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CHISWICK HOUSE GARDENS, BURLINGTON LANE, CHISWICK, LONDON BOROUGH OF HOUNSLOW
TREE-RING ANALYSIS OF YEW STUMPS

SCIENTIFIC DATING REPORT

Martin Bridge

ARCHAEOLOGICAL SCIENCE

ENGLISH HERITAGE

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TREE-RING ANALYSIS OF YEW STUMPS

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SUMMARY
Cross-sectional slices were removed from the stumps of previously felled yew trees in an area of the gardens at Chiswick House known as The Arcade. These proved to be highly variable in both cross-sectional dimensions and minimum likely ages. Ring counts proved difficult due to the presence of exceptionally narrow rings as well as problems associated with multiple rings merging into one at places around the circumference. Although attempts were made at measuring the ring sequences no cross-matching was possible between the trees further emphasising the difficult nature of this material. It is however possible to suggest that several of the larger trees appear to be of early eighteenth-century origin.

CONTRIBUTOR
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INTRODUCTION

Chiswick House lies in west London, about 500m west of the north bank of the Thames, with Chiswick Bridge about 1km to the south-west, and about 1km south of Chiswick High Road (Fig 1, TQ 2101 7753). Chiswick House is an eighteenth-century villa, mostly designed by the third Earl of Burlington, who was also responsible for the design of the gardens from AD 1717 onwards, along with William Kent from AD 1723, although there had been a house and gardens on the site since the late seventeenth century. Lord Burlington died in AD 1753 and after the death of his widow and surviving child, the estate passed to the fifth Duke of Devonshire in AD 1764. Devonshire employed Samuel Lapidge to bring the gardens up to date. The sixth Duke inherited in AD 1811, buying the neighbouring property to the east the following year, demolishing the hall there and extending the gardens. The gardens have undergone several developments since, and have been used as a public park since AD 1929. Further details of the house and gardens can be found in two key works, Travers Morgan Planning (1983) and English Heritage (1989). To the north-east of the House is an eighteenth-century brick ha-ha, with an eighteenth-century Deer House at its north end. Immediately east of this (Fig 2) lies 'The Arcade', an area with a fountain and walkways which were flanked by mature yew (*Taxus baccata* L.) trees, leading to the Orangery and beyond (Fig 3).

The yew trees were felled in AD 2008/9 and it is the stumps of these trees that are the subject of this study. Previous tree-ring studies at the site (Bridge 1999; 2003) had yielded interesting information about a cedar from the main avenue and a camellia. A previous study of yews from Hampton Court, originally an undergraduate study supervised by the author and later published (Moir 1999), suggested that yews could be used in dendrochronological study, although Tyers (2004) highlighted severe issues with missing or aberrant rings in managed yews.

The primary focus of this study was simply to provide approximate ages for the yews planted along the arcade, which it had been noted were very variable in cross-sectional dimensions, in an attempt to relate the stumps to different planting times and hence elucidate some of the history of the development of the gardens. However it was also thought valuable to attempt to cross-match the derived tree-ring series to see if any further information, for example how changing growth rates relate to weather conditions in different years, could be derived in the manner of the Hampton Court study.

METHODOLOGY

The site (Figs 4 and 5) had been cleared previously and stumps of the once-mature yews left exposed for several months. Stumps of a variety of sizes were chosen, and a slice a few centimetres thick was cut with a chainsaw and labelled. The remaining stump was labelled with a metal tag stapled to it, the tags being numbered sequentially from 401 to 419. The stumps were almost exclusively of yew, and only yews were sampled. Three size categories were apparent to the eye, though it was realised that these might not equate directly to age classes. A representative number of each size class, covering the whole area under study, was chosen.

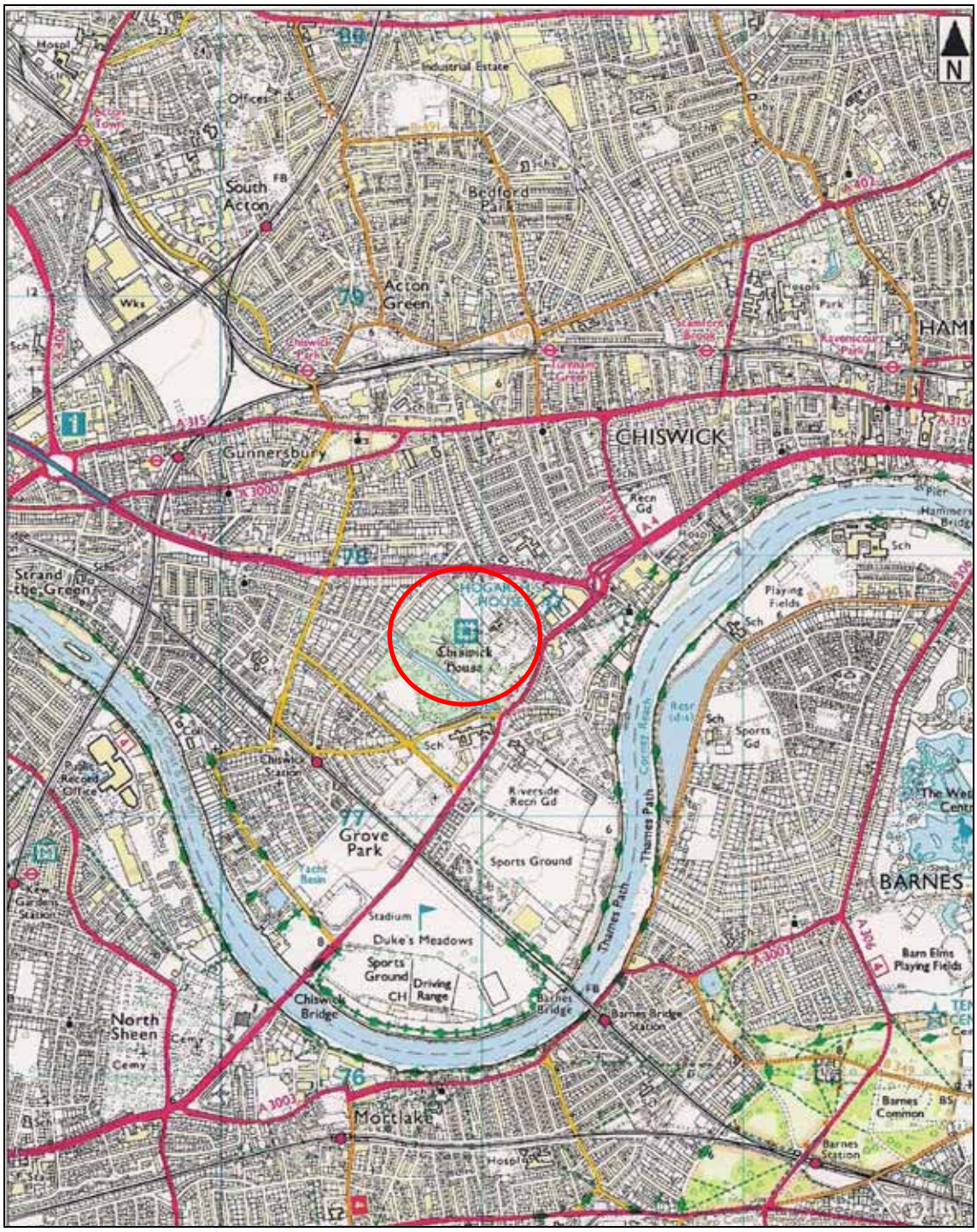

Figure 1. Map to show the location of Chiswick House gardens (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, © Crown Copyright)

Figure 2. Map showing the location of the study area within its immediate environs (based on the Ordnance Survey map with permission of the Controller of Her Majesty's Stationery Office, © Crown Copyright)

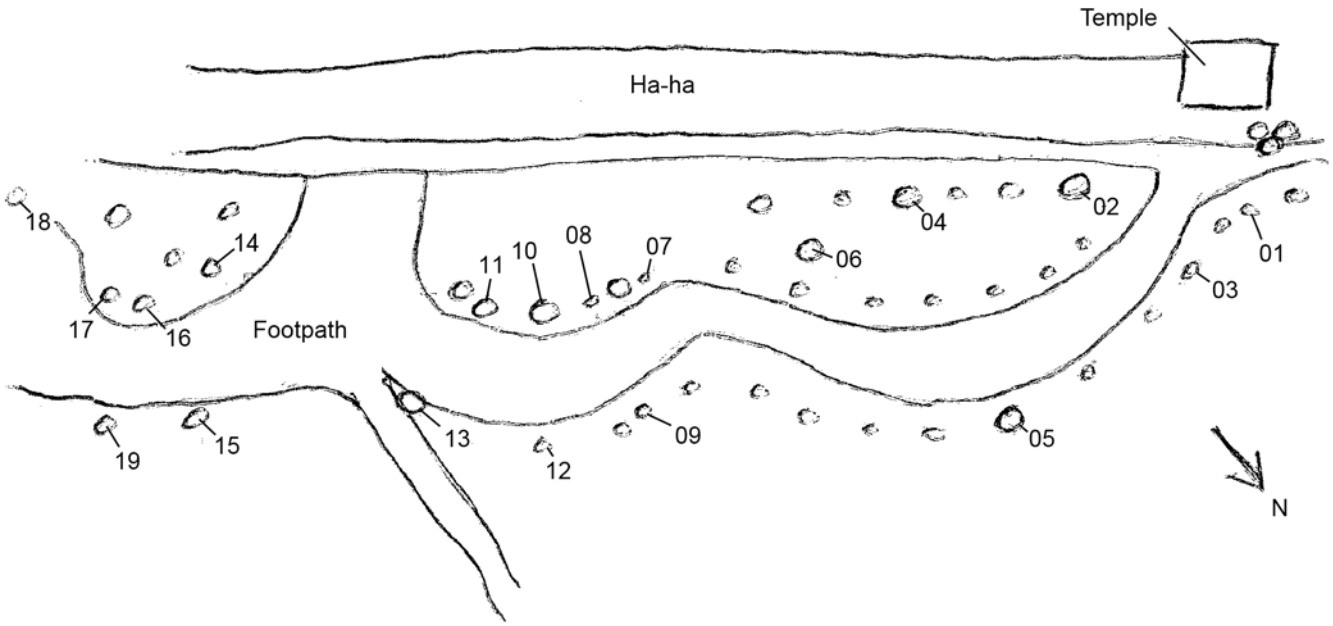

Figure 3. Sketch plan of the study area showing the approximate locations of the stumps sampled (a topographical survey of the site did not become available in time for this report)

Figure 4. View of the study site looking east from near the centre towards the Deer House

Figure 5. View of the study site looking west from near the centre

The samples were sub-sectioned on a bandsaw to facilitate easier preparation and subsequent analysis. These were polished on a belt sander using 80 to 400 grit abrasive paper to allow the ring boundaries to be as clearly distinguishable as possible. The samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (2004). Cross-matching was attempted by a combination of visual matching and a process of qualified statistical comparison by computer. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted on-screen to assist visual comparisons to be made between sequences. This method provides a measure of quality control in identifying any potential errors in the measurements when the samples cross-match.

RESULTS AND DISCUSSION

The stumps in the area known as 'The Arcade' are mostly positioned in relation to the winding paths through the area, although the stumps themselves vary in size quite considerably, from less than 100mm diameter, to in excess of 500mm. Many of the stumps show evidence of having been formed by the fusion of multiple stems, although there still appears to be a large variation in age between the trees felled to leave these stumps. Many, especially of the larger examples, show rot in the innermost rings, though none of the trees had apparently become hollow a few centimetres above ground level.

After polishing, many of those cross-sections which displayed rot in the inner rings were found to have indistinguishable rings in the slightly rotted areas, although wetting the surface often made the ring boundaries temporarily visible. What also became apparent, especially after the surfaces had been polished, was that very few of the radii showed even growth rings. Instead, rings could be seen to 'wedge out' in many places and form lobes in other areas, as illustrated to some extent in Figure 6. It is not surprising therefore that attempts to cross-match the sequences derived from different radii of the same tree failed, and the differences were so marked that problem areas could not be resolved. The reliability these measured sequences was clearly questionable, thus the raw data has not been presented in the Appendix. It was only possible therefore to produce minimum likely ages for each tree, based on the number of rings counted on the clearest radius, with the caveat that some rings may be missing within these estimates. Without the ability to cross-match the series it is not strictly possible to show that the rings are indeed annually formed, although data from previous studies (eg Moir 1999) suggest that they most likely are.

Table 1 gives information on the sizes of the 19 stump cross-sections studied along with their minimum likely ages as indicated by the ring counts undertaken. It is thought that

these estimates are likely to be within 20 years of the true age in the older trees where the pith is present, and within 5 years in the younger trees. This estimate cannot be easily backed up with hard evidence, but is based on the differences between counts on radii from the same tree, with the final numbers being rounded up as an additional factor to make the estimates more robust. Several of the older trees had rotted pith regions and therefore it is not possible to say how many rings should be added in addition to those measured. Nevertheless, given all the caveats, these figures are likely to represent minimum ages of the trees investigated, and show a range from 36 to 280 years. The results have not been able to distinguish between yews which may have been planted out in Lord Burlington's original plan and those which may have been put in only decades later. Tree 13 (CY413), the oldest found, lies at the junction of The Arcade with the path through to the Italianate Garden, and may well be an original Burlington tree, since 280 years would take this back to the late AD 1720s.

The other characteristics of the measured series presented in Table 1 show some interesting variations from those reported by Moir (1999) for the Hampton Court Palace yews. In the Hampton Court yews, the individuals were generally grown as separate trees within a formal garden layout, though most had been repeatedly clipped into shape throughout their lives. Here, the trees were less formally arranged, and would have competed with each other throughout their lives. Only one Chiswick yew (CY412) shows clear signs in its ring series of perhaps having been regularly cut (Fig 7), though all the series show a number of very abrupt declines in growth that could be the result of management. What is immediately obvious from Table 1 is the very high sensitivity values (a measure of the year-to-year variation in ring width) which are all in excess of 0.34. This compares markedly with those reported by Moir at Hampton Court, where the site master formed had a mean sensitivity of just 0.23 (Moir 1999).

The lack of internal cross-matching prevented further meaningful analysis of the ring-width data in relation to climatic data. The interpretation of the approximate ages of the trees is difficult to relate to the likely planting regimes. Trees 406, 410 and 413 must surely have been planted by Burlington and Kent, other old trees may have been planted by them or indeed the 5th, or even the 6th Duke. Later owners may have replaced dead trees, or the trees may have self-seeded and been allowed to grow.

Table 1. Details of the samples of yews taken from 'The Arcade' Chiswick House Gardens, West London

Sample	No. of rings (minimum)	Pith present (+) or absent (-)	Long axis (mm)	Short axis (mm)	Mean ring width (mm)	Sensitivity	Standard deviation (mm)	Autocorrelation
CY401	114	+	250	200	0.96	0.38	0.79	0.80
CY402	51	+	95	80	0.70	0.48	0.88	0.57
CY403	85	+	150	110	0.69	0.41	0.65	0.80
CY404	173	-	460	460	1.07	0.37	0.76	0.75
CY405	114	+	300	230	1.17	0.41	0.86	0.72
CY406	261	-	570	510	0.65	0.38	0.49	0.71
CY407	36	+	110	100	1.60	0.36	1.26	0.87
CY408	49	+	115	105	0.94	0.35	0.71	0.80
CY409	84	+	200	170	1.08	0.38	0.75	0.78
CY410	254	+	400	370	0.53	0.34	0.49	0.73
CY411	236	-	390	320	0.56	0.35	0.47	0.77
CY412	151	-	250	170	0.81	0.39	0.57	0.76
CY413	280	+	470	400	0.55	0.34	0.46	0.76
CY414	194	-	450	360	0.54	0.34	0.41	0.79
CY415	101	+	240	215	0.95	0.43	1.21	0.89
CY416	229	+	330	270	0.56	0.34	0.86	0.87
CY417	247	+	370	320	0.58	0.38	0.67	0.80
CY418	217	-	470	470	0.52	0.35	0.29	0.66
CY419	90	+	220	190	0.91	0.47	0.86	0.83

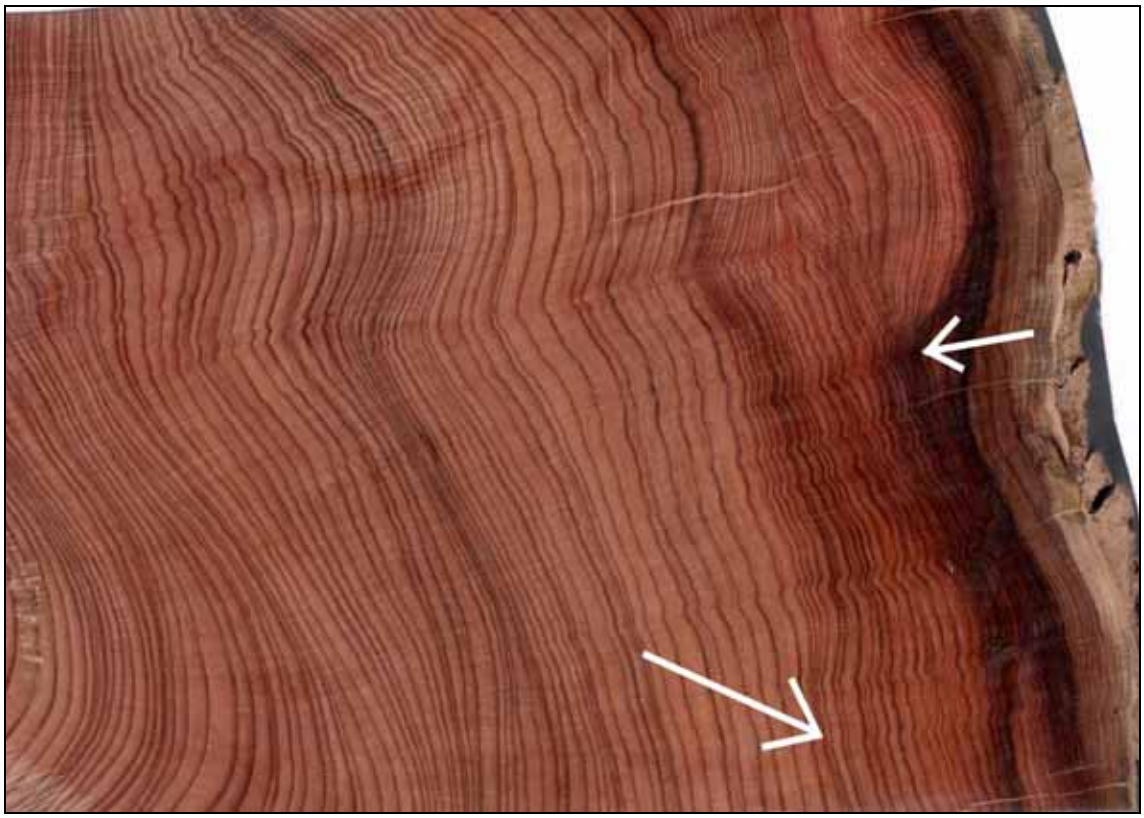

Figure 6. Photograph of part of the surface of sample CY404 showing the 'wedging out ' of rings (arrowed) where several rings appear to merge into a single ring

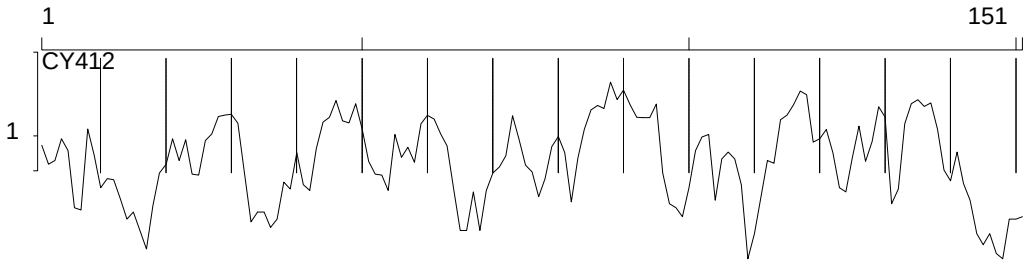

Figure 7. Plot of the ring-width series from sample CY412, showing repeated abrupt growth declines. This plot has the x-axis representing the ring number (probably equating to years) and the y-axis being ring width (mm) on a logarithmic scale.

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