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Summary

Eastbury Manor House, Barking, Greater London is a large three-storey H-shaped brick and timber building built on lands formerly belonging to Barking Abbey. Dendrochronological analysis of twelve timbers from the roof produced a tree-ring chronology for the period AD 1250-1565. The timbers were felled in the spring of AD 1566.

Author's address :-

I Tyers
SHEFFIELD DENDROCHRONOLOGY LABORATORY
Archaeology Research School
West Court 2 Mappin Street
Sheffield
S1 4DT

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Introduction

This document is a technical archive report on the tree-ring analysis of timbers from Eastbury Manor House, Barking (NGR TQ457838). It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. As part of a multifaceted and multidisciplinary study of the building, 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 building. The conclusions presented here may therefore have to be modified in the light of subsequent work.

The manor house of Eastbury at Barking is a large brick structure with an H-shaped plan. The property is owned by the National Trust and leased to the London Borough of Barking and Dagenham who use it for meetings, conferences, and as an educational resource centre. The property is three stories in height with the upper storey open to the roof. The building is on the former estates of nearby Barking Abbey, suppressed in the dissolution of 1539. It is thought the property remained with Henry VIII until 1545 when it passed to William Denham. By 1557 Clement Sysley owned the estate, and it is thought he was responsible for the construction of the house some time before he died in 1578. The tree-ring dating at Eastbury was undertaken at the request of Richard Bond from English Heritage primarily to provide a more precise date for the initial construction. It is clear that the west wing is of the same build as the central block but there is some doubt about the eastern wing, and therefore a secondary aim was to attempt to identify if the eastern wing was of the same date as the rest of the structure.

Methodology

Although exposed timbers are present in the lower two floors, and there is a remarkably complete timber spiral staircase in the building, the dendrochronological sampling programme focused exclusively upon the roof trusses. Twenty three roof trusses, all of similar structure, are present in the wings and central range; many of these timbers include bark-edge. A measured drawing of a typical truss was prepared by Richard Bond (Fig 1). The individual trusses were assigned numbers for use during sampling (Fig 2). A brief survey identified those timbers with the most suitable ring sequences for analysis. Those with more than 50 annual rings and some survival of the original sapwood and bark-edge were sought. Samples were taken from both wings and the central range to investigate whether the structure was the product of a single building campaign.

The most promising timbers were sampled using a 15mm diameter corer attached to an electric drill. The cores were taken from the timbers in the most suitable direction for maximising the numbers of rings for subsequent analysis. The core holes were left open. The ring sequences in the cores were revealed by sanding.

The complete sequences of growth rings in the samples that were selected for dating purposes were measured to an accuracy of 0.01mm using a micro-computer based travelling stage. The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition cross-correlation algorithms (Baillie and Pilcher 1973; Munro 1984) were employed to search for positions where the ring sequences were highly correlated. These positions were checked using the graphs and, where these were satisfactory, new mean sequences were constructed from the synchronised sequences. The *t*-values reported below are 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 must be obtained from a range of independent sequences, and that these positions are supported by satisfactory visual matching.

All the measured sequences from this assemblage were compared with each other and any found to cross-match were combined to form a site master curve. These, and any remaining unmatched ring sequences were tested against a range of reference chronologies, using the same matching criteria: high *t*-values, replicated values against a range of chronologies at the same position, and satisfactory visual matching. Where such positions are found these provide calendar dates for the ring-sequence.

The tree-ring dates produced by this process initially only date the rings present in the timber. The interpretation of these dates relies upon the nature of the final rings in the sequence. If the sample ends in the heartwood of the original tree, a *terminus post quem (tpq)* for the felling of the tree is indicated by the date of the last ring plus the addition of the minimum expected number of sapwood rings which may be missing. This *tpq* may be many decades prior to the real felling date. Where some of the outer sapwood or the heartwood/sapwood boundary survives on the sample, a felling date range can be calculated using the maximum and minimum number of sapwood rings likely to have been present. Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. The sapwood estimates applied throughout this report are a minimum of 10 and maximum of 55 annual rings, where these figures indicate the 95% confidence limits of the range. These figures are applicable to oaks from the British Isles (Hillam *et al* 1987). The dates obtained by the technique do not by themselves necessarily indicate the date of the structure from which they are derived. It is necessary to incorporate other specialist evidence concerning the reuse of timbers and the repairs of structures before the dendrochronological dates given here can be reliably interpreted as reflecting the construction date of phases within the structure.

Results

A total of twelve timbers from various roof elements were selected for sampling, the samples were labelled **1** to **12** (Fig 2 and Table 1). Ten of these timbers were successfully sampled, samples **5** and **12** were unfortunately foreshortened when voids were reached within the timbers. The remaining timbers were rejected for sampling either because they contained too few rings, or because they did not have readily accessible sapwood.

Sequences from the remaining ten samples were measured and compared with each other. Samples **1**, **2**, **4**, **6**, **7**, **8**, **9**, **10**, and **11** were found to match (Table 2) and were combined to form a 316 year master curve, EASTBURY. This was tested against a comprehensive collection of dated tree-ring chronologies from England in an attempt to identify a date for the sequence. It was immediately apparent that the master sequence dates to AD 1250 - AD1565 inclusive (Table 3). The ring sequence from this master is listed in Table 4. The remaining measured sample **3** has failed to produce any visually and statistically acceptable matches and is thus undated by the analysis.

Interpretation

Bark-edge was recorded on two timbers, probable bark-edge recorded on a third (clear identification was prevented by surface abrasion on this timber). Sapwood was present on a further two of the dated samples and the heartwood-sapwood transition on another one (Fig 3). The range of heartwood-sapwood transitions is consistent with a group of timbers which were felled at the same time (Baillie 1982, 57), indicating that they were probably contemporary. Two samples with clear bark-edge both exhibit the very first signs of spring growth for AD 1566 and thus the felling of this material took place in the early spring of AD 1566. Since medieval timbers were usually felled as required and used green (Rackham 1990, 69), a construction date at this point or shortly afterwards is implied. The east wing and the central range both had timbers with bark-edge, which were felled at the same time. It therefore seems likely that the entire roof is part of a single campaign of building. The presence of trees of very similar origin (if not actually derived from the same trees) in both parts (samples **6**, **7**, and **8**) also supports the hypothesis. Clearly the suggestion that Clement Sysley was the builder of Eastbury Manor is confirmed by the analysis.

There are a number of interesting aspects to the results obtained. The material is derived from trees of exceptional age. All except two of the measured cores include more than 100 rings, four had over 200 rings, and the parent tree for sample **10** was probably more than 300 years old. The extensive use of large trees cut into quartered sections although widespread at Eastbury is rarely observed (Rackham 1980, 67). It seems particularly unusual here since the scantling required for the roof structure is not exceptionally large. Finally, the sequences from three samples **6**, **7**, and **8** appear to be very similar; the high degree of correlation between them suggests they may be derived from a single tree. Samples **1**, **2**, and **9** are also similar to each other and to samples **6-8** but in this case there are sufficient differences between each sample to suggest that although they are probably from the same source they may be derived from a number of different trees. In contrast the undated timber, sample **3**, and the dated samples **4**, **10**, and **11** are very different from each other and from the rest of the material indicating that these timbers may be derived from a number of different sources. These observations suggest that from a timber supply point of view Eastbury may warrant further study, especially with its location on a post-dissolution estate and its proximity to the London markets.

Acknowledgements

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Figure 1

A sketch of a typical truss, drawing by Richard Bond.

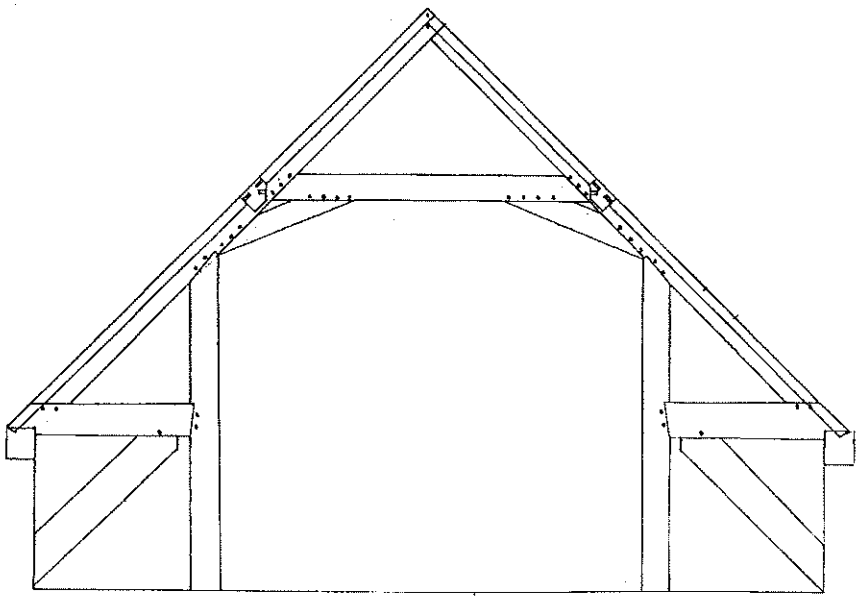

Figure 2

A sketch plan of the roof showing the truss numbering scheme employed during sampling. The small numbers with arrows indicate the approximate position of the sampled timbers. Since several horizontal timbers were sampled there is no attempt to indicate the direction of sampling on this figure.

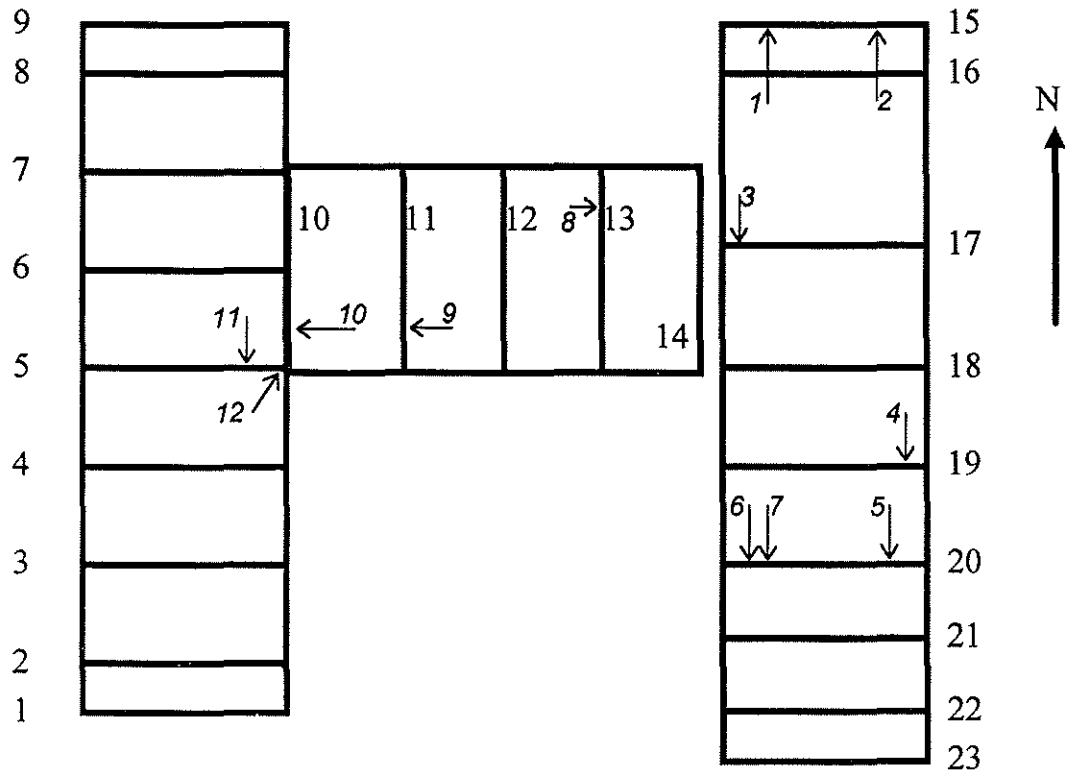

Figure 3

Bar diagram showing the position of the dated sequence

White bar - heartwood rings
Hatching - sapwood
HS - heartwood-sapwood transition
B - bark-edge
?B - probable bark-edge
narrow bars - counted but unmeasured rings

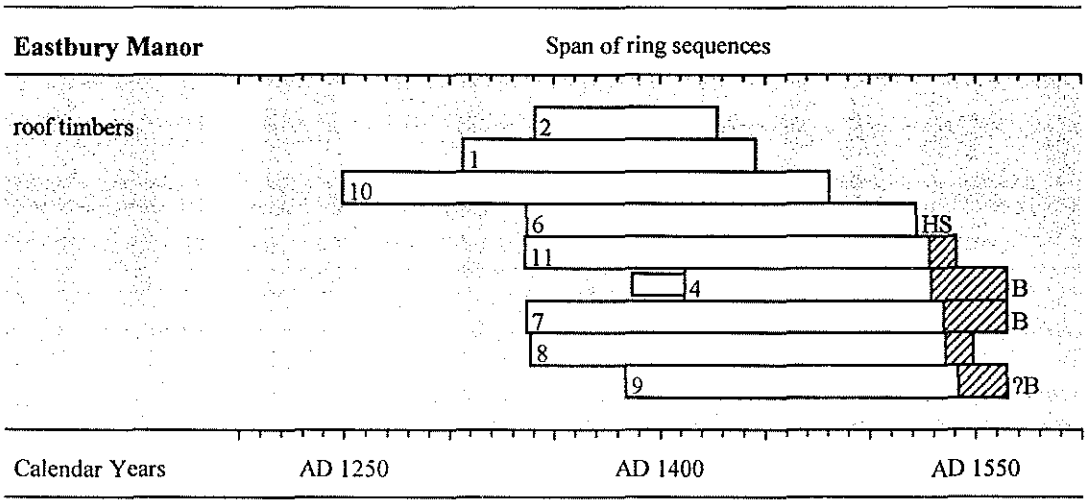

Table 1

List of samples

Core	Origin of core	Total rings	Sap rings	mm/year	Date of sequence	Felling date
1	Truss 15, west post	140	-	1.73	AD 1307-AD 1446	AD 1456+
2	Truss 15, east post	88	-	1.87	AD 1341-AD 1428	AD 1438+
3	Truss 17, west principal	71	9	2.31	-	-
4	Truss 19, east tie-beam	154	36+B	1.16	AD 1412-AD 1565	AD 1566 spring
5	Truss 20, east post	-	-	-	-	-
6	Truss 20, west tie-beam	186	HS	1.25	AD 1337-AD 1522	AD 1532-AD 1577
7	Truss 20, west post	229	30+B	1.06	AD 1337-AD 1565	AD 1566 spring
8	Truss 13, north post	211	13	1.20	AD 1339-AD 1549	AD 1549-AD 1591
9	Truss 11, south post	182	23+?B	1.48	AD 1384-AD 1565	?AD 1566 spring
10	Truss 10, south post	232	-	1.28	AD 1250-AD 1481	AD 1491+
11	Truss 5, east post	206	13	1.00	AD 1336-AD 1541	AD 1541-AD 1584
12	Truss 5, east wall post	-	-	-	-	-

Key: 'Sap rings': HS heartwood/sapwood boundary; B bark edge.

Table 2

t-value matrix for the matching sequences. Values less than 3.0 are not given.

	2	**4**	**6**	**7**	**8**	**9**	**10**	**11**
1	7.56	-	8.29	5.95	7.64	3.58	3.22	-
2		3.29	8.80	6.50	7.77	4.50	-	3.03
4			4.98	4.72	5.47	4.66	-	-
6				11.74	11.20	6.16	4.23	3.18
7					14.44	6.41	3.64	4.96
8						6.61	4.48	-
9							3.55	3.04
10								-

Table 3

Dating the Eastbury Manor chronology, AD 1250-1565. *t*-values with independent reference chronologies.

Area	Reference chronology	*t*-values
Essex	Rookwood Hall Barn (Tyers and Hibberd 1993)	6.9
	Turners Hall (Tyers 1997)	5.9
London	Trig Lane (Tyers 1992)	6.9
	Queen Elizabeth Hunting Lodge (Tyers and Hibberd 1993)	6.9
	Sutton House (Tyers and Hibberd 1993)	8.3
Berkshire	Windsor Castle Kitchen (Hillam forthcoming)	6.8
Hampshire	Alton (Hillam 1978)	5.3
Kent	Kent master (Laxton and Litton 1989)	7.9

Table 4

Ring-width data from site master EASTBURY, dated AD 1250-1565 inclusive

Date	Ring widths (0.01mm)										No of samples									
AD 1250										272										1
AD 1251	343	227	72	62	92	173	209	141	86	194	1	1	1	1	1	1	1	1	1	1
	169	189	155	194	234	170	166	168	177	208	1	1	1	1	1	1	1	1	1	1
	234	183	248	228	163	137	187	65	82	112	1	1	1	1	1	1	1	1	1	1
	81	84	84	64	92	110	84	84	133	147	1	1	1	1	1	1	1	1	1	1
	156	160	224	217	202	154	140	146	140	171	1	1	1	1	1	1	1	1	1	1
AD 1301	218	209	94	105	127	127	164	131	145	161	1	1	1	1	1	1	2	2	2	2
	167	182	174	214	222	219	209	249	265	211	2	2	2	2	2	2	2	2	2	2
	161	159	159	111	101	97	135	145	133	104	2	2	2	2	2	2	2	2	2	2
	90	86	141	155	142	148	235	186	259	253	2	2	2	2	2	3	5	5	6	6
	252	217	146	246	232	218	200	187	152	132	7	7	7	7	7	7	7	7	7	7
AD 1351	164	188	209	196	146	145	181	179	155	176	7	7	7	7	7	7	7	7	7	7
	138	151	182	194	176	157	163	140	165	147	7	7	7	7	7	7	7	7	7	7
	113	113	99	93	123	129	141	141	136	143	7	7	7	7	7	7	7	7	7	7
	124	146	134	142	133	163	166	190	126	119	7	7	7	8	8	8	8	8	8	8
	104	116	130	144	138	160	161	154	135	118	8	8	8	8	8	8	8	8	8	8
AD 1401	124	100	133	152	196	180	108	109	148	169	8	8	8	8	8	8	8	8	8	8
	161	122	100	117	118	87	99	108	104	123	8	9	9	9	9	9	9	9	9	9
	121	105	108	107	84	95	90	103	121	131	9	9	9	9	9	9	9	9	8	8
	130	171	120	124	114	108	120	126	125	139	8	8	8	8	8	8	8	8	8	8
	139	166	168	166	144	128	129	111	139	130	8	8	8	8	8	8	7	7	7	7
AD 1451	126	108	100	146	117	122	107	88	82	65	7	7	7	7	7	7	7	7	7	7
	78	97	117	88	110	108	79	76	89	87	7	7	7	7	7	7	7	7	7	7
	82	94	104	117	141	96	84	112	124	125	7	7	7	7	7	7	7	7	7	7
	127	117	115	102	91	102	107	103	101	118	7	6	6	6	6	6	6	6	6	6
	100	94	93	107	133	157	127	104	119	87	6	6	6	6	6	6	6	6	6	6
AD 1501	80	70	73	99	111	152	139	112	102	102	6	6	6	6	6	6	6	6	6	6
	95	97	89	96	99	84	74	99	117	98	6	6	6	6	6	6	6	6	6	6
	75	88	74	69	91	86	87	85	86	74	6	6	5	5	5	5	5	5	5	5
	102	104	101	88	97	98	98	86	105	112	5	5	5	5	5	5	5	5	5	5
	107	85	91	73	95	76	81	89	105	89	5	4	4	4	4	4	4	4	4	3
AD 1551	91	82	112	140	134	108	91	88	106	107	3	3	3	3	3	3	3	3	3	3
	99	96	82	75	92						3	3	3	3	3					