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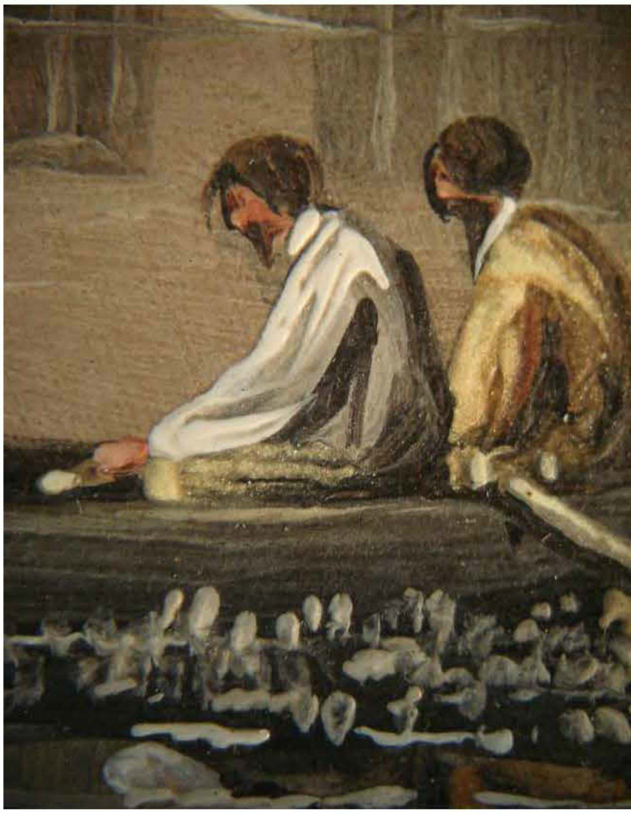
VIEW OF OLD LONDON BRIDGE, BY CLAUDE DE JONGH FROM KENWOOD HOUSE, HAMPSTEAD LANE, HAMPSTEAD, LONDON
DENDROCHRONOLOGICAL ANALYSIS OF OAK BOARDS

SCIENTIFIC DATING REPORT

Ian Tyers



INTERVENTION
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ENGLISH HERITAGE

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SUMMARY
A tree-ring assessment, measurement, and analysis programme was commissioned on the View of Old London Bridge panel painting exhibited at Kenwood House, Hampstead, London. The Old London Bridge panel comprises two horizontal oak boards. Direct tree-ring measurement was undertaken on these boards whilst the panel was undergoing conservation treatment in June 2010. The results identified that one of the two oak boards was derived from a timber imported from the eastern Baltic. This timber was felled after AD 1586.

CONTRIBUTORS
Ian Tyers

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London
EC1N 2ST

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CONTACT DETAILS
Ian Tyers
Dendrochronological Consultancy Ltd
Lowfield House
Smeath Lane
Clarborough DN22 9JN
ian@dendro.co.uk

CONTENTS

INTRODUCTION

This document is a technical archive report on the tree-ring analysis of oak timbers from a panel painting on display at Kenwood House, Hampstead, London. It is beyond the dendrochronological brief to describe the object in detail or to undertake the production of detailed drawings. Elements of this report may be combined with detailed descriptions, drawings, and other technical reports at some point in the future to form either a comprehensive publication or an archive deposition on the object.

METHODOLOGY

The View of Old London Bridge is *c* 1684mm wide and *c* 520mm high. It is constructed of two horizontally aligned oak boards (Fig 1). Each of the boards tapers slightly from one end to the other with widths of *c* 271mm and 256mm at their widest ends, and they are each *c* 9mm thick. The reverse is neatly bevelled and was machine sawn. Visual examination indicated that both boards are radial sections of slow growing, straight-grained oaks.

Tree-ring dating employs the patterns of tree growth to determine the calendar dates for the period during which the sampled trees were alive. The amount of wood laid down in any one year by most trees is determined by the climate and other environmental factors. Trees over relatively wide geographical areas can exhibit similar patterns of growth, and this enables dendrochronologists to assign dates to some samples by matching the growth pattern with other ring sequences that have already been linked together to form reference chronologies.

Dendrochronological samples need to be free of aberrant anatomical features such as those caused by physical damage to the tree, which may prevent or significantly reduce the chances of successful dating.

Standard dendrochronological analysis methods (see eg English Heritage 1998) were applied to each of the two boards. The complete sequences of the annual growth rings in the left- and right- edges of the upper board and the left edge of the lower board, and a partial outermost sequence from the right edge of the lower board, were measured to an accuracy of 0.01mm using a micro-computer based travelling stage. The sequences of ring widths were then plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition, cross-correlation algorithms (eg Baillie and Pilcher 1973) were employed to search for positions where the ring sequences were highly correlated. Highly correlated positions were checked using the graphs and, if any of these were satisfactory, new composite sequences were constructed from the synchronised sequences. Any *t*-values reported below were derived from the original CROS algorithm (Baillie and Pilcher 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative or absolute position need to have been obtained from a range of independent sequences, and that these positions were supported by satisfactory visual matching.

Not every tree can be correlated by the statistical tools or the visual examination of the graphs. There are thought to be a number of reasons for this: genetic variations; site-specific issues (for example a tree growing in a stream bed will be less responsive to rainfall); or some traumatic experience in the tree's lifetime, such as injury by pollarding, defoliation events by caterpillars, or similar. These could each produce a sequence dominated by a non-climatic signal. Experimental work with modern trees shows that 5–20% of all oak trees, even when enough rings are obtained, cannot be reliably cross-matched.

Converting the date obtained for a tree-ring sequence into a useful date requires a record of the nature of the outermost rings of the sample. If bark or bark-edge survives, a felling date precise to the year or season can be obtained. If no sapwood survives, the date obtained from the sample gives a *terminus post quem* for its use. If some sapwood survives, an estimate for the number of missing rings can be applied to the end-date of the heartwood. This estimate is quite broad and varies by region. This report uses a minimum of 8 rings as a sapwood estimate based on comparative data from other groups of eastern Baltic data (eg Tyers 1998; Sohar *et al* 2012).

The analysis may highlight potential same-tree identifications, if two or more tree-ring sequences are obtained that are exceptionally highly correlated. Such pairs, or sometimes more, are then used as a same-tree group and each can be given the interpreted date of the most complete of the samples. They are most useful where several timbers date but only one has any sapwood, or where same-tree identifications yield linkages within or between objects.

RESULTS

The panel was examined at the English Heritage conservation studio in London in June 2010. The panel comprised two oak boards (Table 1), both of which were suitable for measurement and labelled A and B from the top. Due to the length of the panel, ring-width sequences were derived from both ends of both boards. These were synchronised and combined into a single composite sequence for each board. These composites were mathematically constructed from the matched series at their synchronised positions, which were 191 and 239 years in length respectively. But the two series did not match each other. The two individual series were compared with reference data of historic date from throughout England and northern Europe. A number of statistically significant matches were obtained between the board B sequence and reference series, along with other contemporaneous objects. These indicate that the board B composite sequence dates from AD 1340–1578 inclusive (Fig 2; Table 2). The board A series did not give significant correlations to reference data and remains undated.

The dated board is of eastern Baltic origin (ie not of either English or western European origin). It should be noted that the undated board is not obviously different from the dated board in the panel.

The measurement data for the measured boards are listed in Appendix 1

DISCUSSION

Neither of the boards retained sapwood and thus the interpretation given to the dated board is a *terminus post quem* date based on the minimum estimate of eight missing sapwood rings. The interpreted date represents the earliest possible felling date for the dated individual board. This indicates that board B was felled after AD 1586. However where panels are concerned it is necessary to turn this earliest possible felling date into a usage date. Hence it is necessary to make assumptions based on minimum amounts of sapwood being originally present, and that the transport and utilisation of the boards occurred relatively rapidly.

Most groups of panels from English collections that have been examined are dominated by eastern Baltic oak boards and very few retain any sapwood. The Old London Bridge panel thus contains a commonly identified source for the boards, and a common construction methodology where the panel makers appear to be deliberately removing sapwood. This latter feature has been identified in many other panel paintings from both England and the rest of western Europe, and is known to be a formal statute of the panel makers guild in seventeenth-century Antwerp (Wadum 1998).

Eastern Baltic boards of *c* 250–300mm wide are likely to have been minimally trimmed as this appears to have been the 'standard' size of the traded boards. The tree-ring results obtained from boards of these sizes thus appear to be broadly indicating the usage period for these panels. In this case an estimated usage date based on a range of 8–40 trimmed rings is normally used following Baillie (1984). However the format of this panel is unusual and these boards are, as a result, of rather unusual length. Such long straight joints may have required some excess trimming, and thus assuming only minimal trimming has occurred is likely to be invalid. Any additional technical evidence for either seasoning or reuse of these boards would make these panels later, possibly much later, than the dates given here. However it is of note that the analysis of panels with good attributions has demonstrated that the earliest possible dates identified from the dendrochronology usually indicate that the panels were most likely made from unseasoned oak.

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FIGURES

Figure 1 The construction of the View of Old London Bridge panel painting from Kenwood House, Hampstead, London. Photo kindly supplied by English Heritage.

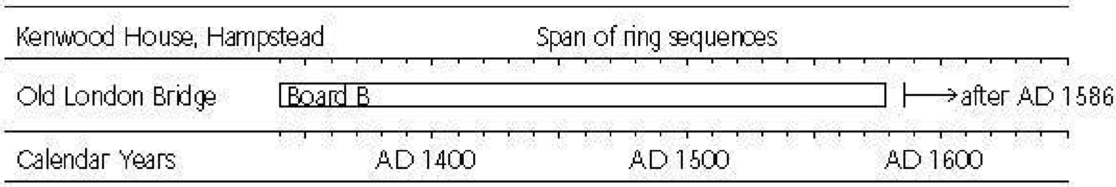


Figure 2 Bar diagram showing the absolute dating position of the dated tree-ring sequence for board B from the View of Old London Bridge panel painting from Kenwood House, Hampstead, London. The interpreted felling date is also shown for the dated board.
KEY. White bar is eastern Baltic oak heartwood.

TABLES

Table 1 Details of the two oak boards from the View of Old London Bridge panel painting from Kenwood House, Hampstead, London

OS0508 Board	Width (mm)	Rings	AGR (mm)	Date of measured sequence	Interpreted result
Board A	259–271	191	1.43	undated	-
Board B	249–256	239	1.08	AD 1340–1578	after AD 1586

KEY: sequences were obtained from the right and left hand edges of both the boards; AGR = average growth rate per year

Table 2 Example t-values between the composite sequence from board B from the View of Old London Bridge panel painting from Kenwood House, Hampstead, London and eastern Baltic oak reference data.

	Board B AD 1340–1578
Westerham Coat of Arms boards A+C (Tyers forthcoming)	9.62
Fletcher panels archive Baltic area 1 (Hillam and Tyers 1995)	8.61
Massacre of the Innocents, Rubens (Tyers 2002)	8.53
Sir Nathaniel Bacon, self-portrait NPG2142 (Tyers 2012)	8.30
William Lambarde NPG4489 (Tyers 2010)	8.16
Judgement of Paris, Rubens NG6379 (Tyers 2006)	8.09

APPENDIX 1

os0508al

246	134	146	184	218	117	243	231	198	148
242	185	203	163	219	192	198	182	130	197
218	215	142	220	135	243	232	236	227	262
333	258	256	268	276	242	218	238	185	295
229	166	125	171	184	122	136	102	122	98
91	121	93	111	101	122	82	84	98	129
145	123	144	187	104	104	92	104	162	158
188	163	172	117	168	187	191	116	155	100
93	121	172	146	201	144	138	135	167	104
115	123	109	175	144	123	142	125	125	113
123	154	105	77	71	75	140	124	82	72
85	100	136	94	97	128	153	116	118	102
127	100	128	117	95	116	85	67	110	77
72	98	92	80	73	104	105	93	89	108
99	100	94	94	104	104	136	110	127	126
128	139	120	136	196	165	120	138	159	121
152	121	150	122	144	139	123	113	75	131
111	111	117	164	160	144	152	138	149	133

os0508ar

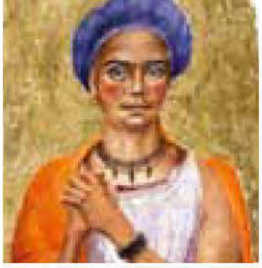
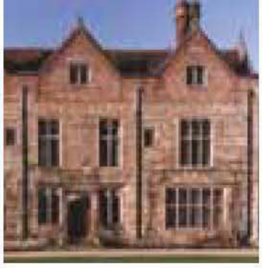
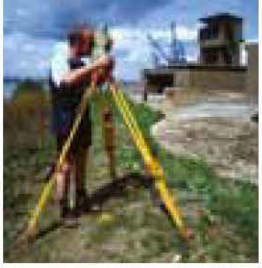
144	178	152	174	104	147	234	174	240	184
184	173	142	156	188	166	114	176	156	146
129	185	161	154	143	168	138	130	180	141
207	171	199	120	225	125	158	178	196	171
222	310	192	242	297	293	316	254	230	195
249	241	143	127	159	162	142	126	181	130
85	73	111	114	138	112	130	106	103	83
116	125	109	126	98	82	93	71	90	155
168	194	139	153	113	148	198	191	116	182
132	143	151	235	174	160	117	118	109	135
98	84	127	103	153	118	115	101	91	116
119	117	147	120	99	91	116	204	208	117
123	120	111	180	135	114	143	132	94	78
63	90	79	94	97	89	119	95	74	98
82	76	94	81	81	73	117	111	91	93
110	94	110	104	102	113	105	187	126	130
127	153	143	110	148	181	153	109	134	142
146	186	136	147	132	144	123	118	100	79
153	132	138	153	205	197	131	129	129	124

os0508bl

170	119	115	116	122	146	109	112	83	104
115	118	103	104	118	113	101	106	94	108
131	83	103	121	109	109	122	113	115	112
81	100	76	92	108	95	121	115	146	116
120	129	116	99	143	130	116	109	113	187
121	142	150	109	164	120	174	112	82	170
161	182	164	101	161	164	164	159	180	160
94	131	135	150	136	158	128	108	144	93
107	72	126	92	94	116	105	80	80	128
117	129	125	118	106	109	133	125	105	94
115	144	133	110	106	120	107	125	115	110
113	97	96	103	102	135	97	124	100	128
126	89	95	85	86	94	105	87	102	91
82	106	112	112	106	118	89	77	73	90
82	119	136	132	120	107	131	106	121	121
152	100	72	101	84	111	108	91	83	99
103	114	101	111	97	106	101	106	120	93
105	126	105	96	97	119	125	126	144	95
89	115	147	102	94	93	143	111	100	85
99	97	66	83	102	86	72	90	63	76
70	59	81	78	78	78	75	70	86	86
65	74	70	84	72	72	62	70	77	69
96	69	75	78	102	93	69	74	61	64
87	90	90	67	72	79	88	90	103	

os0508bro

109	89	100	123	107	113	109	99	84	79
100	105	135	174	122	143	123	148	137	151
119	177	100	87	94	84	97	89	85	98
91	100	100	108	83	97	101	111	89	108
103	113	119	98	83	95	116	115	115	146
98	87	116	133	121	91	81	118	106	92
105	97	89	75	82	73	73	74	86	69
74	76	71	90	76	80	80	78	81	93
97	86	76	83	92	77	88	74	73	86
69	102	99	92	86	98	94	70	76	56
71									

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