

Greenhouses, Orangeries, and Hothouses: A Survey of Chesapeake Forms and Functions, 1750-1825

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... Scorning there
The glassy penthouse of ignoble form,
High on Ionic shafts he bad it tower
A proud rotunda; to its sides conjoin'd
Two broad piazzas in theatric curve,
Ending in equal porticos sublime.
Glass roof'd the whole, and sidelong to the south
Twixt ev'ry fluted column, lightly rear'd
Its wall pellucid. All within was day,
Was genial Summer's day, for secret stoves
Thro' all the pile solstitial warmth convey'd.

This fragment from William Mason's romantic poem, entitled "The English Garden," and published in 1777, conveys something of the high regard in which greenhouses were held by members of the English and European gentry in the 18th century. By use of "secret stoves," their unnatural ability to banish winter's icy reach and to substitute a never ending "Summer's day" within their confines, appealed to both the whimsical and controlling aspects of the gardening mentality. Yet, clearly not all greenhouses were equal. Note the poet's disdain for the plain "glassy penthouse," and his admiration for the more elaborate structure -- columned and adorned with piazzas, porticos, and who knows what else.(1)

That this aesthetic pretension was in fact the major force driving the ascendant popularity of greenhouses in England in the 18th century -- with concerns about the actual functional capabilities of the structures as effective methods of preserving exotic plants playing a distinctly subservient role -- is borne out by the proliferation of picturesque greenhouses to match the equally romantic garden configurations in which they were set. Thus, in the words of one garden historian, "A greenhouse was built for the sake of architecture; it was an ornament for the landscape gardener, a toy house for the architect." And, "Since garden buildings were essentially frivolous, small and comparatively cheap, they became playthings for amateur gentleman architects as well as for established professionals, and they could look like classical temples, Palladian villas or, later, like tiny Gothic castles or Chinese houses."(2)

It was possible for the architectural and design aspects of the structures to outweigh the practical side of the equation because the horticultural goal of the structures was relatively limited in scope. Unlike most modern greenhouses, which really are more like conservatories in that they typically house plants year-round, greenhouses in the 18th and early 19th centuries were intended only to over-winter certain fragile plant varieties. This function is clearly enunciated in the many gardening books of the era. According to McMahon's *The American Gardener's Calendar* -- an influential source of gardening information that was owned by Thomas Jefferson, among others, and published in 1806 -- a "Green-house is a garden-building fronted with glass, serving as a winter residence, for tender plants [that] require no more artificial heat, than what is barely sufficient to keep off frost, and dispel such damps as may arise in the house." This is in stark contrast to the hot-house, which according to McMahon, required continual heat for the survival of the more delicate tropical flora housed there. As the activities of American gardeners, again emulating their English counterparts and models, became more ambitious -- in other words as they attempted to grow and protect an increasingly more exotic range of flowering plants and fruits -- then the need increased for structures that could attain and maintain a higher standard of climate control.(3)

These very different levels of rigor in maintaining a controlled climate were reflected in the design of the respective building types. Large glass windows and other related features aimed at allowing sunlight to enter and warm the building, and then to keep it trapped inside, were incorporated into greenhouse designs from the beginning. In addition, the use of a supplemental heat source -- in the form of a "stove," or a series of flues, running beneath the floor and/or within the walls, to convey hot air emanating from a fire box placed in an adjoining space - was apparently widespread as early as 1718, when Richard Bradley published his influential book, *The Gentleman and Gardener's Kalendar*. Bradley frankly was not a fan of such flue systems, and he lumped them into his larger criticism that greenhouses up to that time were generally poorly designed to protect plants. He pointed out that, "Green-Houses serve more for Ornament than Use: their Situation to receive the South Sun, is the only thing that seems to be regarded towards the Health of the Plants they are to shelter," and that, "sometimes where it happens that a Green-House has been well-consider'd in these Points, all is confounded by the Flues under it, which convey the Heat from the Stoves."(4)

Bradley's concern with the detrimental effect of flue systems is echoed and elaborated by Philip Miller, in his equally influential *Gardener's and Botanist's Dictionary*, first published in 1731 and reprinted in seven subsequent editions during his lifetime, as well as two more after his death in 1771. Miller concedes that such stoves were a high maintenance item and difficult to control, and that great care was needed to ensure that smoke would not leak out of the flues and enter the greenhouse space itself and harm the plants.(5)

Nevertheless, there is no doubt that sub-floor systems for distributing heated air were incorporated into a great many, if not the vast majority, of English greenhouses and hot houses, and they have been found in all but one of the admittedly small number of American greenhouses that have been investigated. In the 19th century, the development of hot water and then steam heating systems immeasurably improved the dependability of greenhouses, but there is no doubt that hot air stoves were successful when they were installed correctly and were conscientiously maintained. For example, a book published in London in 1807 by a builder by the name of George Tod, is a compendium of 26 greenhouses and hot houses

that he had built, all of which incorporate hot air heating systems featuring flues either positioned below the floor or adjacent to the perimeter walls.(6)

The standard greenhouse design called for large windows set into the south facing façade of the structure. But with hot houses, the greater heating requirement encouraged the greatest possible use of glass and slanting of the front wall to maximize solar gain. In the 1751 edition of his *Dictionary*, Miller argued that: “The most tender exotic plants ought to have their glasses so situated as to receive the sun's rays in direct lines as great a part of the year as possible: For which reason the stoves which have upright glasses in front and sloping glasses over them, are justly preferred.” Furthermore, it was strongly recommended that plants in a hot house should be placed within a recessed structure, filled with bark or other material that gave off heat as a result of decomposition, in order to keep the delicate roots sufficiently warmed. As the mania for pine apples, peaches, oranges, and other more delicate fruits became widespread in England in the second half of the 18th century, more and more hot houses - referred to as “pineries,” “peacheries,” “vineries,” and the like -- were added to existing greenhouses or incorporated into new designs. It was in the 19th century, by the way, that the name greenhouse began to be widely superseded by the term “orangery” - possibly reflecting a desire for a more specific, possibly tonier designation, like the other spaces just named.(7)

The recent scholarly interpretation of the significance of greenhouses has taken its cue from the symbolic role generally afforded them by period writers. From a variety of analytical constructs that privilege social, economic, Darwinian, and/or ideological perspectives, formal gardens and greenhouses have been interpreted as status markers of the highest order. Whether intended to reinforce social standing, to indicate economic affluence, to signify owners' mastery of ascendant fashion, to bolster the claims of gentry women to an increased sphere of influence, to serve as wasteful advertising, or to buttress the position of the elite in their age-old conflict with the lower classes, these buildings have attracted considerable attention as exotic expressions of social elaboration. But while considerable effort has been devoted to interpreting these structures according to one theoretical perspective or another, very little time has been spent on actually attempting to find and to record the characteristics of the greenhouses themselves. As a consequence, the published analyses all use virtually the same very short list of less than a half-dozen buildings and sites, and the interpretations remain both superficial and one dimensional.(8)

Only one Chesapeake greenhouse dating to the 18th century appears to survive in relatively complete form - the Wye plantation “orangery,” located in Talbot County, on the Maryland Eastern Shore. Another greenhouse survives as a ruin at Mount Airy, in Richmond, County, Virginia, while two non-extant greenhouses have been intensively studied -- George Washington's greenhouse at Mount Vernon in Virginia and the Carroll greenhouse at Mount Clare, in Baltimore, Maryland. The Mount Vernon greenhouse burned in 1835 and was reconstructed in 1950-51 on the basis of documentary evidence - such as an elevation prepared to secure a fire insurance policy -- and limited archaeological data, while the Mount Clare greenhouse was excavated successively by several groups of archaeologists beginning in the 1970s and extending over the last 20 years. In addition, evidence for sub-floor heating systems has been found at the Calvert site in Annapolis, and at Bel Air in Bowie, Maryland, although it is uncertain how those features relate to the associated structures. The earliest of these is the Mount Clare greenhouse, thought to have been built between 1760 and 1770, with the latest the Mount Airy greenhouse, built in 1798. It is this tiny collection of

structures and sites that has generally served as the basis for current interpretations -- which usually consist of attempts to compare the American evidence with the extensive literature pertaining to English and European greenhouses, followed by suppositions as to possible design influences and inferences about the builder's presumed intentions.(9)

One example may suffice to demonstrate the danger of such an approach. As it happens, the Lloyd family that owned and built the Wye greenhouse, the Tayloes of Mount Airy, and the Carrolls of Mount Clare, all share a degree of familial connection. This relationship has led a number of scholars to assume that direct communication between the branches of the family must have been at the heart of the process of designing these buildings, and at least in part serves as an explanation for their existence when such structures were believed to be so rare in the region. Some scholars even have argued that the presumed architectural similarities between the buildings were so striking as to support this conclusion - although, as we shall see, those similarities are superficial at best. A more serious and successful attempt to search for other greenhouses, both in the Chesapeake and other parts of America, suggests that these interpretations are inferential leaps that do not bear close inspection. Not only were a number of gardening books available that contained detailed descriptions of greenhouses and hot houses, but the number of such structures that existed appears to have been considerably greater than previously believed. Finally, the layout and architectural characteristics of the three structures do not appear to relate to any degree that argues for a linked design process.(10)

First, let's address the question of the rarity of greenhouses in 18th and early 19th -century America. In the Chesapeake, varying levels of evidence exists for several other greenhouses that are known to date before circa 1825. These include four largely extant structures -- at Dumbarton Oaks, in Georgetown, the District of Columbia, dating between 1805 and 1812, Oatlands, in Loudon County, Virginia, dating to 1810 (with a sloping glazed roof reflecting a greater commitment to capturing maximum sunlight), Eyre Hall, in Northampton County, Virginia, built in 1819, and at Battersea in Petersburg, Virginia, built in 1823. Other greenhouses from this period that are known primarily from documentary evidence include those at Westover and Greenspring, respectively the Byrd and Berkeley plantations along the James River, at Prestwould, in Mecklenburg County, Virginia, Bushrod Washington's new greenhouse and hot house at Mount Vernon, at Harlem in Baltimore, and at Hampton, in Towson, Maryland. A search of the online index of the Mutual Assurance Society of Richmond, Virginia, yielded an additional 10 greenhouses for the period 1803 to 1825 -- for a total of at least 20 greenhouses dating before 1825.(11)

The most cursory examination of secondary sources on gardening and architecture reveals evidence for a similarly suggestive number of greenhouses in other regions. Not surprisingly, given the concentration there of so many relatively wealthy families residing on landed estates, Philadelphia seems to have been home to a number of quite pretentious greenhouses. In 1760 the noted naturalist and botanical gardener, John Bartram, built a greenhouse on his property located just west of the city. Archaeological excavations at the site carried out in 1980 apparently revealed portions of the foundations of the structure. Long and narrow at roughly 10 by 40-feet, it matches well with the layout suggested by the various prescriptive sources. Thomas Jefferson described the greenhouse that he saw at the Woodlands estate of William Hamilton, located outside of the city along the Schuylkill River. In contrast with Bartram's, Hamilton's greenhouse was an enormous structure, measuring 140 feet in length and divided into a series of compartments. Other notable

greenhouses could be found at William Penn's estate, Springettsbury, at Lansdowne, the estate of John Penn, at Mount Pleasant in Fairmount Park, and many others.(12)

Early greenhouses are documented as well in Massachusetts and New York in the north, and even as far south as Charleston, South Carolina. Along with the greenhouses at Westover and at Greenspring, the greenhouse at Drayton Hall plantation in South Carolina appears to be one of the earliest structures of its type found in Colonial America. Built in 1747, archaeological excavations at the site of the Drayton Hall greenhouse found no evidence for a heating system. Given the relatively warm South Carolina climate, and since the structure was only 32.5 by 17.5 feet in dimension, the builders presumably were able to depend on solar gain to heat the relatively narrow space. Of the admittedly small number of greenhouses for which this level of detailed information is available, either via archaeology or from documentary records, this is the only example where a second source of heat seems not to have been provided.(13)

While maybe still not approaching Woody Allen's favorite number - "a lot" - I suggest that the result of this admittedly nonsystematic exercise indicates that considerably more of these structures existed in the Chesapeake and in America than anyone may have guessed. And just what do we gain from incorporating this larger sample into our current analysis? Unfortunately, aside from the fact of their existence, very little structural detail is available at this time for most of these greenhouses. But returning to the questions of form and function with which we started this discussion, certain admittedly tentative patterns begin to emerge.

First of all, and not surprising, it appears that the typical greenhouse form described by Bradley, Miller, Gardiner and Hepburn, and many others -- with over-sized glazed windows lining the south-facing wall of the building -- was by far the most common structural type represented. The greenhouse at Wye serves to exemplify this form. The imposing structure is roughly 85 feet long, with a two-story central bay and two slightly narrower wings. Evidence for the heating system was revealed and recorded by Henry Forman in 1962, when he prepared HABS drawings for the building. The large south-facing windows, the high ceiling, narrow width of the greenhouse rooms, with a range of additional spaces to the rear to house the fire box for the heating system, to store tools and fuel, and to provide a buffer against cold north winds, closely parallel the recommendations made in the printed sources. The addition of wings also is found quite frequently in published accounts of greenhouses in England and in America. However, often where this was accomplished - as may have been the case at the Hamilton greenhouse described by Jefferson - 140 feet in length, and divided into compartments - the additions were hothouses, which were needed to propagate more delicate plant varieties. That this was not the case at Wye is demonstrated by the fact that only one stove served the entire structure, and thus the climate in the wings could not have been regulated with any greater control than in the central section.(14)

In contrast, the greenhouse at Mount Airy clearly incorporated the hot house function as well. Only a portion of the front wall of the greenhouse survives, but an insurance plan dating to 1805 indicates that this was flanked on either end by "hot houses." Significantly, in that document the greenhouse is described as having "walls of brick covered with wood," while the hot houses are described as having "sides of glass." Close inspection of the surviving masonry provides evidence for the point where the southeast corner of the eastern hot house had joined with what is now the garden wall, but which seems at one time to have formed the front wall of the building. In addition, the presence of a line of infilled brick located on the

east face of the surviving corner of the central greenhouse section, running on a line forming roughly a 65-degree angle, suggests that this is related to the glassed front/roof of the hot house. Based on the masonry evidence, the hot houses may have been roughly 23 feet in length, and when added to the 49 foot central section, make the total length of the structure an impressive 95 feet. Accounts in the Tayloe papers indicate that three “furnaces” were incorporated into the building, presumably to provide independent heat sources for the three separate sections.(15)

A third building that, from the exterior at least, seems to conform well to the general greenhouse model is the structure at Mount Clare. This greenhouse is roughly rectangular, comprised of two rooms, with their long dimensions oriented in an east-west direction. Clear archaeological evidence exists for the system of subfloor flues and their associated fire boxes in each of the rooms. The heating system for the north room appears to have been added, while the system in the south seems integral to the construction of the building. An addition, almost eight feet wide was added to the south façade of the structure after 1798.(16)

At present the reason for installing the heating system in the north room of the Mount Clare greenhouse is a mystery, as the space would not have had the advantage of a southern exposure to provide the much-needed natural light. The extension to the south room also is somewhat puzzling, as it would either have blocked the light into the greenhouse or, if the wall and the windows were repositioned to the south, would mean that the added space would not have benefited directly from the subfloor heating ducts. Documentary records suggest that a “pinery” was added later in the 18th century, but it is difficult to see how either the dark north room or the enlarged south room could have effectively accommodated that more specialized use.(17)

Other than the roughly rectangular shape of the central greenhouse bays, the southern orientation, and the large windows in that façade, there is little similarity between the Mount Clare, Mount Airy, and Wye greenhouses, by the way, and thus little to suggest that the designs of these structures were the result of any serious collaboration. On the other hand, it is well documented that George Washington consulted at length with Margaret Carroll when he was refining the design for his greenhouse at Mount Vernon in 1784. Washington solicited Margaret Carroll's advice by way of an intermediary, a former aid and kinsman of Carroll's, named Tench Tilghman. In response to Washington's query, Tilghman provided information on the building's dimensions, the height of the ceiling, the size and location of doorways, and other helpful data relating to the Mount Clare greenhouse.(18)

In addition to the hot house wings at Mount Airy, there are other indications that Chesapeake builders undertook more innovative approaches to the problem of propagating and preserving delicate plants. After the death of George and Martha Washington, the General's nephew, Bushrod Washington, inherited Mount Vernon in 1802. Over the next two decades, Bushrod Washington added a number of new structures to the estate in an attempt to upgrade his plantation's agricultural performance. This included experimenting with erecting a variety of buildings made of pisé, or rammed earth, including “one dirt greenhouse.” According to surviving graphic and documentary evidence, the new greenhouse was 50 by 18 feet in dimension, two stories in elevation, and incorporated the traditional oversized windows in its south façade. At the same time, Washington described “two brick houses one covered with wood and one partly glass and partly wood.” The description of the latter structure suggests that it was likely to have served as a hot house. Both of these structures were located quite

near the surviving 18th-century greenhouse constructed by George Washington only 30 years earlier.(19)

Similarly, the greenhouse built by George Carter at Oatlands in 1810 clearly was modeled along the lines of the more innovative designers of the day. Built with a sloping glass roof covering the entire greenhouse room, its design is remarkably similar to drawings found in William Pain's *The Practical House Carpenter*, published in 1796. This greenhouse was modified and updated later in the century, and again in 1903 and 1950, when a hot water heating system was added, the greenhouse room was slightly enlarged, and the glass roof was replaced.(20)

In contrast, the greenhouses built at Dumbarton Oaks ca. 1805 and at Eyre Hall in 1819 appear to have followed the traditional design for such buildings that was popular a full half-century earlier. The Dumbarton greenhouse is long and relatively narrow, with six tall windows and a glass double-door in the south façade. Over the years, the roof was changed twice, both times to add more glass in an attempt to improve the capacity for solar gain. It is not known whether a heating system was incorporated into the original design. With four or five large windows covering the southern façade, a stove room to the rear, and a hot air heating duct running around the perimeter of the interior of the greenhouse room, the Eyre Hall greenhouse bears much more similarity to the greenhouses at Mount Vernon and Wye Plantation than it does to Oatlands. On the other hand, the heating system in use at Eyre Hall seems to have been somewhat more ambitious than those found elsewhere. In fact, given the present level of knowledge, it is difficult to understand just how the Eyre Hall heating system worked. It appears that the hot air emanating from the fire in the rear room was meant to ascend several feet, at which point it was then intended to descend through the wall to the level of the floor in the greenhouse room, pass around the perimeter of the room, and exit via a flue rising within the partition wall to a second chimney. An iron damper still exists at the point in the fireplace flue where the hot air would have begun its descent. How this system could have worked, with hot air expected to descend and then flow in such a circuitous route, remains a puzzle.(21)

The only other structure where heating flues are known to have been incorporated within the rear wall of the plant room is the greenhouse at Wye Plantation. Forman determined that the route of the flue traced around the front of the structure just below the floor, returning to the chimney flue on the rear partition by ascending within the wall. Forman did not realize, however, that the flue actually doubled back on itself (with two flue channels directly superimposed) in the east wing to exit via a chimney positioned at the corner of the central section of the building. This configuration is reminiscent of several proposed examples found in the published sources.(22)

The result of this very preliminary investigation seems to suggest a number of avenues for future research. Most basic is the need to continue to assemble information on the number and range of greenhouses and hot houses that were in existence both in the Chesapeake and throughout English North America. Only when a significantly larger sample of data is available relating to the characteristics of these structures, and to their distribution over time and space, will it be possible to address a range of research questions. For the first time, it might be really possible to address such traditional issues as attributing design sources and assessing the degree of conformity with published descriptions. In addition, it would be interesting to investigate whether Chesapeake greenhouses tended to be conservative in their

design, and/or whether more innovative configurations gained adherence over time. If the number of greenhouses built in the 18th and early 19th-century Chesapeake is found to be substantially larger than previously believed, that may provide additional support for the interpretation that members of the Chesapeake gentry were more invested than their peers in other regions in constructing these buildings as expressions of personal identity and power. But on the other hand, if greenhouses are found in other areas of the country in similar numbers and displaying comparable levels of sophistication, then this finding might undercut current interpretations that the Chesapeake gentry were unusually wedded to such conspicuous displays.

Finally, the potential for archaeology to play a prominent role in pursuing these issues appears to be considerable. For no matter how many greenhouses may be identified through the documentary record, it seems unlikely that a significant number of additional extant structures are to be found. Therefore, it is only through archaeological investigations that we are likely to be able to add important new information about the size and configuration of such structures, and to expand on our currently limited understanding of elusive topics such as how the subfloor heating systems actually worked. Thus, the old charge to archaeologists to “go forth and measure” remains especially apt in this case. The ability to undertake, for the first time, an informed and detailed analysis of this particularly evocative class of structures will depend directly on those results.

Notes

- 1) Printed in, May Woods, *Glass Houses: A History of Greenhouses, Orangeries and Conservatories* (Rizzoli, New York, 1988), p. 70.
- 2) Woods, *Glass Houses: A History*, 1988, Pp. 50-51; also see, John Hix, *The Glass House* (MIT Press, Cambridge, MA, 1974), Pp. 9-18, for a discussion of the history of the development of English and European greenhouse design.
- 3) As early as 1760, John Bartram of Philadelphia made this distinction, referring to his own greenhouse as serving only to preserve “some pretty flowering winter shrubs and plants for winter diversion; not to be crowded with orange trees or those natural to the Torrid Zone, but such as will do, being protected by frost,” in Woods, *Glass Houses: A History*, 1988, p. 68; Bernard McMahon, *The American Gardener's Calendar*, 1806, cited in, Peggy Cornett, “Delicious Flowering Shrubs' and Cape Bulbs in the Monticello Greenhouse,” *Twinleaf Journal* (www.twinleaf.org/articles, 1997).
- 4) A concise but remarkably complete description of a traditional greenhouse is included in an American gardening manual published in 1804: “A Green-house should front the south, be sixteen feet wide, and any length you please. The front should be of sashes twelve to fifteen feet high, and have outside shutters. The roof should be of shingles - the back wall of brick, six to nine feet high, with flues thro' it. There should be a shed to shelter the back wall, and a furnace under the shed to communicate with the flues in the wall, for the purpose of warming the house moderately in frosty weather,” John Gardiner and David Hepburn, *The American Gardener* (Samuel H. Smith, City of Washington, 1804), p. 196; Richard Bradley, *The Gentleman Gardener's Kalendar* (London, 1718), printed in Woods, *Glass Houses: A History*, 1988, p. 56.
- 5) Philip Miller, *Gardener's and Botanist's Dictionary* (London, 1733), under the entry for “Green-house.”

- 6) For a discussion of later developments in greenhouse heating systems, see Hix, *Glass House*, 1974, Pp. 19-41; George Tod, *Plans, Elevations and Sections, of Hot-Houses, Green-Houses, an Aquarium, Conservatories, etc., Recently Built in Different Parts of England for Various Noblemen and Gentlemen* (J. Taylor, London, 1807).
- 7) Printed in Hix, *Glass House*, 1974, Pp. 16, 60-62; all of the 18th and early 19th-century gardening books cited above use the term "greenhouse" exclusively.
- 8) Woods, *Glass Houses: A History*, 1988, Pp. 5-56, clearly elucidates the symbolic approach to the topic; Anne E. Yentsch, "Introduction: Close Attention to Place - Landscape Studies by Historical Archaeologists," in *Landscape Archaeology: Reading and Interpreting the American Historical Landscape*, edited by Rebecca Yamin and Karen Bescherer Metheny (University of Tennessee Press, Knoxville, 1996), Pp. xxiii-xlii, reviews a range of symbolic interpretive approaches to landscapes; Yentsch focuses more specifically on the symbolic importance of greenhouses, and the fad for oranges, in her article, "The Calvert Orangery in Annapolis, Maryland: A Horticultural Symbol of Power and Prestige in an Early Eighteenth-Century Community," in *Earth Patterns: Essays in Landscape Archaeology*, edited by William M. Kelso and Rachel Most (University Press of Virginia, Charlottesville, 1990), Pp. 169-187; Carmen A. Weber, "The Greenhouse Effect: Gender-Related Traditions in Eighteenth-Century Gardening," in Yamin and Metheny, eds., *Landscape Archaeology*, 1996, Pp. 32-51, addresses the role of women in American gardening; Elizabeth Kryder Reid, in her article, "As Is the Gardener, So is the Garden': The Archaeology of Landscape as Myth," in *Historical Archaeology of the Chesapeake*, edited by Paul A. Shackel and Barbara J. Little (Smithsonian Institution Press, Washington, DC, 1994), Pp. 131-148, and Mark P. Leone and Paul S. Shackel, in their article, "Plane and Solid Geometry in Colonial Gardens in Annapolis, Maryland," in *Earth Patterns*, edited by Kelso and Most, 1990, Pp. 153-167, focus on the ideological power of manipulated landscapes; the Darwinian perspective is provided by Fraser D. Neiman, "Were Early Chesapeake Gardens Truthful Signals or Propagandistic Lies?," a paper presented at the Society for Historical Archaeology annual conference in Mobile, Alabama, 2002.
- 9) For the Wye greenhouse, the best published source remains, H. C. Forman, *Old Buildings, Gardens and Furniture in Tidewater Maryland* (Tidewater Publishers, Cambridge Maryland, 1967), Pp. 51-75 - unfortunately, the condition of the fire box at the Wye greenhouse has deteriorated considerably since Forman recorded it in 1962; the Mount Airy greenhouse is briefly discussed in Peter Martin, *The Pleasure Gardens of Virginia: From Jamestown to Jefferson* (Princeton University Press, Princeton, 1991), Pp. 120-123; Arthur Shurcliff's measured drawing (1931) of the Mount Airy garden, showing the site of the greenhouse, is reproduced in Martin, *Pleasure Gardens*, 1991, p. 122; a letter report prepared by Donna Hole, including a compendium of various primary references relating to the Mount Airy greenhouse, is on file at the Colonial Williamsburg Foundation Department of Architectural Research; information on the Mount Vernon greenhouse, and an account of the 1950-51 restoration project, can be found in two articles and an in-house report prepared by Walter M. Macomber, "Report of Physical Research Findings and Recommendations for the restoration of Green House Built by George Washington at Mount Vernon," on file, Mount Vernon Library (1950), "Greenhouse-Quarter Reconstruction," Mount Vernon Ladies' Association, *Annual Report, 1951* (1952), Pp. 35-40, and "The Rebuilding of the Greenhouse-Quarters," Mount Vernon Ladies' Association, *Annual Report, 1952* (1953), Pp. 19-26; the report on the findings from

- the archaeological excavations at Mount Clare is by Dennis J. Pogue, Esther C. White, and Christy E. Leeson, "Archaeological Investigations at the Mount Clare Orangery (19 BC 10B), Baltimore City, Maryland," a report prepared for the Carroll Park Foundation (2002); for the Calvert hypocaust, see Yentsch, "The Calvert Orangery," in *Earth Patterns*, edited by Kelso and Most, 1990, Pp. 169-187; the work at Bel Air is summarized in Thomas R. Wheaton, "Drayton hall Archeological Testing of the Orangerie," a report prepared for the National Trust for Historic Preservation (1989), p. 36; see Billie Britz, "The Orangery in England and America," *Antiques* 145(4):594-601, for a recent recapitulation of the familiar information.
- 10) See Weber, "Greenhouse Effect," in *Earth Patterns*, edited by Kelso and Most, 1990, Pp. 32-51, for the significance of women in developing Chesapeake gardens, as well as a discussion of the presumed importance of family relationships in the design of the selected greenhouses; also see Woods, *Glass Houses: A History*, 1988, Pp. 82-84. Please note that the author does not question whether women may have played a particularly active role in garden and greenhouse design, just that the current line of reasoning does not appear convincing.
- 11) The year 1825 has been selected as the cut-off for the present study because by that date changes in American society and the appearance of new technology in the form of hot water heating systems appear to have begun to have a significant impact on greenhouse design. The greenhouse at Dumbarton Oaks is briefly discussed in Britz, "Orangery in England and America," 1996, p. 600; a relatively detailed body of information is available for the Oatlands greenhouse, and is presented in the *Oatlands Plantation Historic Structures Report*, prepared for the National Trust for Historic Preservation (1998); for the Eyre Hall greenhouse, see H.C. Forman, *The Virginia Eastern Shore and its British Origins* (Eastern Shore Publishers, Easton, Maryland, 1975), Pp. 115-129; the information on Battersea was provided by Willie Graham (Personal Communication, 2003); for Westover, see Woods, *Glass Houses: A History*, 1988, p. 69, and Martin, *Pleasure Gardens of Virginia*, 1991, p. 72; for Greenspring, see Cornett, "Delicious Flowering Shrubs," 1997, p. 1; for Prestwould, see Martin, *Pleasure Gardens of Virginia*, 1991, Pp. 127-131 - the greenhouse is shown on an undated plan of the property, which is owned by the Historic Prestwould Foundation; for Bushrod Washington's greenhouse and hot house, see, Gardiner Hallock, "Pise Construction in Early 19th-Century Virginia," a paper presented at the Vernacular Architecture Forum annual meeting, Williamsburg, Virginia, 2002; the greenhouse at Harlem is depicted on *Warner & Hanna's Plan of the City and Environs of Baltimore* (1801), which is reproduced in Barbara Wells Sarudy, *Gardens and Gardening in the Chesapeake, 1700-1805* (Johns Hopkins University Press, Baltimore, 1998), p. 61, while a second depiction of the apparently altered greenhouse, dating to 1834, is reproduced in Sarudy, *Gardens and Gardening*, 1998, plate 9; the Hampton greenhouse apparently burned in 1928 and was reconstructed in 1976, see Lynne Dakin Hastings, *Hampton National Historic Site* (Towson, Maryland, 1986); in addition to the greenhouses at Mount Vernon and at Mount Airy, greenhouses appear in the Mutual Assurance Society records for the following individuals (the date given is the first year the greenhouse appears in the listing), all of whom lived in either Richmond or Petersburg, Virginia: Benjamin Harris (1815), Joseph Gallego (1820), Mary Anderson (1815), Benjamin Tate (1819), Robert Manard (1820), Patrick Durkin (1822), Edmund Rootes (1825), Robert Stanard (1822), and Peter Chevallie (1825).
- 12) In addition to the discussion of Bartram's activities to be found in Woods, *Glass*

- Houses: A History*, 1988, p. 68, the results of the archaeological investigations are summarized in John L. Cotter, Daniel G. Roberts, and Michael Parrington, *The Buried Past: An Archaeological History of Philadelphia* (University of Pennsylvania Press, Philadelphia, 1992), Pp. 280-281; according to this source, the excavators found evidence for a stone floor, and for “a series of brick channels [that] had funneled heat through the base of the structure.” See Weber, “Greenhouse Effect,” in *Landscape Archaeology*, edited by Yamin and Metheny, 1996, Pp. 43-49, for a discussion of several additional 18th-century Philadelphia greenhouses. Although he appears to have considered building a separate greenhouse structure, Thomas Jefferson finally elected to add a small glass-enclosed arched loggia to his house, instead. In a letter from April 1811, Jefferson provides some insight into his thinking on the subject: “You enquire whether I have a hot house, greenhouse, or to what extent I pay attention to these things. I have only a green house, and have used that only for a very few articles. My frequent and long absences at a distant possession render my efforts even for the few greenhouse plants I aim at, abortive,” Cornett, “Delicious Flowering Shrubs,” 1997, p. 5.
- 13) In addition to the archaeological data, a crucially important source of information on the Drayton Hall greenhouse is provided by a contemporary drawing of the façade. In the drawing, the date 1747 is included above the centrally placed door; see Wheaton, “Drayton Hall Archaeological Testing,” 1989, for a full description of the archaeological findings. See Woods, *Glass Houses: A History*, 1988, Pp. 84-87, for a discussion of several greenhouses from New York and Massachusetts. According to Woods, a greenhouse built by Andrew Faneuil in Boston is reported to have been built as early as 1710.
 - 14) See Bradley, *Gardener's Kalendar*, 1718, Miller, *Gardener's Dictionary*, 1733, and Gardiner and Hepburn, *American Gardener*, 1804; see Forman, *Old Buildings*, 1967, Pp. 51-75.
 - 15) The hypotheses relating to the masonry evidence are based on a field investigation carried out by the author and Amy Speckart in March 2002; Mount Airy Declaration of Assurance, Mutual Assurance Society, November 18, 1805; Hole file on Mount Airy, Colonial Williamsburg Foundation.
 - 16) Pogue, White, and Leeson, “Mount Clare Orangery,” 2002, Pp. 34-47.
 - 17) Pogue, White, and Leeson, “Mount Clare Orangery,” 2002, Pp. 34-47.
 - 18) The correspondence between Washington and Tilghman is published in, *The Papers of George Washington, Confederation Series*, Volume 2, edited by W.W. Abbott (University Press of Virginia, Charlottesville, 1992), Pp. 30-31 and 42-44.
 - 19) Bushrod Washington to James Rawlings, August 8, 1815, and Bushrod Washington to St. George Tucker, August 13, 1815, transcribed letters on file, Mount Vernon Ladies' Association; also see, Hallock, “Pise Construction,” 2002.
 - 20) William Pain, *The Practical House Carpenter* (Boston, 1796); see *Oatlands Historic Structure Report*, 1998.
 - 21) This interpretation of the configuration of the heating system is based on information gathered in a field investigation undertaken by the author, Amy Speckart, and Michael Bourne in May 2002.
 - 22) The new findings pertaining to the route of the heating ducts is based on physical investigations performed by the author, Amy Speckart, Michael Bourne, and Fraser Neiman in May 2002; numerous examples of extremely circuitous routes for flues within walls are reproduced in Hix, *Glass House*, 1974.

