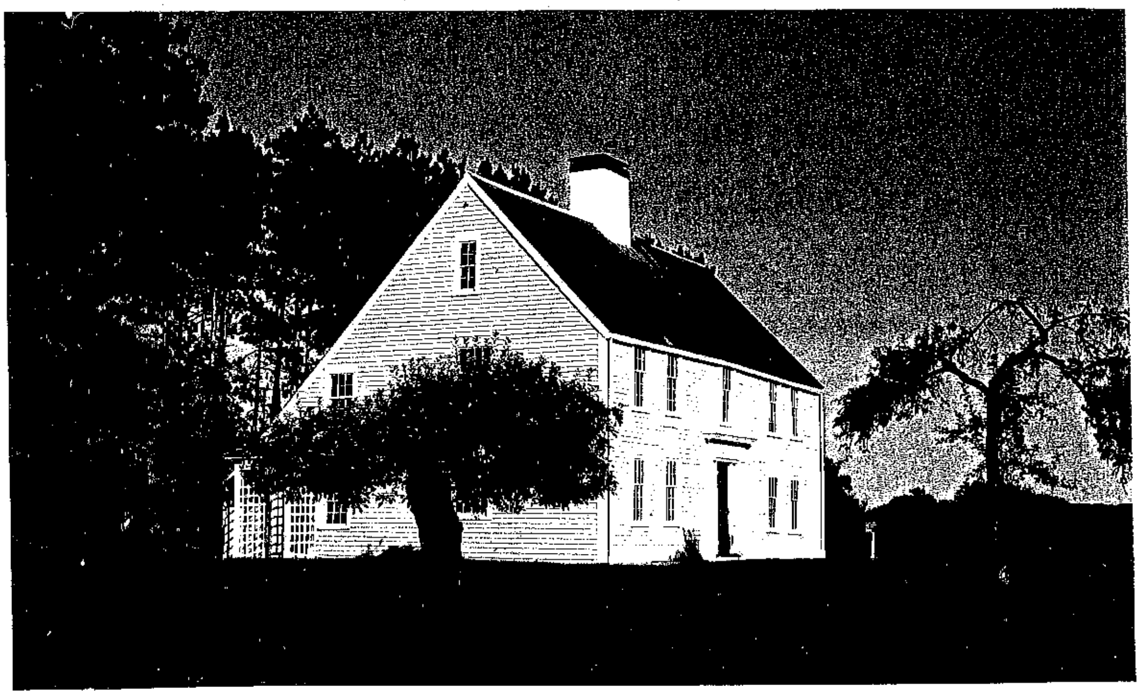
# TREE-RING DATING OF

# THE PAINE HOUSE

**53 Jeffrey's Neck Road**
**Ipswich, Massachusetts**



**For the Trustees of Reservations**

**by the**

**Oxford Dendrochronology Laboratory**
**Oxfordshire, England**

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## *PAINE HOUSE, 53 Jeffrey's Neck Road, Ipswich, Massachusetts*

*Felling dates:* **Spring 1693, Winter 1693/4, and Spring 1694**

*Site chronology produced:* ***PHI*** 1546-1693

*Architectural Description and Historical Documentation:*

The Paine House, which faces south, is five bays wide and two-and-one-half stories in height with an integral lean-to. The building retains many significant features from its original seventeenth century construction and from updatings and alterations in the eighteenth century. Notable survivals include shadow-molded sheathing in several places, an early-Georgian corner cupboard and bolection-molded fireplace surround in the southwest room, and a partially subterranean dairy in the lean-to. The house was restored in 1930 by Mrs. Robert G. Dodge, whose family acquired the property in 1916. Post and beam cases were removed in many places and the revealed timbers stripped of paint (a condition that facilitated the recent core sampling). The southeast room was returned to a presumed early appearance. The plaster ceiling was removed and parts of the fireplace wall were fitted with reused vertical sheathing. The lean-to was opened up to form a single room. The house, used primarily as a guest house, never received modern plumbing or heating.

According to deeds, when Robert Paine, Sr. transferred the property to his son, Robert in 1689, the son was already living in a house on the premises. The location of the son's house has not as yet been determined.[1]

The presumed construction date of 1694 identified by dendrochronology, would mean that Robert Paine, Jr. built this house before he conveyed the property to his son-in-law, Daniel Smith. Some recent studies have suggested that the house was built after the transfer.[2]

*Assessment:*

The Paine House was examined and its potential for dendrochronological dating was assessed by Anne Grady on Sept. 5, 2002. The frame was found to be a mixture of oak and pine timbers. Oak was used for the posts, first floor chimney girts, joists, and some studs, purlins, braces or collar beams in the main and lean-to attics. Few timbers with complete sapwood or bark edges were noted, and those that did have complete sapwood tended to be small members with a limited number of rings.

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[1]Michael Burrey, sampling assistant, who is a restoration carpenter, pointed out an unusual feature on the east wall of the southeast room that could be interpreted as suggesting that an earlier structure abutted the east side of the present building. Spaced along the girt are wedged pins. If one were attaching two frames together, one way of holding them in place would be to drive pins through both frames and then to make certain that the pins could not withdraw on either side by inserting wedges on both sides. See accompanying illustration.

[2]Abbott Lowell Cummings, Massachusetts and its First Period Houses, *Architecture in Colonial Massachusetts*, Vol. 51 of Publications of the Colonial Society of Massachusetts, Boston: The Colonial Society of Massachusetts, 1979, 155; Anne Grady, Paine-Dodge House National Register of Historic Places nomination, part of the Thematic Nomination of First Period Buildings in Eastern Massachusetts, 1986.

*Methodology:*

All timbers sampled were of red oak (*Quercus rubra*). Generally, samples were restricted to what appeared to be primary first-use timbers. Those timbers which looked most suitable for dendrochronological purposes with complete sapwood and/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, and are shown on the diagrammatic floor plans.

The dry samples were sanded on a bench-mounted belt sander, or linisher, 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.

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 are 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.

Statistically, *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.

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. Here, a single strong matching position 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 state.

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 was 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 between 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 latterly re-written in Microsoft Visual Basic by M R Allwright and P A Parker.

*Available Reference Chronologies:*

It is fortunate that over 30 individual site master chronologies and two major regional chronologies have now been produced for dating buildings in eastern Massachusetts. Over the last few years, the Society for the Preservation of New England Antiquities (SPNEA), assisted by a Survey and Planning grant from the Massachusetts Historical Commission (MHC), undertook a phased project to develop standard tree-ring chronologies for oak in Eastern Massachusetts. In Phase I, completed in 2000-2001, dendrochronologists Ed Cook and Paul Krusic from the Great Bay Tree-Ring Laboratory, Durham, Hew Hampshire, dated six buildings of known construction date, five of which have produced individual site chronologies, as well as the Boston Archaeological Master Dating Chronology (***BOSTON01***) covering the years 1513-1996 (Table 3, top). During the second phase of the project a further thirteen site masters were produced, and five site masters from the material produced by Dr William Robinson in 1975 were reviewed. The material from which these eighteen site chronologies were produced was combined to form a new master chronology of 316 years, ***BOSTON02***, spanning the years 1454-1769 (Table 3, middle), mainly independent of the one produced in the previous year. Finally, additional work commissioned for the most part by SPNEA during the latter part of 2002 has produced a further eight chronologies, extending into southern New Hampshire and Rhode

Island (Table 3, bottom). It is this corpus of replicated and independent reference chronologies which is now allowing reliable matches to be made, both with individual timbers, and with site composites.

*Ascribing Felling Dates:*

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples that 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 spring vessels or earlywood formed, or the latewood or summer growth, a *precise felling date and season* can be given.

If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then obviously it is impossible to give a precise felling date. In Britain, *Quercus rober* grows with clearly identifiable sapwood from which an *estimated felling date range* can be given for each sample. Generally, the conventional method used to identify sapwood is to determine whether the earlywood, or spring, vessels are filled with tyloses, that is the true definition of heartwood[3]. Colour change is often striking, and generally follows suit, but there are significant exceptions where there is no colour change, or it does not align with the H/S boundary. The number of sapwood rings can be estimated by using an empirically derived sapwood estimate with a given confidence limit. A recent review of the geographical distribution of dated sapwood data from historic building timbers in Britain has shown that a 95% range of 9-41 rings for southern counties and 12-46 for the north is typical for England (Miles 1997).

Unfortunately, it has not been possible to apply an accurate sapwood estimate to oaks in Massachusetts at this time. Primarily, it would appear that there is a complete absence of literature on sapwood estimates for oak anywhere in the country.[4] 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 *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. Sapwood ring counts between 6 and 28 have been recorded in the Phase II material, suggesting that a narrower sapwood estimate than that used in Britain will eventually be produced for white oaks in eastern Massachusetts (Miles *et al* 2002).

[3] Dr Peter Savill, Dept of Plant Sciences, Oxford Univ. personal communication.

[4] Dr Henri Grissino-Mayer, Univ of Tennessee, personal communication.

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 number of rings lost in sampling, if any meaningful interpretation of felling dates is to be made.

If no sapwood or heartwood/sapwood boundary survives, then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* or *felled after* date. As no sapwood estimate has yet to be produced for New England oaks, no attempt has been made in determining a *terminus post quem.*

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).

*Sampling Procedures:*

On September 29, 2002, Michael Burrey took core samples from six timber in the Paine House. In three cases he took an additional sample from the same timber. The 5/8" holes left by the coring were filled with wooden plugs stained to match the surrounding wood. The date acquired by measuring and analysing the cores enabled the dendrochronologists to construct a preliminary 142-year site master (chronology of tree-ring patterns) for three timbers in the building. Unfortunately, owing to absence of bark edge on any of the sampled timbers no precise felling dates could be identified

On November 7, 2002, Michael Burrey and Michael Worthington of the Oxford Dendrochronology Laboratory made a return visit to the Paine House and acquired five additional samples, all of which had complete sapwood.

The sample locations are described in Table 1, and are shown on the drawings as recorded by Anne Grady.

*Results and Conclusions:*

Altogether eight timbers were sampled, some more than once to obtain complete sapwood. These included the east chimney girt in the hall, three chimney posts, a corner post, two studs, and a wall brace. The majority of these samples were slow-grown with between 50 and 150 rings.

Initially, multiple radii were combined to form single-timber mean ring widths. These were then compared with other timber samples and five were found to match each other, as shown in Table 2. The chimney girt, corner post, and a chimney post matched particularly well together. All five of these timbers were combined to form the 148-year site master ***PHI***. This dated exceptionally well with the reference chronologies, spanning the years 1546-1693.

Sample ***phi8***, despite having only 38 rings, matched the reference chronologies independently exceptionally well. The best match was a *t*-value of 8.02 with the Parson Capen House, Topsfield (***ALC2***). Because it also matched consistently with the other components of ***PHI***, it was included in the site master.

One further sample, ***phi5***, was dated but not included in the site master. This is due primarily to the poorer matches with other dated samples from the site. Nevertheless, this sample matched consistently with other individual site chronologies, albeit with lower than average *t*-values. It also matched the site master ***PHI*** with a *t*-value of 3.89. However, it must be remembered that this sample had only 34 rings and the visual matches were acceptable.

Two timbers failed to date, despite reasonable sample lengths. Sample ***phi4*** was from a rear wall-brace and is composed of two cores, each of which had a defect precluding continuous measurements. Therefore four individual segments were used to construct the mean ***phi4*** which totalled 99 rings. Sample ***phi7*** was from the left rear chimney post and was sampled twice, with a short length of core retaining complete sapwood. The longer cores had 74 and 114 rings each, and the short length had 20. Despite these reasonable sample lengths, there was no positive match between the individual segments, or with the reference chronologies individually. This is probably because the tree was very slow-grown and the ring sequences distressed.

The production of felling dates ranging from the spring 1693 through to the spring 1694 would suggest a construction period starting in 1694, unless both the principal and subsidiary timbers were stockpiled. This date is somewhat earlier than the post-1700 date proposed by Abbott Cummings (1979b, 155), and is significant in dating sheathing board shadow mouldings during a time of transition from creased to bead or featheredged profiles around 1700 (Cummings 1979a, 178).

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