucurbita sp. – pumpkin / squash	Fragaria sp. – strawberry	Rubus sp. – Brambles /raspberry	Prunus persica – peach	Trifolium sp. – clover	Cyperus sp. – sedge / nut grass	Acalypha sp. – copperleaf	Mollugo sp. – carpetweed	Linum sp. – toadflax	Stachys sp. – "betony" / "woundwort"	Prunus sp. – cherry	Acacia sp. – an acacia	Grand Total
Periods	**Early-Mid 17th C.**	2	1	1	1	1	1	1	1	1	6	1	1	4	4	5	3	1	2	1						38
	Late 17th C.										4	1	3	2	5	4	4	1	5	1	1	1	1			33
	Early 18th C.									2				4	2	2	3							1	1	15 
	Grand Total	2	1	1	1	1	1	1	1	3	10	2	4	10	11	11	10	2	7	2	1	1	1	1	1	86
Ethnohistorical and Ethnobotanical Plant Uses	**Native American Potherbs**																									
	Native American Starchy Seed Foods																									
	Native American Pumpkin/ Squash																									
	Native American Fruits and Berries																									
	Non-Food Plants (Indigenous & European)									? ↕																
	European Fruits & Vegetables																									
	Native American Medicines									+				+	+	+										
	European Medicines									+				+	+	+										

This cross-tabulation shows the distribution of early-eighteenth-century plant remains relative to the same eight ethnobotanical use categories as in the previous early and late-seventeenth-century breakdowns (Tables 8.4 and 8.5). While it illustrates the continuity of indigenous berries, squash/pumpkin, and at last one European fruit (peach), it shows the near-disappearance of indigenous potherbs, nutritional seed-bearing and medicinal plants, as well as the lack of European vegetables by the first quarter of the eighteenth century. The recovery of a single cherry pit is inconsistent with archival references to its presence in the early seventeenth century. The disappearance of sedge (*Cyperus* sp.) suggests that the local wetlands may have been drained and filled or that it was no longer being harvested in the vicinity by the early 1720s–'30s.

Graphic: Joel Grossman, Ph.D. © 2010

nally as of the thirteenth century with quinces, but with oranges and limes by the seventeenth century (Davidson 2006, 483; Wilson 1999, 126). The other possibility is that that the seventeenth-century Dutch of New Netherland may have experimented with early examples of "orangery." An early heated, and apparently glassed-in, building had been built at the Hortus Botanicus of Leiden as of 1599, called the *Ambulacrum,* to house exotic collections and dormant plants, and to train students during the winter (Swan 1998, 11; Huxley 1978, 230; Cook 2007b, 120). Given the strong links between Dutch East and West India Company doctors, apothecaries, botanists, officials, and the University of Leiden (see below); it is plausible that similar protective structures may have been tried in New Amsterdam as well.

The recovery of sedge (*Cyperus* sp.) from the early and late-seventeenth-century deposits may reflect both environmental conditions and a combination of indigenous and European cultural patterns. Its "nut-like tubers" are edible, either raw or cooked, were known in the Rhine drainage as "German Sarsaparilla," and used there as a substitute for coffee (Fernand and Kinsey 1958, 107–10). Because of its pleasant odor, "sweet sedge" was used in Europe to cover the floors of churches and homes (Grieve 1931, 726–30). In addition to its Native American use as cordage and basket-making material, sedge was known in nineteenth-century America as a diuretic and "sudoric" treatment for profuse sweating (Ripley and Dana 1875, XIV, 748). Although present in the earlier deposits, no sedge was recovered from the early-eighteenth-century samples; a change that suggests either that the local wetlands may have been drained or filled, or that it was no longer being collected or growing in the vicinity by the early 1720s-'30s.

The transition from the early to late seventeenth century was characterized by three contrasting trends: (1) continuity of fruits and berries of both local and foreign origin; (2) the disappearance of most of the earlier indigenous potherbs and starchy-seed esculents (edible plants, either wild or cultivated); and (3) by the appearance of members of the *Brassica* or cabbage family. In addition to the dropping out of six plants belonging to Eastern Agricultural Complex, the transition to the late seventeenth century was demarcated by the appearance of toadflax (*Linum* sp.) and woundwort (*Stachys* sp.), both apparently alien introductions from Europe (Tables 8.2, 8.3, 8.5, 8.9). Potential medicinal plants dropped by one-half in the late seventeenth century, down from the early-seventeenth-century total of thirteen to six. Finally, although recognized as a member of the prehistoric Eastern Agricultural Complex, carpetweed *(Mollugo* sp.) was not identified until the late seventeenth century (Table 8.5).

The early-eighteenth-century sample was distinguished by a pronounced reduction in overall plant diversity. However, fruit and berry plants (strawberries and brambles), pumpkin/squash, as well as peaches, continued from the earlier seventeenth century into the first quarter of the eighteenth century (Table 8.6). The singular appearance of cherry pits only in the early-eighteenth-century deposits was late for the settlement's horticultural history; Van der Donck recorded the successful importation and cultivation of cherry trees at least by the first half of the seventeenth century (Goedhuys 2008, 25).

Sampling and recovery issues aside, the revised stratigraphic and artifact sequence, and quantified comparisons of shifting plant diversity between the early seventeenth and early eighteenth centuries suggests: (1) that what were potentially indigenous potherbs, starchy seed-bearing foods, and medicinal plants were concentrated only in the early-seventeenth-century phase of the sequence, but had disappeared from the archaeological record by the first quarter of the eighteenth century; (2) a sharp decline in indigenous plant diversity, both food-related, and of potential medicinal uses between the early and late seventeenth century; (3) a continuity of indigenous fruits, berries, and squash/pumpkin (as well as peach)—but no vegetables—into the early eighteenth century; and (4) the introduction of European vegetables and fruits in the early seventeenth century.

INDIGENOUS PLANTS OF THE "THE EASTERN AGRICULTURAL COMPLEX"

Pre-Contact Starchy Seed Plants and Potherbs

Although often dismissed as "introduced," "weedy," "alien," "emergent," "naturalized," "adventive [*sic*]," "invaders," "pioneering" species, or simply "pests" (Dudek et al. 1998, 66; Richardson etal. 2000, 93), and often interpreted as indicators of environmental trauma, nearly 30 percent of the nineteen seed varieties from the initial early to mid-seventeenth-century samples may have been derived from indigenous antecedents, that were exploited either as food sources, dyes, or as medicinal plants (Table 8.4). Archaeological findings from prehistoric sites throughout eastern North America, and historic ethnobotanical accounts, have underscored the important roles these formally underappreciated potherbs and high-carbohydrate seed-producing plants over the last two millennia in the Northeastern United States (see Smith 1989; 1992; Delcourt 2004).

Although no evidence for maize, beans, or sunflower cultivation was recovered from the historic seventeenth-century deposits at Broad Street, in addition to pumpkin/squash, fruits and berries, eight of the seventeenth-century seed types—amaranth (*Amaranthus* sp.), lambsquarters (*Chenopodium* sp.), knotweed (*Polygonum* sp.), purslane (*Portulaca* sp.), tobacco (*Nicotiana* sp.), bedstraw (*Galium* sp.), pokeweed (*Phytolacca* sp.), and carpetweed (*Mollugo* sp.) belong to what is now defined by North American archaeologists as prehistoric and contact-period potherbs and/or starchy seed-bearing components of the two thousand-year-old pre-maize "Eastern Agricultural Complex" (Smith 1989), or the "early Woodland garden complex" (Delcourt 2007, 42; Watson 1989). Five of the Broad Street plants have been identified in the archaeological and ethnobotanical literature as potherbs: pokeweed (*Phytolacca* sp.), purslane (*Portulaca* sp.), amaranth (*Amaranthus* sp.), lambsquarters (*Chenopodium* sp.), and carpetweed (*Mollugo* sp.) (Delcourt 2004, 42, 106). Three others from the early to mid-seventeenth-century contexts may have been exploited for their high-starch-yielding seeds, knotweed (*Polygonum* sp.), amaranth (*Amaranthus sp*.), and lambsquarters (*Chenopodium* sp.) (McAndrews and Boyko-Diakonow 1989; Byrne and Finlayson 1998; Delcourt 2004, 94) (Tables 8.2 and 8.3).

Both amaranth and chenopods have a long history in the archaeological and ethnohistorical record as significant Native American food plants, long recognized for Mexico and the Andes, but only recently for eastern North America (Safford 1917; Sauer 1950; Sauer 1967). "Amaranths are fast growing, cereal like plants that produce high protein grains in large, sorghum-like seed heads" (National Academy of Sciences 1975, 14). Both wild and domesticated South American and Mexican species have been recorded to produce yields of between eight hundred and one thousand pounds per acre; with nutritional qualities distinguished by high levels of protein (+15%), amino acids, especially lysine (6.2%), and fat (3–6%) (Cole 1979, 275–79). Chenopodium, like amaranth (as well as pokeweed and bedstraw), thrives in disturbed "anthropogenic" habitats "as an invasive plant . . . near barns, fields, and along roadsides" or "other humanly altered environments" (Martin et al. 1951, 389–90; Fernald and Kinsey 1958, 185; Delcourt 2004, 86). The Mohawk name for lambsquarters was "loves villages" (Fenton 1942, 525).

Over the last thirty years, archaeologists working in the eastern United States have argued that these indigenous potherbs and seed-producing plants began to be exploited, collected, or "quasi-cultivated," several thousand years before the appearance of maize (ca. AD 800 and 1100); and—after an initial period of transition as floodplain-adapted species between 2000–1500 BC—were under cultivation between 500 and 0 BC (Smith 1992, 12). Significantly, both knotweed *(Polygonum* sp.*)* and lambsquarters (*Chenopodium* sp.) were recovered from prehistoric storage pits or caches in caves outside their natural habitat range, with knotweed constituting upward of 30 percent of the "small seed assemblage" in some excavated prehistoric sites (Delcourt 2004, 42, 106). Likewise, roughly contemporary charred seeds of amaranth and *Chenopodium quinoa* were recovered from pre-Inca deposits dating to between 1000 and 1500 BC from a hilltop occupation site in the southern Andes of Peru (Grossman 1983, 86).

In North America, and building on early work by Jonathan Sauer (1952) on the floodplain adaptation of pokeweed, later scholars have argued that many of these plants (e.g., pumpkin/squash/gourds, amaranth, chenopods) were "tightly tethered," if not pre-adapted, to disturbed open floodplain environments created first by annual flooding and which later expanded into "open habitats created by human activities whenever opportunities arose" (Struever 1964, 102–103; Smith 1992, 29).

Likewise, Watson proposed that amaranth was exploited for its edible seeds as a member of a "panoply of tolerated, encouraged or quasi-cultivated plants" by at least 1000 BC (Watson 1989, 555–71). Subsequently, Watson and Kennedy (1991) also proposed that this process was both gradual and "gender-specific," and tightly linked to the role of women in planting (Smith 1992, 31). As such, their presence in the early Dutch deposits may no longer be easily dismissed as "emergent" "weeds"—indicative of environmental trauma—of "modern" origin, but instead as potential carryovers, or transplants, of long-established indigenous foods—perhaps extending back many centuries before the arrival of the Dutch.

However, given the fact that only single specimens of lambsquarters *(Chenopodium* sp.*)* and amaranth (*Amaranthus*) were recovered from early-seventeenth-century contexts, it is difficult to evaluate their presence based on either the contextual or morphological criteria of domestication (thickening of seed casing)—identifiable only with electron microscope scans not readily available at the time of the original analysis of the Dutch West India Company samples—set forth by Bruce Smith in his study of Midwestern prehistoric specimens of chenopods (Smith 1992, 110–23).

In addition, the recovery of pollen and seeds of purslane from cores near Iroquois sites in the Great Lakes region, dating to between the fourteenth and sixteenth centuries, suggests that purslane was also exploited as a North American potherb, and possibly as a source of nutritional seeds, both before and after European contact (Byrne and McAndrews 1975, 726–27). The persistent association of purslane with the better-known prehistoric Native American crops (corn, pumpkin/squash, and beans) has been interpreted by North American archaeologists as indicative of Iroquois agriculture beginning at least 650 years earlier than estimated—ca. AD 1350 (Delcourt 2004, 92–94; McAndrews and Boyko, Diakonio 1989, 528–30; Byrne and McAndrews 1975, 726–27). In addition, Delcourt and others classified purslane as a critical element of prehistoric sustenance, of equal import with other traditionally recognized indigenous cultigens: "Evidence of local cultivation of plants included pollen from maize and cucurbits [pumpkin/squash], pollen and seeds of sunflower, and *pollen and seeds of purslane*" (Delcourt and Delacourt 2004, 94; emphasis added; Byrne and Finlayson 1998, 94–107).

Two non-food plants, bedstraw (*Galium* sp.) and tobacco (*Nicotiana* sp.), both recognized as members of the Eastern Agricultural Complex, were recovered from seventeenth-century contexts at the site. A single seed of bedstraw (Galium) was recovered from an unambiguous early-seventeenth-century context (Component 13—see Tables 8.2 and 8.3). Although bedstraw has been included by prehistoric archaeologists in the Eastern Agricultural complex because of its utility as a late prehistoric Native American dye (Delcourt 2004, 42), its presence may also have been due to its importance as an indigenous and/or European medicinal plant. Finally, one tobacco seed was recovered from Component 38 (the "Tienhoven Basket/Cask"), which can now be dated to post-1650 to 1660, versus late in the seventeenth century (Jan Baart pers. com. Dec. 4, 2009; see Tables 8.1, 8.2, 8.3). A second possible example of a tobacco seed came from a 1630–1650 context (Component 13; Tables 8.1, 8.2, 8.3). However, a question mark in the original laboratory seed inventory notes puts its identity in question. Both only provided material evidence that tobacco was present in the mid-seventeenth century—a fact that was already well documented in the archival record (Jacobs 2005, 231, 261; 2009, 124–28).

Ethnohistorical Parallels and Analogues

Archaeological evidence is generally restricted to the recovery of either burned or waterlogged seeds; ethnohistorical archival sources may also include references to the use of soft tissue (leaves, roots, and stems) that are not generally preserved in the archaeological record. In addition to their long tenure in prehistoric archaeology, historic ethnobotanical accounts suggest that the recovery of pokeweed, amaranth, lambsquarters, and purslane in the seventeenth-century deposits in New Amsterdam may also reflect their continuity as "carryovers" or the residual byproducts of indigenous patterns of exploitation as esculents, or potherbs, and/or, as I suggest below, as medicinal plants. Members of the amaranth and *Chenopodium* families, pokeweed and purslane were exploited as potherbs both in Europe and by contact-period indigenous groups in the eastern United States (Delcourt 2004, 42; Hedrick 1919, 43–44; Foster and Duke 2000, 243). Pokeweed is native to eastern North America, and in addition to the use of its berries as a dye, its young leaves are edible and taste like asparagus (Peterson 1977, 46; Grieve 1931, 648). The Iroquois, the Mohegan, and the Ojibwa harvested lambsquarters (*Chenopodium* sp.) as a vegetable (Tantaquidgeon 1972, 83; Waugh 1916, 117; Arnason, Hebda, and Johns 1981, 2209; Regan 1928, 240). Both were documented as historic-era potherbs and "spinach" in North America (Hedrick 1919, 43,161).

Knotgrass or bistort (*Polygonum* sp.) was broadly recognized in Europe as a garden herb that was exploited both as a potherb and for its medicinal qualities. Its starchy root was eaten in eastern and northern Europe "in times of scarcity as a substitute for bread" (Hedrick 1919, 449). Where encountered, it was presumed to have been "an escape from cultivation" (Grieve 1931, 105) and was described by the sixteenth-century herbalist Fuchs as being "commonly found along paths" (Dressendorfer 2001, 901). Of potential relevance to its recovery in seventeenth-century contexts in New Amsterdam, Grieve advised that "when it has a corner in the Kitchen garden, it is well to pluck it now and then, even when it is not immediately required for culinary purposes" (Grieve 1931, 103).

Finally, purslane, or "pulsey", was used in seventeenth-century Europe as "a pleasant salad herb . . . with oil, salt and vinegar"; the younger shoots in salads and the older shoots as "potherbs . . . [and] . . . largely cultivated in Holland" (Grieve 1931, 660). The sixteenth-century German botanist Fuchs listed purslane as a vegetable and its buds as substitute for capers (Dressendorfer 2001, 903). It was also recorded in colonial-era Native American contexts in eastern Canada. In 1605 Champlain observed purslane in native gardens among the Maine coast and noted that it grew in "large quantities among the Indian corn" (Hedrick 1919, 451).

The presence of many of these exploited seed, potherb, and medicinal plants in the seventeenth-century contexts from the Pearl Street block both broadens the range of potential indigenous foods and resources available to the early Dutch inhabitants and supports the argument that they may have been more dependent on Native American foods and plants in the first half of the seventeenth century than previously recognized. Several scholars have pointed to poor crop yields in the first half of the seventeenth century, but not—other than corn—to the exploitation of other Native American food sources that may have been available (Jacobs 2005, 220; Jacobs 2009, 119: Folkerts 1996, 42–52). As alluded to in my introduction, recent research by students of climate history has suggested that the stressed agricultural production of the mid-seventeenth century (and specifically the decade of 1640) may be partially attributed to broader worldwide patterns of severe weather events, including spikes in volcanic activity, drought, and extreme cold during what has been called the Little Ice Age (Parker 2008, 1063–73; Gehring 2009, 78).

THE SEARCH FOR EUROPEAN VEGETABLES

In addition to underscoring the role of indigenous plants, this reanalysis has yielded new, and apparently the first, material evidence for the presence of European vegetables in the archaeological record of seventeenth-century New Netherland. This previous gap in the physical record was particularly perplexing because archival sources suggested that a broad range of Dutch garden vegetables, including members of the *Brassica* or cabbage family, should have been archaeologically visible in the seventeenth and eighteenth-century samples at Pearl Street.

The "discovery" of seeds of European-derived vegetables came about during the reanalysis of the original seed tabulations by the author, which led to the identification of a thirty-year-old data entry error in the laboratory and computer records. The 1984 laboratory inventory included entries of five seeds that were initially identified as members of the nightshade family (*Solanaceae*) (Grossman et al. 1985, Appendix II). However, comparison of the hard copy duplicates to the computer files revealed that although these entries had been corrected as *"Brassica"* in the original laboratory notes, they had not been transferred and corrected in the final database inventory as submitted with the official draft report (Grossman et al. 1985). Once rectified, the question became: (1) What vegetables were represented, and (2) how might they be distinguished?

Given the fact that most members of the *Brassica* or cabbage/mustard family are characterized by small (ca. 1.65 to 2.1 mm) round to oval seeds only distinguished from one another by small increments in size, two lines of evidence were used to define which vegetables may have been actually present: (1) a comparison of the seed sizes of the archaeologically recovered *Brassica* to control samples of modern garden varieties and to those of "wild" mustard seeds (introduced from Europe and adapted to the Northeast, and (2) a review of ethnohistorical literature to refine the range of potential *Brassica* cultigens in the archaeological record.

Metric Comparisons of Modern Brassica and Wild Mustard Seeds

Eight kinds of modern garden *Brassica* (cabbage, kale, Brussels sprouts, turnip, broccoli, cauliflower, and radish) were measured and averaged (from ten seeds per type) to yield a median diameter for each seed type. A "fudge factor" of 10 percent above and below the mean diameter was then plotted to show the size range of each seed type relative to the sizes of each of the five archaeologically recovered specimens. In addition, samples of seeds from beets and radishes were measured, but neither belonged to the *Brassica* family of vegetables, and both fell outside the size ranges of the "modern" seeds of that genus (Table 8.7).

The results showed that the five cases of archaeologically recovered *Brassica* or cabbage/mustard family seeds overlapped in size with six of the modern comparative samples: kale, turnip, broccoli, Brussels sprouts, cabbage, and cauliflower. In addition, the archaeologically recovered *Brassica* seeds were compared to size ranges of "Wild Mustard" seeds—from the published measurements in the Cornell University inventory *Weeds of the Northeast* (Uva, Neal, and diTomaso 1997). These overlapped in size with five introduced varieties: "Yellow rocket," Hedge mustard, Field pennycress, Virginia pepperweed, and "Wild Mustard" (Table 8.7).

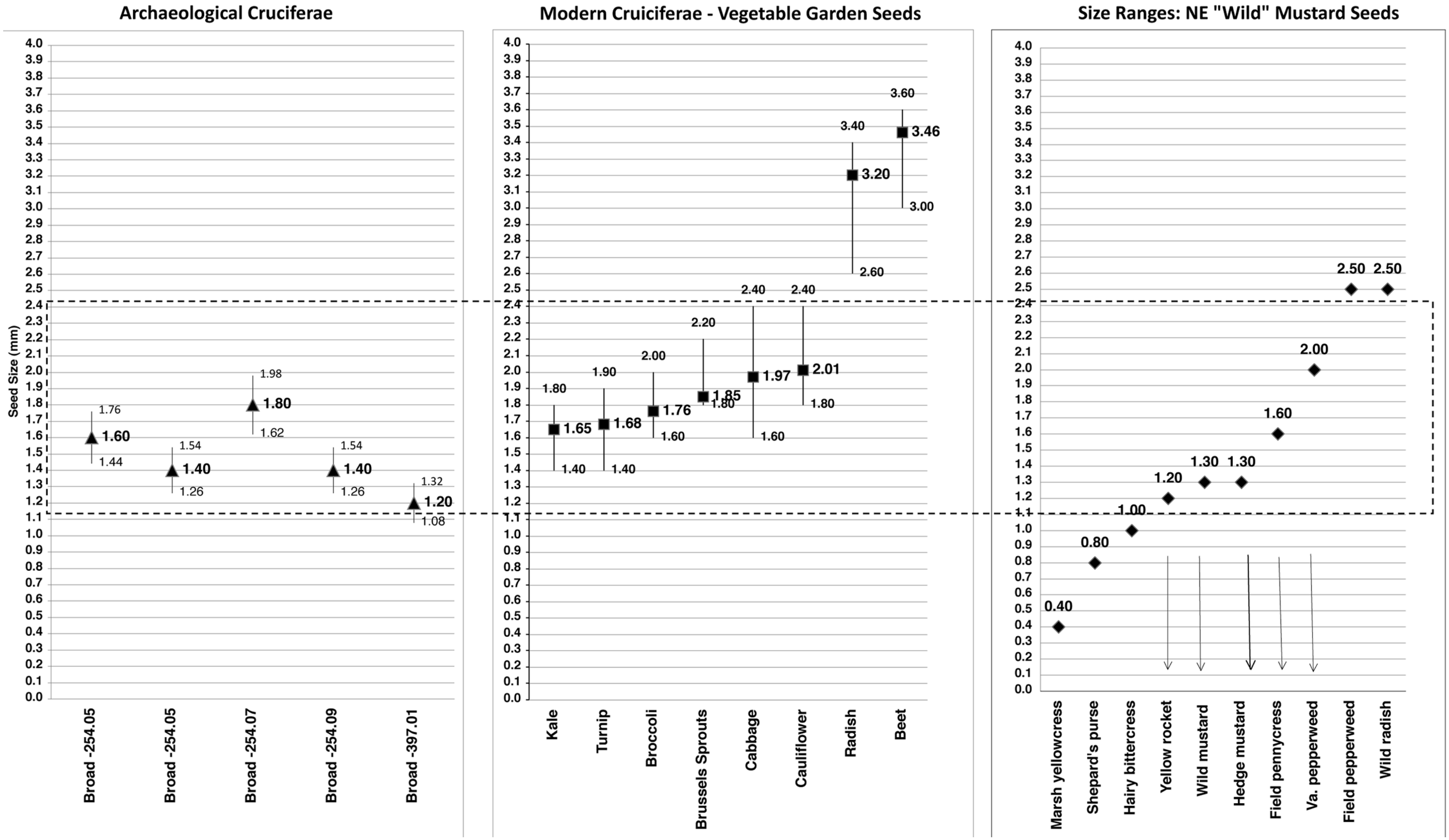
When cross-referenced to *Sturtevant's Edible Plants of the World* (Hedrick 1919), (1) each of the metrically comparable "Wild Mustard" species was of European origin, naturalized in the northeast United States, and described as escaped "weeds" in the modern botanical literature, (2) most were also harvested in the wild or cultivated as garden herbs in both Europe and the eastern United States and Canada, and 3) all were classed as "esculents" or edible plants in eighteenth and nineteenth-century accounts. Three—"Yellow Rocket," "Hairy Bittercress" (also referred to as "Scurvy Grass"), and "Hedge Mustard"—were formerly used as "salads," potherbs, and/or "spinach" (Hedrick 1919, 82, 141, 536). "Wild Mustard"—also referred to as "Wild Radish" (Uva et al. 1997, 170–71)—was described by Sturtevant as a "troublesome weed of Europe naturalized in northeastern America," but its leaves were eaten as a salad and its pungent seeds used as a substitute for mustard (Hedrick 1919, 483–84).

Ethnobotanical and Historical Clues

Four sixteenth and seventeenth-century botanical accounts and plant catalogs (Table 8.8) were then surveyed to refine the range of the potential *Brassica* suggested by seed measurements (Table 8.7). Two, Van Tienhoven, secretary to the director of New Amsterdam, and Van der Donck, wrote about Dutch vegetables in New Netherland. The third and fourth sources came from lists of plants compiled by sixteenth and seventeenth-century Dutch botanists working in Holland. One of the latter came from the work of Van der Groen, the official gardener of William III, who published *The Dutch Gardener* (1669). The fourth continental source came from a recently published archive of 1,115 watercolor paintings of plants, known as the *Libri Picturati,* which was the first morphologically precise illustrated catalogue of native and exotic plants in the Low Countries (de Koning et al. 2008).

The *Libri Picturati* was apparently conceived, coordinated, technically defined, and annotated by Carolus Clusius (or Charles de L'Ecluse [1526–1609]), physician and botanist, who—as we will discuss below in the context of medicinal plants and the role of botanical training at Leiden University—later became professor of botany and designed the *Hortus Botanicus* at the University of Leiden (of which only 25% , versus 100%, as had been previously assumed by earlier scholars, was dedicated to

Table 8.7. Metric Comparison of *Brassica* Seeds



This three-part table uses measurements of seed size between (1) the archaeologically recovered specimens, (2) relative to modern (store-bought) varieties, and (3) published seed measurements for “wild” mustard varieties found in the Northeast United States, to help define which members of the cabbage/mustard family of vegetables actually may have been under cultivation in seventeenth-century New Amsterdam. As demarcated by the dotted rectangle outline, overlaps in size suggest that the historic/archaeological seeds may have corresponded to upward of six varieties of garden vegetables and/or five examples of European-introduced “wild” mustard (all of which served as seventeenth-century potherbs or condiments). When additionally evaluated relative to contemporary historical sources from New Amsterdam and Europe (see Table 8.8), the actual range of seventeenth-century vegetables appear to have been limited to cabbage, kale, turnip, and possibly cauliflower, beets, and spinach, but probably not, until perhaps as late as the nineteenth century, broccoli or Brussels sprouts. Although mentioned in Holland at the time, neither the seed measurements or literature for New Amsterdam suggest the seventeenth-century presence of radishes in the range of garden vegetables. Graphic: Joel Grossman, Ph.D. © 2010

TABLE 8.8. Table of Sixteenth and Seventeenth-Century Archival References to *Brassica*

MODERN BRASSICA	HISTORIC 17th CENTURY LITERARY REEFERENCES				ARCHAEOLOGICAL SEEDS
(Mustard/Cabbage Family)	Van der Donck [New Amsterdam] *(Goedhuys 2008, 28)*	Van Tienhoven [New Amsterdam] *(Singleton 1909, 14)*	Van der Groen [Holland] (Oldenburger-Ebbers, 1990, 167)	Clusius/Saint Omer, [Holland] *Libri Picturati - ca. 1564-59, (de Koning et. al, 2008; Uffelen 2008; Egmond 2008)*	*Projected Identifications—Seed Sizes & Historical References (See Table 13-8)*
Cabbage	X	X	X	X (n=14)	§
Turnip	X			X (n=1)	§
Mustard				X (n=5)	§
Kale				X (n=3)	§
Broccoli					
Cauliflower				X (n=1)	?
Radish			X		
Brussels sprouts					
Kohlrabi *				X(n=1)	
Rape *				X(n=1)	

This comparison of contemporary New World and European ethnobotanical accounts and plant inventories, together with the metric (seed-size) identifications of archaeologically recovered seeds (see Table 8.7), suggests the possible presence of cabbage, kale, mustard, turnip, and possibly cauliflower, beets, and spinach, but no evidence, either physical or archival, for the seventeenth-century presence of broccoli, Brussels sprouts, or radish in New Amsterdam. (Note: * = not measured; n = number of varieties listed.)

medicinal plants) (Cook 2007b, 119; van Uffelen 2008a, 54–59; Egmond and Ramon-Laca 2008, 45; Hophouse 1977, 118). Clusius's detailed annotations included morphological attributes, information on the "ecological character" [*sic*] and geographic distribution, and advice on the best ways to grow plants in gardens (Egmond 2008, 20). This sixteenth-century source is important in this context (1) because of the caliber of scientific data it showed was available to seventeenth-century students of medicine and botany at Leiden, (2) because it reflected an "ecological" approach to the categorization of plants by habitat—i.e., plants growing in marshes, by the sea, in "rough, sandy, and sunny places," etc. (Savoiea et al. 2008, 91), and (3) because it included Cauliflower in the mid-sixteenth-century catalogue of Brassica, suggesting that it was probably present in seventeenth-century New Amsterdam as well.

The later-seventeenth-century work of Van der Groen, the official gardener of William III, included a formalized plant inventory and conceptual design templates for the layout for a typical Dutch "kitchen" garden and "fruit and berry" garden. His template for the ideal "kitchen" garden was divided into four functionally and spatially distinct quadrants: "Brassicas and roots," salad plants, medicinal herbs, and aromatic herbs. Van der Groen's list of "Brassicas and roots" included "Canadian Onion," asparagus, beet, cabbage, carrot, Spanish radish, and "others" (Oldenburger-Ebbers 1990, 167). Unfortunately, his grouping of "Brassicas and roots" into one category obscured the distinction between true cabbage and non–cabbage family vegetables.

The 1650 report by Van Tienhoven listed the contents of the first gardens in New Netherland as being "made and planted in season with all sorts of potherbs, particularly parsnips, carrots and cabbage, which bring great plenty husbandman's dwellings," including "whatever else is normally found in a cabbage and kitchen garden" (O'Callaghan 1856, 369; Jacobs, 2005, 28; 2009, 9). Likewise, Van der Donck also explicitly mentioned the cultivation of turnips: "Turnips are as good and firm as any sand turnip in this country [Holland] can be" (Goedhuys 2008, 31; Jacobs 2009, 9). Turnips were also under cultivation in seventeenth-century Canada, New England, and Jamestown (Hedrick 1919, 120).

Three of the historical sources—Van der Groen, Van der Donck, and Van Tienhoven—included cabbage in their lists of garden plants of the *Cru-*

ciferae/Brassica family (Table 8.8). Cabbage was recorded in Canada by 1540, observed in Haiti by 1556, in Brazil by 1647, and in Virginia by 1669 (Hedrick 1919, 114). Given that both Van der Donck and Van Tienhoven mentioned it, it is probable that cabbage was also one of the first *Brassicae* in New Amsterdam (Goedhuys 2008, 28; O'Callaghan 1856, 368). However, neither Van der Donck nor Van Tienhoven mentioned the wider range of vegetables in the modern inventory of *Brassica* or cabbage family produce, for example, mustard, broccoli, kale, or Brussels sprouts. Van der Groen mentioned the radish in Holland, but it was not mentioned by Van der Donck or Van Tienhoven in their lists of *Brassicae* in New Amsterdam. This omission may not have been an oversight (Table 8.8).

Although not explicitly mentioned by any of these archival references, kale—an "open" green without the closed head of cabbage or edible "flowers" of cauliflower or broccoli (Hedrick 1919, 107)—may have been present in New Amsterdam early on. Kale was observed in Haiti as early as 1565, and recorded in Virginia by 1669 (Hedrick 1919, 108–109). Not only is kale early in the New World historical record, but modern nutritional studies rank it highest (by 30 to 50%) among the vegetables for vitamin K and Lutein (a key source of carotenoids in the lens of the eye) relative to turnip greens, Swiss chard, and raw spinach (Liebman and Hurley 2009, 15). In his 1543 *New Herbal*, Fuchs discussed five kinds of *Brassica* as a group, but only explicitly mentioned cabbage and kale, an omission suggesting that the two were primary in the mindset of sixteenth-century herbalists (Dressendorfer 2001, 910).

The ethnobotanical record also suggests that two modern members of the *Brassica* or cabbage/mustard family, broccoli and Brussels sprouts, not mentioned by Van der Donck, Van Tienhoven, or Van der Groen, may not have been part of the seventeenth-century inventory of garden produce in New Amsterdam. Broccoli was not commonly mentioned or illustrated by European botanists until the early eighteenth century (Hedrick 1919, 110–11). Brussels sprouts were not documented in Belgium, France, or England until the early nineteenth century, and not in American gardens until 1806; and its seeds were not listed for sale here until 1828 (Hedrick 1919, 112). Finally, although not mentioned by the three other sources, a single variety of cauliflower was depicted and described, together with fourteen kinds of cabbage and four kinds of kale, in the mid-sixteenth-century *Libri Picturati* by Clusius (van Uffelen 2008b, 117, Fig. 4).

Thus, based on these multiple lines of archival and metric evidence, the comparison of the five archaeological samples to modern *Brassica* seeds, to seed sizes for "Wild Mustard," and, finally, to historic sixteenth and seventeenth-century botanical surveys, the actual diversity of garden vegetables may in fact have been quite limited for seventeenth-century Manhattan. Out of the range of potential candidates, the five archaeological seeds could have derived from either cabbage, kale, turnip, and possibly cauliflower, or from one of five varieties of introduced "wild" mustard, of which three were exploited as either potherbs or condiments (Tables 8.7 and 8.8). Finally, given the dynamic European and transatlantic trade in seeds from the sixteenth century onward, the inclusion of cabbage, cauliflower, turnip, beets, and spinach in a 1673 English catalogue of seeds suggests that these garden cultivars may also have been available in mid-seventeenth-century New Amsterdam (Thick 1990, 115–16).

Taken together, the archaeological and ethnobotanical evidence coalesce to suggest that the early-seventeenth-century plants represented an amalgam of both native and introduced varieties; some long recognized, such as indigenous fruits, berries, and squash/pumpkin; others only recently recognized as nutritional sources from indigenous potherbs and seed-bearing food sources; augmented by what can now be described as imported European members of the *Brassica/Cruciferae* family; and finally, as will be argued below, the recognition that at least half of the early-seveneteenth-century archaeologically recovered seeds may have been present at the site due to their medicinal qualities.

INDIGENOUS AND EUROPEAN MEDICINAL PLANTS

The importance of medicinal plants among contact-period Native American groups is well established in the ethnobotanical and historical literature.

What is new here is the notion that many of the excavated seeds found in Lower Manhattan may be archaeological manifestations of these ethnobotanical patterns. As elaborated below, my idea that some of the archaeologically recovered seeds may have been used as medicines initially came from historical suggestions that a seventeenth-century medicinal garden may have been planted within the block by one of the Dutch West India Company surgeons, presumably Dr. Hans Kierstede, and from the fact that his wife played an important role with Native American women (Grossman 1985, 2000). This premise led me to incorporate the work of William A. Fenton, Native American ethnobotany, and that of European herbalists, to expand on the idea that some, if not most, of the identified plants may have been used both as foods and, perhaps more importantly, as medicines in seventeenth-century New Amsterdam.

Cross-Cultural and Interregional Patterns of Exchange

In his important 1942 study of indigenous medicinal plants and cross-cultural exchange, "Contacts between Iroquois Herbalism and Colonial Medicine," Fenton highlighted the fact that knowledge of medicinal plants was not restricted in function to specific ethnic groups or localized territories. His observations on intertribal networks of exchange throughout the northeast are important because they provide a basis for looking beyond the limits of Manhattan Island for Native American ethnobotanical analogues. In particular, his work with linguistic parallels documented that similar plant names cross-cut tribal and geographic boundaries, and that much of the Native American knowledge was interregional, with common linguistic cognates and uses shared between distinct indigenous groups throughout the northeast and mid-Atlantic regions. He explicitly wrote: "In comparing present Iroquois and Algonquian plant names we find some names that have similar meanings and yet we cannot be sure in which direction such ideas traveled [between different ethnic groups]" (Fenton 1942, 505). These interregional networks of medical and botanical knowledge were also at times long-distance. Fenton cited the example of an injured Mohawk warrior who traveled 2,100 miles to be treated by a tribal surgeon (Fenton 1942, 512).

Fenton furthermore noted that scholars and early botanists were "hard put to decide which plants a century after contact were native and whether Indians or colonists first used them medicinally" (Fenton 1942, 514). However, it is also clear that the exchange of medicinal information and plant knowledge was going on in both directions—clearly in the eighteenth century, and probably so in the seventeenth century as well. Fenton cited the observation of two eighteenth-century botanists working in North America to suggest that "the Indians were eager to learn the remedies of the white physicians" (Fenton 1942, 525).

His World War II–era ethnobotanical work on Native American medicinal plants also underscored the problems posed by the reticence of native herbalists to divulge traditional secrets, specifically concerning their uses and sources. He noted that native plant collectors and traders were aware of the financial gains possible and were thus reluctant to share their knowledge (Fenton 1942, 506). He also identified impediments to ethnobotanical interpretation caused by linguistic ambiguities and the issues of inconsistent transliterations between what the Dutch thought they heard and later botanical attributions, with many native names remaining unknown to European botanists until Peter Kalm and John Bartram began to apply the techniques of Linné (Carl Linnaeus) in the eighteenth century (Fenton 1942, 515).

Despite these constraints, similar networks of information exchange have been documented in the historical and archaeological record of Dutch, English, and French interregional trade. Not only do archaeologists and historians now recognize fluid interregional patterns of exchange between Dutch and English settlements along the eastern seaboard (Wilcoxen 1987, 23–37), but in addition, ceramics experts working in Jamestown have recognized the difficulty of distinguishing English from "Dutch" ceramics in the early seventeenth century. They concluded that "much of the material culture found in early 17th century sites in North America is the result of Dutch Traders who offered better rates . . . than the English" (Straub and Luccketti 1996, 20). Parallel historical research now also corroborates the existence of dynamic trade networks between

Jamestown and New Amsterdam in the first half of the seventeenth century (Matson 2009, 100).

These patterns of fluid trade of material goods and information between the English and the Dutch were paralleled by concurrent exchanges between the Dutch of New Netherland and the French Jesuits of Canada (Fenton 1942, 511). Jesuit missionaries were steeped in Dutch medical literature and maintained dynamic networks for the international exchange of drugs and medicinal knowledge through the publication of medical "handbooks" and broadly dispersed networks of pharmacies in Europe and the Americas (Anagnostou, 2007, 301–302). Similar to the writing of Clusius of Leiden, discussed below, "These [Jesuit] handbooks contain[ed] descriptions and drawings of many indigenous plants, information about the best period to collect them and optimal storage conditions, explanations about their medicinal effects, and advice for the preparation of different medications" (Anagnostou, 2007, 301). Their motives were similar to those of the seventeenth-century Dutch botanists, doctors, and apothecaries. For the Dutch, English, and Jesuits, European drugs were expensive, hard to come by, and often lost their effectiveness after long international voyages (Anagnostou 2007, 300). It is also probable that what the Dutch knew of indigenous medicinal plants was, like the material record, shared between the English settlers of Jamestown and, in all probability, with the French Jesuits of Canada.

Finally, Goedhuys's 2008 translation of botanical names and origins of plants listed in Van der Donck's 1655 *A Description of New Netherland* also suggests that the repertoire of medicinal plants known to the mid-seventeenth-century Dutch of New Amsterdam may have come from multiple ecological zones throughout the northeast, and in several cases from distant, and in one instance, international sources. Seven (7) or 20 percent of Van der Donck's inventory were introduced species. One (*Scholopentria*) came from Florida, and at least one other, "Dragon's Blood," was native to Indonesia (Goedhuys 2008, Appendix, 144).

These ethnohistoric observations are important for the following assessment of the plants found in the archaeological features of New Amsterdam because they imply that indigenous and European medicinal knowledge traveled in a fluid network of interregional exchange over considerable distances, and across tribal, and/or ethnic boundaries throughout the northeast and the mid-Atlantic regions of the eastern United States.

Ethnobotanical Evidence of Medicinal Plants

Despite the limits posed by the excavated seeds being defined to only the genus level, the difficulties of correlating pre-Linnaean plant descriptions by sixteenth and seventeenth-century herbalists to modern varieties, and ambiguities over the direction of information exchange, it is possible to identify multiple cases from North American and European ethnobotany to suggest that similar patterns of cross-cultural and interregional, if not international, botanical exchange were taking place in seventeenth-century New Amsterdam.

At the most general level, of the nineteen plants identified in the earliest deposits, at least ten were recognized, both in North America and Europe, for their medical qualities, and many as members of the household garden. Of these, no less than five (blueberry, knotweed/knotgrass, or "bistort," amaranth, raspberry, and lambsquarters) were recognized as *astringents*—substances that shrink tissue, dry up secretions, and restrict blood flow. At least three (including knotweed, or "bistort," and toadflax) served as *diuretics* that help in the elimination of liquids, especially urine. Two of the identified plants (pumpkin/squash and lambsquarters) were well-known *anthelmintic* cures for intestinal worms (Meyer 1972, 148–58).

At a more specific level, the following treatment of the recovered plants from the seventeenth-century Pearl Street site can be organized into three primary cross-cultural categories: (1) indigenous medicinal plants of probable local origin that were either analogues of recognized European plants or adopted by the Dutch, (2) medicinal plants that could have come from either indigenous North American or European sources, and (3) plants with documented indigenous and European medicinal uses of probable European origin. Together, they highlight multiple ethnobotanical parallels in indigenous and European medicinal uses between the properties and uses of potential medicinal plants by different, and often distant, indigenous groups in the northeast (Table 8.9).

Table 8.9. Table of Potential Plant Origins

NATIVE AMERICAN	BILATERAL OR ANALOGUES (ORIGIN UNDETERMINED)	EUROPEAN
		Linum sp. – toadflax (EU: diuretic, jaundice; NA: repertory)
		***Stachys* sp.** – "Betony" (EU:17th c. "aspirin"; NA:VD, colic
		Citrus sp. – (scurvy, Late 17th c.)
		***Trifolium* sp**. – clover (NA: colds, repertory & milk flow)
		Brassica sp. – cabbage/kale ? (EU: hair loss, cranial hematomas)
	***Portulaca* sp.** Purslane (NA: intestinal & urinary tract, skin; EU: scurvy)	
	***Polygonum* sp.**- knotweed, "Bistort" (astringent, skin wounds, bleeding)	
	***Galium* sp.** - bedstraw (NA: orthopedic aid; EU: hysteria, epilepsy, skin)	
***Chenopods* sp.** – amaranth & lambsquarters (astringent, worms)		
***Phytolacca* sp.** – pokeberry (skin ailments, blood purifier)		
***Curcurbita* sp**. – Squash/ Pumpkin (intestinal worms, bladder)		
***Frageria* sp.** – strawberries (dysentery, bladder ailments)		
***Nicotiana* sp**. – tobacco (diverse -cf. Monardes)		

Although limited to predominantly the genus level of botanical identification, and only suggestive, the identified plants can be grouped into three transatlantic categories: (1) those of probably indigenous or of Native American origin, (2) those that could be from either continent, herein defined as Bilateral or Analogous (origin undetermined, or parallel uses at the genus level), and (3) those of probable European origin. This "best guess" depiction of potential origins suggests a balanced mixture of both indigenous and introduced species—many with parallel transatlantic ethnobotanical functions—most visibly during the early to mid-seventeenth century, but incrementally less so by the early eighteenth century. Graphic: Joel Grossman, Ph.D. © 2010

Indigenous Medicinal Plants

In addition to their nutritional value, at least five of the early plants (amaranth, lambsquarters, pokeweed, pumpkin/squash, and strawberries) may have been present because of their medicinal qualities.

Chenopods (*Amaranthus sp. and Chenopodium* sp.)—"Lambsquarters," "Goosefoots," and "Wormseed"

Chenopods were recognized by both Native American and European herbalists for their medicinal qualities. The seventeenth-century English herbalist Culpeper lauded Amaranth for stopping blood flow in both men and women, and bleeding, either from the nose or a wound, and specifically recommended it as a "most gallant anti-venereal and a singular remedy for the French Pox" (Potterton 1983, 15). The herbalist Grieve pointed to its use to treat chronic diarrhea, dysentery, fevers, and malaria . . . and commented that it was superior to quinine (Grieve 1931, 30). Additionally, a synonym for lambsquarters (several varieties of chenopods) in seventeenth-century Europe was "pilewort" (Meyer 1972, 95), or "smearwart," reflecting its use as an ointment to clean and heal chronic skin sores, which the English herbalist Gerard said "they do scour and mundify" (Grieve 1931, 365). In tandem with their European medicinal analogues, the leaves of both amaranth and lambsquarters were used by Native Americans as astringents to reduce swelling, to treat dysentery, diarrhea, and ulcers, and to stop intestinal bleeding (Foster and Duke 2000, 243). The Mohegan used an infusion of amaranth leaves for sore throats (Tantaquidgeon 1972, 70, 128). The Iroquois used lambsquarters to treat diarrhea, as a salve for burns, and to aid with milk flow (Herrick 1977, 315–16).

But perhaps the most striking parallels in medicinal qualities were manifested by the use of several species of chenopods to treat intestinal worms. In both continents, varieties of *Chenopodium* were seen as effective *anthelminic* treatments for the removal of round worms and hookworms, "especially in children" (Grieve 1931, 885; Chevalier 1996, 186). One species of *Chenopodium,* native to the northeast*,* was commonly referred to as "wormseed" in Europe and as "American wormseed" in the United States (Grieve 1931, 189, 854–55). In 1895, the active ingredient from *Chenopodium* seeds was distilled to yield "Wormseed or Chenopodium Oil," which was used extensively in World War I as a preferred prescription capable of removing 95 percent of a patient's worms with three treatments (Grieve 1931, 856).

Significantly, three scholars, working on the ethnobotany and indigenous medicines of three different eastern Native American groups, documented parallel medicinal uses of *Chenopodium* seeds for the treatment of worms. The Natchez, derived from the Mississippian Moundbuilders, gave the plant as a pediatric treatment for worms in children (Taylor 1940, 22). The Rappahannock, who in the seventeenth century lived near the English settlement of Jamestown, Virginia, gave children a concoction of stewed *Chenopodium* seeds for worms (Speck 1942, 30), and the Seminole administered a decoction of the whole plant for "worm sickness" (Sturtevant 1954, 241).

Squash/Pumpkin (*Curcurbita* sp.)

Like *Chenopodium* seeds, those of pumpkin and squash have long been seen as important cures for both intestinal worms and urinary tract ailments. The Iroquois used an infusion of pumpkin seeds to treat children with reduced urination (Rousseau 1945, 66). As an early introduction to Europe, the sixteenth-century German herbalist Fuchs recommended pumpkin seeds, which he lumped together with cucumbers, melons, and cantaloupe—an ambiguity perhaps reflecting its recent arrival from America—"when the bladder is being difficult," a prescription that coincided with the modern use of extract of pumpkin seeds for urinary and prostate problems (Dressendorfer 2001, 918, 928). Pumpkin seeds have also been long recognized as a Native American cure that was adopted by American doctors in the early nineteenth century as "among the most valued anthelminics for the removal of tapeworm" (Ripley and Dana 1875, Vol. XIV, 87–88). They are still used by modern herbalists as a nontoxic treatment to excise tapeworms in pregnant women and children (Chevallier 1996, 194).

Pokeweed (*Phytolacca* sp.)—"American Nightshade," "cancer root," "American spinach"

The twentieth-century herbalist Grieve described pokeweed as "one of the most important of indigenous American plants" (Grieve 1931, 648). It was widely viewed as a dermatological cure for skin diseases by both Europeans and Native American healers (Grieve 1931, 648; Speck et al. 1942, 29). The Delaware Indians used it as a stimulant to treat rheumatism, as a blood purifier, for chronic sores, and to treat glandular swelling (Tantaquidgeon 1972, 27, 32, 78). Illustrating parallel medicinal uses between often distant groups, the Rappahannock of Virginia used pokeweed as a dermatological aid to treat poison ivy, rheumatism, warts, and piles (Speck et al. 1942, 29). Likewise, the Iroquois in New York also used it as a dermatological treatment for sprains, rheumatism, bruises, swollen joints, bunions, "skin lumps," as an expectorant to treat liver sickness, as a blood purifier, and as a love medicine (Parker 1910, 93; Herrick 1977, 316–17). The Mohegan used a salve from its leaves to treat sore breasts and as an antidote against poison (Tantaquidgeon 1972: 74, 83; Parker 1910, 93).

Strawberries (*Fragaria* sp.)

Strawberries were important to both Native Americans and Europeans for their medicinal qualities. The University of Michigan Database of Ethnobotany currently documents fourteen specific medicinal uses for strawberries by the Iroquois alone, many pertaining to stomach ailments (Moerman 2004; http://herb.umd.umich.edu/). These included its use as a blood remedy, as a treatment for stomach bleeding, for the regulation of menstrual flow, for bloody diarrhea, for sties, for babies with colic, for gonorrhea, strokes, as a wash for chancre sores, to soothe teething babies, as a general blood remedy, and as an antidote for snakebite (Herrick 1977, 352; Moerman 2004). The Ojibwa used strawberries for stomach aches, especially with children (Smith 1932, 384). Similarly, the Chippewa used the berries to treat "cholera infantism," or children's dysentery (Densmore 1928, 346). Although farther away, the Cherokee also used strawberries to treat dysentery, urinary and bladder problems, kidney disease, jaundice, scurvy, and nerves (Hamel and Chiltoskey 1975, 57). Referring specifically of its use by native peoples in New Amsterdam, Van Rensselaer wrote: "They would brew cat-nip for the sick or strengthen an invalid with a decoction of strawberry leaves" (Van Rensselaer 1898, 74). The European herbalist Grieve described strawberries as a common medicinal component in seventeenth-century "pharmacopoeias" and cited the seventeenth-century herbalist Culpeper who saw them as "singularly good for the healing of many ills" (Grieve 1931, 777).

Transatlantic or Bidirectional Analogues

Three of the identified seed types (purslane, bedstraw, and knotgrass) occurred in both European and North American contexts and could have come from either source (Table 8.9).

Purslane (*Portulaca* sp.)

In addition to now being recognized as a potherb on both continents, purslane was also used in the seventeenth century as a medicinal herb by both North American indigenous peoples and European herbalists. As Fenton warned, it also represents a good example of the difficulty of establishing the direction of these transatlantic parallels in its use as a medical plant. It was appreciated as an important medicinal plant at least by the sixteenth century and was listed in Fuchs's *New Herbal* of 1543 as a cure for many ailments (Grieve 1931, 661). Also known as "pulsey," it was prescribed by the mid-seventeenth-century herbalist Culpepper as a treatment for gout (Grieve 1931, 660). In the 1650s, Gerard recommended the raw leaves to ease teeth "that are set on edge with eating of sharpe [*sic*] and soure [*sic*] things" (Grieve 1931, 660). Purslane was also seen by sixteenth and seventeenth-century Dutch explorers as a cure for scurvy, perhaps due to its high vitamin content. In his 1593 voyage to the South Sea, near Cape Saint Thomas off Brazil , Sir Richard Hawkins found a "great store of the herbe [*sic*] purslane . . . which he used to treat his scurvy-suffering crew" (Hedrick 1919, 451). Its medicinal qualities may have to do with the fact that it contains several neurohormones, reported to reduce tissue hemorrhage, its high levels of vitamins A, C, and E, riboflavin, calcium, phosphorus, magnesium, and iron; and like fish oils, it is one of the richest natural sources of omega-3 fatty acids (Shimer 2004, 98; Peterson 1977, 72; Foster and Duke 2000, 110).

The ethnobotanist Shimer wrote that "Native American people ate purslane, but were more interested in its medicinal applications" (Shimer 2004, 100). Although it was cooked and seasoned by the Iroquois as a potherb (Waugh 1916, 118), they also used the juice from its leaves as a dermatological treatment for burns, insect bites, and bruises (Herrick 1977, 318). Tea from its leaves was used for diarrhea, stomach aches, and urinary tract infections (Shimer 2004, 100). Likewise, the Rappahannock of Virginia used the leaves to make a topical salve to treat "footage trouble," or sore feet (Speck 1942, 28).

Bedstraw (*Galium* sp.)

Galium is both a European and American genus and as such could have derived from either continent. It was recognized by European herbalists and North American indigenous peoples as a dye, for its medicinal qualities and for the shared chemical characteristics among different species of the genus (Grieves 1931, 92; Delcourt 2004, 42; de Koning 2008, 121). As reflected by the sixteenth-century reference to bedstraw as "cheese rennet," for its ability to curdle milk, these organic characteristics contributed to its medicinal qualities as well. Used mainly as a diuretic and for skin problems, in 1735 the Irish herbalist K'oeh wrote of bedstraw that "when applied to burns, the crushed flowers alleviate inflammation, and when applied to wounds, they heal them" (Chevallier 1996, 212). Among European herbalists it was also formerly "highly esteemed as a remedy for epilepsy and hysteria and externally for cutaneous eruption, and is currently recognized as a popular remedy for gravel, stone and urinary tract diseases" (Grieves 1931, 91). The seventeenth-century English herbalist Gerard described it as "good for weary traveler" and his contemporary Culpeper recommended it for interior bleeding (Grieve 1931, 91). In his *New Herbal* of 1543, Fuchs listed it as a protection against the bite of poisonous animals as well as a treatment for earaches and goiters (Dressendorfer 2001, 901).

In addition to its contact-period use as a dye, the genus *Galium* has also been documented by ethnobotanists as a widely used medicinal plant among a number of northeastern Native American groups. The Iroquois used it to treat swollen testicles and ruptured skin, as an eye medicine, to treat babies with backaches, as a treatment for venereal disease (presumably of European origin), and as a "love medicine" (Herrick 1977, 440). The Ojibwa also prescribed it as a dermatological drug, for kidney and urinary tract ailments, and, following European contact, to treat tuberculosis (Smith 1932, 387). The Penobscot of Rhode Island used it to treat gonorrhea, as well as for kidney ailments (Speck 1917, 331).

Knotweed (*Polygonum* sp.)

Known in Europe as bistort, or "bistorta" in seventeenth-century contexts, knotweed/knotgrass is a worldwide genus that, like bedstraw, shares common chemical and medicinal properties between diverse European and American species (Grieve 1931, 105, 205). In the 1930s, the herbalist Grieve recognized knotweed as "one of the strongest astringent medicines in the vegetable kingdom for internal and external bleeding" and "of proved excellence in diarrhea, dysentery, cholera and all bowel complaints and in hemorrhages" as well as for the treatment of infant diarrhea, hemorrhoids, piles, ulcerated tonsils, and discharges of the nose, vagina, urethra, and ears (Grieve 1931, 106–107).

In his *New Herbal* of 1543, Fuchs prescribed bistort or knotgrass to stop bleeding, evacuate the bladder, and sink fevers and lauded the plant for its utility in the treatment of "wounds, diarrhea, menstrual problems" (Dressendorfer 2001, 916). In 1652, Culpeper described its "Diverse Medical Uses" and recommended it for stings or bites; its root "hinders abortion or miscarriage," its leaves kill worms in children, stop inflammation of mouth and throat, and with plantain, form an external salve for gonorrhea (Potterton 1983, 29). In 1682, the herbalist Salmon specifically recognized its astringent properties and prescribed knotgrass to treat the "spilling of blood," kidney infections, inflammation, and because it "cleanses and heals old filthy wounds" (Grieve 1931, 458).

This European recognition of the medicinal qualities of the various species of *Polygonum* was matched by equally diverse, and often parallel, medicinal uses by Native American herbalists in the northeast United States. The University of Michigan ethnobotanical database (Moerman 2004; http://herb.umd.umich.edu/) listed twenty-one medicinal uses of *Polygonum* among the Iroquois and the Ojibwa. The Algonquin of Quebec used the astringent qualities of its leaves to stop bleeding (Black 1980, 188).

A related species, Pennsylvania Smartweed *(Polygonum pennsylvanicum)*, was used by unspecified groups of American Indians as a tea to treat diarrhea, bleeding of the mouth, and epilepsy (Foster and Duke 2000, 180). The Iroquois adopted the introduced variety of knotgrass, *Polygonum persicaria,* to treat rheumatism in the feet and legs, and as a heart medicine (Herrick 1977, 315). They used *Polygonum hydropiper* (marshpepper) to treat chills "when cold," as a gastrointestinal aid for indigestion, and to treat children with swollen stomachs (Herrick 1977, 314). The Iroquois used a third variety of knotweed *(P. arenastrum)* to treat injuries from miscarriages, as a love medicine, and to heal sore backs (Herrick 1977, 314). They used "prostrate knotweed" *(P. aviculare)* for children's diarrhea and bleeding from cuts and wounds (Herrick 1977, 313).

Knotweed or "bistorta" may have also been one of the earliest medicinal plants imported from New Netherland to the University of Leiden Medical Garden in the early seventeenth century. Writing from Leiden in 1633, Johan de Laet noted that "there are a great variety of herbaceous plants, some of which bear splendid flowers and others are considered valuable for their medicinal properties. I cannot avoid describing here two of this class, although their use is not yet known" (Jameson 1909, 55). He continued to describe how "[t]wo plants were sent to me from New Netherland that grew finely last year (1632) in the medical garden of this city [Leiden]" (Jameson 1909, 55, footnote 1; 56, footnote 1). Johan de Laet, both a director of the Dutch West India Company and an accomplished seventeenth-century botanist who maintained a herbarium in Leiden, included a drawing and description of the two plants, which Jameson identified as *Polygonum artifolium*, or "heart-leaved tear-thumb," and *Polygonum sagittatum*, or "arrow-leaved tear-thumb" (Jameson 1909, 56).

While it is not possible to link the genus-level seed identifications from the Pearl Street flotation samples with either of these two "species-specific" identifications by Jameson, the presence of *Polygonum* in the early-seventeenth-century contexts in New Amsterdam suggests that, given De Laet's treatment of these plants as important medicinal specimens, worthy of import to the Hortus Botanicus of Leiden, their transport to Holland may have reflected parallel Transatlantic uses, and/or the possibility that they were "recognized" as similar to known European varieties.

European Medicinal Plants

In addition to the *Brassica*, three other plants were probably introduced and possibly utilized for their medicinal qualities by both Dutch and native herbalists: betony or *Stachys* sp., clover, and toadflax (Table 8.5). Although not specifically discussed, some of the excavated European cultivars may also have been used in the sixteenth and seventeenth centuries as medicines. In addition to their value as foods, cabbage and kale were listed by Fuchs for the treatment for hair loss and cranial hematomas (Dressendorfer 2001, 910).

European Betony (*Stachys* sp.)—"Woundwort," "Heal-all"

The potential presence of betony was represented by one seed from a single late-seventeenth-century context (Component 14; Tables 8.2, 8.3, 8.5). One of more than three hundred worldwide species, *Stachys* sp. is alien to North America and was probably introduced from Europe (USDA 2009). Its species diversity and wide distribution was matched by an equally broad range of medicinal uses and applications. Variously known as "Woundwort," "Heal-all," "Self Heal," and betony, it was viewed as the aspirin of the seventeenth century. Pavord described it as "one of the most important cure-alls in the medieval canon" (2005, 18). It was valued as a treatment for headaches, facial pain, "frayed nerves," premenstrual cramps, poor memory, tension, and as an astringent for headaches and congestion; during the first century AD, the physician to the Emperor Augustus "claimed that betony would cure 47 different illnesses" (Chevallier 1996, 270). Of possible relevance to its recovery at Pearl Street, the herbalist Grieves noted, "It was largely cultivated in the physic gardens, both of the apothecaries and the monasteries, and may still be found growing in the sites of these ancient buildings" (Grieve 1931, 97). Its recovery in the late-seventeenth-century deposits—in association with other seventeenth-century cultivars (toadflax, clover, and *Brassica*)—suggests that it may have been introduced as a medicinal plant.

Documented for three indigenous groups in the northeast (the Chippewa, Ojibwa, and the Delaware), multiple ethnobotanical references suggest that *Stachys* sp. may also have been adapted by them as a medicinal plant after its presumed introduction from Europe. Two references to its use by the Delaware tell of its use with nightshade and snakeroot to treat venereal disease—presumably of European origin (Tantaquidgeon 1942, 29, 35, 80). The Chippewa of the northern United States and southern Canada employed an infusion of its leaves to treat abdominal pain described as "sudden colic" (Densmore 1928, 344).

Clover (*Trifolium* sp.)

Clover was found in both early- and late-seventeenth-century, but not eighteenth-century, samples (Tables 8.2, 8.3, 8.4, 8.5, 8.6). The presence of clover is pertinent to this discussion of medicinal plants because it was of unambiguous European origin and because it appears to have been widely adopted by a diverse number of Native American groups in the northeast after its introduction in the seventeenth century. Three northeastern indigenous groups, the Iroquois and Mohegan of New York, and the Algonquin of Quebec, adopted clover as a cold remedy and for whooping cough (Black 1988, 188; Hamel et al. 1975, 29).

Toadflax (*Linum* sp.)

Although only detected in one late-seventeenth-century context (Tables 8.2,8.3, 8.5), archival sources suggest that toadflax was probably in place by the early seventeenth century. It was reported to have been under cultivation in New Netherland and New England by the 1620s and 1640s (Ripley and Dana 1875, 292; Hedrick 1977, 338). Van der Donck listed it as an herb of the mid-seventeenth-century gardens of New Amsterdam (Goedhuys 2008, 28). Toadflax was perceived to have had medicinal benefits in sixteenth-century Europe, at least a century before the arrival of the Dutch in New Netherland. In 1543, Fuchs mentioned its benefits as a diuretic and as a remedy for jaundice (Dressendorfer 2001, 914), as did the seventeenth-century English herbalist Gerard (Grieve 1931, 816). Its seeds were lauded by Culpeper for multiple remedies, including for "pains of the breast [and to] softens [*sic*] hard swellings" (Grieve 1931, 230). It also represents a clear example of a European medicinal plant that was both naturalized early on and adopted by Native American healers. Although no local ethnobotanical references are documented for New York, the Cherokee adopted toadflax to treat "violent colds, coughs and diseases of the lungs, fevers, and to relieve "gravel or burning during urination" (Hamel and Chiltoskey 1975, 34; Taylor 1940, 34).

CROSS-CULTURAL VECTORS OF ETHNOBOTANICAL EXCHANGE

Archaeological and Ethnohistorical Evidence

> Fresh wounds and dangerous injuries they know how to heal wonderfully with virtually nothing. They also have a cure for lingering sores and ulcers. They can treat gonorrhea and other venereal diseases so easily as to put many an Italian physician to shame. They do all this with herbs, roots, and leaves from the land, having medicinal properties known to them and not made into compounds.
>
> —Adriaen Van der Donck, ca. 1655

There are no proofs in archaeology, only parallels and patterns. However, multiple lines of evidence, archival, archaeological, and ethnobotanical, converge to suggest that the waterfront block of the Dutch West India Company, and the focus of the excavation on the Strand (Pearl Street) in lower Manhattan was a center of Native American and Dutch interaction in the early seventeenth century. This long-standing locus of Native American occupation may also have contributed to its being a focal point for information exchange, especially concerning medicinal plants, between, as I will argue, the women of both cultures. This suggestion is based on six lines of evidence: (1) the recovery of late prehistoric Woodland or contact-period Native American artifacts at the site; (2) historical references to the long-term use of the excavated site at and near Pearl Street by Native Americans; (3) historical sources pointing to the presence in this waterfront block at Pearl and Whitehall of one of the colony's first doctors, Dr. Hans Kierstede, who worked for the Dutch West India Company sometime between 1638 and the middle of the seventeenth century; (4) the close association of his wife, Sara Kierstede, with native traders and women as a multilingual speaker of indigenous dialects; (5) historical references to the presence of a medicinal garden maintained by an unnamed doctor (presumably Dr. Kierstede) in the first half of the seventeenth century; and finally, (6) the identification of indigenous and European medicinal plants among the recovered seeds from the site.

Archaeological evidence suggests that the shoreline Pearl Street block, between modern Broad and Whitehall (also generally referred to as the Strand), was a locus of indigenous activities, before, during, and after the arrival of the Dutch. The site was bounded on the east by a key marine landing spot, referred to as "Canoe Place" (Van Rensselaer 1898, 32), which also served as a hub linking marine and terrestrial transport to the southernmost end of a major Native American roadway (modern Broadway) up the spine of the Island (Bolton 1922). It also corresponds with the location of the subsequent Dutch boat repair area at the mouth of the tidal marsh outlet at what would become Broad Street (Van Laer 1974, I: 111; Innes 1902, 5, 45).

The excavation at Pearl Street also documented a number of Native American artifacts from both mixed and unmixed historic-era deposits. A total of eleven indigenous ceramic shards, including a broken pipe stem, and thirty-one indigenous chipped stone tools (flakes, cores) were recovered. These contact-period or Late Woodland artifacts, dating to between the thirteenth and seventeenth centuries, appear to have been either utilized or deposited during or shortly before the seventeenth-century Dutch occupation at this site. In addition, the excavation encountered five shell wampum beads in the wooden-bottomed basket or cask (Component 38; see Table 8.1) which was abandoned and filled in sometime after 1650, and initially cut into the surface, sometime before that date (Grossman et al. 1985, Plate VIII6). These finds were important, because they dovetail with multiple historical references to Native American interaction and trade with the Dutch along Pearl Street during the seventeenth century.

The association between the Pearl Street block and the growing of medicinal plants can be dated to the seventeenth-century tenure of Dr. and Mrs. Kierstede at the site. Although not named directly, an intriguing reference in Van der Donck's mid-seventeenth-century *A Description of New Netherland* suggests that some of the potential medical plants excavated from within the block may have reflected the efforts of Dr. Kierstede, one of the settlement's first Company doctors: "A certain surgeon once laid out a fine garden and, *as he was a botanist as well*, planted many medicinal species he found growing wild, but with his departure this came to an end" (Goedhuys 2008, 32; emphasis added).

Hans Kierstede arrived as a prominent officer of the Company with Director Kieft in 1638, was given the parcel of land and a dwelling in what was the westernmost lot of the excavated block at the corner of Pearl Street and Whitehall, and worked as the West India Company doctor from his arrival to his departure from company employment to take up private practice in 1648 (Fernow 1976). This time frame suggests that it may have been his "fine garden" of medical plants, and that it existed sometime in the late 1630s to the early 1640s, or about the time he married Sara Kierstede in 1642 (Van Rensselaer 1898, 24).

Despite the lack of any in-depth references to the medical background of Dr. Kierstede, or his botanical training or studies in New Amsterdam, knowledge of local Native American medicinal plants was particularly well documented for his wife, Sara Kierstede. While many of the surviving historical references to her come from secondary turn of the century sources, primarily from the work of Singleton and Van Rensselaer, and are often dismissed by historical scholars as what might be called "oral traditions" or even multigenerational folklore, these accounts begin to take on a new and more credible stature in light of the archaeological and ethnobotanical data. According to these traditions, Sara Kierstede and her three sisters were multilingual, Dutch and English speakers, daughters of Anneke Jans, the first midwife in the settlement, and, "having been born and brought up among the 'Wilden', they had learned the Algonquin language, which they understood and spoke with fluency" (Van Rensselaer 1898, 22). One historian described Sara Kierstede as "being probably more learned in the native Indian tongues than anyone in the province" (Singleton 1909, 172). As the daughter of a native-speaking midwife, it is probable that her interest in, and knowledge of, local medical plants may have come as much from her mother, one of the first Dutch West India Company midwives, as it did from her later union with Dr. Hans Kierstede.

Her ability to communicate with the native women also appears to have contributed to making her new compound at the corner of Pearl and Whitehall a "safe haven" for local Dutch–Native American interaction, at least between the women of both cultures in the mid-seventeenth century:

> The Dutch women had become well acquainted with the wild people who surrounded them and were on friendly terms with them. Madame Kierstede was particularly kind to them, and as she spoke their language fluently, she was a great favorite among them; and it was owing to her encouragement that the savages ventured within the city walls to barter their wares. . . . For their better accommodation and protection Madame Kierstede had a large shed erected in her backyard, and under its shelter there was always a number of squaws who came and went as if in their own village, and plied their industry of basket and broom-making, stringing wampum and sewing, and spinning after their primitive

> mode; and on market days they were able to dispose of their products protected by their benefactress, Madame Kierstede. (Van Rensselaer 1898, 26)

Furthermore, in addition to her linguistic skills, one reference clearly links the women of the Kierstede family to a tradition of knowledge concerning locally derived medicines and medicinal plants. A century later, Van Rensselaer lauded Mrs. Alexander's (the granddaughter of Dr. and Mrs. Hans Kierstede) medical skills and the fact that she was held in high esteem by the native ladies, "as a great 'medicine woman', and with her salve for burns, which her grandmother [Sara Kierstede] had been taught to prepare by the great Dr. Kierstede, and which is to-day [ca. 1740] sold under his name" (Van Rensselaer 1898, 355).

Other, predominantly secondary, references also hint that (1) the waterfront block at Pearl Street was both, given the Native American artifacts recovered, a pre-contact landing site, and (2) in tandem with the above quote, it may have continued as a safe place for the native women well into the mid-eighteenth century. Speaking of the annual permission granted to New Jersey Indians to visit Manhattan, Mrs. Van Rensselaer noted that after landing, the native women "proceeded in procession to the open space provided for them behind Mr. Phillipse's house, which had been kindly set apart for their use by that gentleman, when the ancient camping ground on the Strand, by Dr. Kierstede's house, had been required by the builder" (Van Rensselaer 1898, 352–53).

The historical references to the interplay between Sara Kierstede and early-seventeenth-century Native American women coming to Manhattan are important because they are consistent with regional patterns of native women being tied to botanical knowledge in general, and to knowledge of medicinal plants in particular. Speaking of the native women of New Netherland in the mid-seventeenth century, Van der Donck wrote that "[t]he women do all the farming and planting," and thus by extension had firsthand knowledge of medicinal plants (Goedhuys 2008, 97). Similarly, in 1644 the Reverend Johannes Megapolensis observed that "the women are obliged to prepare the land, to mow, to plant and to do everything [involved with plants and agriculture]" (Jameson 1909, 174; Jacobs 2005, 25).

Augmenting these historical references to indigenous women as botanical experts, one account by Fenton underscores their role as keepers of medicinal knowledge in both the Hudson River drainage and the Great Lakes region. Fenton told of the early-eighteenth-century explorer Lafitau, who "made field trips and questioned Mohawk herbalists" (Fenton 1942, 519). After an unsuccessful search for an American species of ginseng, he returned in three months only to "unexpectedly encounter the mature plant growing within striking distance of a [native woman's] house; to his dismay, a Mohawk woman, whom he had employed to search for it on her own, recognized it as one of their ordinary remedies" (Fenton 1942, 518–19).

The association of medicinal plants with the contact-period Native American and Dutch-era occupation site in Lower Manhattan is also consistent with the suggestion, put forward by Gordon Day nearly sixty years ago, that "[p]lants used by Indians for medicinal purposes may owe their existence in many localities to the transplanting hand of an Indian herbalist" (Day 1953, 340). These ethnohistorical examples may also help explain both the ethnobotanical role of Mrs. Kierstede in the transference of Native American medicinal knowledge and the presence of so large an assortment of indigenous and European medicinal plants in the seventeenth-century deposits at Pearl Street site.

Institutionalized Protocols of Plant Collecting and the Role of Women Informants

The role of multilingual Dutch women and indigenous informants as culture brokers for the systematic collection and exchange of medicinal plants and knowledge can be traced to long-standing policies of the Dutch East and West India Companies, to the teaching of company officials, doctors, medical students, and botanists at the University of Leiden, and to strong corporate links between the University of Leiden and the *Hortus Botanicus* of Leiden under Clusius—all of which came together to play a central role in the development of scientific and administrative protocols for the collection of botanical specimens and medicinal information for

Dutch expeditions. These antecedents in turn derived from two specific traditions in European medicine and botany. The first reflected official corporate practices mandating the collection of exotica and plants in search of profit and new medicines in newly discovered territories. The second stemmed from the long-standing tradition of using local and foreign, multiethnic and multilingual, women informants to garner information on local medicinal plants and cures.

While close corporate-university ties were previously documented for the late seventeenth century (Stern 1989, 181; Oldenburger-Ebbers 1990, 166), new research by Dutch scholars at the *Hortus Botanicus* archives at Leiden (*The Clusius Project*), has established that these links were firmly in place by the early seventeenth century; before and during the initial settlement of New Amsterdam. As early as 1601, Clusius of the *Hortus Botanicus* and Professor Pauw of the School of Medicine of Leiden wrote a formal memorandum to officials of the Dutch East India Company with the aim of implementing rigorous procedures for plant collecting entitled *Instructions to Apothecaries and Surgeons who will Board the Fleet to the East Indies in the Year 1602* (van Uffelen 2008a, 57). Their instructions were precise and exacting. Like their Jesuit counterparts mentioned above, they stipulated what to collect and how specimens were to be collected, listing "branches bearing leaves, fruits, and flowers . . . pressed between paper . . . together with sketches of . . . how they grow, whether they are large or small, deciduous or not, the names of trees and how they are used (Swan 2007, 235–36). They also gave guidance and mandates "to question and learn from people of all stations and sexes—from statesmen, scholars, and artists as well as from craftsmen, sailors, merchants, peasants and '*wise women*'" (Schiebinger 2007, 131).

The importance of women informants was not new to seventeenth-century European doctors and students of *Materia Medica* (Egmond 2007, 28–31; Barona 2007, 102; Cook 2007b, 204; Schiebinger 2007, 132). Various fourteenth to eighteenth-century herbalists credited their insights and sources to "highly expert old women" as the chief repositories of multigenerational folk knowledge on the herbs and medicinal plants of Europe (Arber 1986, 319–20). One sixteenth-century herbalist confided that he was "not ashamed to be the pupil of an old peasant woman" (Arber 1986, 321). Even the eighteenth-century Swedish botanist, Linnaeus (who also spent time at the *Hortus Botanicus* of Leiden) wrote: "It is the folk whom we must thank for the most effacious medicines, which they keep [*sic*] secrete" (Schiebinger 2007, 130–31). A modern scholar writing about one of Dr. Kierstede's contemporary medical counterparts, Dr. Bontius, who studied at Leiden and was serving at the Dutch East India Company outpost of Batavia (modern Jakarta), has argued that this hurdle and veil of indigenous secrecy was only breached, as may have been the case for Mrs. Kierstede of New Amsterdam, by a "growing population of mixed heritage and multilingual abilities, many of whom became crucial information brokers" (Cook 2007a, 115).

In this context, Clusius of the *Hortus Botanicus* of Leiden is important for his role in disseminating awareness of cross-cultural methods of information gathering to Dutch and European students of botany and medicine. These graduates often subsequently served as officials in company expeditions and settlements. Clusius did this through his own research and through his wildly disseminated translations—into many languages—of, and commentaries on, the botanical studies of the sixteenth-century Spanish physician and botanist Nicolás Monardes and other Iberian scholars. In particular, these studies detailed Monardes's botanical and medical experiments with the "newe Medicines and newe Remedies" coming from the New World (Barona 2007, 101; Pavord 2005, 303), and served as the principal reference texts for seventeenth-century students and practitioners of medicine (Thomás 2007, 176). Of particular relevance, Monardes wrote of the importance of indigenous knowledge and the value of what we today call "oral history" from local informants, especially indigenous women informants. As his medical disciples would later reiterate, Monardes specifically lauded native women as seasoned practitioners and for the quality of their cures, which he described as being "very good and in accordance with good medicine" (Bleichmar 2007, 96). He also taught his students the importance of women herbalists as information brokers. Quoting an informant who had written him, Monardes specifically noted: "If we know anything of the matters I have treated . . . we learned it from the female Indians" (Bleichmar 2007, 95).

These antecedents involving the role of women informants in Europe, Asia, and the New World and institutionalized protocols for organized plant collecting and experimentation suggest intriguing parallels with the multilingual and cross-cultural links to indigenous women suggested for Mrs. Kierstede on the Strand of New Amsterdam. It is furthermore probable that these parallels are not happenstance, idiosyncratic or unique to any one region, but instead suggest broader historical patterns that in all probability influenced, if not prescribed, Dutch and Native American mechanisms of information exchange in New Netherland in the third and fourth decades of the seventeenth century. For a historical analogue, one can turn to the Old Testament (Exodus 3:22) and to what Robert Alter has described as the "social phenomenon" of the "sojourner," a Biblical female noun which recognized women as "the porous boundary between adjacent ethnic communities: borrowers of the proverbial cup of sugar, sharers of gossip and women's lore" (Alter 2004, 324).

SUMMARY OF RESULTS

This reanalysis of the archaeological sequence, ethnobotanical records, and historic plant remains suggests:

1. The archaeologically dated sequence of early-seventeenth, late-seventeenth, and early-eighteenth-century samples provides new quantified evidence documenting major temporally specific patterns and shifts in the relative prevalence and diversity of European and indigenous plant types between the early seventeenth and eighteenth centuries. These trends showed specifically that: (a) Indigenous potherbs and starchy seed food sources (and the potential medicinal plants) were restricted to the early seventeenth century and dropped out of the sequence by the late seventeenth century; (b) The European garden vegetables of the cabbage/mustard family were restricted to early- to mid- and late-seventeenth-century contexts, but were not identified in any early-eighteenth-century deposits; (c) The late-seventeenth-century sample was distinguished from earlier deposits by a ca. 50 percent reduction in plant diversity and by the introduction of carpetweed, toadflax, and woundwort (Fig. 8.2); (d) The early-eighteenth-century sample of edible plant foods was characterized by a sharp reduction of ca. 80 percent in the number and diversity of all varieties relative to the early-seventeenth-century sample and was limited to four types, three of local origin (pumpkin/squash, strawberries, and brambles) and one, peach, of European origin (Fig 8.2).

2. Many, if not most, of the identified early-seventeenth-century plants were characterized by the 1630s by "emergent" species adopted to disturbed open habitats that were anthropogenic in origin (influenced by human intervention), which may have been intentionally selected, collected, protected, transplanted, and/or cultivated. The mere presence of many of these "emergent" species suggests that (a) they were probably humanly introduced or symbiotic, and (b) that Lower Manhattan was heavily disturbed by the second quarter of the seventeenth century, if not earlier by Native American land-use patterns.

3. Insights from prehistoric North American archaeology and ethnobotany suggest that what had been commonly dismissed as invasive weeds, may have served as both Native American and colonial-era starchy seed sources and potherbs. With the exception of the ubiquitous peach pit, most of the plants from the first half of the seventeenth century were dominated by indigenous squash, collectable fruits and berries, and an assortment of what are suggested to be both prehistoric and contact-period Amerindian foods, medicinal and craft plants. This diversity exclusively in the early-seventeenth-century deposits significantly broadens the range of locally available edible food sources of indigenous origin. It also supports the idea that the early Dutch inhabitants may have been more dependent on a broader range of Native American food sources than previously recognized (Table 8.4).

4. The sharp transformations in the diversity of indigenous and potentially introduced plants also dovetails with modern studies of later New York City historical habitats to suggest a long record of disturbance and change in even our supposedly most pristine, or "primeval" habitats in the metropolitan area (Horenstein 2007; Brash 2007; see Peteet, ch. 9 in this volume). By the early to mid-seventeenth century, the local urban setting had

already undergone profound environmental transformations. The magnitude of these changes, between the early seventeenth and early eighteenth centuries, also underscores the danger of relying on either contemporary or recent historical inventories of supposedly pristine ecological "type" sites for environmental reconstruction. While some recent reconstructions have attempted to describe conditions as far back as 1609, no archaeological evidence exists to establish the identity or changing diversity of colonial plants in Manhattan prior to a ca. twenty year period, plus or minus five years, between the 1630s and 1650s.

5. The reevaluation and correction of the original 1980s laboratory and database records, together with the metric analysis of the colonial seeds relative to modern varieties, suggested the probable presence of several varieties of European garden vegetables belonging to the cabbage family (*Brassica*), in the seventeenth-century deposits, clearly by the late seventeenth century, and possibly as early as the second quarter of the century (Tables 8.4, 8.5, and 8.6).

6. The archival and historical folk references to Doctor Kierstede and his multilingual wife Sara's practice of providing shelter to Native American women, recent insights into the importance of women informants to Dutch East and West India Company doctors and botanists, the wide range of potential medicinal plants, the breadth of ethnobotanical references to their use, come together to underscore the import of women, both Native American and Dutch, as primary information brokers in the exchange of botanical and medicinal knowledge in seventeenth-century New Amsterdam.

7. Coupled with new insights into Dutch traditions of plant collecting and the transatlantic exchange of new medicinal plants and knowledge, the role of women and Dutch/Native American informants in New Amsterdam can now be partially attributed to the nexus of influences. These included early traditions of relying on "old wise women" for "folk" knowledge of medicinal plants. Through the translations of Clusius, they integrated the training of Dutch doctors and botanists in techniques of oral history and the use of informants, especially women informants, much based on, or influenced by, the sixteenth-century work of the Iberian doctor Monardes. Finally, they incorporated formalized methods and protocols, taught at seventeenth-century university-based botanical gardens and aimed at sensitizing students to the economic and scientific potential for cross-cultural transfer of knowledge from native women herbalists and practitioners.

8. Finally, this revised chronology and historic ethnobotanical sequence illustrates the potential for archaeology to provide independent "proxies," and/or "ecological benchmarks," to help refine otherwise ill-defined episodes of environmental change in the Hudson River drainage, in general, and the onset of the "Historic Horizon," in particular. Estimates—based primarily on historical assumptions, geomorphological and pollen core data, often interpolated, or by a radiocarbon dates blurred by a large +/- one hundred-year sigma, or standard deviation—for the timing of this transition have spanned from the early seventeenth to the mid-eighteenth centuries (Pederson et al. 2004, 246; Koster and Pienitz 2006, 521, Fig. 5; Russell et al. 1993, Fig. 2, 654–58; Hilgartner and Brush 2006, 482; Gehrels et al. 2006, 954, 958; Maenza-Gmelch 1997, 27, Table 2, 33). The dominance of "emergent" species in the earliest samples and the identification of order of magnitude shifts in the diversity of colonial plant remains within the Dutch West India block suggest that the advent of the "Historic Horizon" in the Lower Hudson is visible in the archaeological record by the second quarter of the seventeenth century in general, and probably by the 1630s in particular.

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REFERENCES CITED

Alter, Robert. 2004. *The Five Books of Moses: A translation with commentary*. New York: W. W. Norton.

Anagnostou, S. 2007. The international transfer of medicinal drugs by the Society of Jesus (sixteenth to eighteenth centuries) and connections with the work of Carolus Clusius. In *Carolus Clusius: Towards a cultural history of the Renaissance naturalis*, ed. Florike Egmond, Paul Hoftijzer, and Robert P. W. Visser, 293–312. Amsterdam: Royal Netherlands Academy of Arts and Sciences.

Arber, A. 1986. *Herbals: Their origin and evolution: A chapter in the history of botany 1470–1670.* Third Edition. Cambridge: Cambridge University Press.

Arnason, T., R. J. Hebda, and T. 1981. Use of plants for food and medicine by Native Peoples of Eastern Canada. *Canadian Journal of Botany* 59(1): 2189–2325.

Barona, J. L. 2007. Clusius' exchange of botanical information with Spanish scholars. In *Carolus Clusius: Towards a cultural history of the Renaissance naturalist,* ed. Florike Egmond, Paul Hoftijzer, and Robert P. W. Visser, 99–116. Amsterdam: Royal Netherlands Academy of Arts and Sciences.

Black, M. J. 1980. *Algonquin ethnobotany: An interpretation of Aboriginal adaptation in South Western Quebec.* Ottawa: National Museums of Canada, Mercury Series Number 65.

Bleichmar, D. 2007. Books bodies and fields: Sixteenth-century transatlantic encounters with the New World Materia Medica. In *Colonial botany: Science, commerce, and politics in the early modern world,* ed. Londa Schiebinger and Claudia Swan, 83–99. Philadelphia: University of Pennsylvania Press.

Bolton, R. P. 1922. *Indian paths in the great metropolis. Indian notes and monographs, miscellaneous series 23.* New York: Museum of the American Indian, Heye Foundation.

Brash, A. R. 2007. New York City's primeval forest: A review characterizing the type ecosystem. In *Natural history of New York City's parks and Great Gull Island*, ed. Alice Deutsch, Vol. X, 55–79. New York: Transactions of the Linnaean Society of New York.

Byrne, R., and J. H. McAndrews. 1975. Pre-Columbian purslane (*Portulaca oleracea L*) in the New World. *Nature* 253: 726–27.

Byrne, R., and W. D. Finlayson. 1998. Iroquoian agriculture and forest clearance at Crawford Lake, Ontario. In *Iroquoian peoples of the land of rock and water, AD 1000–1650: A study in settlement archaeology*, ed. W. D. Finlayson, Vol. 1, 94–107. London: London Museum of Archaeology, University of Western Ontario.

Cantwell, A.-M., and D. deZerega Wall. 2001. *Unearthing Gotham: The archaeology of New York City*. New Haven: Yale University Press.

Chevallier, A. 1996. *The encyclopedia of medical plants*. New York: D. K. Publishing.

Cole, J. N. 1979. *Amaranth: From the past for the future*. Emmaus: Rodale Press.

Cook, H. J. 2007a. Global economics and local knowledge in the East Indies: Jacobus Bontius learns the facts of nature. In *Colonial botany: Science, commerce, and politics in the early modern world,* ed. Londa Schiebinger and Claudia Swan, 100–18. Philadelphia: University of Pennsylvania Press.

———. 2007b. *Matters of exchange: Commerce, medicine, and science in the Dutch golden Age.* New Haven and London: Yale University Press.

Cronon, W. 1983. *Changes in the land: Indians, colonists, and the ecology of New England.* New York: Hill and Wang.

Dallal, D. 1996. Van Tienhoven's basket: Treasure or trash? In *One man's trash is another man's treasure,* ed. A. G. A. van Dongen, 215–24. Rotterdam: Museum Boymans-van Beuningen.

Davidson, A. 2006. *The Oxford companion to food*, 2d ed. Oxford and New York: Oxford University Press.

Day, G. M. 1953. The Indian as an ecological factor in the northeastern forest. *Ecology* 34(2): 329–46.

De Koning, J., G. van Uffelen, A. Zemanek, and B. Zamanek. 2008. *Drawn after nature: The complete botanical watercolours of the 16th-century Libri Picturati.* Zeist: KNNV Publishing.

Delcourt, P. A., and H. R. Delcourt. 2004. *Prehistoric Native American ecological change: Human ecosystems in eastern North America since the Pleistocene.* New York: Cambridge University Press.

Denevan, W. M. 1992. The pristine myth: The landscape of the Americas in 1492. *Annals of the Association of American Geographers* 82(3): 369–85.

Densmore, F. 1928. Uses of plants by the Chippewa Indians. *SI-BAE Annual Report* 44: 273–379.

Dressendorfer, W. 2001. Medical plants in modern herbal medicine. In L. Fuchs*, The new herbal of 1543*, 925–28. Paris: Tachen.

Duco, D. H. 1987. *De Nederlandse kleipijp, handboek voor dateren en determineren [The Dutch clay tobacco pipe, manual for dating and determination].* Leiden: Pijpenkabinet Foundation.

Dudek, M. G., L. Kaplan and M. M. King. 1998. Botanical remains from a seventeenth-century privy at the Cross Street site. *Historical Archaeology* 32(3): 63–71.

Egmond, F. 2007. Clusius and friends: Cultures of exchange in circles of European naturalists. In *Carolus Clusius: Towards a cultural history of the Renaissance naturalist*, ed. Florike Egmond, Paul Hoftijzer, and Robert P. W. Visser, 9–48. Amsterdam: Royal Netherlands Academy of Arts and Sciences.

———. 2008. The making of the Libri Picturati A16–30. In *Drawn after nature: The complete botanical watercolours of the 16th-century Libri Picturati,* ed. J. De Koning, G. van Uffelen, A. Zemanek, and B. Zamanek, 12–21. Zeist: KNNV Publishing.

———, P. Hoftijzer, and R. P. W. Visser. 2007. *Carolus Clusius: Towards a cultural history of the Renaissance naturalist*. Amsterdam: Royal Netherlands Academy of Arts and Sciences.

Egmond, F., and L. Ramón-Laca. 2008. Dramatis personae. In *Drawn after Nature: The complete botanical watercolours of the 16th-century Libri*

Picturati, ed. J. De Koning, G. van Uffelen, A. Zemanek, and B. Zamanek, 44–48. Zeist: KNNV Publishing.

Fenton, W. N. 1942. Contacts between Iroquois herbalism and colonial medicine. *Smithsonian Report for 1941*: 503–26.

Fernald, M. L., and A. C. Kinsey. 1965. *Edible wild plants of eastern North America*. Reprint of 1958 edition. New York: Dover.

Fernow, B., ed. 1976. *Records of New Amsterdam 1653–1674*. Baltimore: Genealogical Publishing.

Folkerts, J. 1996. The failure of West India Company farming on the island of Manhattan. In *de Halve Maen. Magazine of the Dutch colonial period in America* 69, 42–52.

Foster, S., and J. A. Duke. 2000. *Medicinal plants and herbs—eastern/central*. Peterson Field Guides. Boston, New York: Houghton Mifflin.

Fuchs, L. 2001. *The new herbal of 1543*. New Kreuterback. [A Complete Colored Edition]. Cologne: Tachen.

Gehrels, R.W., W. A. Marshall, M. J. Gehrels, G. Larsen, J. R. Kirby, J. Eiriksson, J. Heinemeier, and T. Shimmield. 2006. Rapid sea-level rise in the North Atlantic Ocean since the first half of the nineteenth century. *The Holocene* 16(7): 949–65.

Gehring, C. 2009. New Netherland: The formative years, 1609–1632. In *Four centuries of Dutch American relations,* ed. Hans Krabbendam, Cornelis A. van Millen, and Giles Scott-Smith, 74–84. Amsterdam: Uitgeverij Boom.

Goedhuys, D. W., trans. 2008. *Adriaen Van der Donck: A description of New Netherland,* ed. Charles T. Gehring and William A. Shorto. Lincoln and London: University of Nebraska Press.

Goodfriend, J. D. 1992. Before the melting pot: Society and culture in colonial New York, 1664–1730. Princeton: Princeton University Press.

Grieve, Mrs. M. 1981. *A modern herbal, Vols. I and II*. Reprint of 1931 edition. New York: Dover.

Grossman, J. W. 1983. Demographic changes and economic transformations in the south central highlands of pre-Wari Perú. *Nawpa Pacha* 21: 45–126. Berkeley: Institute of Andean Studies.

———. 1985. Environmental shifts and changing food patterns at the 17th century Dutch West India site in Lower Manhattan. Paper presented at the annual meeting of the Council of Northeast Historical Archaeology (CNHEA), Ottawa, Canada, October 27.

———. 2000. Mrs. Kierstede's rear yard: The archaeological discovery and ethno-botanical, cartographic, and archival reanalysis of the 17th century Dutch West India Company remains in Lower Manhattan, New York. Paper prepared for the Regia Civitas and Institute of Archaeology of the Hungarian Academy of Sciences Conference: Medieval Towns and its Citizens, Budapest, Hungary, June 1–4.

———. 2003. From Raritan Landing to Albany's riverfront: The path toward total 3D archaeological site recording. In *People, places, and material things: Historical archaeology of Albany, New York. Chapter 15: Battles and breakthroughs,* ed. Charles Fisher. New York State Museum Bulletin 499 (2003): 167–86.

———. 2008. Future of archaeology in 21st century: Human-landscape interactions. In *2008 Encyclopedia of archaeology*, ed. Deborah Pearsall, Vol. 2: 1458–76. Oxford: Elsevier/Academic Press.

———, M. Meyers, N. Stehling, J. Diamond, D. Dallal, W. Roberts, H. Greenfield, M. Davenport, G. Meyers, and M. Washington. 1985. *The excavation of Augustine Heerman's warehouse and associated 17th century Dutch West India Company deposits: The Broad Financial Center mitigation final report, 1985.* Report on file at the New York City Landmarks Preservation Commission, and the New York State Museum, Albany.

Hamel, P. B. and M. U. Chiltoskey. 1975. *Cherokee plants and their uses—A 400 year history*. Sylva: Herald Publishing.

Hammett, J. E. 2000. Ethnohistory of aboriginal landscapes in the southeastern United States. In *Biodiversity and Native America*, ed. P. E. Minnis and W. J. Elisens, 248–99. Norman: University of Oklahoma Press.

Hedrick, U. P. 1977. *Sturtevant's edible plants of the world*. Reprint of 1919 edition. New York: Dover.

Herrick, J. W. 1977. Iroquois medical botany. PhD diss., State University of New York, Albany.

Hilgartner, W. B., and G. S. Brush. 2006. Prehistoric habitat stability and post-settlement habitat change in a Chesapeake Bay freshwater tidal wetland, USA. *The Holocene* 16(4): 479–94.

Horenstein, S. 2007. Inwood Hill and Isham Parks: Geology, geography, and history. In *Natural history of New York City's parks and Great Gull Island*, ed. Alice Deutsch, 1–54. New York: *Transactions of the Linnaean Society of New York,* Vol. X.

Huey, P. 1988. Aspects of continuity and change in colonial Dutch material culture at Fort Orange, 1624–1664—A dissertation in American civilization. Philadelphia: University of Pennsylvania.

Hunt, J. D., ed. 1990. *The Dutch garden in the seventeenth century*. Washington: Dumbarton Oaks Research Library and Collection.

Huxley, A. 1998. *An illustrated history of gardening*. Reprint of 1978 edition. New York: Paddington Press.

Innes, J. H. 1922. New Amsterdam and its people: Studies, social and topographical, of the town under Dutch and early English rule. New York: Charles Scribner's Sons.

Jacobs, J. 2005. *New Netherland: A Dutch colony in seventeenth century America.* Leiden-Boston: Brill.

———. 2009. *The colony of New Netherland: A Dutch settlement in seventeenth-century.* Ithaca and London: Cornell University Press.

Jameson, F., ed. 1909. Description of the Towne of Mannadens, 1661. In *Narratives of New Netherland, 1609–1664. Digital archives: Original narratives of early American history*. Reproduced under the Auspices of the American Historical Association. New York: Charles Scribner's and Sons.

Janowitz, M. F. 1993. Indian corn and Dutch pots: Seventeenth-century floodways in New Amsterdam/New York. *Historical Archaeology* 27(2): 6–24.

Kelso, W. M., with B. Straub. 1997. *1996 interim report on the APVA excavations at Jamestown, Virginia.* Richmond: Association for the Preservation of Virginia Antiquities.

———. 2004. *Jamestown rediscovery 1994–2004*. Richmond: Association for the Preservation of Virginia Antiquities.

Köster, D., and R. Pienitz. 2006. Late-Holocene environmental history of two New England ponds: natural dynamics versus human impacts. *The Holocene* 16(4): 519–32.

Krabbendam, H., C. A. van Millen, and G. Scott-Smith, eds. 2009. *Four centuries of Dutch American relations: 1609–2009.* Amsterdam: Uitgeverij Boom.

Liebman, B., and J. Hurley. 2009. Rating rutabagas: Not all vegetables are equal. *Nutrition Action Newsletter* 36(1) (January/February): 9–15. Washington: Center for Science in the Public Interest (www. cspinet.org).

Maenza-Gmelch, T. 1997. Holocene vegetation, climate, and fire history of the Highlands, southeastern New York, USA. *The Holocene* 7(1): 25–37.

Mallios, S. (with contributions by G. Fesler). 1999. *The Reverend Richard Buck site: Archaeological excavations at 44JC568.* Richmond: Association for the Preservation of Virginia Antiquities.

———. 2000. *At the edge of the precipice: Frontier ventures, Jamestown's hinterland, and the archaeology of 44JC802.* Richmond: Association for the Preservation of Virginia Antiquities.

Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. American wildlife and plants: A guide to wildlife food habits—The use of trees, shrubs, weeds, and herbs by the birds and mammals of the United States. New York: Dover.

Matson, C. Economic networks of Dutch traders and the British colonial empire. In *Four centuries of Dutch American relations,* ed. Hans Krabbendam, Cornelis A. van Millen, and Giles Scott-Smith, 97–107. Amsterdam: Uitgeverij Boom.

McAndrews, J. H., and M. Boyko-Diakonow. 1998. Pollen analysis of varved sediment at Crawford Lake, Ontario: Evidence of Indian and European farming. In *Quarterly Geology of Canada and Greenland*, ed. R. J. Fulton, 528–30. Ottawa: Geological Survey of Canada.

Meyer, J. E. 1972. *The herbalist*. Ninth ed. of 1918 printing. New York: Self-published.

Military Advisory Board. 2007. National security and the threat of climate change: Report from a panel of retired senior US military officers. CNA Corporation, 3. Virginia.

Miller, N. 1989. What mean these seeds: A comparative approach to archaeological seed analysis. *Historical Archaeology* 23(2): 50–59.

Moerman, D. E. 2004. *Native American ethnobotany*. Portland, OR, and Cambridge, MA: Timber Press. University of Michigan Database of Ethnobotany: http://herb.umd.umich.edu/.

National Academy of Sciences. 1975. *Unexploited tropical plants with promising economic value*. Washington: National Academy of Sciences.

Nordås, R., and N. P. Gleditsch. 2007. Climate change and conflict. *Political Geography* 26: 627–38.

O'Callaghan, E. B., and B. Fernow, trans. 1856. *Documents relative to the colonial history of the State of New York.* 15 vols. Albany: Weed, Parsons.

Oldenburger-Ebbers, C. 1990. Notes on plants used in Dutch gardens in the second half of the seventeenth century. In *The Dutch garden in the seventeenth century,* ed. J. D. Hunt, 159–74. Washington, DC: Dumbarton Oaks Research Library and Collection.

Parker, A. C. 1910. *Iroquois uses of maize and other food plants*. Albany: University of the State of New York.

Parker, G. 2008. Crisis and catastrophe: The global crisis of the seventeenth century reconsidered. *American Historical Review* (October): 1053–79.

Pavord, A. 2005. *The naming of names: The search for order in the world of plants.* New York: Bloomsbury.

Pederson, D. C., D. M. Peteet, D. Kurdyla, and T. Guilderson. 2005. Medieval warming, little ice age, and European impact on the environment during the last millennium in the lower Hudson Valley, New York, USA. *Quaternary Research* 63: 238–49.

Peterson, L. A. 1977. *Edible wild plants: Eastern/central North America*. Peterson field Guides. New York: Houghton Mifflin.

Pluis, J. 1998. *De Nederlandse tegel: Designs and names 1570–1930 [The Dutch tile: Designs and names].* Leiden: Nederlands Tegelmuseum/ Vrienden van het Netherlands Tegelmuseum, in samenwerking met Primavera Pers.

Poole, Sidman P. 1934. Geographic interpretation of New Amsterdam. *Bulletin of the Geological Society of Philadelphia* 32: 42–64.

Potterton, D., ed. 1983. *Culpepper's color herbal*. New York: Sterling.

Ramon-Laca, L. 2008. The additions by the Count of Arenberg. In *Drawn after nature: The complete botanical watercolours of the 16th-century Libri Picturati,* ed. Jan De Koning, Greta van Uffelen, Alicja Zemanek, and Bogden Zamanek, 54–69. Zeist: KNNV Publishing.

Reagan, A. B. 1928. Plants used by the Bois Fort Chippewa (Ojibwa) Indians of Minnesota. *Wisconsin Archeologist* 7(4): 230–48.

Richardson, D. M., P. Pysek, M. Rejmanek, M. G. Barbour, F. D. Panetta, and C. J. West. 2000. Naturalization and invasion of alien plants: Concepts and definitions. *Diversity and Distributions* 6: 93–107.

Ripley, G., and C. A. Dana, eds. 1873–76. *The American cyclopedia: A popular dictionary of general knowledge*, XIV (1875). New York: D. Appleton, 88–89.

Rothchild, N. A., D. deZ. Wall, and E. Boesch. 1987. *The archaeological investigation of the Stadt Huys block: A final report.* Report on file with the New York City Landmarks Preservation Commission.

Rousseau, J. 1945. Le folklore botanique de Caughnawaga. Montreal, Canada. *Contributions de l'Institut botanique l'Universite de Montreal* 55: 7–72. Montreal: University of Montreal.

Russell, E. W. B., R. B. Davis, R.S. Anderson, T. E. Rhodes, and D. S. Anderson. 1993. Recent centuries of vegetational change in the glaciated north-eastern United States. *Journal of Ecology* 81: 647–64.

Safford, W. E. *A forgotten cereal of ancient America. 1917. Proceedings of the 19th International Congress of the Americanists, Washington, D.C.* 1915: 286–97.

Sauer, J. D. 1950. The grain amaranths: A survey of their history and classification. *Annals of the Missouri Botanical Garden* 37: 561–632.

———. 1952. A geography of pokeweed. *Annals of the Missouri Botanical Garden* 39: 113–25.

———. 1967. The grain amaranths and their relatives; A revised taxonomy and geographic survey. *Annals of the Missouri Botanical Garden* 54: 103–37.

Savoiea, A. U., A. Zemanek, and B. Zemanek. 2008. The beginnings of ecological thought. In

Drawn after nature: The complete botanical watercolours of the 16th-century Libri Picturati, ed. J. De Koning, G. van Uffelen, A. Zemanek, and B. Zemanek. Zeist: KNNV Publishing.

Schiebinger, L. 2007. Prospecting for drugs: European naturalists in the West Indies. In *Colonial botany: Science, commerce, and politics in the early modern world,* ed. Londa Schiebinger, and Claudia Swan, 119–33. Philadelphia: University of Pennsylvania Press.

———, and C. Swan, eds. 2007. *Colonial botany: Science, commerce, and politics in the early modern world.* Philadelphia: University of Pennsylvania Press.

Shimer, P. 2004. *Healing secrets of the Native Americans: Herbs, remedies, and practices that restore the body, refresh the mind, and rebuild the spirit.* New York: Black Dog and Leventhal.

Singleton, E. 1968. *Dutch New York.* Reprint of 1909 edition. New York: Ayer.

Smith, B. D. 1989. The independent domestication of indigenous seed-bearing plants in eastern North America. In *Emergent horticultural economics of the eastern woodlands, Occasional Papers No. 7*, ed. W. Keegan, 3–48. Carbondale: Center for Archaeological Investigations, Southern Illinois University.

———, with contributions by C. W. Cowen and M. P. Hoffman. 1992. *Rivers of change: Essays on early agriculture in eastern North America.* 1st. ed. Washington, DC, and London: Smithsonian Institution.

Smith, H. H. 1932. Ethnobotany of the Ojibwa Indians. *Bulletin of the Public Museum of Milwaukee* 4: 327–525.

Sjostrand, S., and Sharipah Lok bt. Sted Idrus. 2007. *The Wanli shipwreck and its ceramic cargo.* Nanhai Marine Archaeology Sdn. Bhd. in collaboration with the Ministry of Culture, Arts and Heritage Malaysia and the Department of Museums Malaysia.

Speck, F. G., R. B. Hassrick, and E. S. Carpenter. 1942. Rappahannock herbals, folk-lore, and science of cures. *Proceedings of the Delaware County Institute of Science* 10: 7–55.

Stern W. T. 1989. Horticulture and botany. In *The age of William III & Mary II: Power politics and patronage 1688–1702,* ed. Robert P. Maccubbin and Martha Phillips, 179–85. Williamsburg: The College of William and Mary in Virginia.

Stokes, I. N. P. 1967. *The iconography of Manhattan Island, Vol. I–IV.* Reprint of 1915–1925 edition (New York: Robert H. Dodd). New York: Arno Press.

Straub, B., and N. Luccketti. 1996. *1995 interim report*. Richmond: APVA Jamestown Rediscovery.

Struever, S. 1964. The Hopewill interaction sphere in riverine–western Great Lakes culture history. In *Hopewellian studies*, ed. J. R. Caldwell and R. L. Hall, 87–106. Springfield: Illinois State Museum, Scientific Papers No. 12.

Sturtevant, W. 1954. The Mikasuki Seminole: Medical beliefs and practices. PhD diss., Yale University.

Swan, C. 1998. *The Clutius botanical water colors: Plants and flowers of the renaissance.* New York: Harry N. Abrams.

———. 2007. Collecting naturalia in the shadow of early modern Dutch trade. In *Colonial botany: Science, commerce, and politics in the early modern world*, ed. Londa Schiebinger and Claudia Swan, 223–36. Philadelphia: University of Pennsylvania Press.

Tantaquidgeon, G. 1972. *Folk medicine of the Delaware and related Algonquian Indians*. Harrisburg: Pennsylvania Historical Commission Anthropological Papers no. 3.

Taylor, L. A. 1940. *Plants used as curatives by certain southeastern tribes.* Cambridge: Botanical Museum of Harvard University.

Thick, M. 1990. Garden seeds in England before the late eighteenth century—II, The trade in seeds to 1760. *Agricultural History Review* 38(II): 105–16.

Thomás, J. P. 2007. Two glimpses of America from a distance: Carolus Clusius and Nicolás Monardes. In *Carolus Clusius: Towards a cultural history of the renaissance naturalist,* ed. Florike Egmond, Paul Hoftijzer, and Robert P. W. Visser, 173–93. Amsterdam: Royal Netherlands Academy of Arts and Sciences.

USDA, ARS, National Genetic Resources Program. 2009. Germplasm Resources Information Network (GRIN). National Germplasm Resources Laboratory, Beltsville, MD. http://www.ars-grin.gov/cgi-bin/npgs/html/taxon.pl?312174.

Uva, R. H., J. C. Neal, and J. M. DiTomaso. 1997. *Weeds of the Northeast*. Ithaca and London: Comstock Publishing Associated, a Division of Cornell University Press.

Van der Groen, Jan. 1670. *Den Nederlandtsen Hovenier.* Amsterdam: Marcus Doornick.

Van Laer, A. J. F. 1974. *New York historical manuscripts: Dutch. Vol. 1, Register of the provincial secretary, 1638–1642.* Baltimore: Genealogical Publishing Co.

Van Lemmen, H. 1997. *Delftware tiles*. Woodstock: The Overlook Press.

Van Rensselaer, Mrs. J. K. 1898. *The Goede Vrouw of Mana-ha-ta: At home and in society 1609–1760*. New York: Charles Scribner's Sons.

Van Uffelen, G. 2008a. The *Libri Picturati* and the early history of the Hortus Botanicus Leiden. In *Drawn after nature: The complete botanical watercolours of the 16th-century Libri Picturati,* ed. J. De Koning, G. van Uffelen, A. Zemanek, and B. Zamanek, 54–59. Zeist: KNNV Publishing.

———. 2008b. Food plants. In *Drawn after nature: The complete botanical watercolours of the 16th-century Libri Picturati,* ed. J. De Koning, G. van Uffelen, A. Zemanek, and B. Zamanek, 116–17. Zeist: KNNV Publishing.

Viele, Egbert L. 1865. *Sanitary and topographical map of the city and island of New York prepared for the Council of Hygiene and Public Health of Citizens, Association of New York upon the sanitary condition of the city.* New York: D. Appleton.

Watson, P. J. 1989. Early plant cultivation in the eastern woodlands of North America. In *Foraging and farming: The evolution of plant exploitation*, ed. D. R. Harris and G. C. Hillman, 555–71. London: Unwin Hyman.

Watson, P. J., and M. Kennedy. 1991. The development of horticulture in eastern woodlands of North America: Women's role. In *Engineering archaeology*, ed. J. Gero and M. Conkey, 255–75. Oxford: Basil Blackwell.

Waugh, F. W. 1916. *Iroquois foods and food preparation*. Ottawa: Canada Department of Mines.

Wilcoxen, C. 1987. *Dutch trade and ceramics in America in the seventeenth century*. Albany: Albany Institute of History and Art.

Wilson, A. C. 1999. *The book of marmalade*. Philadelphia: University of Pennsylvania Press.