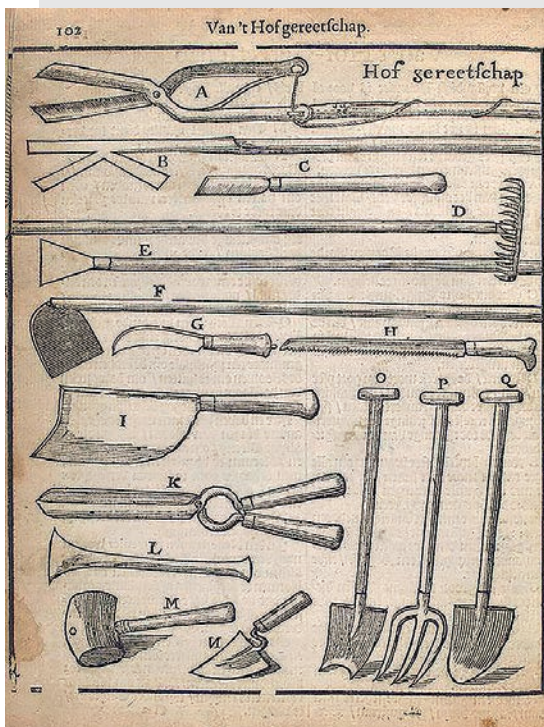


de Halve Maen



Journal of The Holland Society of New York
Vol. 95, No. 1 2022



A 3D Reconstruction of a Seventeenth-Century New Amsterdam Garden

by Joel W. Grossman

THROUGHOUT THE WINTER of 1983 and 1984, archaeological investigations were initiated along the original colonial shoreline block at Pearl Street in the Financial District of Lower Manhattan. Mandated by the New York City Landmarks Preservation Commission over a four-month field season (October 1, 1983–February 2, 1984), the project consisted of a one-month testing and site-preparation phase, and then an intensive three-month data recovery phase of wide-area excavations.¹ This multi-stage deep urban historic archaeological testing program led to the discovery of the well-preserved early Dutch settlement of New Amsterdam.²

The excavation focused on Pearl Street, an illustrious block in New York City history. It was the epicenter of shoreline commercial activity, and as described by John H. Innes, was the “seat of the large part of the wholesale and retail trade of the town.”³ Pearl Street, a wide, shell-covered,

Joel W. Grossman is a professional archaeologist. He received his BA and Ph.D. in Andean archaeology as a Fulbright-Special Career Fellow from the University of California, Berkeley. In 1983 Greenhouse Consultants, Inc., of Atlanta, Georgia, under contract with the firm of Fox and Fowle Architects, Inc., employed him as field director, principal investigator (PI), and principal author (PA) to conduct archaeological research at the corner of Pearl and Whitehall Streets (33 Whitehall Street), for HRO International, LTD. (The Ronson Organization).

pavement facing the bay known as the “Strand” (meaning “shore” or “beach”), was laid out in 1630.⁴ The Strand, fronting this wide shoreline center of commercial activity, was next to the fortress. It served as the main access route to the local import/export dock at Moore Street, and to the weekly market at the corner of Pearl and Whitehall Streets that took place in front of the westernmost lot (nineteenth C lot 14) of the block.

The discoveries from the block included the foundations and cobblestone floor of the colony’s first warehouse in North America, a major tactical and logistical factor leading to the superior economic infrastructure in trade for the Dutch West India Company (WIC).⁵ After 1638, the warehouse was administered by Augustijn Heermans, who arrived in 1633 and worked for the Dutch trading company of Peter Gabrys of Amsterdam.⁶ Peter Gabrys was the son of Charles or Caral Gabrys, merchant of Amsterdam and a WIC director.⁷

In addition to the “Heermans’ warehouse” (it was the WIC’s), the block contained the settlement’s first church, one of the earliest taverns, the first company-initiated doctor’s office of Dr. Hans Kierstead (whose family settled in the block in 1638 and lived there until about 1710),⁸ and the residence of WIC Secretary Cornelius Van Tienhoven. Major features and structural elements of both the Kierstead and Van Tienhoven residences were excavated, and, in some cases, their artifacts identified with the timing of the seventeenth- and eighteenth-century occupations.

¹ Joel W. Grossman, “Phase I Report and Mitigation Report for the Broad Street Plaza Site, N.Y.: Area I, Lots 12–14.” (New York, 1983): LMPC Report No. 316—Available for digital download from the NYC Landmarks Preservation Commission, NYC. Archaeology Reports - LPC (nyc.gov). The name “Broad Financial Center” is a misnomer. Broad Street was two blocks away, to the north-east, marked by a colonial tidal outlet to Collect Pond. The correct name for the site is the “Pearl Street Site,” a designation followed in this article.

² In 2011 I wrote the revised chronology, ethnohistory, and ethnobotany of seventeenth-century New Amsterdam, excavated along Pearl Street in Lower Manhattan, titled “Archaeological Indices of Environmental Change and Colonial Ethnobotany in seventeenth Century Dutch New Amsterdam” [hereafter Grossman, “Indices”]. The article is published as chapter 8 in *Environmental History of the Hudson River: Human Uses that Changed the Ecology, Ecology that Changed Human Uses* (SUNY Press, as the Proceedings of Hudson River Environmental Society (HRES) Conference: Environmental History of the Hudson River: Human Uses that Changed the Ecology, Ecology that Changed Human Uses (Hyde Park, NY. November 6th, 2009, Peekskill, NY).

³ John H. Innes, *New Amsterdam, and Its People: Studies, Social and Topographical, of the Town Under Dutch and Early English Rule* (New York, 1902), 45.

⁴ Esther Singleton, *Dutch New York* (New York, 1909, rpt. 2018), 14.

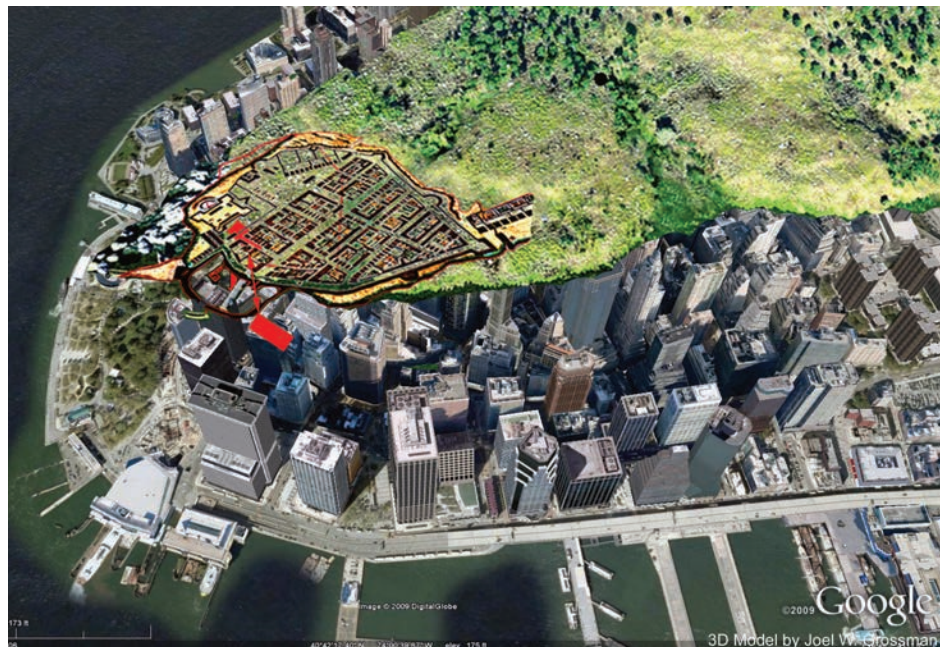
⁵ “Description of the town of Mannadens, 1661,” in J. Franklin Jameson, ed., *Narratives of New Netherland, 1609–1664* (New York, 1909), 86.

⁶ Joel W. Grossman, ed., with contributions by (in alphabetical order), Karen Bluth, Bonnie A. Bogumil, Diane Dallal, Michael Davenport, Joseph E. Diamond, Haskell Greenfield, Leo Hershkowitz, Melba J. Myers, George E. Myers, Jr., Peter Namuth, Andrew Neuhart, Lisa Panet, William I. Roberts IV, Nancy A. Stehling, Sara Stone, and Mindy Washington, *The Excavation of Augustine Heermans’ Warehouse and Associated seventeenth-century Dutch West India Company Deposits, The Broad Financial Center Mitigation Report* (New York, 1985), hereafter cited as *Excavations Report*. [Grossman authored sections IA, IB, and IC, “Introduction,” and Section X: “Conclusions: Summary of Results,” X1–21].

⁷ Jameson, 375; see Grossman, “Indices,” 86; Jaap Jacobs, *New Netherland: A Dutch Colony in Seventeenth Century America* (Leiden and Boston, 2005), 258.

⁸ Jameson, 375.

*Figure 1. 3D terrain model showing the extent of the seventeenth-century New Amsterdam relative to the topography and ground cover of Lower Manhattan and the modern setting of the excavated block (red rectangle) of the Dutch West India Company discovered fronting Pearl and Whitehall Streets. Note the culturally defined open ground cover and lack of continuous forest canopy. The landscape was altered and maintained by human clearing and fire by indigenous and Dutch settlers, alike. The 3D terrain model is rendered after an earlier version published in the volume *Environmental History of the Hudson River* (Grossman 2011, Figure 8.1, Courtesy SUNY Press).*



Van Tienhoven came from Utrecht to New Netherland in 1633 as a WIC clerk under the administration of Wouter van Twiller.⁹ The WIC appointed him as provincial secretary from 1638 to 1656.¹⁰ Tienhoven was a man of great stature and great controversy. In addition to representing WIC interests before company magistrates in Amsterdam in 1650, his fame also includes a much-referenced 1650 manifesto, “Answer to the Representation of the New Netherland,” discussed below, on what we today label as a brief ethnobotany of Dutch horticulture in New Netherland. His stature, however, is forever tinged by his involvement in “Kieft’s massacre” of 1643.¹¹ It is not a coincidence that his professional benchmarks—his 1633 arrival, and his promotion to secretary in 1638—coincide with my suggested start and end dates for the five-year-long period of initial occupation on the block.

These archaeological discoveries of undisturbed colonial remains resulted in the recovery, computer inventory, and conservation of 43,318 Dutch, British, and Native American artifacts, of which 21,746 artifacts, or 50 percent, predate the early eighteenth century. Of these, thirty-five, or 44 percent of the total of eighty excavated stratigraphic components, derived from undisturbed colonial-era features and deposits.¹²

The stratified archaeological record of the buried Dutch settlement also yielded strong quantified, naturally stratified, dated and undisturbed, ethnobotanical evidence of environmental change during

the colonial period, evidence not otherwise available through the written or archival record alone (figures 2 and 3).¹³ Thus, after first introducing the archaeological discovery and its record of preserved colonial seeds, recent insights into stylistic trends in the history of seventeenth- and eighteenth-century Dutch garden design will be highlighted. The three lines of evidence—archaeological, ethnobotanical, and archival—will then be combined to present for the first time a 3D computer model of what an early seventeenth-century New Netherland garden might have looked like (figure 5).

The Archaeological Discovery: The deeply interred archaeological site was excavated eight to twelve feet below street grade in midwinter. The rescue excavation was done over a sixteen-week period by protecting the archaeologists and artifacts from the elements under heated all-weather, plastic- and steel-reinforced, air-inflated, custom-built “greenhouse” shelters. We used a variety of applied-technology tools to expedite the discovery, exposure, and inventory process of excavating the buried settlement. These applied-technology aids included a high-precision computer infrared transit for pinpoint-precise coordinate (x, y, z) recording, the development of overhead stereo photogrammetric recording systems to reduce the time needed for manual field documentation of hand-drawn plans, and the development and installation of a concurrent on-site conservation facility.

These capabilities were integrated with mainframe Fortran computer-based, database-controlled laboratory, conservation, and data processing in an on-site facility and off-site laboratory of Greenhouse Consultants, Inc., under whose contract I worked as field director. In this context, the conservator played a central role in managing the strategy of the excavation and the ongoing emergency chemical stabilization of the often-fragile colonial finds. The conservator also controlled the

⁹ *Ibid.*, 332.

¹⁰ Van Tienhoven also served as fiscal from 1652 until 1656. See Jacobs, 486.

¹¹ For the 1650 manifesto see, Jameson, *Narratives*, 333. While the 1643 episode is known as “Kieft’s massacre,” it was Van Tienhoven who led the reconnaissance team that brought about the slaughter of eighty Lenape men, women, and children on February 25 and 26 at their encampment in Pavonia, New Jersey, *ibid.*, 228.

¹² Grossman, *Excavations Report*, X-7.

¹³ *Ibid.*; Grossman, “Indices,” 77–122; Joel W. Grossman, “Mrs. Kierstead’s Rear Yard: The Archaeological Discovery and Ethno-botanical, Cartographic, and Archival Reanalysis of the Seventeenth-Century Dutch West India Company Remains in Lower Manhattan, New York,” given before the Regia Civitas and Institute of Archaeology of the Hungarian Academy of Sciences Conference, Medieval Towns and Its Citizens, Budapest, June 1–4, 2000; Grossman, “Mrs. Kierstead’s Rear Yard: The Archaeological Discovery and Ethno-botanical Reanalysis of Colonial Dutch West India Company Remains in Lower Manhattan, New York,” invited paper before the 30th Annual Meeting of the Society for Historical Archaeology, (Quebec, January 7, 2000); Grossman, “From Raritan landing to Albany’s Riverfront: The Path Toward Total 3D Archaeological Site Recording,” in Charles Fisher, ed., *People, Places and Material Things: Historical Archaeology of Albany, New York*. Chapter 15: Battles and Breakthroughs, *New York State Museum Bulletin* 499 (Albany, 2003), 167–86; Grossman, “The Future of Archaeology in the 21st Century: Human Landscape Interactions,” *Encyclopedia of Archaeology*, Deborah Pearsall, ed. (Oxford, 2008), vol. 2, 1458–1476; Grossman, *Indices*, 77–122.

design and implementation of the National Park Service database system for the inventory and quantification of the identity, material, age, provenience, coordinates, class of artifact, identified dates, and the artifact associations of all excavated items. These enhanced capabilities provided daily feedback of tabulated breakdowns of the identity, provenience, and age of all excavated, conserved, and stabilized artifacts—concurrent with the fieldwork, instead of long after.¹⁴

Based on a preliminary Phase I cultural resource sensitivity study of the block by the author in 1983, I gambled that the early features and structural remains of the settlement were preserved below the early nineteenth-century basement floors, in waterlogged deposits facing encroaching sea level rise. I first dewatered the block with well heads drilled on the surrounding streets, brought in dock workers to put in protective shoring to bolster adjacent buildings against collapse, and used heavy equipment, and many dump truck loads, to cut away and haul off the rubble fill from the basements. Following the fill removal, I deployed large backhoe-mounted jackhammers to penetrate through the four-course-thick basement floors, apparently laid down to buffer the early nineteenth-century residents from the rising water table. Once through the brick flooring throughout the entire block, the excavation penetrated down to the underlying lenses of “green clay,” interspersed with bands of waterlogged red sands of the original land surface at the southern tip of Manhattan.¹⁵

We quickly realized we had discovered the buried Dutch settlement because resting on the exposed “green clay” of the underlying deposits was a museum-quality, early seventeenth-century Dutch-decorated smoking pipe, with a fleur-de-lys molded into it in relief. We were standing on the early seventeenth-century surface. Indeed, we were standing on the four-hundred-year-old surface of the WIC warehouse.

Finally, in addition to the first warehouse and the homes of the settlement’s first residents, the excavation uncovered three early seventeenth-century double-barrel wooden cisterns or privies outside the warehouse. Each had an exterior builder’s trench with artifacts that dated the construction of the feature, and well-preserved colonial artifacts in its interior fill which dated the contents to the early to late sev-

enteenth century. The team also discovered three seventeenth-century yellow brick structures, two oval artifact-filled cisterns and a massive rectangular yellow brick structure, interpreted to be a unique cistern form, measuring five by ten feet in plan, with an interior rectangular basin plastered with triangular tiles with a seven-course-thick, yellow-brick base.¹⁶ Its waterworn interior suggests that it held liquids, probably water. The yellow brick “cistern” was made of small (7 x 3 x 1 inch) imported rectangular yellow Dutch bricks, often used as ballast in trans-Atlantic voyages and for the construction of cisterns.¹⁷ It was sawed into quarter sections, boxed up for long-term storage, and archived in the warehouse of New York City.

Another unique find was the exposure of the surviving first course of a small (7.5 x 9.5 feet), dry-laid, stone foundation, discovered filled with a discarded, or rejected, shipment of 7,196 smashed clay smoking pipes, from two distinct pipe cash deposits in the small building—but with cross-mends between them that render them contemporary—representing two early eighteenth-century periods, postdating 1720. The early eighteenth-century pipe forms can be described as “ordinary” late seventeenth- to early eighteenth-century pipes of the type archaeologists find after the Dutch occupation period in Manhattan

(1664).¹⁸ Some, approximately 36 percent, are marked with the maker’s mark of “RT” for the Robert Tippet family, half from Bristol and half from London.¹⁹ The mass of the smashed pipe cash (99 percent unsmoked) of the over 7,000 broken pipes contained a minimum number of 882 complete pipe bowls, a discovery that represented the largest such find of colonial smoking pipes in North American historical archaeology.²⁰

The over forty-three thousand excavated and conserved Dutch, Native American, and British artifacts (now housed in the New York State Museum in Albany) included hundreds of impressive exhibition-quality specimens. Of note, while the discoveries included no early colonial coins, we did discover a very early token, a copper alloy commemorative token, with the date of 1590 on one side. On the obverse, the token is embossed with six bunched arrows in a fist representing

¹⁴ Melba Myers, “Conservation and Data Processing,” in Grossman, *Excavations Report*, III: 1–14.

¹⁵ Grossman, “Section B, The Earliest 1640–1650 Features and Deposits,” *ibid.*, X: 12.

¹⁶ Grossman, “Summary of Results,” X: 25.

¹⁷ *Ibid.*, X: 27–29.

¹⁸ Dallal, “Pipes,” Plate V I-11.

¹⁹ *Ibid.*, VII: 39–40.

²⁰ *Ibid.*, VII: 39.

Pipe smoking was ubiquitous among men in the seventeenth century. Johann Carl Loth, called Carlotto Bavarese, “Old Man Lighting a Pipe” (c. 1660). Art Institute of Chicago.



six of the united provinces of the Dutch Republic.²¹ The token, issued by Prince Maurice of Nassau to commemorate his election as stadtholder of the city of Utrecht, was discovered wedged in a crevasse in the cobblestone floor of Heermans' warehouse.²² The token must have arrived as an heirloom brought from the Netherlands, because its date preceded the founding of the Dutch settlement by some thirty to forty years.²³

The Chronological Framework: Archaeological and Archival Time Markers. The dates of the features and colonial deposits were based predominantly on establishing the initial manufacture date for each category of ceramics, glass, and ceramic smoking pipes recovered through controlled natural stratigraphic excavation. Early glass from the seventeenth century was difficult to date, and it was only with the arrival of diagnostic glass types in the eighteenth and nineteenth centuries that dateable types become recognizable. The one secure time marker for early glass was the initial appearance of lead glass after 1676. All glass was tested for lead by scanning each fragment with ultraviolet light which caused the specimen to glow if lead is present.²⁴ No dated colonial coins, other than the early token, were recovered, so no coin dates were available. The shortage of coinage in the colony lasted into the late 1640s. "In 1649, Stuyvesant and his council suggested importing ten thousand guilders in coin from the Dutch Republic to reduce the use of *sewant*" or wampum, for barter.²⁵

The laboratory analysis of the dated artifacts permitted the reconstruction of five major periods of occupation, of which the last two were ephemeral in nature and too small, in both artifact and seed count, to warrant comparison with earlier botanical samples. The three primary comparative periods spanned from the first third of the seventeenth century, through to the first quarter of the eighteenth century. These three-time markers were demarcated first by the earliest post-1633, early-seventeenth-century finds; then by post-1680, late-seventeenth-century deposits; and finally by post-1720, early-eighteenth-century, contexts. As mentioned, the subsequent post-1795 and post-1844 features contained too few seeds for viable comparison. Of the 43,318 predominantly colonial artifacts excavated, over 50 percent derived from the first three periods

of the deposits dating to between the first quarter of the seventeenth and first quarter of the eighteenth centuries, post-1720. In other words, these three early periods overlapped with the social and economic transition from a Dutch cultural focus to a British-dominated society.

It is important to highlight the assigned date of 1633 for the initial occupation of the site. This revised assessment is based on the availability of new comparative materials from Jamestown, Virginia; the Netherlands; the international comparisons with dated Dutch pipe forms; from seventeenth-century legal documents over construction disputes over early structures along Pearl Street after 1633;²⁶ and from the dates of recovered colonial artifacts from tightly chronologically controlled farmstead sites in the hinterland of the rural Virginia near Jamestown.²⁷ Multiple lines of archaeological evidence from the earliest deposits and features at the Pearl Street site, come together to support an early seventeenth-century start date. These clues included post-1630-era pipe bowl forms, decorative tile motifs including a corner bull's, or spider's, head, a corner design element now dateable to a revised *Terminus post quem* ("limit after which" or TPQ) of the 1620s, and finally, initial manufacture dates for Dutch earthenware and delftware with TPQ dates as early as post-1600, and some with early earthenware types with TPQ dates of post-1580.²⁸

Finally, in addition to these early artifact TPQs, or initial manufacture dates, an early post-1633 initial occupation date along Pearl Street is supported by the recovery of eighteen post-1620 and post-1630 glass prunts or roemers (raised relief-molded decorative adornos in the form of raspberries on the stem of Dutch and German goblets) from the earliest seventeenth-century Components (a) Component IA, foundations and (b) early seventeenth-century features, IIA, all restricted to the early seventeenth century. The *Corning Journal of Glass Studies* published two technical benchmarks, or time markers, concerning the early-seventeenth-century antiquity of prunts: "A bell-shaped foot was introduced about 1620 and the prunts were formed as raspberry or lion's head masks from about 1630."²⁹ Similar glass adornos have been recovered from tightly dated shipwrecks from the first quarter of the seventeenth century.³⁰

The early artifact dates for the initial phase of occupation are supported by some

of the few surviving colonial documents from early seventeenth-century litigation concerning disputes over early construction projects in Lower Manhattan in the vicinity of Pearl Street, prior to the date of the litigation in 1639. One surviving legal brief recorded the construction of one of several tobacco barns which measured, in one case, one hundred feet in length, twenty-four feet in width, by ten feet high.³¹ These early storage structures were the focus of commercial activity in the colony. "Already in 1638, the provincial government appointed the first tobacco inspectors . . . to supervise the quality of the New Netherland tobacco."³²

The earliest characterizations of their residences described their homes being made from "hewn planks, with gardens enclosed behind and with the sides with hewn planks."³³ Windmills were built in lower Manhattan early on. There was a horse mill in 1626, and a wind-powered mill sawed timber for the ship *Nieu Nederland* in 1630 and 1631.³⁴ Specific to the Pearl Street block, Innes suggested in 1902 that within a few years after 1633 "they extended easterly along Pearl Street [to become] the seat of trade for the towne

²¹ William I. Roberts, "Artifact Analysis: Small Finds," *Excavations Report VIII*: 1–27; Token Provenience: Strata Group-1A, Component 6, Context 135, VIII: 19, Plate VIII-2.

²² Augustijn (aka Augustine) Heerman' arrived in New Amsterdam in 1633, Jameson, *Narratives*, 289.

²³ Roberts, "Small Finds," VIII: 16–18; Plate VIII-2.

²⁴ Joseph Diamond, "Artifact Analysis: Glass," *Excavations Report*, VI-16.

²⁵ Jacobs, 126, 108.

²⁶ A. J. F. Van Laer, *New York Historical Manuscripts; Dutch Vol. I. Register of the Provincial Secretary, 1638–1642* (Baltimore, 1974), 111; Innes, *New Amsterdam and its People*, 5, 45.

²⁷ W. M. Kelso and B. Straub, "1996 Interim report of the APVA excavations at Jamestown" (Virginia: Association for the Preservation of Virginia Antiquities, 1997), 14; Seth Mallios, *At the Edge of the Precipice: Frontier Ventures, Jamestown's Hinterland, and the Archaeology of 44JC802* (Richmond, VA, 2000), 50, Figure 58; Grossman, "Human Landscape Interactions," 81.

²⁸ Ibid.; Nancy A. Stehling and Melba Myers, "Artifact Analysis: Ceramics," *Excavation Report*, V-1-V48.

²⁹ Cf. *Journal of Glass Studies X* (Corning, 1986), 114 and XI, 43. Leeds 1961 exhib. Cat. No. 33.

³⁰ Diamond, "Artifact Analysis: Glass," *Excavations Report*, VI-0-VI-12; Jane Klose, *Identifying Ceramics: an introduction to the analysis and interpretation of ceramics excavated from 17th to 20th century archaeological sites and shipwrecks in the south-western Cape* (Cape Town, 2007), 35, 135; Grossman, *Indices*, 80–84.

³¹ Jacobs, 126, 179.

³² Ibid.

³³ Jameson, *Narratives*, 94.

³⁴ Jacobs, 129.

and the focus of shoreline commercial activity.”³⁵ The brewery and tavern were in place by 1631, and “a mean barn” of a church was erected by 1633.³⁶

In addition, a 1639 affidavit before Secretary Van Tienhoven, who lived within the investigated block, specifically referred to the extent of buildings in the 1630s.³⁷ The brief listed the construction of a bake house, a church with house and stable in the rear, a large shed for both buildings, a goat house, as well as other structures.³⁸ His home (Building A) was excavated and reconstructed, like Pompeii, by carefully removing a parallel series of lineal stains in the buried early seventeenth-century red sand of the colonial surface, to reveal the negative impressions of horizontal hewn wooden beams of the early seventeenth-century basement/first-floor framework. The excavation also revealed the stratigraphically associated, early seventeenth-century shell-mortared stone foundations of his home, as well as two contemporary early seventeenth-century artifact-filled double-barrel wooden cisterns (one covered by an eighteenth-century wall), and what has become a somewhat famous find, a well-preserved buried rope basket immediately outside Van Tienhoven’s home.³⁹

Based on these new archaeological and archival lines of evidence over the revised age determinations and antiquity of the earliest colonial artifact from the site, together with the dates established by early seventeenth-century legal documents describing construction initiatives along the street detailed by Van Laer (1974), I argue that the block along Pearl at Whitehall was first occupied over a five-year period between 1633 and 1638.⁴⁰ These lines of chronologically controlled archaeological and historical evidence also provide a clear three-phase, diachronic, or sequential framework for the analysis of the environmentally significant changes in plant diversity between the early seventeenth and early eighteenth centuries (figures 2 and 3).

The Archaeological and Ethnobotanical Plant Record: These colonial-era shifts in artifact ratios through time were also paralleled by marked, quantifiable, changes in the ratios, or relative proportions, of plant remains (mostly in the form of charred seeds) from the three definable periods of occupation (early-seventeenth to early-eighteenth century) from which adequate seed samples were recovered. Samples of soil, from undisturbed and well-dated deposits were “floated” to recover the seeds with a custom-designed water tank system with circulating sub-

merged jets of water and air bubbles. The water jets broke up the soil matrix, and the air bubbles helped separate and float the seeds to the surface to be skimmed off with fine sieves. Each batch of recovered seeds was sorted under a microscope to separate and identify seeds to the genus and species levels by stratigraphic association and date.

The diversity and relative numbers of seed samples were rendered as three-dimensional serrations, or statistical cross-tabulations of shifting plant types between the three major temporal and analytical sample groups: early seventeenth-century (post-1633) deposits, late seventeenth-century (post-1680) contexts, and the early eighteenth-century (post-1720) contexts.⁴¹ The early seventeenth-century deposits coincided with the period of Dutch rule. The late seventeenth-century sample overlapped with the post-1664 takeover of the colony by the English.⁴²

A total of 2,085 plant specimens (mostly charred seeds) were recovered from the excavation of the Dutch settlement, of which 1,457, or about 70 percent, were identified to the genus or species level by Lisa Panet of Greenhouse Consultants Inc. A total of twenty-nine distinct seed types

were identified from the entire sample from all periods represented.⁴³ A total of 117 distinct seeds, comprising twelve different plant types, were identified in the earliest, post-1633, early seventeenth-century sample. Ten new varieties, for a total component seed count of seventy-three, were introduced in the second half of the seventeenth century, and then three were added for the later early eighteenth-century sample (figure 2). Some were represented by single seeds; others, such as was the case with raspberries, were represented by 1,175 specimens from one context.⁴⁴

³⁵ Van Laer, 111; Innes, *New Amsterdam and Its People*, 5, 45; Grossman, “Indices,” 81.

³⁶ Innes, 3, 58; Stokes, *Iconography*, 267.

³⁷ Jacobs, 66. This practice of sanctioned civil litigation was in place early on. Jacobs wrote: “Already in 1625, the customary practices in civil law in the Netherlands were established in New Netherland.”

³⁸ Van Laer, 108–109.

³⁹ Diane Dallal, “Van Tienhoven’s basket: Treasure or Trash?” in *One man’s trash is another man’s treasure*, A. G. A. van Dongen, ed. (Rotterdam, 1996), 215–24.

⁴⁰ Van Laer, 111; Grossman, *Indices*, 80–84.

⁴¹ Grossman, *Indices*, Tables 8.4, 8.5 and 8.6. See figures 1, 2, and 5.

⁴² Jacobs, 99.

⁴³ Grossman, *Indices*, 90, Table 8.2; see Figures 1, 2 and 5.

⁴⁴ *Ibid.*

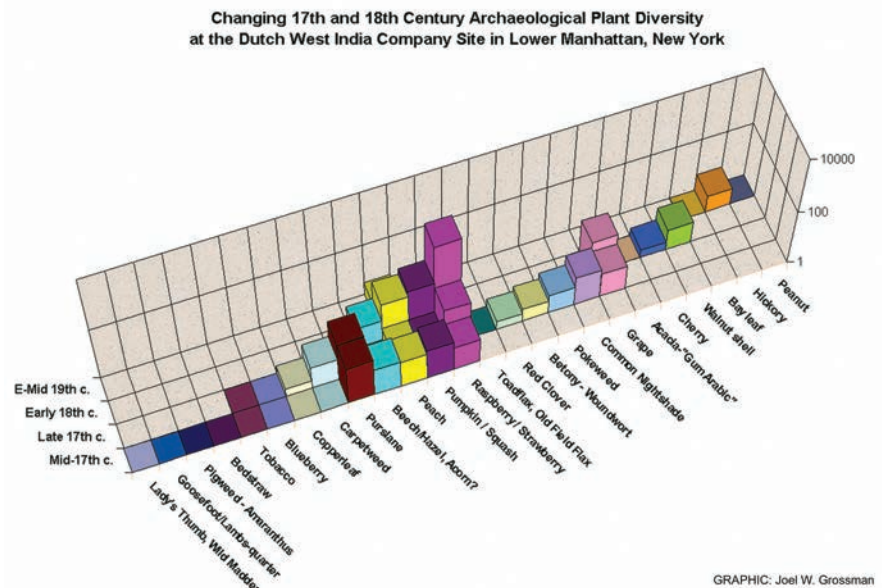


Figure 2. 3D cross-tabulation plot of changing distribution of tabulated plant types by time from archaeologically recovered, identified, and dated historic seeds from the original colonial surface, colonial building foundations, and from the contents of double-barrel wooden cisterns, and features of the seventeenth-century Dutch West India Company (WIC) site. After Grossman, *Human Landscape Interactions*, Figure 2:1462; See Grossman, “Indices.”

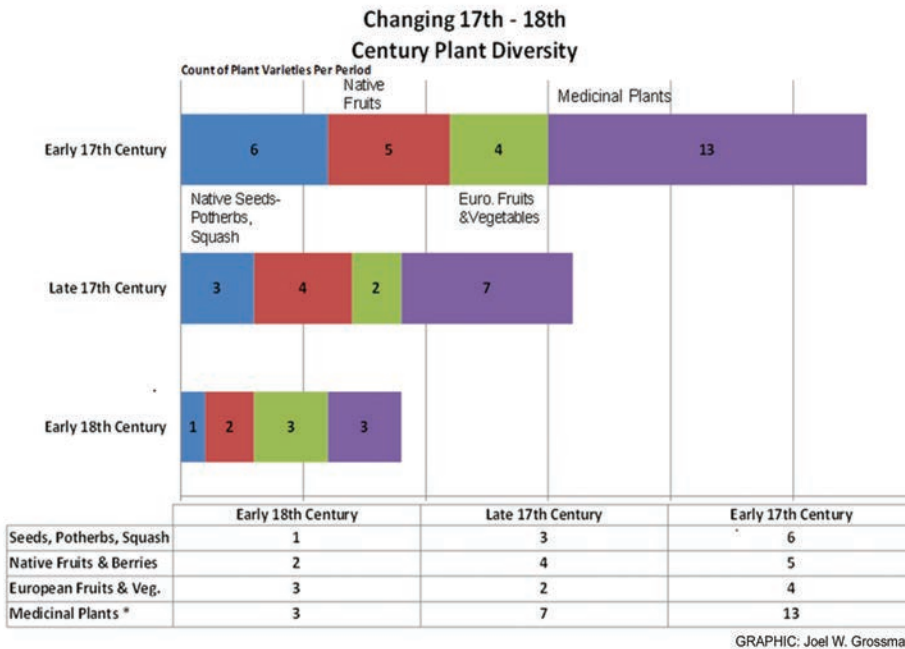


Figure 3. Two-dimensional cross-tabulation plot detailing diminishing plant diversity between the early seventeenth and early eighteenth centuries. The quantified comparisons document a 38-percent drop in plant diversity between the early seventeenth and late seventeenth centuries (post-1680) and a nearly 70-percent drop in plant diversity by the early eighteenth century (post-1710). (After Grossman 2011: Table 8.2; courtesy of SUNY Press). Native seeds and medicinal plants showed the sharpest reductions. Medicinal plants dropped from thirteen to three by the early eighteenth century. Native seeds and potherbs dropped from six varieties down to one over the same period. (See Grossman 2011). These diachronic patterns of species reduction suggest the local environment of lower Manhattan (below Canal) had undergone significant habitat impacts, species loss and ecosystem degradation by the middle to the end of the seventeenth century.

In general, these quantified trends showed a 38-percent decrease in species diversity between the earliest period and the second, post-1680 sample, and an even sharper decrease of about 70 percent by the early eighteenth century (figure 3). The identified samples were tabulated and entered in a computer database listing the coordinates, artifact associations, and the most recent dates of the associated diagnostic artifacts. The ascribed dates for each of the botanical samples were established on the identified age of the latest artifacts excavated in association with each sample of recovered charred seeds.

Together, these identifications and comparisons provided critical new evidence to characterize the changing environment and shifting plant communities of the Dutch and Native American waterfront residents of the Pearl Street block. The earliest seventeenth-century seeds, from the post-1633 sample, revealed that except for peach pits only indigenous cultigens and native and foreign “weed” types could be identified (see figure 2). The early seventeenth-century flotation sample yielded a total 117 seeds, from thirty-eight different contexts representing nineteen plant types, and they could be identified to the species or genus level (after Grossman 2011: 90, Table 8.4). Fifteen were food cultigens, and thirteen represented medicinal plants. The only identified cultigens in the earliest post-1633 deposits were—except for peaches (peach orchards are documented in New

Netherland in 1639)⁴⁵ and one specimen of citrus—borrowed from exploited indigenous plants, known to archaeologists as the Eastern Agricultural Complex.⁴⁶ Among the plant members of this constellation of native foods are included pumpkin, acorn, strawberry, raspberry, and tobacco. Of this complex, acorns, strawberries, and raspberries continued and increased in each subsequent dated sample until the first decade of the eighteenth century. Seeds of chenopods, *Amaranthus* or pigweed and *Chenopodium* or goosefoot, were both part of the Eastern Agricultural Complex, and were well represented in the early seventeenth-century sample (see figure 2). Tobacco seeds were recovered from two seventeenth-century deposits; one from the early fill of a double-barrel wooden cistern (Component 13), and from the fill of a seventeenth-century rope bucket, or cask, cut into the lowest red sands of the site (Component 38).⁴⁷

As a footnote to some of the high-profile plants recovered, the presence of tobacco from exclusively seventeenth-century contexts—with none from later deposits—is consistent with colonial accounts of the early economy and practices of the Dutch tobacco traders of New Netherland. It is also consistent with accounts of Mr. Heermans, who operated the colony’s first warehouse, discovered as one of the major finds of the excavation. The Dutch tried to replicate the abundant local supplies of indigenous tobacco grown by the Native Americans on Long Island beginning with

the tenure of Governor Minuit in 1630, but with little success compared to the accomplishments of Dutch planters in Brazil and Guyana.⁴⁸ Instead, the Dutch residents and merchants of New Netherland got their tobacco via barter with Native traders from Long Island, English settlers in New England, and through a lively coastal trade with the English colonists of Virginia.⁴⁹ Between 1641 and 1664, Dutch merchants invested in fourteen voyages of trade to English Virginia and “maintained a coastal fleet of sloops to bring ‘Virginia Leaves’ to New Amsterdam.”⁵⁰ The excavated early seventeenth-century warehouse of Augustine Heermans, served as a critical

⁴⁵ Jacobs, 107.

⁴⁶ William Cronon, *Changes in the Land, Indians, Colonists, and the Ecology of New England* (New York, 1953); Alfred Crosby, *The Columbian Exchanges: Biological and Cultural Consequences of 1492*, forward by Otto van Mering (Westport, CT, 1972); Paul A. Delcourt and Hazel R. Delcourt, *Prehistoric Native American Ecological Change: Human Ecosystems in Eastern North America Since the Pleistocene* (New York, 2004); William M. Denevan, “The Pristine Myth: The Landscape of the Americas in 1492,” *Annals of the Association of American Geographers* 82, no. 3 (1992), 369–85; J. E. Hammett, “Ethnohistory of aboriginal landscapes in the southeastern U.S.,” in Paul E. Minnis and Wayne J. Elisens, eds., *Biodiversity and Native America* (Norman, OK, 2001), 248–99; G. M. Day, “The Indian as an Ecological Factor in the Northeastern Forest,” *Ecology* 34 (1953), 2: 329–46.

⁴⁷ Grossman, “Indices,” 88, Table 8.2.

⁴⁸ Van Cleef Bachman, *Peltries or Plantations: The Economic Policies of the Dutch West India Company and New Netherland, 1623–1639* (Baltimore, 1969), 63.

⁴⁹ Leo Herschkowitz, “Block History” in *Excavations Report*, vol. II: 1–38.

⁵⁰ Oliver A. Rink, *Holland on the Hudson: An Economic and Social History of Dutch New York* (Ithaca, 1998), 8.

entrepôt for both this transatlantic and intercoastal trade. This attribution is based on surviving archival records, Heermans described himself as “the first beginner in the Virginia Tobacco trade.”⁵¹

The change to the late seventeenth-century botanical inventory, a sample of seventy-three specimens from thirty-two discrete stratigraphic contexts, represented the introduction of three new plant varieties (carpetweed, flax, and woundwort), and a reduction in plant diversity of over 57 percent from the previous sample.⁵² The subsequent early eighteenth-century sample was marked by the introduction of two new plant varieties (cherry and Acacia) out of a total of fifteen plants and a drop-off of six plants; it represented an additional 56-percent decline in diversity from the late seventeenth-century plant inventory.⁵³

Finally, the chronological contrasts between the early seventeenth- and early eighteenth-century samples excavated from the colonial site document an approximate 70-percent drop in species diversity in less than a hundred years.⁵⁴ This post-1664 period of English influences was marked by the continuity of several cultigens from the earliest early seventeenth-century occupation phase, and by the introduction of new plant types. Of the initial weed varieties, purslane and carpetweed continued and were predominant, while the indigenous grains of *Amaranthus* or pigweed, and *Chenopodium* or goosefoot, dropped out of the sequence after the initial post-1633 period, as did citrus.⁵⁵ Of the earliest food sources, pumpkins, acorns, peaches, strawberries, and raspberries continued to predominate in the sample into the eighteenth century. In addition, the transition to English rule coincided with the recovery of nine new plant types: clover, beans, pokeweed, black nightshade, flax, sedge, mint or catnip, and grape.

In sum, the archaeological plant record from the seventeenth-century Pearl Street excavation showed five major patterns, or quantified trends, within the multi-century record of changing plant diversity:

1. For the earliest post-1633 period, the plants represented an equal mix of indigenous varieties and those from, or possibly from, Europe.

2. This archaeological botanical evidence, combined with the ethnobotanical and ethno-historical record

suggests that many of the identified colonial plants were not only not simply “weeds,” but instead functioned as foods, dyes, and medicinal plants.

3. The recovered plant varieties indicated emergent—especially for the earliest early seventeenth-century period—open, sun-drenched, chemically altered, and disturbed . . . often *humanly disturbed*, or anthropogenic habitats and environmental conditions, commonly referred to as “waste ground.”

4. The range of identified plants showed significant, order of magnitude, drops in the diversity of plants between the early seventeenth century, and the early eighteenth centuries. The quantified totals by period showed a 38-percent decrease between the early and late seventeenth centuries, and an even sharper decrease of about 70 percent by the early eighteenth century.

5. The marked shifts, or drop-offs, in relative plant diversity between the early seventeenth- and early eighteenth-century samples suggest that the local urban setting had undergone profound environmental transformations by the early eighteenth century.⁵⁶

Thus, the recovery of preserved seventeenth-century plant remains from the colonial Dutch settlement buried beneath 1984 Manhattan presented significant new insights into the diversity and nature of the seventeenth- and eighteenth-century environments of New Netherland. None of the seventeenth-century plants excavated from lower Manhattan suggest an ornamental flower garden. Except for the ubiquitous peach pit, all the plants from the first half of the seventeenth-century deposits were dominated by adopted indigenous plants and by the introduction of colonizing European “weed” exotics into the local environment. The dated archaeological record also showed that the indigenous varieties dropped out of the archaeological sequence, first by the end of the seventeenth century, and then completely after the English takeover of New York in the mid-eighteenth century (figure 3).

New Archival Sources and Changing Horticultural Patterns Through Time: The archaeological and botanical evidence from the 1984 excavation and the

quantified comparisons between the dated artifacts and plant specimens documented chronologically significant changes in plant diversity through time across the early New Netherland landscape. The post-1680s shifts in artifacts documented by the stratified chronology at the Dutch West India Company site can now be seen to be paralleled by new archival evidence about changes in garden design and function between the early and late seventeenth centuries in Holland.⁵⁷ It’s an important story.

In addition, there was at the time of the excavation little available comparative archaeological or archival data, or literature, in English dealing with the ethnobotany of Dutch horticulture in the Americas in general, and design of colonial Dutch gardens. As late as the late 1990s, ten to fifteen years after the excavation at Pearl Street, our understandings of Dutch agricultural history were hampered by a paucity of scholarly translations from Dutch to English.

The two exceptions were the availability of mid-seventeenth century works by Adrian van der Donck with his 1655 *Description of New Netherland*, an official response to an earlier report to the Dutch West India Company by Van Tienhoven, who resided within the Pearl Street block. Of relevance to this study, Tienhoven’s 1650 report before Dutch West India Company officials in Amsterdam listed the contents of gardens in New Netherland about twenty or thirty years after, I argue, the initial occupation of Pearl Street. In 1856, New York historian Edmund B.

⁵¹ Innes, *New Amsterdam and its People*, 54, 281.

⁵² Grossman, *Indices*, 88, Table 8.2; see Figures 1, 2 & 5.

⁵³ *Ibid.* See Figures 2 and 3.

⁵⁴ *Ibid.*, 90; Table 8.2; Figure 2.

⁵⁵ Sensitivity to the nutritional and cultural significance of chenopods as a key Native American food source—with deep roots in the archaeological record—is not new in American anthropology. It can be traced back to Safford in 1917 with his introduction of Pre-Inca Andean grain, quinoa, to the scientific community, and J. D. Sauer’s call in 1950 to reclassify American chenopods of *Amaranth* and *Chenopodium* as culturally critical grains in “The Grain *Amaranth*: a Survey of Their History and Classification,” *Annals of the Missouri Botanical Garden* 37 (1950): 561-632; see also W. E. Safford, “A forgotten cereal in ancient America,” *Proceedings of the Nineteenth International Congress of the Americanists* (Washington, D.C., 1917).

⁵⁶ Grossman, *Indices*, 90; Tables 8.2 and 8.3, Figure 5.

⁵⁷ John Dixon Hunt, ed., *The Dutch Garden in the Seventeenth Century* (Washington, D.C., 1990); John Dixon Hunt, Florike Edmond, Paul Hoftijzer, and Robert P. W. Visser, eds., *Carolus Clusius: Towards a culture history of the Renaissance naturalist* (Amsterdam, 2007), 9-48; De Jong 1990, Oldenburger-Embers 1990).

O’Callaghan quoted Tienhoven as follows: “made and planted in season all sorts of potherbs, particularly parsnips, carrots, and cabbage, which bring great plenty [to] husbandman’s dwelling . . . whatever else is normally found in a cabbage or kitchen garden.”⁵⁸ Until recently, this brief listing, together with Van der Donck’s writings, were the only descriptive materials in English pertaining to gardens from Dutch literature of the seventeenth century, which were limited in their characterizations of the interior makeup and design of a seventeenth-century garden.

In 1989, however, an important breakthrough for English-speaking scholars came about as the result of an international forum on seventeenth-century Dutch gardens at Dumbarton Oaks in Washington, D.C., which was published in English in 1990. Organized by James Dixon Hunt and hosted in English, the symposium brought together leading scholars on the history, function, and external influences affecting the changing patterns in sixteenth- through eighteenth-century Dutch garden design.⁵⁹

The first manifestations of elaborate country homes and cursively designed

gardens in Holland did not begin to flourish until the draining of lowland swamps in the middle of the seventeenth century created the availability of new reclaimed lands. The first elements of elaborate country living in ornately landscaped country estates began to flourish only after the end of the Eighty-Years’ War in 1648, when country houses and gardens were laid out and improved everywhere in the province of Holland.⁶⁰ This initial, but short-lived, stage in the development of more elaborate garden designs was truncated in 1672 when “many country houses were destroyed by the invading troops of Louis XIV.”⁶¹ Only after 1672 were “generations of burgers and merchants [able] to invest large amounts of capital in the embellishment of their country estates.”⁶²

The advent of ornately and cursively designed Dutch gardens, and garden art, was spurred by two major influences in the late 1670s. One was the rise of William III to the rank of Stadholder in 1674 and his construction of ornate gardens at his country-hunting lodge between 1679 and 1684.⁶³ Inspired by the court, other Dutch Stadtholders and members of the

wealthy merchant class began to emulate this transformation of farm-like country retreats into elaborate estates with ornately landscaped gardens, but only after 1680.⁶⁴

The second influx of innovative ideas, coincident with the rise of William III, brought about influences by, and copies of, French garden art, technology, and patterns of garden design in the 1670s and 1680s. William III sent members of the court to study in France and bring back to Holland French innovations in fountain design and technology, including the French practice of multicolored flower beds, hot houses, the introduction of trop-

⁵⁸ E. B. O’Callaghan and B. Fernow, trans. *Documents Relative to the Colonial History of the State of New York*. 15 vols. (Albany, 1856), 1: 369.

⁶⁰ John Dixon Hunt, “‘But Who does know what a Dutch garden is?’: The Dutch Garden in the English Imagination,” in Hunt, *The Dutch Garden*; See also John Dixon Hunt and Erik de Jong, “The Anglo-Dutch Garden in the Age of William and Mary,” *Journal of Garden History* 8 (1988), 2–3.

⁶¹ Erik de Jong, “For Profit and Ornament: the function and Meaning of Dutch Garden Art in the Period of William and Mary,” in Hunt, 13–48.

⁶² *Ibid.*, 32.

⁶³ *Ibid.*, 33.

⁶⁴ *Ibid.*, 37.

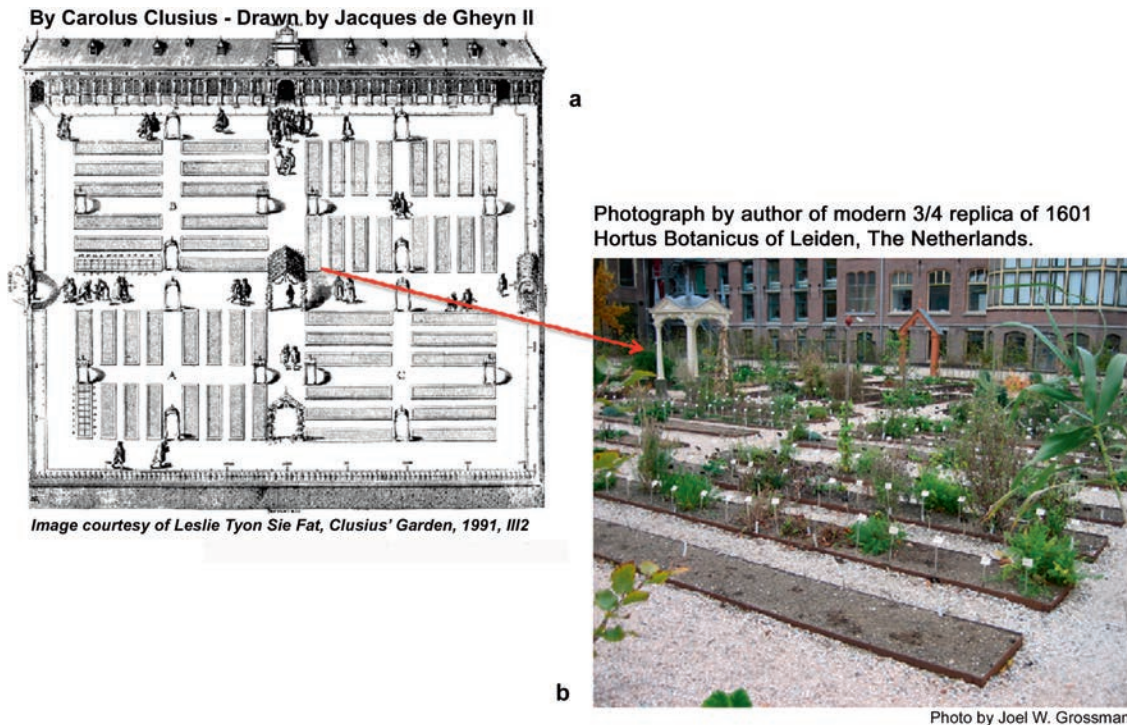


Figure 4. a) Drafted historic template for an early seventeenth-century, four-part Dutch garden, the Hortus Botanicus of the University of Leiden, designed in 1601 by the botanist and physician Carolus Clusius. Plan of Clusius’s 1601 garden was drawn by Jacques de Gheyn II (Tjoin Sie Fat, 1991, III 2; Edmond et al., 2007). **b)** Photograph by author of one quadrant of the modern ¾ replica of Clusius’s Hortus Botanicus at the University of Leiden in 2009. Following the early template, the kitchen garden served not for decoration or leisure, but instead as a mixed, four-part—orchard, berry, vegetable, and herb/medicinal—garden.

ical plants, and French patterns of garden design with diagonal subdivisions; these were adopted by the Dutch between 1680 and 1685.⁶⁵

Until the reign of William III in the 1680s, gardens were small, fenced-off enclosures symmetrically subdivided to accommodate a vast diversity of domestic and foreign plants. The Dutch word for garden, *tuin*, means “fenced in” and “enclosed space.”⁶⁶ “The term most frequently applied to them was “little,” and their features were a series of self-contained areas and what in 1633 John Evelyn called “close-walks.”⁶⁷

A breakthrough in the availability of original texts, as translations of otherwise unavailable Dutch works in botanical and ethnobotanical history, came about as the result of the modern release of a pivotal late seventeenth-century book, *The Dutch Gardener* by Jan van der Groen, originally published in Holland in 1669.⁶⁸ His work was, in turn, based on the original teachings and templates of Carolus Clusius, botanist and physician, who designed the *Hortus Botanicus* of the University of Leiden in the beginning of the seventeenth century.⁶⁹ As the following article by Peter Rose illustrates, *The Dutch Gardener* is part of a collected volume containing a cookbook with critical culinary information, with tasty seventeenth-century recipes offered in English.⁷⁰

While the excavation at Pearl Street identified the range of colonial plants present in Lower Manhattan in the seventeenth and eighteenth centuries, the Van der Groen book both listed appropriate plants for a proper Dutch garden, and following the templates of Clusius nearly a century before, defined the internal layout and composition of a small four-part garden. This important translation of Van der Groen, described in detail how a proper Dutch garden was to be subdivided up into quadrilateral sections and separate beds, what plants were appropriate for planting where, and for what purposes. Oldenburger-Ebbers translated one of Van der Groen’s proscriptions for the layout of a Dutch garden, as follows:

The square or rectangular area was first divided into four equal parts by two crossing paths. Inside the enclosing fence or wall was a narrow border and a path. The four parts were then divided into a pattern of rectangular beds. Part of the area might

also be turned into a flower garden or ornamental arrangement of box. Some garden plans indicate also that the French pattern of division was sometimes used. The area was first divided by two diagonals and then into rectangular beds. The four respective divisions of the kitchen garden were usually devoted to brassicas and roots, salad plants, medicinal herbs, and aromatic herbs.⁷¹

He cited Van der Groen’s list to document some of the most cultivated and used plants in seventeenth century Holland. It included six hundred species of both domestic and imported exotics, and included apple, pear, sweet cherry, Morello cherry, plum, peach, apricot, almond, dwarf Russian almond, black mulberry, quince, medlar, dwarf medlar, black walnut, hazel fig, raspberry, red currant, and gooseberry. Other core plants in seventeenth century Holland included: “orange, lemon, lime, fig, prickly pear, pomegranate, olive, oleander, common myrtle, laurel, strawberry tree, carob tree and Judas tree.”⁷²

The list was diverse and international. Some plants came from the Netherlands, others from North, Central, South America, India, Indonesia, and the Cape of Good Hope. North American plants adapted well to Holland, and included the sunflower, Canadian lily, Rocky Mountain Red Cedar, and evening primrose. However, while the Dutch may have been fond of importing exotics and souvenirs from foreign trading posts, they could not successfully cultivate tropical plants until hothouses were introduced into Holland after 1685.⁷³

Oldenburger-Ebbers’ research into seventeenth-century botanical sources went on to distinguish the difference between the use and distribution of pre-1680 multi-crop “orchard” versus their subsequent manifestation as large scale installations with long rows of widely spaced monocrop fruit trees. In essence, as I illustrate with the 3D reconstruction, the early seventeenth-century orchard was a mixed, four-part design, with a fruit, berry, vegetable, and potherb/medicinal amalgamation plants (see figure 5). To quote Oldenburger-Ebbers, “The seventeenth-century orchard was fruit and berry garden; alongside fruit trees, there were berry bushes and grapevines. The orchard was usually fenced in a square or rectangle. . . . For the boundary of the orchard, Van der Groen advised specific

species, including alder or rowan,” and recommended that for “fragrance in the garden, chamomile was planted by arbors and along walks.”⁷⁴

In conclusion, the preserved plant remains found in association with dated archaeological artifacts from the undisturbed, naturally stratified, colonial deposits discovered at Pearl and Whitehall Streets have emerged as key environmental time capsules, and ecological indicators of environmental change, for the reconstruction of past environmental conditions and local habitats. The identified shifts in the relative proportions of dated plant varieties suggest that profound environmental change or trauma appear to have been well underway during the earliest, post-1633 period (figures 2 and 3). If what the quantified archaeological data suggest is indeed the case, they imply that by the time of the late eighteenth and nineteenth centuries, when European and American naturalists began to publish inviting descriptions and paint romantic landscapes promoting the beauty of eastern North American environmental conditions, the habitats of lower Manhattan had been already drastically changed from pre-contact conditions. The implications are not good for those using historic botanical descriptions by eighteenth- and nineteenth-century naturalists to reconstruct the environmental characteristics, and the range of plant communities, indigenous to the former colonial landscape. Together, the archaeological and ethnobotanical evidence (figures 1, 2, and 3) strongly suggests that as early as the second quarter of the seventeenth century the environment of the colonial New York region had long since ceased

⁶⁵ Ibid., 40.

⁶⁶ Carla Oldenburger-Ebbers, “Notes on Plants Used in Dutch Gardens in the Second Half of the Seventeenth Century,” in Hunt, 164.

⁶⁷ De Jong, “For Profit and Ornament: the Function and Meaning of Dutch Garden Art in the Period of William and Mary, 1650–1702,” in Hunt, 15.

⁶⁸ Hunt, 182.

⁶⁹ Van der Groen, *Den Nederlandtsen Hovenier* (1969, repr Utrecht).

⁷⁰ Grossman, *Indices*, 98.

⁷¹ Peter G. Rose, *The Sensible Gardener: Dutch Foodways in the Old and New World* (Syracuse, 1989; paperback edition 1998); Peter G. Rose, *History on Our Plate: Recipes from Americas Dutch Past for Today’s Cook* (Syracuse, 2019).

⁷² Oldenburger-Ebbers, “Notes on Plants Used in Dutch Gardens in the Second Half of the Seventeenth Century,” in Hunt, 167.

⁷³ Ibid., 170.

⁷⁴ Ibid.



Figure 5. Early seventeenth-century mixed four-part fruit, berry, vegetable, and potherb/medicinal garden. The 3D computer model was rendered by the author over a six-month period, using the terrain- and landscape-modeling program *Vue de Esprit-4*. Each plant is an individual 3d.obj file that can be animated enmasse with other plants to sway in the wind. The 3D model shows the four-part layout and distribution of plants within a typical early seventeenth-century Dutch garden. The three-dimensional garden reconstruction is based on two lines of evidence: 1) the dated Pearl Street archaeological sample of changing seed diversity through time, between the early seventeenth and early eighteenth centuries, combined with, 2) the seventeenth-century templates of gardens by Clusius, as well as the descriptions of garden compositions and structures by Van der Gruen aka. *Gheyn II* (Egmond et al., 2007, 9–49).

to be, in the words of Thomas Aquinas, a pristine reflection of “God’s Order in the Universe.”⁷⁵

The 3D Model: Finally, with these three streams of information (archaeological, the dated Pearl Street samples of early seventeenth- and early eighteenth-century Dutch and British-era seeds, combined with figures 2 and 3, historical, and ethnobotanical insights into New Netherland garden design, and templates for early seventeenth-century gardens by Van der Groen), I had the opportunity to photograph the modern ¾ scale model of the original Hortus Botanicus of Leiden (figures 4a and 4b). This opportunity came about while presenting in Amsterdam on the Pearl Street discovery for the celebration of the 400th anniversary of the voyages of Henry Hudson—as part

of the Dutch Visiting Scholars program—sponsored by the Netherlands Institute of Heritage.

Building from these multiple lines of evidence, it became possible to construct in the computer, and populate with the appropriate plants, a viable 3D model of an early seventeenth-century Dutch garden (figure 5). Each plant is an independent 3D .obj file that can be animated, individually, or enmasse with other plants, to sway in the wind. Finally, the construction process for the 3D model mandated the need for “digital cultivation” and computerized tilling to portray the “plowed” soil as digital elevation models (DEMs) of each of the cultivated plots with ridges and furrows. The furrows also provided each computer model with raised ridges in rows, with intervening channels for irrigation.

The three-dimensional reconstruction

above shows the four-part layout and distribution of plants within a typical early seventeenth-century Dutch garden. It was laid out in life and in template by Clusius, the physician and botanist for the Hortus Botanicus of Leiden in 1601 (figure 4a and 4b). In accordance with his guidance and the later writings of Van der Groen, I rendered the garden as a relatively small, four-sided plot, divided in four quadrants, with intersecting interior paths and interior fencing, with fruit trees positioned along the corners and sides. Shade trees border the property, and grape vines are trellised along the sides of interior fencing, which separated the other functional areas (animals, people) within the larger Dutch compound. Corn was grown outside the garden boundaries.

⁷⁵ Martin Dauntton, ed., *The Organisation of Knowledge in Victorian Britain* (Oxford, 2005).