Oxford Dendrochronology Laboratory
Interim Report 2006/47

The Tree-Ring Dating of Historic Buildings from Eastern Long Island, New York

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Summary:

CUTCHOGUE, Old House (41º 00.36N; 72º 29.38W) *Felling dates:* **Winter 1698/9**
Braces (2/3) 1695(19), 1694(21); Stud 1698(23C); Girts (1/2) 1698(30C); Tiebeam (0/1); Rail (0/1); Joist (0/1); *Ex situ* offcuts (0/4).

ORIENT POINT, Terry-Mulford House (41º 08.99N; 72º 16.85W)
Felling dates: **Summer 1715 and Winter 1715/16**
Tiebeams (2/3) 1715(21C), 1622(+91 rings not dated); Girts (2/3) 1714(15½), 1705(17); Braces (0/2); Sill beam (0/1); Sheathing boards (0/2).

EAST HAMPTON, Home-Sweet-Home (40º 57.26N; 72º 11.70W) *Felling dates:* **Winter 1719/20**
Braces 1719(15C, 11C, 9C); Posts (0/4). *Site Master* 1650-1719 HSH.

EAST HAMPTON, Gardiner-Brown House (40º 57.59N; 72º 11.53W)
Felling dates: **Spring 1746, Summer 1746, and Winter 1746/7**
Braces 1746(15C), 1745(23½C, 11½C); Studs 1746(15C^2, 14C^2, 13C), 1745(32½C, 22½C^2, 11½C^2, 10½C, 8½C, 21¼C). *Site Master* 1607-1746 LVI.

All included in *Site Master* 1505-1746 LNGISL06 (t = 5.4 NY; 5.3 WEB; 5.2 FORES; 5.1 OGC; 5.0 CHM)

Seven houses on the eastern end of Long Island, New York were sampled between the 22nd and 24th of November 2003, and four have now been successfully dated. The oldest of these is the Old House, Cutchogue, which produced two precise felling dates of winter 1698/9, suggesting a construction period commencing in 1699 or within a year or two afterwards. At Orient Point, the Terry-Mulford House produced a precise felling date of summer 1715 and another from the winter of 1715/16, suggesting a construction date of 1716 or shortly thereafter. At Home-Sweet-Home, East Hampton, three wall-braces produced precise felling dates of winter 1719/20, suggesting construction began in 1720 or 1721 at the latest. Finally, also at East Hampton, the Gardiner-Brown House produced sixteen precise felling dates ranging from the spring of 1746 to the winter of 1746/7, indicating that construction most likely began in 1747. Samples from three other houses, the Halsey House in Southampton, Mulford Farm in East Hampton, and Sylvester Manor on Shelter Island, failed to date at this time, but may do so in the future as more chronologies are produced from the region.

The total of 19 samples from 18 timbers from the four dated buildings were combined to form the 242-year site master LNGISL06, which dated, spanning the years 1505-1746. Matches with chronologies from New York, Connecticut, Massachusetts, and Rhode Island were used to date the master chronology, and some of these chronologies were only developed in the last year or two, explaining why it has taken three years to produce these positive results.

The research project was organised by Dr Gaynell Stone of the Suffolk County Archaeological Association.

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December 2006

How Dendrochronology Works

Dendrochronology has over the past 20 years become one of the leading and most accurate scientific dating methods. Whilst not always successful, when it does work, it is precise, often to the season of the year. Tree-ring dating is well known for its use in dating historic buildings and archaeological timbers to this degree of precision. However more ancillary objects such as doors, furniture, panel paintings, and wooden boards in medieval book-bindings can sometimes be successfully dated.

The science of dendrochronology is based on a combination of biology and statistics. Fundamental to understanding of how dendrochronology works is the phenomenon of tree growth. Essentially, trees grow through the addition of both elongation and radial increments. The elongation takes place at the terminal portions of the shoots, branches, and roots, while the radial increment is added by the cambium, the zone of living cells between the wood and the bark. In general terms, a tree can be best simplified by describing it as a cone, with a new layer being added to the outside each year in temperate zones, making it wider and taller.

An annual ring is composed of the growth which takes place during the spring and summer and continues until about November when the leaves are shed and the tree becomes dormant for the winter period. For the two principal American oaks, the white and red (*Quercus alba* and *Q. rubra*), as well black ash (*Fraxinus nigra*), and many other species, the annual ring is composed of two distinct parts: the spring growth or early wood, and the summer growth, or late wood. Early wood is composed of large vessels formed during the period of shoot growth which takes place between March and May, before the establishment of any significant leaf growth. This is produced by using most of the energy and raw materials laid down the previous year. Then, there is an abrupt change at the time of leaf expansion around May or June when hormonal activity dictates a change in the quality of the xylem, and the summer, or late wood is formed. Here the wood becomes increasingly fibrous and contains much smaller vessels. Trees with this type of growth pattern are known as ring-porous, and are distinguished by the contrast between the open, light-coloured early wood vessels and the dense, darker-coloured late wood.

Other species of tree are known as diffuse-porous, and this group includes the tulip, or yellow-poplar (*Liriodendron tulipifera L.*). Unlike the ring-porous trees, the spring vessels consist of a very small spring vessels which become even smaller as the tree advances into the summer growth. The annual growth rings are often very difficult to distinguish under even a powerful microscope, and one often needs to study the medullary rays, which thicken at the ring boundaries.

Dendrochronology utilises the variation in the width of the annual rings as influenced by climatic conditions common to a large area, as opposed to other more local factors such as woodland competition and insect attack. It is these climate-induced variations in ring widths that allow calendar dates to be ascribed to an undated timber when compared to a firmly-dated sequence. If a tree section is complete to the bark edge, then when dated a precise date of felling can be determined. The felling date will be precise to the season of the year, depending on the degree of formation of the outermost ring. Therefore, a tree with bark which has the spring vessels formed but no summer growth can be said to be felled in the spring, although it is not possible to say in which particular month the tree was felled.

Another important dimension to dendrochronological studies is the presence of sapwood and bark. This is the band of growth rings immediately beneath the bark and comprises the living growth rings which transport the sap from the roots to the leaves. This sapwood band is distinguished from the heartwood by the prominent features of colour change and the blocking of the spring vessels with tyloses, the waste products of the tree's growth. The heartwood is generally darker in colour, and the spring vessels are usually blocked with tyloses. The heartwood is dead tissue, whereas the sapwood is living, although the only really living, growing, cells are in the cambium, immediately beneath the bark. In the American white oak (*Quercus* alba), the difference in colour is not generally matched by the change in the spring vessels, which are often filled by tyloses to within a year or two of the terminal ring. Conversely, the spring vessels in the American red oak (*Q* rubra) are almost all free of tyloses, right to the pith. Generally the sapwood retains stored food and is therefore attractive to insect and fungal attack once the tree is felled and therefore is often removed during conversion.

Methodology: The Dating Process

All timbers sampled were of oak (*Quercus* spp.) from what appeared to be primary first-use timbers, or any timbers which might have been re-used from an early phase. Those timbers which looked most suitable for dendrochronological purposes with complete sapwood or reasonably long ring sequences were selected. *In situ* timbers were sampled through coring, using a 16mm hollow auger. Details and locations of the samples are given in the summary table.

The dry samples were sanded on a linisher, or bench-mounted belt sander, using 60 to 1200 grit abrasive paper, and were cleaned with compressed air to allow the ring boundaries to be clearly distinguished. They were then measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.01mm. Thus each ring or year is represented by its measurement which is arranged as a series of ring-width indices within a data set, with the earliest ring being placed at the beginning of the series, and the latest or outermost ring concluding the data set.

As indicated above, the principle behind tree-ring dating is a simple one: the seasonal variations in climate-induced growth as reflected in the varying width of a series of measured annual rings is compared with other, previously dated ring sequences to allow precise dates to be ascribed to each ring. When an undated sample or site sequence is compared against a dated sequence, known as a reference chronology, an indication of how *good* the match is must be determined. Although it is almost impossible to define a visual match, computer comparisons can be accurately quantified. Whilst it may not be the best statistical indicator, Student's (a pseudonym for W S Gosset) *t*-value has been widely used amongst British dendrochronologists. The cross-correlation algorithms most commonly used and published are derived from Baillie and Pilcher's CROS programme (Baillie and Pilcher 1973), although a faster version (Munro 1984) giving slightly different *t*-values is sometimes used for indicative purposes.

Generally, *t*-values over 3.5 should be considered to be significant, although in reality it is common to find demonstrably spurious *t*-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-value ranges of 5, 6, or higher, and for these to be well replicated from different, independent chronologies with local and regional chronologies well represented. Users of dates also need to assess their validity critically. They should not have great faith in a date supported by a handful of *t*-values of 3's with one or two 4's, nor should they be entirely satisfied with a single high match of 5 or 6. Examples of spurious *t*-values in excess of 7 have been noted, so it is essential that matches with reference chronologies be well replicated, and that this is confirmed with visual matches between the two graphs. Matches with *t*-values of 10 or more between individual sequences usually signify having originated from the same parent tree.

In reality, the probability of a particular date being valid is itself a statistical measure depending on the *t*-values. Consideration must also be given to the length of the sequence being dated as well as those of the reference chronologies. A sample with 30 or 40 years growth is likely to match with high *t*-values at varying positions, whereas a sample with 100 consecutive rings is much more likely to match significantly at only one unique position. Samples with ring counts as low as 50 may *occasionally* be dated, but only if the matches are very strong, clear and well replicated, with no other significant matching positions. This is essential for intra-site matching when dealing with such short sequences. Consideration should also be given to evaluating the reference chronology against which the samples have been matched: those with well-replicated components which are geographically near to the sampling site are given more weight than an individual site or sample from the opposite end of the country.

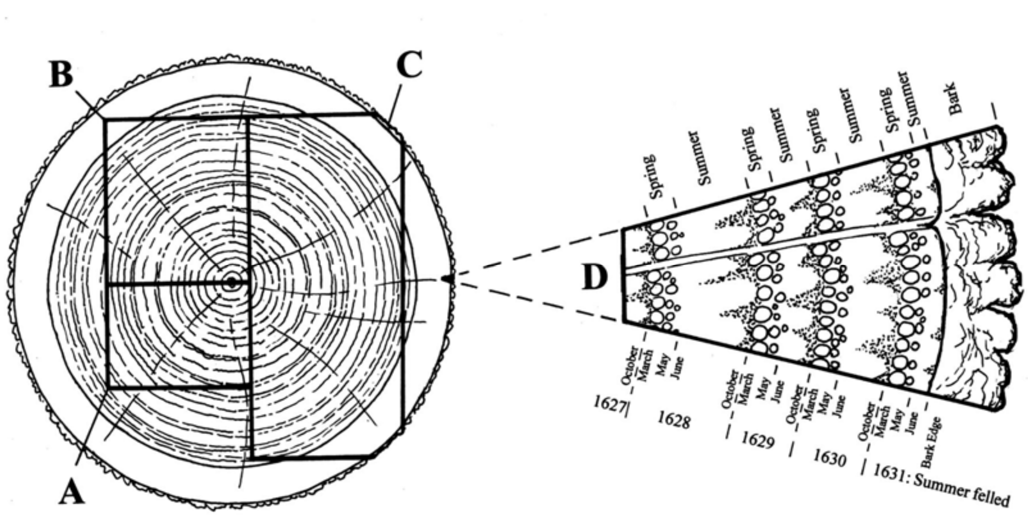
It is general practice to cross-match samples from within the same phase to each other first, combining them into a site master, before comparing with the reference chronologies. This has the advantage of averaging out the 'noise' of individual trees and is much more likely to obtain higher *t*-values and stronger visual matches. After measurement, the ring-width series for each sample is plotted as a graph of width against year on log-linear graph paper. The graphs of each of the samples in the phase under study are then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, are averaged to form a mean curve for the site or phase. This mean curve and any unmatched individual sequences are compared against dated reference chronologies to obtain an absolute calendar date for each sequence. Sometimes, especially in urban situations, timbers may have come from different sources and fail to match each other, thus making the compilation of a site master difficult. In this situation samples must then be compared individually with the reference chronologies.

Therefore, when cross-matching samples with each other, or against reference chronologies, a combination of both visual matching and a process of qualified statistical comparison by computer is used. The ring-width series were compared on an IBM compatible computer for statistical cross-matching using a variant of the Belfast CROS program (Baillie and Pilcher 1973). A version of this and other programmes were written in BASIC by D Haddon-Reece, and re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

Ascribing and Interpreting Felling Dates

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. For samples which have sapwood complete to the underside of, or including bark, this process is relatively straight forward. Depending on the completeness of the final ring, i.e. if it has only the early wood formed, or the latewood, a *precise felling date and season* can be given.

Where the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then the question of when the tree was felled becomes considerably more complicated. In the European oaks, sapwood tends to be of a relatively constant width and/or number of rings. By determining what this range is with an empirically or statistically-derived estimate is a valuable aspect in the interpretation of tree-ring dates where the bark edge is not present (Miles 1997). The narrower this range of sapwood rings, the more precise the estimated felling date range will be.



Section of oak tree with conversion methods showing three types of sapwood retention resulting in **A** *terminus post quem*, **B** a felling date range, and **C** a precise felling date. Enlarged area **D** shows the outermost rings of the sapwood with growing seasons (Miles 1997, 42)

Unfortunately, it has not been possible to apply an accurate sapwood estimate to either the white or red oaks at this time. Primarily, it would appear that there is a complete absence of literature on sapwood estimates for oak anywhere in the country (Grissino-Mayer, *pers comm*). The matter is further complicated in that the sapwood in white oak (*Quercus alba*) occurs in two bands, with only the outer ring or two being free of tyloses in the spring vessels (Gerry 1914; Kato and Kishima 1965). Out of some 50 or so samples, only a handful had more than 3 rings of sapwood without tyloses. The actual sapwood band is differentiated sometimes by a lighter colour, although this is often indiscernible (Desch 1948). In archaeological timbers, the lighter coloured sapwood does not collapse as it does in the European oak (*Q rober*), but only the last ring or two without tyloses shrink tangentially. In these circumstances the only way of being able to identify the heartwood/sapwood boundary is by recording how far into the timber wood boring beetle larvae penetrate, as the heartwood is not usually susceptible to attack unless the timber is in poor or damp conditions. Despite all of these drawbacks, some effort has been made in recording sapwood ring counts on white oak, although the effort is acknowledged to be somewhat subjective.

As for red oaks (*Quercus rubra*) it will probably not be possible to determine a sapwood estimate as these are what are known as 'sapwood trees' (Chattaway 1952). Whereas the white oak suffers from an excess of tyloses, these are virtually non-existent in the red oak, even to the pith. Furthermore, there is no obvious colour change throughout the section of the tree, and wood-boring insects will often penetrate right through to the centre of the timber. Therefore, in sampling red oaks, it is vital to retain the final ring beneath the bark, or to make a careful note of the approximate number of rings lost in sampling, if any meaningful interpretation of felling dates is to be made.

Similarly, no study has been made in estimating the number of sapwood rings in tulip-poplar or black ash, or for any of the pines.

Therefore, if the bark edge does not survive on any of the timbers sampled, then only a *terminus post quem* or *felled after* date can be given. The earliest possible felling date would be the year after the last measured ring date, adjusted for any unmeasured rings or rings lost during the process of coring.

Some caution must be used in interpreting solitary precise felling dates. Many instances have been noted where timbers used in the same structural phase have been felled one, two, or more years apart. Whenever possible, a *group* of precise felling dates should be used as a more reliable indication of the *construction period*. It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure under study. However, it is common practice to build timber-framed structures with green or unseasoned timber and that construction usually took place within twelve months of felling (Miles 1997).

Details of Dendrochronological Analysis

The results of the dendrochronological analysis for the building under study are presented in a number of detailed tables. The most useful of these is the summary **Table 1**. This gives most of the salient results of the dendrochronological process, and includes details for each sample, its species, location, and its felling date, if successfully tree-ring dated. This last column is of particular interest to the end user, as it gives the actual year and season when the tree was felled, if bark is present, an estimated felling date range if the sapwood was complete on the timber but some was lost in coring, or a *terminus post quem*. Often these *terminus post quem* dates begin far earlier than those with precise felling dates. This is simply because far more rings have been lost in the initial conversion of the timber.

It will also be noticed that often the precise felling dates will vary within several years of each other. Unless there is supporting archaeological evidence suggesting different phases, all this would indicate is either stockpiling of timber, or of trees which have been felled or died at varying times but not cut up until the commencement of the particular building operations in question. When presented with varying precise felling dates, one should always take the *latest* date for the structure under study, and it is likely that construction will have been completed for ordinary vernacular buildings within twelve or eighteen months from this latest felling date (Miles 1997).

Table 2 gives an indication of the statistical reliability of the match between one sequence and another. This shows the *t*-value over the number of years overlap for each combination of samples in a matrix table. It should be born in mind that *t*-values with less than 80 rings overlap may not truly reflect the same degree of match and that spurious matches may produce similar values.

First, multiple radii have been cross-matched with each other and combined to form same-timber means. These are then compared with other samples from the site and any which are found to have originated from the same parent tree are again similarly combined. Finally, all samples, including all same timber and same tree means are combined to form one or more site masters. Again, the cross-matching is shown as a matrix table of *t*-values over the number of years overlaps. Reference should always be made to **Table 1** to clearly identify which components have been combined.

Table 3 shows the degree of cross-matching between the site master(s) with a selection of reference chronologies. This shows the county or region from which the reference chronology originated, the common chronology name together with who compiled the chronology with publication reference and the years covered by the reference chronology. The years overlap of the reference chronology and the site master being compared are also shown together with the resulting *t*-value. It should be appreciated that well replicated regional reference chronologies, which are shown in **bold**, will often produce better matches then with individual site masters or indeed individual sample sequences. Due to the fact that chronologies are still to be developed for many parts of the eastern seaboard of America, the number of chronologies are often limited to just one or two, and this information would alternatively be presented in the summary text.

Figures include a bar diagram which shows the chronological relationship between two or more dated samples from a phase of building. The site sample record sheets are also appended, together with any plans showing sample locations, if available.

Publication of all dated sites for English buildings are routinely published in *Vernacular Architecture* annually, but regrettably there is at the present time no vehicle available for the publication of dated American buildings. However, a similar entry is shown on the summary page of the report, and this hopefully could be used in any future publication of American dates. This does not give as much technical data for the samples dated, but does give the *t*-value matches against the relevant chronologies, provides a short descriptive paragraph for each building or phase dated, and gives a useful short summary of samples dated. These summaries are also listed on the web-site maintained by the Laboratory, which can be accessed at `www.dendrochronology.com`. The Oxford Dendrochronology Laboratory retains copyright of this report, but the commissioner of the report has the right to use the report for his/her own use so long as the authorship is quoted. Primary data and the resulting site master(s) used in the analysis is available from the Laboratory on request by the commissioner and bona fide researchers. The samples form part of the Laboratory archives, unless an alternative archive, such as the Colonial Williamsburg Foundation in association with the ODL, has been specified in advance.

Summary of Dating

A total of 94 samples were taken from seven houses on the eastern end of Long Island, New York. The number of samples taken from each building ranged from 7 to 22, limited by the number of suitable timbers available (as at Home-Sweet-Home and Sylvester Manor), or time constraints (as at the Terry-Mulford House).

Standard dendrochronological techniques were used to first combine the multiple samples from same timbers, and then to group timbers into same-tree means. Apart from the Gardiner-Brown House, where all 16 timbers sampled were successfully matched together, the Long Island samples were notable for their lack of consistent internal cross-matching, both within and between sites. Indeed, many of the multiple samples from the same timber failed to match each other conclusively, which is always an indicator that the successful dating of such timbers unlikely. A major problem is not the lack of growth rings, but instead an excess of rings, with some samples having over 175 annual rings, with one example having 276 rings and another having 263. It has been noted in eastern Massachusetts that samples that are too slow-growing often do not match each other due to either complacent or distressed ring sequences. Part of this might be as a result of the low-lying land, resulting in the roots of the oak trees being always saturated. Oaks generally do not like to have their feet soaking, and such oaks tend to grow more slowly. Another problem is that oaks on low lying land do not react in the same way to the rainfall element as would a tree growing in a drier situation. Instead they would only be picking up the change in temperature during the growing season. Coupled with the coastal influence from the ocean, the weather patterns will be significantly different from that found further inland. Similar problems have been encountered in south-eastern Massachusetts during the past few years. Another possible factor which might account for the poor cross-matching between samples is the possibility of importation of timbers from further afield.

Despite this, a small number of samples were found to match each other, both within sites and between sites. Although the strength of match between samples was lower than expected, nevertheless these were found to consistently match at the same date. Matches were found for some individual samples, or group of samples, with adjacent reference chronologies from Massachusetts and Rhode Island, but these were not conclusive on their own. Therefore, the data were given to the Lamont-Doherty Earth Observatory Tree-Ring Laboratory, Columbia University, Palisades, New York. Here the data was worked on 'blind', i.e. the tentative dates removed for the process of analysis. The data were then standarised in accordance with the working practices of the Columbia Laboratory, and was then run through the COFECHA matching procedure (Holmes, 1983). This allowed a floating (undated) chronology to be constructed with 18 samples. This was then checked through the visual comparisons of individual graphs, and any inconsistencies checked with the original core samples. The resulting undated master chronology was then compared with dated reference material from New York, Connecticut, Massachusetts, and Rhode Island, and was found to date conclusively. When the individual samples making up this master chronology had individual dates ascribed, most of these corresponded with the tentative ones from the first stage of the analysis. Given the geographical location of the buildings, this collaborative two-pronged approach to the analysis was invaluable to the successful outcome of the project.

Thus, the floating chronology **LNGISL06** was reliably dated to span the period 1505-1746, with 242 years of growth. This is made up of 5 samples (from 4 timbers) from the Old House Cutchogue, 4 from the Terry-Mulford House, Orient Point, 3 from Home-Sweet-Home, East Hampton, and 7 from the Gardiner-Brown House, East Hampton. The dating of these individual samples is discussed below. Some of the sites such as the Gardiner-Brown House and Home-Sweet-Home produced site-specific master chronologies, but these were not used in the overall dating of the sites; instead the individual components were used in the Long Island master chronology **LNGISL06**.

The Old House, Cutchogue (41º 00.36N; 72º 29.38W)

Thirteen timbers were sampled at the Old House, Cutchogue. These were from a variety of timbers including girts, braces, and a stud, tiebeam, and joist. Four other unidentified offcuts resulting from recent repairs were also collected. Most of the timbers were of white oak, although a brace, a joist, and two of the timber offcuts were of red oak. Most of the samples had ring counts of over 100, with several with over 180 rings.

Five sequences from four timbers were found to match together including a stud (**ohc1**), two braces (**ohc3** and **ohc6**), and a chimney girt (**ohc7**). Two of these, the stud **ohc1** and the girt **ohc7**, retained complete sapwood and both were therefore felled during the winter of 1698/9. All of these were some of the longer-ringed sequences, with samples **ohc3a1** and **ohc3a2**, coming from the same core with about 15 years lost at the interface of the two core segments. This latter segment finished at 1695 with 19 rings of incomplete sapwood, and brace **ohc6** finished at 1694 with 21 rings of incomplete sapwood. Therefore it is likely that both are coeval with the 1698/9 felling date. Given this clustering, a construction period commencing in 1699 or 1700 is most likely.

Local historians have previously used Town Records to assume that the Old House was built in the 1660s, based on the fact that early settler Benjamin Horton moved to the Corchaug Dividend in 1655. The restoration of the Old House in typical medieval style may not reflect its original appearance. Early photos show it with an addition to the rear (north) side; when the addition was removed, an intact leaded casement window was found in the wall. It is one of two original *in situ* windows in America, and was used as a model for replacement windows in the restoration. The building was used as a barn and as housing for local Native Americans before being discovered by a WPA architect in the 1930s and brought to the attention of local people for preservation.

Terry-Mulford House, Orient Point (41º 08.99N; 72º 16.85W)

A total of 14 samples were taken from 11 timbers from the primary phase part of the house. Six of the samples were from the main tiebeams and girts, plus two samples from rear wall-braces, and a section of a sill beam, previously removed for repair. In addition, two slices from severed ends of rear wall sheathing boards were cuts and sent on by the owner.

Most of the timbers sampled were of white oak, although the left-hand girt and the right-hand chimney girt were of red oak. First, secondary cores taken to ensure maximum sample length and sapwood retention were cross-matched and combined to form the mean **tmh5**. Multiple samples from **tmh1** and **tmh2** did not match sufficiently well to allow cross-matching. Ring counts were generally of more than 100, with one tiebeam having 174 rings and the two sheathing boards had 184 and 186 rings respectively. Despite having higher than average ring counts, only four timbers were found to match together: **tmh2b**, **tmh3**, **tmh4**, and **tmh5**, all from the principal girts and tiebeams.

Two of the timbers retained complete sapwood: the left-hand chimney girt (**tmh2b**) was found to have been felled in the summer or autumn of 1715, whilst the tiebeam above (**tmh4**) was found to have been felled during the following winter, 1715/16. The right-hand chimney girt (**tmh3**) had incomplete sapwood with a last measured ring date of 1705. Allowing for missing sapwood to the bark edge it is likely that this is contemporary with the precise felling dates already derived. Two samples from the left-hand chimney tiebeam also dated (**tmh5a1** and **tmh5b**), although only the inner sections up to a cup or ring shake dated. Both of these inner sections had a last measured ring date of 1622, although this does not in any way represent the felling date of the timber. We need to add on the 91 rings, complete to the bark edge, of the outer section of core (**tmh5a2**) to bring the earliest possible felling date to after 1713. As little if any rings were lost at the interface of the two core segments, it is not likely that the felling date of this timber would be much beyond 1713; therefore it too is likely to be coeval with the 1715-16 felling dates of the other timbers. Given these dates, it is most likely that the construction of the timber frame of the house would have commenced during 1716, or within a year or two beyond this.

This date is somewhat later than the postulated building date of pre-1640, which was based on assumptions from the reading of documents, from the historic locale, from the architecture, from the white oak in the environment, and from the archaeological artefacts. A deed for the area east of Hashamomack to Matthew Sunderland and others (by letters patent from the Earl of Stirling through James Farrett) dated 1636/37 was one clue to inhabitance in the area (Elinor Williams *pers comm*). A second clue to that was the "industrial" area nearby in Hashamomack – a pre-1640 turpentine manufacturing enterprise and later a mill owned by John Budd. (Gaynell Stone *pers comm*). The first deed for the dividend was 1666 and the Thomas Terry I deed of 1672 had an 'edifice' on the property.

The dating is, however, in line with the general architectural style and quality of the building. The house is exceptional for having two longitudinal summer beams both upstairs and down, a sign of quality which is also reflected in the high-status finish in the chamfers and in decorative stops. Such a lavish degree of carpentry in a pre-1640 woodcutter's bunkhouse is not likely. It is clear that this building has replaced an earlier, no doubt more basic and crude, timber structure. Additionally, the use of vertical oak sheathing is found on later 17th and early 18th century houses in the Newport and eastern Massachusetts area.

The dating evidence is bolstered by the thousands of artefacts excavated by Dr. Frank Turano, Stony Brook University, found beneath the house while raising it for restoration. These totalled 64,000 and are generally of the 18th century. No metal tools or ceramics from the 17th century were found, although fragments of the lead cames of leaded glass windows were found, as well as the openings of three horizontal casement windows once in the walls.

Home Sweet Home, East Hampton (40º 57.26N; 72º 11.70W)

An assessment of this building for tree-ring dating potential was made, but most of the timber frame was found to be covered with decorative finishes. However, a lean-to on the rear of the building revealed virtually the whole of the rear wall framing on the upstairs floor level. Here seven timbers were sampled: three braces cut from very slow-grown heart-sawn timbers, and four principal posts and corner posts which contained equally-slow-grown timber which were boxed heart. All of these timbers had a series of assembly marks which ran from IIII on the far rear corner post to VII on the front corner post. The braces, being relatively small in section, had between 61 and 70 rings, whilst the posts had between 112 and 203 rings. The braces were all red oak, whilst the posts were all of white oak. All samples retained sapwood complete to the bark edge with the exception of one of the corner posts.

None of the main posts cross-matched. However, the three braces did match, and were combined to form the 70-ring site master **HSH**. This was dated through the use of the Long Island master, and spanned the years 1650-1719.

All three braces were found to be felled in the winter of 1719/20, and it is highly likely that the structure was constructed during 1720, or at the latest 1721.

Architectural historian Robert Hefner, who has studied this asymmetrical south-facing structure (not facing the main street) thinks it dates from *c*. 1720 - 1740 based on its architectural style. There are no documents indicating who built the house or when it was built, but there is a document indicating it existed by 1746. The house retains a distinguished assemblage of Georgian woodwork dating from the original construction and from an updating in the mid 18th century.

The Gardiner-Brown House, East Hampton (40º 57.59N; 72º 11.53W)

This house had 22 samples taken from 16 timbers, all from the attic structure. Despite having suffered from a serious fire, all timbers sampled retained sapwood complete to the bark edge. Most of the studs and braces had been radially riven from larger-sectioned trunks, and therefore had maximum ring sequences remaining within each timber. Some main structural timbers were assessed in the roof, as well as on the floors below, but were from faster-grown, boxed-heart timbers which were less likely to date, and therefore were not sampled. Nine of the timbers sampled were of white oak, and the remaining seven were of red oak.

A number of multiple samples were taken to obtain the bark edge, and these were combined first to form same-timber means. Subsequent analysis identified timbers originating from the same tree, and three different same-tree means were constructed, in addition to four other individual samples. Thus the sixteen timbers were reduced to seven individual trees and these produced a site master **LVI** of 140 rings.

As sixteen samples dated, and all had complete sapwood, sixteen precise felling dates were produced. One was from the spring of 1746, nine from the summer or autumn of 1746, and six from the winter of 1746/7. This is the largest assemblage of precise felling dates from a phase of building yet to be encountered in a New England building, or on the eastern seaboard. Clearly the timbers were felled specifically for the construction of the house, and it can be stated with a high degree of confidence that construction commenced during 1747.

This house, to distinguish it from the Gardiner Greek Revival "White" house down the street, is stated in several local histories to have been built in 1740 by David Gardiner (1692-1751) fourth proprietor of Gardiner's Island. The land on which it stands on was deeded in 1741 to David Gardiner by his wife Rachel's father, Abraham Schellinger. Rachel died in 1744 according to her gravestone in the South End burying ground. *East Hampton's Heritage: An Illustrated Architectural Record* credits it as the oldest gambrel roof and earliest 2 l/2 story centre chimney house in the village (Lancaster, Stern and Hefner 1996: 35). It was moved back from the street in 1924 and subsequent extensive changes and additions, as well as a fire, leave little of the original fabric present except for the 1740s frame and lower roof timbers. According to architectural historian and Town Historian Sherry Foster, the house is typical of the Connecticut River mansions of the time, which historian Kevin Sweeney has studied as the 'signature' of the wealthy merchants, the "Kings of the Connecticut River." The house has been professionally studied and restored by the Ladies Village Improvement Society for use as their headquarters.

Mulford Farm, East Hampton (40º 57.27N; 72º 11.69W)

Josiah Hobart of Massachusetts, who became a Sheriff of Suffolk County, acquired the property in 1676 and probably built the house *c*. 1680. Architectural historians Zach Studenroth and Dan Topping's architectural study in 1982 revealed the extensive structural changes the house has undergone – from the removal of facade gables to the construction of an east side lean-to roof covering storm damage and the present gable roof.

A total of 13 samples were taken from 10 timbers, all from the primary phase of the house, with the exception of one from the rear wallplate of the phase III extension. Timbers sampled included a valley rafter, four principal rafters, two of which have been reset, a collar, purlin, brace, and principal post. All timbers sampled were of white oak, except the purlin and the phase III wallplate. Most of the samples had over 100 growth rings, with one having an exceptional 263 rings. Most of the timbers also retained complete sapwood.

Only three samples were found to match together (**mul3**, **mul6**, and **mul7**). They were all principal rafters and were combined to form the 180-year mean **mul367**. Two of the samples retained complete sapwood, which aligned at the same relative year 180. Unfortunately, this sequence did not match conclusively with any of the other samples within the site, or from any of the other sites on Long Island, or with the Long Island master chronology. It, as well as all the individual samples from this site, were all compared with the dated reference chronologies from the adjoining regions, but again no conclusive or consistent matches were found.

Sylvester Manor – Shelter Island (40º 04.67N; 72º 20.70W)

The second house at Sylvester Manor is said to have been built in 1734/35, in keeping with its Georgian style. No documents attest to that construction date, but there is a record of a lawsuit in 1737 giving Brinley Sylvester ownership of a 'building' on the Manor. Architectural historian Robert Hefner thinks the architecture reflects the 1740s, possibly the 1730s.

The building was thoroughly assessed for dendrochronological potential. Although there were plenty of timbers exposed in the roof frame and attic floor structure, all were fast-grown boxed-heart timbers with less than 30 to 40 rings, and as such entirely unsuitable for dendrochronology. Some ceiling joists and beams were also assessed in the cellar and again these appeared to be similarly unsuitable. On the two floors in between virtually all of the timbers are covered over with later finishes such as plaster or panelling. It was only through the removal of a casing at the bottom of the small service staircase that a timber with complete sapwood was accessible. The removal of a small panel in the sitting room allowed access to a rail which gave some rings but no sapwood. Finally the two intermediate outside posts to the left-hand outside wall were sampled at floor level where small sections of skirting had been removed.

Altogether eight samples were taken from the four available timbers. The posts were found to be extremely distorted at the point of sampling, and three radii from one of these failed to match each other, which is an indicator that none of the radii will date. Similarly, three radii from the front girt failed to match other, despite having as many as 134 rings. All timbers sampled were of white oak, except the front girt which was of red oak. Only the girt from the service staircase had complete sapwood and reasonably clear ring patterns, although these were very tight in places. The core had broken at a defect mid-way through, but both segments had 93 and 153 rings, making the tree almost 250 years old. However, none of the samples matched each other, or any other samples from the other sites on Long Island, or with the Long Island master or other reference chronologies.

The only way there is going to be a chance of dating this building is to obtain many more samples from timbers which are not distorted or too stunted in their growth. And to achieve this the timbers would need to be exposed, which would involve a considerable amount of dismantling of the decorative finishes and lifting of floor boards. Should the house ever require rewiring or substantial plumbing renewal, then the opportunity should be taken to access the timbers which might be exposed at the time.

Halsey House – Southampton (40º 52.49N; 72º 23.53W)

This old house in Southampton was long thought to be built in 1648, possibly because the village moved from its original site by the Town Pond to the current location on the larger Agawam Pond around this time, the property being purchased at that time by Thomas Halsey, Sr., an original settler of the Town. When Halsey died in 1677, no house is mentioned in his will. However Town Records indicate his son had a new house at the time. The house was probably built by Thomas Halsey, Jr, (who died in 1688), between 1677 and 1688. The house consists of two structures joined, with very different architectural styles; the newer south (right-hand) part, *c*. 1720, has no front fascia cove as the other side does.

A total of 17 samples were taken from 13 timbers. The first six were from the right-hand section thought to date from *c*. 1720, two others from principal posts from the left-hand section, the rear one (**hhs8**) thought to have been re-used from an earlier house, and which had evidence of charring. Finally, 5 sections of *ex situ* roof boards were found in the attic, all with complete sapwood but few rings.

From the second phase, timbers sampled included the right hand chimney girt and tiebeam, rear right-hand chimney post, rear wall-plate, and two ceiling joists. Most had complete sapwood and excessive ring counts, one with as many as 276, the most found so far on Long Island. All were of white oak. However, none of the samples matched each other conclusively, and or any other samples from the other sites on Long Island, or with the Long Island master or other reference chronologies.

The two timbers from the left-hand side of the house, **hhs7** and **hhs8**, were of white oak and had some historic beetle damage, suggesting that they had been exposed to dampness for a prolonged period. These two timbers had 192 and 182 rings respectively and were found to cross-match with a *t*-value of 8.31. One of the outer fragments (**hhs8b2**) to the rear post could not be matched with the other segments comprising **hhs8** had 12 rings of sapwood complete to the bark edge, showing that this sequence extended to close to the bark edge. The combined mean of both posts **hhs78** had 192 rings but again unfortunately could not be dated with any of the other samples or reference chronologies. Finally, the five red oak offcuts of roof boards, despite all having complete sapwood, failed to match each other conclusively, and therefore is was not possible to use these to augment the felling dates of the first or second phases of roof construction.

Conclusions

Seven houses on the eastern end of Long Island, New York were sampled during 2003 and four have now been successfully dated. The oldest of these is the Old House, Cutchogue, which produced two precise felling dates of winter 1698/9, suggesting a construction period commencing in 1699 or within a year or two afterwards. At Orient Point, the Terry-Mulford House produced a precise felling date of summer 1715 and another from the winter of 1715/16, suggesting a construction date of 1716 or shortly thereafter. At Home-Sweet-Home, East Hampton, three wall-braces produced precise felling dates of winter 1719/20, suggesting construction began in 1720 or 1721 at the latest. Finally, also at East Hampton, the Gardiner-Brown House produced sixteen precise felling dates ranging from the spring of 1746 to the winter of 1746/7, indicating that construction most likely began in 1747. Samples from three other houses, the Halsey House in Southampton, Mulford Farm in East Hampton, and Sylvester Manor on Shelter Island, failed to date at this time, but may do so in the future as more chronologies are produced from the region.

Of the 94 samples taken, 19 of these from 18 timbers were combined to form the 242-year master chronology **LNGISL06**, which dated, spanning the years 1505-1746. Matches with chronologies from New York, Connecticut, Massachusetts, and Rhode Island were used to date the master chronology, and some of these chronologies were only developed in the last year or two, explaining why it has taken three years to produce these positive results.

This pilot project has highlighted a number of recommendations for future dendrochronological work in the area. The master chronology needs to be improved by the addition of many more samples, and extended to the present day. Some of this can be accomplished by the analysis of living tree core samples, but the only way representative historic data can be obtained is through the sampling of eighteenth century or earlier timber structures. Given the difficult geographical situation of eastern Long Island with the climatic influence of the sea, it is essential that many more samples be taken from each building. Although on average 50% more samples were taken from the buildings than would normally be required in Massachusetts or Virginia, only about 20% of these samples were successfully dated. It is recommended the number of samples taken be increased to double or triple, with an ideal number being between 15 and 25. Samples taken should not only include those with sapwood complete to the bark edge, but should also include timbers selected only for their long ring sequences. Exceptionally narrow or distorted ring sequences are best avoided, whilst some timbers with good ring sequences might be sampled twice to get a better average. Whilst this increased sampling strategy will inevitably increase the cost of a typical dendrochronological study, it will significantly increase the chances of a successful outcome.

Acknowledgements

Dr Gaynell Stone organised the dendrochronological study of eastern Long Island, and provided the historical descriptions of the individual houses. The research project was funded by the Ladies Village Improvement Society (Gardiner-Brown House), East Hampton Village (Home-Sweet-Home), East Hampton Historical Society (Mulford Farm), Southampton Historical Society (Halsey House), Andrew Fiske

Memorial Center for Archaeological Research at UMass, (Sylvester Manor), the Old House Committee (Cutchogue), and Mrs Charles Gamper (Terry-Mulford House). Richard Barons, Maria Brennan, James Grathwohl, Mac Griswold, Robert Hefner, Hugh King, Bill Peters, Marilyn Rittenour, Barbara Schwartz, and Elinor Williams all assisted on site during sampling. Overnight accommodation was arranged in East Hampton by Maria Brennan of the Ladies Village Improvement Society, and by Mr Richard Barons of the Southampton Historical Society at the Southampton Inn. Ms Anne A Grady provided transport and co-ordinated the sampling of the buildings, commented on an early draft of this report, and distributed the final version.

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Table 1: Summary of Tree-Ring Dating

EASTERN LONG ISLAND, NEW YORK

OLD HOUSE, CUTCHOGUE, NEW YORK

Sample number & type		Species	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
* **ohc1**	c	QUAL	3rd upstairs stud from front on RH side wall	1532-1698	1675	23C	167	0.60	0.14	0.122	Winter 1698/9
ohc2	c	QURU	Upstairs front brace to tiebeam RH side wall	-		12C	87	0.82	0.13	0.139	
* **ohc3a1**	c	QUAL	Upstairs RH brace to wall plate on front wall	1505-1592			88	1.23	0.33	0.134	
* **ohc3a2**	c		ditto	1607-1695	1676	19	89	0.54	0.13	0.160	
ohc4	c	QUAL	LH chimney tiebeam	-		36C	171	0.81	0.31	0.161	
ohc5a1	c	QURU	3rd upstairs ceiling joist from front in RH room	-			30	1.48	0.21	0.131	
ohc5a2	c		ditto	-			36	1.27	0.26	0.155	
ohc5a3	c		ditto	-			41	1.32	0.22	0.134	
* **ohc6**	c	QUAL	Upstairs LH brace to wall plate on front wall	1535-1694	1673	21	160	0.93	0.36	0.135	
* **ohc7**	c	QUAL	R H chimney girt	1517-1698	1668	30C	182	0.89	0.41	0.134	Winter 1698/9
ohc8	c	QUAL	Front ground floor girt chimney bay	-		14 ½C	111	0.82	0.27	0.180	
ohc9	c	QUAL	LH chimney girt	-		21C	185	0.79	0.34	0.162	
ohc10a1	c	QUAL	*Ex situ* timber	-			39	0.64	0.13	0.154	
ohc10a2	c		ditto	-		39	85	0.74	0.13	0.126	
ohc10a3	c		ditto	-		+33C	33	0.63	0.07	0.112	
ohc11	c	QURU	*Ex situ* timber	-		9C	49	1.98	0.63	0.170	
ohc12	c	QUAL	*Ex situ* timber	-		51C	144	0.75	0.17	0.129	
ohc13	c	QURU	*Ex situ* timber	-		7	45	1.93	0.60	0.159	

Key: *, † = sample included in site-master; c = core; mc = micro-core; g = graticule; Θ = pith included in sample; Φ = within 5 rings of centre; Ω = within 10 rings of centre; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn, or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; QUAL = *Quercus Alba* (White oak), QURU = *Q Rubra* (Red oak)

TERRY-MULFORD HOUSE, ORIENT POINT, NEW YORK

Sample number & type		Species	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
tmh1a1	c	QURU	L H girt	-			122	1.24	0.87	0.137	
tmh1a2	c		ditto	-		21C	45	0.63	0.13	0.129	
tmh1b	c		ditto	-		22	74	0.65	0.23	0.133	
tmh2a1	c	QUAL	L H chimney girt	-			66	1.52	0.35	0.133	
tmh2a2	c		ditto	-		9	82	1.01	0.21	0.121	
* **tmh2b**	c		ditto	1613-1714	1699	15½C	102	1.39	0.30	0.108	Summer 1715
* **tmh3**	c	QURU	R H chimney girt	1551-1705	1688	17	155	1.45	0.76	0.096	
* **tmh4**	c	QUAL	L H tiebeam	1542-1715	1694	21C	174	1.04	0.48	0.179	Winter 1715/16
tmh5a1	c	QUAL	L H chimney tiebeam	1559-1622			64	1.11	0.40	0.206	
tmh5a2	c		ditto	-		27C	91	0.95	0.28	0.143	
tmh5b	c		ditto	1559-1622			64	1.21	0.34	0.187	
* **tmh5**			Mean of **tmh5a1** + **tmh5b**	1559-1622			64	1.17	0.28	0.160	After 1713
tmh6	c	QUAL	R H chimney tie	-		17C	148	0.90	0.30	0.148	
tmh7	c	QUAL	L H brace rear wall LH bay	-		13	87	1.32	0.22	0.130	
tmh8	c	QUAL	R H brace rear wall LH bay	-		16	127	0.87	0.24	0.155	
tmh9	s	QUAL	*Ex situ* section from sill beam repair	-		23	139	1.08	0.60	0.150	
tmh10	s	QUAL	Rear sheathing board	-			186	0.85	0.22	0.130	
tmh11	s	QUAL	Rear sheathing board	-			184	1.19	0.36	0.134	

HOME-SWEET-HOME, EAST HAMPTON, NEW YORK

Sample number & type		Species	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
hsh1	c	QUAL	Corner post IIII	-			92+20 NM	1.18	1.10	0.208	
* **hsh2**	c	QURU	Brace IIII	1650-1719	1710	9C	70	0.98	0.40	0.160	Winter 1719/20
* **hsh3**	c	QURU	Brace V	1659-1719	1708	11C	61	1.07	0.46	0.191	Winter 1719/20
hsh4	c	QUAL	Post V	-		15 ½C	203	0.82	0.59	0.207	
hsh5	c	QUAL	Post VI	-		23C	189	0.75	0.27	0.170	
* **hsh6**	c	QURU	Brace VII	1650-1719	1704	15C	70	0.78	0.36	0.235	Winter 1719/20
hsh7	c	QUAL	Corner post VII	-		16C	187	0.69	0.62	0.198	
* = HSH **Site Master**				1650-1719			70	0.97	0.34	0.154	

Key: *, † = sample included in site-master; c = core; mc = micro-core; g = graticule; Θ = pith included in sample; Φ = within 5 rings of centre; Ω = within 10 rings of centre; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn, or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; QUAL = *Quercus Alba* (White oak), QURU = *Q Rubra* (Red oak)

GARDINER-BROWN HOUSE, EAST HAMPTON, NEW YORK

Sample number & type		Species	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
lvi1	c	QURU	Rear brace RH attic wall	1632-1745	1722	23½C	114	1.77	0.48	0.118	Summer 1746
* **lvi2**	c	QUAL	2nd stud from rear RH attic wall	1623-1745	1723	22 ½C	123	0.98	0.31	0.148	Summer 1746
lvi3	c	QURU	3rd stud from rear RH attic wall	1638-1745	1713	32½C	108	1.46	0.37	0.144	Summer 1746
lvi4	c	QURU	1st stud from rear LH attic wall	1679-1745	1734	11½C	67	1.69	0.46	0.149	Summer 1746
* **lvi5**	c	QURU	2nd stud from rear LH attic wall	1686-1745	1735	10½C	60	1.94	0.38	0.148	Summer 1746
lvi6a	c	QURU	Rear brace LH attic wall	1638-1734			97	1.61	0.44	0.125	
lvi6b	c		ditto	1657-1745	1734	11½C	89	1.37	0.30	0.131	
lvi6			Mean of **lvi6a** + **lvi6b**	1638-1745	1734	11½C	108	1.54	0.43	0.129	Summer 1746
lvi7a1	c	QUAL	3rd stud from rear LH attic wall	1673-1692			20	0.84	0.15	0.145	
lvi7a2	c		ditto	1678-1731			54	1.20	0.44	0.196	
lvi7b	c		ditto	1710-1746	1731	15C	37	1.35	0.32	0.214	
lvi7			Mean of **lvi7a1** + **lvi7a2** + **lvi7b**	1673-1746	1731	15C	74	1.18	0.37	0.185	Winter 1746/7
lvi8a	c	QUAL	4th stud from rear LH attic wall	1666-1731			66	1.65	0.50	0.201	
lvi8b	c		ditto	1724-1746	1732	14C	23	1.66	0.41	0.227	
lvi8			Mean of **lvi8a** + **lvi8b**	1666-1746	1732	14C	81	1.66	0.49	0.199	Winter 1746/7
* **lvi9**	c	QUAL	5th stud from rear LH attic wall	1639-1745	1723	22½C	107	1.31	0.55	0.170	Summer 1746
* **lvi10**	c	QUAL	6th stud from rear LH attic wall	1607-1745	1724	21¼C	139	0.92	0.17	0.130	Spring 1746
lvi11	c	QUAL	7th stud from rear LH attic wall	1674-1746	1733	13C	73	1.97	0.74	0.220	Winter 1746/7
lvi12a1	c	QUAL	8th stud from rear LH attic wall	1630-1730			101	1.16	0.47	0.167	
lvi12a2	c		ditto	1737-1746		+10C	10	1.33	0.27	0.145	
lvi12b	c		ditto	1721-1744	1729	15	24	1.51	0.27	0.154	
lvi12			Mean of **lvi12a1** + **lvi12a2** + **lvi12b**	1630-1746	1729	15C	117	1.20	0.46	0.164	Winter 1746/7
lvi13a	c	QUAL	9th stud from rear LH attic wall	1668-1746	1730	16C	79	1.79	0.77	0.233	
lvi13b	c		ditto	1734-1746	1735	11C	13	1.81	0.64	0.293	
lvi13			Mean of **lvi13a** + **lvi13b**	1668-1746	1732	14C	79	1.78	0.76	0.235	Winter 1746/7
lvi14a	c	QURU	10th stud from rear LH attic wall	1641-1745	1734	11½C	105	1.35	0.36	0.132	
lvi14b	c		ditto	1709-1745	1735	10½C	37	1.07	0.21	0.139	
lvi14			Mean of **lvi14a** + **lvi14b**	1641-1745	1735	11 ½C	105	1.34	0.36	0.131	Summer 1746
lvi15	c	QURU	11th stud from rear LH attic wall	1638-1745	1737	8 ½C	108	1.15	0.28	0.117	Summer 1746
lvi16a	c	QUAL	Front brace LH attic wall	1681-1731	1731	H/S	51	1.37	0.42	0.184	
lvi16b	c		ditto	1719-1746	1731	15C	28	1.58	0.52	0.233	
lvi16			Mean of **lvi16a** + **lvi16b**	1681-1746	1731	15C	66	1.42	0.45	0.194	Winter 1746/7
* **lvi1346**		QURU	Mean of **lvi1** + **lvi3** + **lvi4** + **lvi6**	1632-1745			114	1.67	0.45	0.120	
* **lvi716**		QUAL	Mean of **lvi7** + **lvi8** + **lvi11** – **lvi13** + **lvi16**	1630-1746			117	1.35	0.54	0.175	
* **lvi145**		QURU	Mean of **lvi14** + **lvi15**	1638-1745			108	1.24	0.31	0.116	
* = **LVI Site Master**				1607-1746			140	1.23	0.27	0.108	

Key: *, † = sample included in site-master; c = core; mc = micro-core; g = graticule; ⊖ = pith included in sample; Φ = within 5 rings of centre; Ω = within 10 rings of centre; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn, or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; QUAL = *Quercus Alba* (White oak), QURU = *Q Rubra* (Red oak)

MULFORD FARM, EAST HAMPTON, NEW YORK

Sample number & type		Species	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
Phase 1											
mul1	c	QUAL	Valley rafter	-		25¼C	94	1.00	0.38	0.177	
mul2a1	c	QUAL	Rear principal rafter (reset) T II	-			127	1.01	0.29	0.132	
mul2a2	c		ditto	-		+22¼C	22	0.75	0.07	0.108	
mul2b	c		ditto	-		+44¼C	44	0.87	0.09	0.098	
mul3	c	QUAL	Front principal rafter T II	-		30¼C	159	0.90	0.22	0.133	
mul4a	c	QUAL	Collar T II	-			263	0.57	0.15	0.165	
mul4b	c		ditto	-		H/S	75	0.48	0.08	0.140	
mul5	c	QURU	2nd purlin from top bay T II - III	-		½C	74	1.17	0.40	0.133	
mul6	c	QUAL	Front principal rafter T IIII	-			159	1.09	0.24	0.127	
mul7	c	QUAL	Rear principal rafter T VI (moved next to IIII)	-		¼C	167	0.83	0.18	0.132	
mul8	c	QUAL	Rear brace to T III	-		29¼C	156	0.87	0.25	0.132	
mul9	c	QUAL	Rear post T IIII	-		22½C	134	1.17	0.77	0.182	
mul367	c	QUAL	Mean of **mul3**, **mul6**, and **mul7**	-			180	0.93	0.19	0.105	
Phase 3											
mul10a	c	QURU	Rear wallplate	-		H/S ?	47	1.27	0.23	0.126	
mul10b	c		ditto	-		10	53	1.40	0.35	0.136	

SYLVESTER MANOR, SHELTER ISLAND, NEW YORK

Sample number & type		Species	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
syl1a1	c	QUAL	N girt on back staircase	-			93	0.75	0.39	0.140	
syl1a2	c		ditto	-		21C	153	0.56	0.31	0.193	
syl2a	c	QURU	Front RH girt	-			65	0.48	0.17	0.197	
syl2b	c		ditto	-		8	127	0.80	0.25	0.159	
syl2c	c		ditto	-			134	0.53	0.20	0.194	
syl3a	c	QUAL	N centre post W wall	-		2	64	0.64	0.27	0.157	
syl3b1	c		ditto	-			94	0.62	0.15	0.143	
syl3b2	c		ditto	-		9	41	0.45	0.17	0.196	
syl3c	c		ditto	-		44C	73	0.56	0.44	0.180	
syl4	c	QUAL	S centre post W wall	-			75	0.80	0.36	0.163	

Key: *, † = sample included in site-master; c = core; mc = micro-core; g = graticule; ⊝ = pith included in sample; Φ = within 5 rings of centre; Ω = within 10 rings of centre; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn, or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; QUAL = *Quercus Alba* (White oak), QURU = *Q Rubra* (Red oak)

HALSEY HOUSE, SOUTHAMPTON, NEW YORK

Sample number & type		Species	Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges
hhs1a1	c	QUAL	RH chimney girt	-		H/S	161	1.05	0.37	0.147	
hhs1a2	c		ditto	-		+18½C	18	0.53	0.09	0.146	
hhs1b	c		ditto	-		½C	47	0.61	0.22	0.161	
hhs2	c	QUAL	1st rear joist from RH chimney girt	-		1½C	174	0.71	0.26	0.143	
hhs3	c	QUAL	1st front joist from RH chimney girt	-		27½C	177	0.76	0.19	0.125	
hhs4	c	QUAL	RH chimney tie	-		29	276	0.85	0.36	0.153	
hhs5a1	c	QUAL	Rear RH chimney post	-		H/S	180	0.89	0.46	0.205	
hhs5a2	c		ditto	-		+8C	8	1.34	0.26	0.265	
hhs6a1	c	QUAL	Rear wallplate	-		H/S	165	0.90	0.40	0.140	
hhs6a2	c		ditto	-		+17C	17	0.56	0.06	0.092	
hhs6b	c		ditto	-		C	126	0.61	0.16	0.136	
hhs6c1	c		ditto	-		1	30	0.65	0.07	0.093	
hhs6c2	c		ditto	-		+19½C	19	0.62	0.08	0.191	
hhs7	c	QUAL	Front corner post	-		H/S	192	0.74	0.42	0.146	
hhs8a	c	QUAL	Rear LH corner post (re-used and charred)	-			158	0.62	0.22	0.201	
hhs8b1	c		ditto	-		H/S	182	0.61	0.21	0.206	
hhs8b2	c		ditto	-		+12C	12	0.83	0.09	0.082	
hhs8			Mean of **hhs8a** + **hhs8b1**	-		H/S	182	0.63	0.21	0.176	
hhs78			Mean of **hhs7** + **hhs8**	-		H/S	192	0.71	0.32	0.138	
hhs9	s	QURU	*Ex situ* roof board	-		10¼C	39	2.16	0.60	0.144	
hhs10	s	QURU	*Ex situ* roof board	-		18¼C	66	1.39	0.86	0.138	
hhs11	s	QURU	*Ex situ* roof board	-		9¼C	38	2.06	0.49	0.147	
hhs12	s	QURU	*Ex situ* roof board	-		11½C	36	2.16	0.30	0.104	
hhs13	s	QURU	*Ex situ* roof board	-		13½C	37	1.88	0.39	0.111	
*** = LI3 Site Master (2006)**				**1505-1746**			**242**	**1.16**	**0.26**	**0.100**	

Key: *, † = sample included in site-master; c = core; mc = micro-core; g = graticule; Θ = pith included in sample; Φ = within 5 rings of centre; Ω = within 10 rings of centre; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn, or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; QUAL = *Quercus Alba* (White oak), QURU = *Q Rubra* (Red oak)

Explanation of terms used in Table 1

The summary table gives most of the salient results of the dendrochronological process. For ease in quickly referring to various types of information, these have all been presented in Table 1. The information includes the following categories:

Sample number: Generally, each site is given a two or three letter identifying prefix code, after which each timber is given an individual number. If a timber is sampled twice, or if two timbers were noted at time of sampling as having clearly originated from the same tree, then they are given suffixes '**a**', '**b**', etc. Where a core sample has broken, with no clear overlap between segments, these are differentiated by a further suffix '**1**', '**2**', etc.

Type shows whether the sample was from a core 'c', or a section or slice from a timber's'. Sometimes photographs are used 'p', or timbers measured *in situ* with a graticule 'g'.

Species gives the four-letter species code used by the International Tree-Ring Data Bank, at NOAA. These are identified in the key at the bottom of the table.

Timber and position column details each timber sampled along with a location reference. This will usually refer to a bay or truss number, or relate to compass points or to a reference drawing.

Dates AD spanning gives the first and last measured ring dates of the sequence (if dated),

H/S bdry is the date of the heartwood/sapwood transition or boundary (if identifiable).

Sapwood complement gives the number of sapwood rings, if identifiable. The tree starts growing in the spring during which time the earlywood is produced, also known also as spring growth. This consists of between one and three decreasing spring vessels and is noted as *Spring* felling and is indicated by a ¼ C after the number of sapwood ring count. Sometimes this can be more accurately pin-pointed to very early spring when just a few spring vessels are visible. After the spring growing season, the latewood or summer growth commences, and is differentiated from the proceeding spring growth by the dense band of tissue. This summer growth continues until just before the leaves drop, in about October. Trees felled during this period are noted as *summer* felled (½ C), but it is difficult to be too precise, as the width of the latewood can be variable, and it can be difficult to distinguish whether a tree stopped growing in autumn or *winter*. When the summer growth band is clearly complete, then the tree would have been felled during the dormant winter period, as shown by a single C. Sometimes a sample will clearly have complete sapwood, but due either to slight abrasion at the point of coring, or extremely narrow growth rings, it is impossible to determine the season of felling.

Number of rings: The total number of measured rings included in the samples analysed.

Mean ring width: This, simply put, is the sum total of all the individual ring widths, divided by the number of rings, giving an average ring width for the series.

Mean sensitivity: A statistic measuring the mean percentage, or relative, change from each measured yearly ring value to the next; that is, the average relative difference from one ring width to the next, calculated by dividing the absolute value of the differences between each pair of measurements by the average of the paired measurements, then averaging the quotients for all pairs in the tree-ring series (Fritts 1976). Sensitivity is a dendrochronological term referring to the presence of ring-width variability in the radial direction within a tree which indicates the growth response of a particular tree is "sensitive" to variations in climate, as opposed to complacency.

Standard deviation: The mean scatter of a population of numbers from the population mean. The square root of the variance, which is itself the square of the mean scatter of a statistical population of numbers from the population mean. (Fritts 1976).

Felling seasons and dates/date ranges is probably the most important column of the summary table. Here the actual felling dates and seasons are given for each dated sample (if complete sapwood is present). Sometimes it will be noticed that often the precise felling dates will vary within several years of each other. Unless there is supporting archaeological evidence suggesting different phases, all this would indicate is either stockpiling of timber, or of trees which have been felled or died at varying times but not cut up until the commencement of the particular building operations in question. When presented with varying precise felling dates, one should always take the *latest* date for the structure under study, and it is likely that construction will have been completed for ordinary vernacular buildings within twelve or eighteen months from this latest felling date (Miles 1997).

Table 2a: Matrix of *t* -values and overlaps for components of **tmh5**

Sample:	**tmh5b**
Last ring date AD:	1622
tmh5a1	5.23 64

Table 2b: Matrix of *t* -values and overlaps for components of **lvi1346**

Sample:	**lvi3**	**lvi4**	**lvi6**
Last ring date AD:	1745	1745	1745
lvi1	9.39 108	8.97 67	10.25 108
	lvi3	12.63 67	14.59 108
		lvi4	14.92 67

Table 2c: Matrix of *t* -values and overlaps for components of **lvi716**

Sample:	**lvi8**	**lvi11**	**lvi12**	**lvi13**	**lvi16**
Last ring date AD:	1746	1746	1746	1746	1746
lvi7	10.05 74	10.00 73	10.02 74	10.71 74	9.70 66
	lvi8	10.16 73	9.24 81	11.24 79	10.34 66
		lvi11	8.37 73	12.33 73	9.71 66
			lvi12	9.62 79	9.19 66
				lvi13	12.32 66

Table 2d: Matrix of *t* -values and overlaps for components of **lvi145**

Sample:	**lvi15**
Last ring date AD:	1745
lvi14	13.49 105

Table 2e: Matrix of *t* -values and overlaps for components of site master **LVI**

Sample: Last ring date AD:	**lvi2** 1745	**lvi5** 1745	**lvi716** 1746	**lvi9** 1745	**lvi10** 1745	**lvi145** 1745
lvi1346	4.62 114	6.74 60	5.86 114	3.40 107	2.82 114	8.94 108
	lvi2	0.79 60	4.22 116	4.17 107	4.81 123	3.59 108
		lvi5	4.37 60	0.61 60	0.94 60	4.34 60
			lvi716	3.70 107	2.90 116	5.05 108
				lvi9	2.19 107	4.14 107
					lvi10	2.63 108

Table 2f: Matrix of *t* -values and overlaps for components of **mul367**

Sample: Last ring date AD:	**mul6** 1159	**mul7** 1180
mul3	6.34 138	3.90 159
	mul6	5.67 146

Table 2g: Matrix of *t* -values and overlaps for components of **hhs8**

Sample: Last ring date AD:	**hhs8b1** 1187
hhs8a	5.17 158

Table 2h: Matrix of *t* -values and overlaps for components of **hhs78**

Sample: Last ring date AD:	**hhs8** 1187
hhs7	8.31 182

Table 2i: Matrix of *t* -values and overlaps for components of site master **LNGISL06**

Sample:	**lvi2**	**lvi5**	**lvi716**	**lvi9**	**lvi10**	**lvi145**	**tmh2b**	**tmh3**	**tmh4**	**tmh5**	**hsh2**	**hsh3**	**hsh6**	**ohc1**	**ohc3a1**	**ohc3a2**	**ohc6**	**ohc7**
Last ring date AD:	1745	1745	1746	1745	1745	1745	1714	1705	1715	1622	1719	1719	1719	1698	1592	1695	1694	1698
lvi1346	4.62 114	6.74 60	5.86 114	3.40 107	2.82 114	8.94 108	3.79 83	3.03 74	4.19 84	0.00 0	4.67 70	1.92 61	2.82 70	0.84 67	0.00 0	0.56 64	0.98 63	0.79 67
lvi2		0.79 60	4.22 116	4.17 107	4.81 123	3.59 108	3.21 92	2.23 83	2.79 93	0.00 0	1.29 70	0.21 61	0.00 70	1.99 76	0.00 0	2.21 73	1.46 72	0.33 76
lvi5			4.37 60	0.61 60	0.94 60	4.34 60	1.73 29	1.33 20	3.75 30	0.00 0	5.89 34	2.87 34	1.51 34	2.19 13	0.00 0	3.52 10	0.55 9	1.75 13
lvi716				3.70 107	2.90 116	5.05 108	2.34 85	0.00 76	2.81 86	0.00 0	2.49 70	0.00 61	1.12 70	1.11 69	0.00 0	1.44 66	0.89 65	0.00 69
lvi9					2.19 107	4.14 107	3.10 76	0.42 67	0.29 77	0.00 0	0.52 70	0.00 61	1.60 70	0.86 60	0.00 0	0.07 57	0.00 56	0.05 60
lvi10						2.63 108	1.67 102	1.41 99	2.20 109	0.00 16	1.57 70	1.41 61	1.02 70	1.63 92	0.00 0	0.93 89	1.62 88	1.70 92
lvi145							3.70 77	2.60 68	3.02 78	0.00 0	5.15 70	3.59 61	4.38 70	0.84 61	0.00 0	0.93 58	0.58 57	1.01 61
tmh2b								1.55 93	3.16 102	0.63 10	1.55 65	2.06 56	3.03 65	2.31 86	0.00 0	1.38 83	1.41 82	1.22 86
tmh3									4.22 155	4.89 64	0.49 56	1.78 47	0.45 56	1.15 148	2.67 42	2.54 89	2.31 144	4.99 148
tmh4										5.75 64	3.51 66	2.17 57	1.38 66	1.72 157	2.63 51	1.55 89	4.60 153	3.16 157
tmh5											0.00 0	0.00 0	0.00 0	1.29 64	1.93 34	0.24 16	2.27 64	2.60 64
hsh2												2.39 61	4.50 70	1.15 49	0.00 0	2.77 46	0.06 45	1.72 49
hsh3													6.64 61	1.68 40	0.00 0	1.40 37	1.32 36	1.54 40
hsh6														2.54 49	0.00 0	0.38 46	0.00 45	0.00 49
ohc1															4.26 61	2.09 89	2.23 160	2.30 167
ohc3a1																0.00 0	4.67 58	4.52 76
ohc3a2																	1.46 88	4.50 89
ohc6																		4.59 160

Table 3: Dating of master chronology **LNGISL06** (1505-1746) against reference chronologies at 1746

County or region:	*Chronology name:*	*Short publication reference:*	*File name:*	*Spanning:*	*Overlap:*	t-*value:*
New York	Mohonk	*(Cook unpubl)*	NY	1449-1987	242	5.39
Connecticut	Joseph Webb House, Wethersfield	*(Miles and Worthington 2006)*	WEBB	1483-1763	242	5.33
Pennsylvania	Morgan Homestead	*(Cook unpubl)*	FORES	1458-1988	242	5.20
Massachusetts	Rockport buildings	*(Miles 2004)*	OGC	1563-1710	148	5.10
Massachusetts	Fairbanks House, Denham	*(Miles et al 2002)*	fhd10	1546-1654	109	4.96
Massachusetts	Chestnut Hill Meeting House	*(Miles et al 2003)*	CHM	1609-1767	138	4.94
Massachusetts	South-East Massachusetts	*(Miles and Worthington unpubl)*	SEMASS3	1609-1796	138	4.64
Massachusetts	Eastern Massachusetts	*(Miles et al 2002)*	BOSTON02	1454-1769	242	4.62

Bar diagram showing dated timbers in chronological position