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Brooke House, Hackney, London

Tree-ring Analysis of Timbers

Ian Tyers

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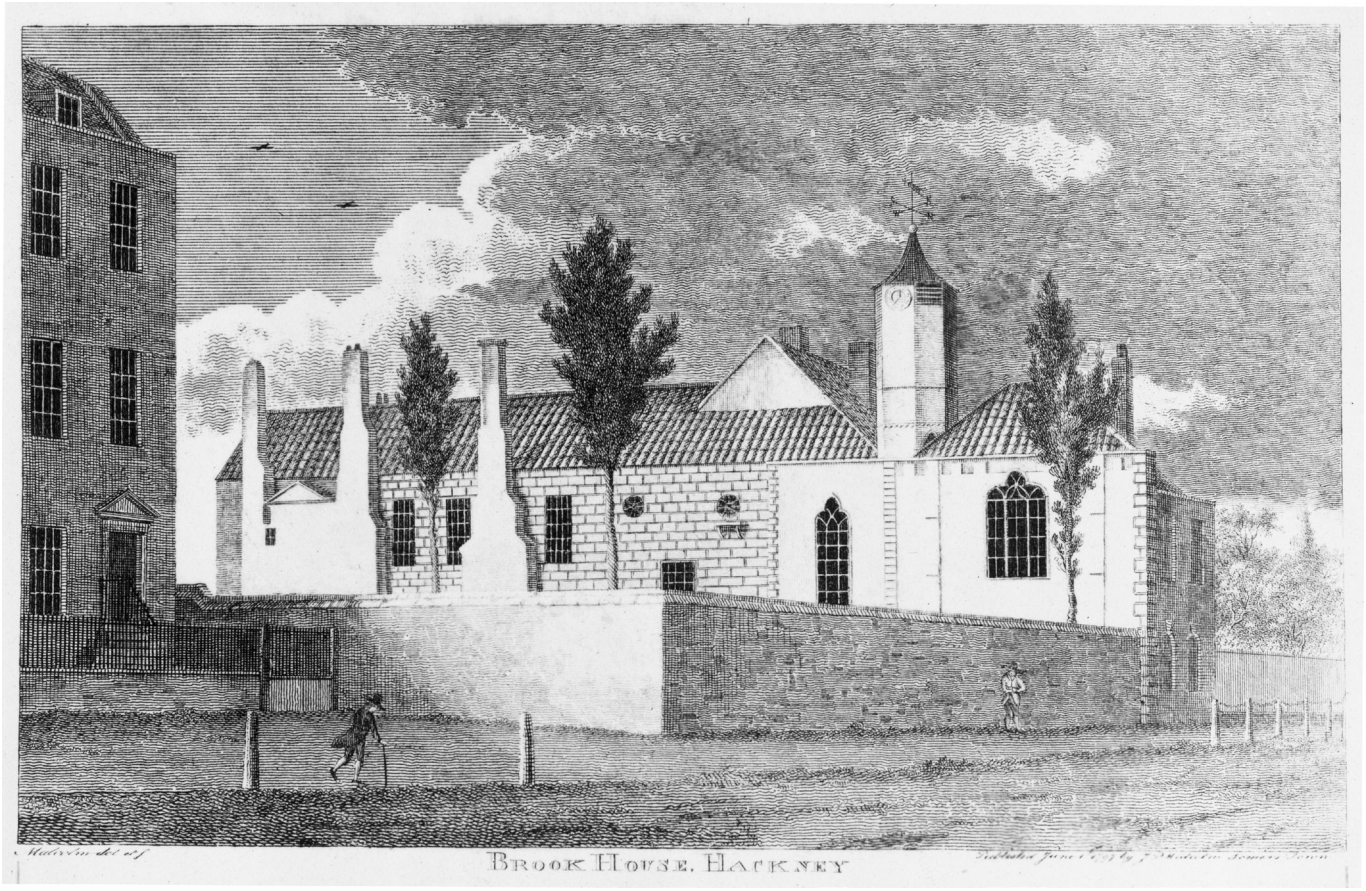

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BROOKE HOUSE, HACKNEY, LONDON

TREE-RING ANALYSIS OF TIMBERS

Ian Tyers

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SUMMARY

A tree-ring assessment, measurement and analysis programme was commissioned on timbers from Brooke House. This building suffered bomb damage in 1940 and was demolished in 1954–5. Retained parts of the building are in the English Heritage Architectural Study Collection. Direct tree-ring measurement was undertaken on boards from disarticulated panelling, and cores were taken from structural timbers, including moulded door jambs. The results identified that some of the oak panelling was derived from later sixteenth-century timbers imported from the eastern Baltic. The structural timbers were probably all locally sourced oak and one was successfully dated as felled in AD 1538.

CONTRIBUTORS

Ian Tyers

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INTRODUCTION

The English Heritage Architectural Study Collection (ASC) is a collection of architectural fragments: metalwork, plasterwork, woodwork, ceramics (including bricks, pottery, and glass), and wallpaper. Objects that reveal both decorative and technical developments come predominantly from London domestic housing dating up to *c* AD 1830.

As part of an ASC digital cataloguing project various timber accessions in the ASC from a number of properties were assessed for their dendrochronological potential. This document is a technical archive report on the tree-ring analysis of oak timbers and oak panelling from Brooke House, Hackney, a large medieval building demolished in 1954–5, and which form part of the ASC. It is beyond the dendrochronological brief to describe this material 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 material.

Brooke House was located on the north-west quadrant of the Lea Bridge Road roundabout in Hackney (Fig 1). Originally in the Neville family and then the Percy family it was surrendered to Henry VIII in lieu of debt in AD 1535. It was then owned and refurbished by Thomas Cromwell before returning to Henry VIII in mid-AD 1536. From *c* AD 1560 onwards it was owned and again rebuilt or refurbished by Henry Carey, 1st Baron Hunsdon. During World War II it suffered extensive bomb damage and the surviving building was recorded, excavated, and demolished in 1952–5. The results of this study were published as part of the *Survey of London* (Eden *et al* 1960). Fragments were retained by London County Council which, following the abolition of the Greater London Council, were transferred to English Heritage. At the time of the analyses reported here they were stored in Shropshire.

METHODOLOGY

Selected timbers in store from Brooke House, and elsewhere, were examined at the English Heritage storage warehouse at Atcham, Shropshire, in March 2010. Material from Brooke House was assessed as suitable for sampling and analysis. Core sampling took place in November 2010, and boards were collected for analysis at the same time.

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 five cores obtained from timbers in store and each of the 13 boards collected and returned to storage. The complete sequence of the annual growth rings in the cores and from the edges of the boards was 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 are 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)), and would use a minimum of 10 rings for the English material (eg English Heritage 1998) if required.

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.

Eastern Baltic boards of *c* 250–325mm width 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 timbers. In this case an estimated usage date based on a range of 8–40 trimmed rings is used following Baillie (1984).

RESULTS

Five cores were obtained from three large moulded oak door jambs and two unmoulded oak timbers on the same pallets in the store (Table 1), the moulded timbers are similar to those illustrated in Eden *et al* 1960 (fig 6, and pl 23; Figs 2 and 3). In addition a disparate group of disarticulated oak boards that are similar to those illustrated in Eden *et al* (1960 pl 26) were collected (Table 2; Figs 4–7). The similarity of each component of the latter group to those identifiable in the Eden *et al* (1960) illustration suggests these latter are likely to be from the Long Gallery.

The five cores include one complete to bark edge, and two complete to the onset of sapwood. The boards are each entirely heartwood. Visual assessment of other structural and decorative timbers in store excluded a variety of fast grown, twisted, or fragmentary timbers. All the sampled structural timbers were from reasonably straight grained oak trees and all the boards are radial sections of slow growing, straight grained oak trees.

All 18 selected timbers were suitable for measurement. The measurement data for the measured cores and boards are listed in Appendix 1. Three pairs of the tree-ring series, from boards B and C, boards D and E, and boards F and G, were each found to cross-match each other strongly (*t*-values see Tables 3 and 4), and these were each combined into single composite sequences mathematically constructed from the matched series at their synchronised positions. These three composites and the five individual core series and the remaining seven individual board series were compared with reference data of historic date from throughout England and northern Europe. A number of statistically significant matches were obtained between some of the sequences and reference series, along with other contemporaneous objects. These indicated dates for one of the cores (Table 1) and ten of the boards (Table 2) in each case indicating dates in the sixteenth century (Fig 8; Tables 5–7). Four of the cores, and three of the boards did not give significant correlations to reference data and remain undated.

The dated core is of south-eastern English origin and is complete to bark edge, with felling indicated in the winter of AD 1538. The ten dated boards are all of eastern Baltic origin (ie none are of either English or western European origin), with heartwood end dates between AD 1535 and AD 1550 (Fig 8).

DISCUSSION

The dated core was obtained from a large plain timber that retained sapwood and bark. The bark-edge date obtained from this for winter AD 1538 places this timber in the period after the return of the house to Henry VIII. Disappointingly this date identifies that it was not part of a documented gift of oaks from Henry VIII to Cromwell in AD 1535, thought to be intended for Brooke House and one of which was probably identified in the structural timbers of nearby Sutton House, the home of Ralph Sadleir, Cromwell's builder (Belcher *et al* 2004, 18–21). It is not known to this author if there are references to structural works in the house at this date. The other moulded timbers failed to cross-match this timber, each other, or to reference data, and it seems possible they were derived from a different period in the history of the building. Eden *et al* (1960, 16) discuss detailed differences in constructional technique in some of the door jambs of the building and suggest this related to different work team practises. The lack of tree-ring matching between the individual timbers may suggest there are other differences between them and they represent a more diverse group than hitherto imagined. Alternatively the tree-ring results may simply reflect the diversification and mixing of timber sources through the sixteenth-century timber supply network of London.

None of the selected boards retained sapwood and thus the interpretations given to the dated boards are *terminus post quem* dates based on the minimum estimate of eight missing sapwood rings. At this stage the interpreted dates represent the earliest possible felling dates for each of the individual boards. Combining these interpreted felling dates identifies the latest of these, which indicates that the boards, assuming that they are the product of a single scheme, were all felled after AD 1558. However to turn this earliest possible felling date into a usage date it is necessary to make assumptions about the speed of transport and utilisation of the boards. This panelling has toolmarks that suggest it was most likely made from unseasoned oak. A usage date of after AD 1558 but before *c* AD 1590 is suggested for the Brooke House panelling. This places it in the period of Henry Carey, 1st Baron Hunsdon.

Most groups of panelling that have been examined are dominated by eastern Baltic oak boards and very few retain any sapwood. The Brooke House panelling thus contains a commonly identified source for the boards, and a common construction methodology where the makers appear to be deliberately removing sapwood. All the boards are a single radius, ranging from true radials to moderately tangential sections, with no centres or centrelines within the boards. The plain boards were a maximum of 6–14mm thick, with the three moulded boards at17mm thick.

Eastern Baltic tree-ring data is not internally uniform. There are three major sub-groups that probably indicate different zones of export across the region. These zones shift through time and since there are intermediate tree-ring series these areas probably overlap to some extent. The identification and delimiting of those zones is still the subject of on-going research and debate amongst dendrochronologists. Currently the two major

sixteenth-century zones are called Baltic1 and Baltic2 following Hillam and Tyers (1995), pending the identification of their geographical source region. The Brooke House material contains examples of these two sub-types (those of Baltic1 type in Table 3 and combined as BHB1 in Table 6, and those of Baltic2 type in Table 4 and combined as BHB2 in Table 7). It is worth noting that these types are as usual mixed, and of indistinguishable function. Here, for example, the three moulded boards forming identical fluted pilasters and probably all from the Long Gallery (boards H, I, and J) comprise two of Baltic1 type and one of Baltic2 type. The use of the composite series (Baltic1, Baltic2, from Hillam and Tyers 1995) in the supporting *t*-value tables in this report provides little risk of non-independent cross matching since none of the Brooke House material had previously been prepared for tree-ring analysis, and there are no same-tree matches to any of the components of Baltic1 or Baltic2.

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FIGURES

Figure 1: Former location of Brooke House, Hackney. © Crown Copyright and database right 2015. All rights reserved. Ordnance Survey Licence number 100024900

Figure 2: Jamb 88084596/3 from Brooke House, Hackney, during coring (Core 3), photo kindly supplied by Peter Marshall

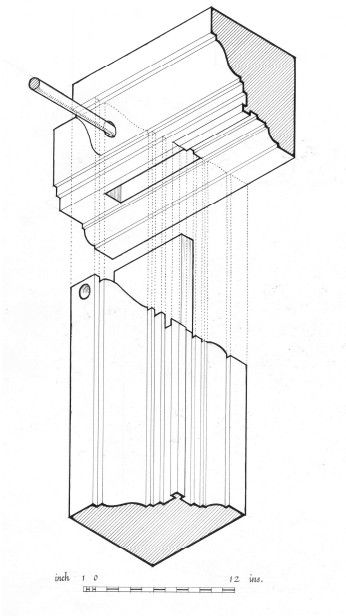

Figure 3: Drawing of equivalent door timbers from Eden et al *(1960, 16 fig 6) © English Heritage*

Figure 4: Smaller boards A–E from Brooke House, Hackney; all grain running top to bottom, soot presumably from fire or bomb damage still visible (photograph Ian Tyers)

Figure 5: Medium sized boards F, G, L, and M (left to right) from Brooke House, Hackney; all grain running top to bottom (photograph Ian Tyers)

Figure 6: Larger board K, and moulded boards H, I and J (left to right) from Brooke House, Hackney; all grain running top to bottom (photograph Ian Tyers)

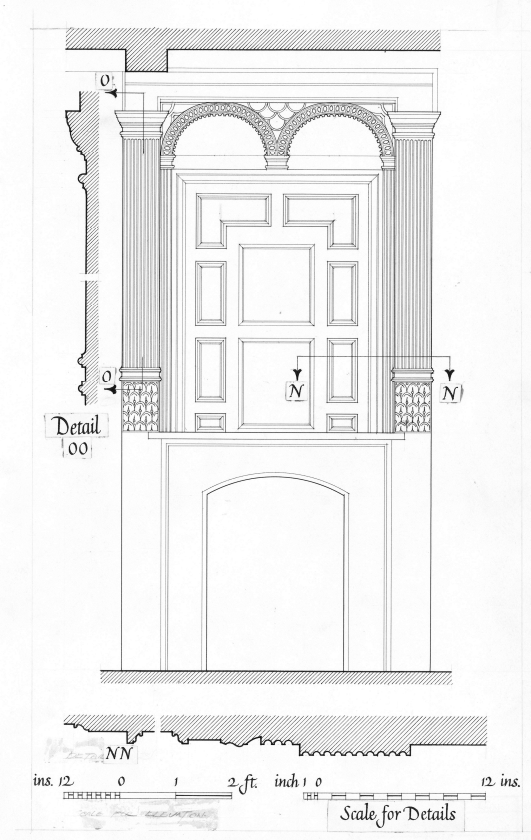

Figure 7: Drawing of equivalent panelling from Eden et al *(1960, pl 26) ©Historic England*

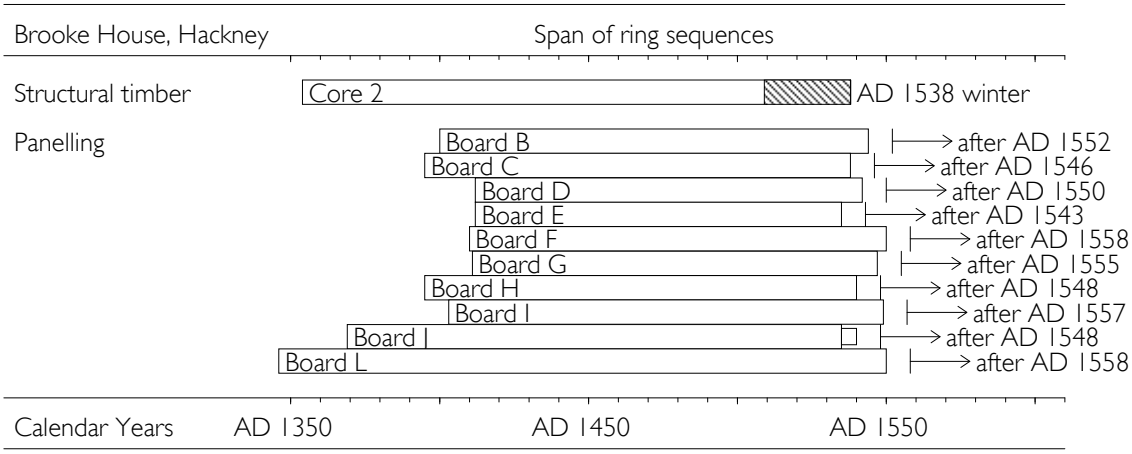

Figure 8: Bar diagram showing the absolute dating positions of the dated tree-ring sequences for a core and ten boards from Brooke House, Hackney. The felling date and interpreted felling dates are also shown for each dated timber

KEY. White bars are oak heartwood, hatched bars are oak sapwood, narrow bars are unmeasured rings.

TABLES

Table 1: Details of the five oak cores from Brooke House, Hackney

Core	Size (mm)	Rings	AGR (mm)	Date of measured sequence	Interpreted result
1 Door 4311	230 x 200	82	2.58	undated	-
2 unlabelled	200 x 160	185 29+Bw	1.22	AD 1354–1538	AD 1538 winter
3 88084596/3	230 x 200	81	1.87	undated	-
4 88084596/1	180 x 150	97	1.07	undated	-
5 88084594/1	210 x 190	107	1.01	undated	-

KEY: size of cross-section, width x height; Bw, complete oak ring under bark, winter felled. AGR = average growth rate per year

Table 2: Details of the 13 analysed oak boards from Brooke House, Hackney

Board	Size (mm)	Rings	AGR (mm)	Date of measured sequence	Interpreted result
Board A	107 x 170 x 11	93	1.78	undated	-
Board B	222 x 177 x 12	145	1.14	AD 1400–1544	after AD 1552
Board C	229 x 177 x 12	144	1.20	AD 1395–1538	after AD 1546
Board D	306 x 175 x 10	131	1.31	AD 1412–1542	after AD 1550
Board E	306 x 170 x 11	124	1.36	AD 1412–1535	after AD 1543
Board F	944 x 225 x 10	141	1.57	AD 1410–1550	after AD 1558
Board G	947 x 224 x 13	137	1.52	AD 1411–1547	after AD 1555
Board H	1279 x 216 x 17	146	1.45	AD 1395–1540	after AD 1548
Board I	1282 x 170 x 17	147	1.40	AD 1403–1549	after AD 1557
Board J	1283 x 175 x 17	167+5	0.99	AD 1369–1535	after AD 1548
Board K	1387 x 233 x 11	208	1.12	undated	-
Board L	1059 x 267 x 6	205	1.28	AD 1346–1550	after AD 1558
Board M	1059 x 170 x 14	69+8	2.10	undated	-

KEY: Size of board, using tree vertical grain direction as the length; length x width x thickness, actual alignment on the walls may differ; +5, +8, number of rings in unmeasured outer sections of boards. AGR = average growth rate per year

Table 3: Showing t-values between four individual boards from Brooke House, Hackney. Boards B & C are derived from a single tree, and were combined into sequence B+C in Table 6. All four sequences were combined to form sequence BHP1 in Table 6

	C	H	J
B	15.17	7.61	6.40
C		9.01	9.07
H			6.35

Table 4: Showing t-values between six individual boards from Brooke House, Hackney. Board pairs D & E and F & G are each derived from a single tree, and were combined into sequences D+E and F+G in Table 7. All six sequences were combined to form sequence BHP2 in Table 7. – t-values less than 3.0

	E	F	G	I	L
D	23.26	4.21	3.90	5.06	3.46
E		-	-	5.68	-
F			24.56	-	6.05
G				-	6.61
I					4.19

Table 5: Showing example t-values between the sequence from core 2 from Brooke House, Hackney and English oak reference data.

	Core 2 AD 1354–1538
Surrey, Reigate Priory School (Bridge 2003)	7.57
London, Southwark Hays Wharf (Blatherwick and Bluer 2009)	7.37
Surrey, Home Farm Newdigate (Bridge 1998)	7.18
London, Southwark Bankside boat (Tyers 1996)	7.05
London, Barking Abbey Road barrels (Tyers 2001a)	6.94
Sussex, Crawley Hall at Singleton (Tyers unpubl)	6.50

Table 6: Showing example t-values between the composite sequence from four boards from Brooke House, Hackney, the individual board or composite tree series series, and eastern Baltic oak reference data

	BHB1	B+C	H	J
Fletcher panels Baltic area 1 (Hillam and Tyers 1995)	15.17	12.66	12.52	8.76
Henry VIII after Holbein, Trinity College, Eworth (Tyers 2002)	10.50	10.19	10.60	7.07
Nicholas Heath, Archbishop, Eworth NPG1388 (Tyers 2012)	10.31	9.12	7.28	6.84
Henry VIII after Holbein, Petworth (Tyers 2001b)	9.55	10.11	9.59	5.73
Henry Howard, after Scrots NPG4952 (Tyers 2012)	9.43	8.84	6.27	8.18
London Sutton House boards area 1 (Tyers 1991)	8.72	7.48	9.30	4.86

Table 7: Showing example t-values between the composite sequence from six boards from Brooke House, Hackney, the individual board or composite tree series, and eastern Baltic oak reference data

	BHB2	D+E	F+G	I	L
Fletcher panels Baltic area 2 (Hillam and Tyers 1995)	15.42	7.90	7.09	6.79	11.66
Thomas Wentworth NPG1851 (Tyers 2012)	11.30	6.06	5.64	5.32	6.78
London Sutton House boards area 2 (Tyers 1991)	11.18	5.95	5.65	6.76	8.82
Jacques Wittewronghele, Rothamsted (Tyers 2013)	10.18	6.78	5.11	4.93	7.03
Elizabeth I Coronation Portrait NPG5175 (Tyers 2012)	9.58	5.84	4.87	4.83	7.69
Elizabeth I Darnley Portrait NPG2082 (Tyers 2012)	9.51	7.00	5.37	5.93	4.81

APPENDIX 1

bhcore1

536	486	512	514	416	456	349	274	372	399
248	272	276	225	363	319	427	377	297	352
422	367	380	319	393	309	398	226	217	273
264	310	275	256	192	215	105	208	172	263
187	269	212	185	204	113	150	192	389	273
307	344	344	304	174	161	185	146	231	156
176	238	157	164	173	158	159	151	155	154
144	121	198	186	159	192	192	158	154	149
129	157								

bhcore2

350	216	160	129	151	268	235	294	444	421
356	264	273	210	178	172	115	62	114	119
175	181	153	146	139	214	201	144	199	164
166	153	220	224	195	117	84	75	90	100
105	150	158	152	191	174	156	148	142	179
225	201	252	167	175	169	195	170	149	85
85	120	138	165	154	128	236	149	188	214
166	140	81	82	140	154	89	119	111	83
70	97	113	151	129	96	96	80	86	96
100	72	75	63	67	94	78	93	85	86
67	72	88	62	57	37	43	42	45	46
51	76	74	95	112	78	59	50	82	62
77	123	133	71	64	74	94	95	70	58
72	68	82	99	103	120	126	102	81	85
100	99	124	117	92	103	69	44	64	67
59	38	87	90	90	82	73	79	97	79
100	74	78	79	69	72	70	72	100	83
82	78	72	92	80	110	74	91	77	108
114	146	117	107	132					

bhcore3

204	163	223	205	237	327	291	376	320	286
263	262	332	291	199	189	273	219	367	262
172	176	187	231	237	209	209	253	197	185
154	146	120	240	214	231	182	135	155	154
154	172	121	124	69	107	105	89	119	204
122	241	185	150	187	214	172	176	184	257
141	113	100	95	106	114	133	100	161	96
139	220	267	186	228	132	164	119	124	84
119									

bhcore4

97	98	66	99	101	76	88	61	86	74
102	66	94	129	138	116	104	151	157	163
167	148	115	158	142	124	127	121	132	151
117	83	58	97	73	89	91	94	108	133
92	116	129	134	90	68	59	81	108	72
107	125	142	159	114	146	112	84	104	122
141	125	138	103	80	85	80	99	96	104
94	110	88	110	90	97	120	100	53	89
90	104	83	135	142	110	145	148	114	108
115	87	69	85	84	85	86			

bhcore5

150	198	217	194	203	250	182	248	320	241
175	140	126	148	153	121	137	128	83	85
85	116	89	113	103	127	133	89	98	61
86	107	106	103	84	74	52	53	78	48
79	67	79	56	65	78	73	84	85	76
64	69	90	111	96	87	85	76	70	98
113	90	104	109	88	87	62	86	85	84
84	72	55	74	49	54	56	50	47	70
42	41	55	41	39	40	62	64	68	49
63	102	75	50	63	75	59	121	80	114
164	136	160	151	145	195	154			

bhboard_a

288	196	171	133	82	180	205	222	206	169
190	192	307	234	184	168	168	163	206	204
189	273	208	201	222	181	129	222	213	250
237	142	142	138	103	148	155	161	146	200
191	145	182	137	197	178	174	75	116	155
104	149	131	146	142	192	224	209	188	124
143	164	193	147	343	219	132	169	159	179
169	175	101	138	161	237	173	152	201	106
260	183	163	233	142	120	188	159	200	168
191	208	164							

bhboard_b

166	131	116	92	108	138	168	154	164	136
77	125	175	171	144	140	171	135	130	74
116	93	85	78	76	87	87	64	71	77
105	112	88	96	116	116	112	102	85	120
127	159	182	151	154	176	140	112	135	162
94	101	103	105	139	135	133	133	82	101
141	89	68	59	113	124	97	123	157	153
112	114	145	110	100	72	75	81	80	58
82	102	118	96	88	92	128	145	114	107
109	93	77	81	71	89	76	112	103	82
81	136	114	130	73	105	127	102	98	115
121	117	107	116	103	150	143	101	83	108
91	130	127	101	107	107	140	145	119	121
117	115	83	101	114	118	119	129	104	111
118	127	145	154	142					

Bhboard c

116	135	65	93	125	145	136	136	108	101
141	200	160	161	134	90	151	197	165	128
146	156	136	146	85	117	109	83	93	80
88	75	77	68	106	105	105	107	97	123
128	127	97	131	137	143	162	175	150	151
180	142	136	127	136	104	98	109	131	124
139	143	146	93	112	125	72	68	66	128
116	92	122	140	146	121	103	123	117	89
69	80	71	76	65	141	164	161	105	80
98	138	149	96	90	108	76	72	65	76
70	70	88	104	75	86	119	114	106	86
106	129	116	116	101	152	137	135	138	138
183	197	145	116	143	129	187	208	180	142
156	160	172	130	130	128	122	84	116	127
106	133	128	92						

bhboard_d

145	99	164	141	190	118	140	205	170	232
153	186	110	124	114	132	165	170	161	120
131	130	156	124	127	117	133	86	161	109
105	121	111	154	124	123	82	121	138	188
115	100	149	110	135	87	85	83	108	88
73	52	87	81	118	113	111	97	85	80
69	67	69	99	144	112	217	159	137	116
122	108	193	103	161	184	180	218	131	126
103	141	123	157	86	66	76	62	77	124
137	118	166	100	170	153	138	157	238	195
187	136	197	209	177	191	147	112	129	113
102	103	171	118	167	115	86	110	120	121
88	100	141	128	128	168	136	148	151	152
191									

bhboard_e

104	93	189	139	184	141	159	253	205	246
168	187	134	136	118	144	169	169	160	104
123	132	151	124	131	129	130	85	125	113
106	117	112	146	140	127	83	119	152	169
126	98	150	117	135	85	84	80	95	103
56	58	84	96	116	107	128	105	81	78
73	76	72	95	138	112	230	167	134	113
128	106	193	118	179	166	175	200	127	145
100	155	132	159	90	58	79	78	70	130
159	135	181	114	193	181	178	190	302	264
242	167	235	263	207	217	161	110	119	126
93	101	159	130	173	111	88	111	127	108
93	95	142	151						

bhboard_f

119	187	202	154	168	137	185	134	160	163
87	104	92	115	85	91	105	104	157	143
124	121	122	126	150	182	145	118	142	112
195	172	155	134	152	157	155	126	158	167
191	166	144	107	141	118	144	170	161	143
155	96	131	86	86	104	137	147	184	109
118	105	136	113	122	144	142	99	109	86
134	184	140	124	156	151	187	170	195	184
130	148	120	234	141	248	159	194	177	174
178	197	159	202	175	189	178	205	228	246
224	240	215	197	193	245	207	196	175	166
144	208	194	182	139	106	221	139	168	154
147	142	123	130	215	150	158	215	143	193
129	221	167	162	221	159	206	203	188	236
131									

bhboard_g

189	201	160	177	147	211	147	181	165	78
122	102	124	104	100	118	119	149	148	123
125	133	123	148	178	152	115	142	105	194
177	141	147	151	159	148	123	154	167	181
159	141	112	146	134	144	173	158	140	146
83	121	75	75	102	122	134	186	103	93
100	109	100	117	146	134	90	101	85	116
188	146	138	150	150	177	156	155	153	137
114	127	200	112	214	131	142	161	139	143
175	161	207	162	172	162	194	235	231	215
229	167	153	199	209	197	179	168	153	148
190	183	205	134	111	237	149	169	163	142
143	134	143	255	155	160	202	142	220	139
205	189	136	226	166	202	140			

bhboard_h

143	134	69	119	261	258	215	293	169	192
210	404	309	289	261	152	269	285	280	146
211	249	182	185	95	168	103	140	73	93
131	149	91	83	183	183	148	153	135	146
183	144	167	135	184	162	175	181	234	255
255	165	237	210	142	139	109	210	160	197
198	201	168	133	135	329	171	146	105	165
70	78	110	142	238	105	95	169	139	132
126	145	145	89	84	97	113	96	80	69
80	104	133	115	128	110	67	71	78	77
120	121	80	74	101	103	137	108	128	92
105	127	141	83	92	104	101	93	88	90
111	137	100	51	95	97	103	94	103	64
93	114	173	200	128	103	95	61	94	139
155	159	158	117	174	177				

bhboard_i

90	73	127	137	123	143	134	64	71	64
63	62	67	63	53	86	80	104	92	80
43	53	74	59	57	64	87	69	59	63
115	106	80	119	90	106	73	74	95	80
90	121	171	193	158	116	71	159	134	124
102	195	157	121	91	105	92	125	120	150
136	155	148	200	169	211	137	102	113	148
333	92	208	137	175	261	188	160	205	141
152	148	165	292	277	209	212	202	167	214
192	171	241	194	80	163	140	135	216	163
151	207	129	229	293	147	100	134	153	182
171	205	262	157	174	84	146	141	161	127
153	177	163	138	146	81	107	152	123	104
202	142	142	159	203	163	208	167	181	165
142	144	198	127	108	160	156			

bhboard_j

158	107	92	78	92	120	159	152	142	132
114	191	174	195	144	115	128	134	126	139
160	197	160	158	165	107	114	133	67	85
110	119	98	132	73	87	107	106	125	128
100	80	137	117	146	107	126	171	163	131
90	130	128	140	100	102	112	95	92	96
138	118	92	92	86	83	109	89	104	87
105	89	117	102	109	96	134	81	94	104
125	109	128	100	111	87	73	87	90	89
94	68	79	52	61	97	88	76	84	114
100	88	84	102	89	63	66	62	79	44
65	110	98	92	70	52	61	89	84	67
72	58	72	40	47	61	71	76	59	69
45	57	89	76	71	62	71	79	97	90
65	93	92	84	80	93	87	91	102	81
86	89	99	105	81	82	65	109	98	81
85	96	89	69	73	75	98			

bhboard_k

82	85	75	85	68	67	72	75	71	106
104	90	71	77	62	49	73	104	77	105
119	133	149	128	143	163	137	162	127	119
135	135	151	121	120	131	179	127	179	176
160	129	138	147	84	125	135	132	149	153
145	108	94	122	114	133	148	138	119	148
137	109	104	151	153	132	141	99	86	129
124	131	136	119	107	109	112	50	78	71
68	61	60	53	48	65	65	66	63	74
90	85	121	80	92	102	91	142	140	143
127	134	88	88	95	83	94	116	106	102
87	98	121	100	113	123	90	83	76	86
66	77	92	98	103	126	120	95	74	82
86	96	90	78	59	74	66	76	94	92
110	118	104	117	72	72	104	85	89	77
116	90	101	105	86	69	72	83	139	132
81	97	108	105	104	113	108	108	126	132
102	102	106	134	137	123	113	101	126	121
128	124	130	155	165	135	132	107	91	98
104	161	146	134	190	128	173	175	164	193
157	135	157	150	175	192	256	193		

bhboard_l

115	124	125	154	120	184	180	210	252	190
166	140	88	114	155	77	140	161	191	126
111	162	120	121	163	116	103	78	88	99
56	74	111	101	120	125	102	149	117	113
105	142	125	141	134	134	114	89	120	58
117	82	140	146	131	130	133	70	109	119
172	107	137	139	104	96	121	93	87	83
94	78	94	70	81	79	84	60	74	86
72	72	89	121	126	120	106	83	126	90
87	153	131	111	194	174	142	139	119	173
131	140	96	139	155	96	119	92	160	89
132	129	129	110	139	79	136	110	115	136
124	167	173	190	118	128	156	140	145	170
154	116	145	98	124	160	155	155	131	132
190	149	158	162	147	129	112	124	123	192
129	105	107	147	155	205	149	156	169	142
90	153	168	124	131	149	117	108	165	180
159	140	136	106	108	127	157	143	153	107
155	143	120	121	116	114	96	131	143	99
117	199	109	190	106	141	147	106	129	101
122	138	155	125	109					

bhboard_m

306	246	208	209	167	171	222	177	229	208
286	241	172	160	228	135	259	262	310	224
182	205	161	158	194	203	184	205	277	205
220	331	311	216	205	175	108	145	246	247
194	202	235	166	233	269	223	184	200	139
150	116	173	195	187	126	133	137	223	267
201	236	153	270	225	237	183	362	254	

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