2673

Ancient Monuments Laboratory
Report 98/97

TREE-RING ANALYSIS OF TIMBERS FROM BROOMFIELD HOUSE, ENFIELD, LONDON

M C Bridge

Ancient Monuments Laboratory Report 98/97

TREE-RING ANALYSIS OF TIMBERS FROM BROOMFIELD HOUSE, ENFIELD, LONDON

M C Bridge

Summary

Various phases of this building were sampled in March 1997. The timbers were all smoke-blackened by recent fires, and many were more extensively damaged. The cross-wing of the earliest existing phase of the present building, which contains decorative quadrant framing atypical of the London region, was successfully dated, the tree used for the tie having been felled in AD 1562. This confirms the date proposed on stylistic grounds. One timber which now stands on a brick base was felled after AD 1733 and now has to be interpreted as part of a different phase of work on the building to that previously proposed.

Author's address :-

DR M C Bridge
Honeysuckle Cottage
Cage End, Hatfield Broad Oak
Bishop's Stortford
HERTS
CM22 7HT

TREE-RING ANALYSIS OF TIMBERS FROM BROOMFIELD HOUSE, ENFIELD, LONDON

Introduction

This report details the dendrochronological work carried out at this site on the request of Richard Lea of English Heritage. It forms only a small part of the overall studies being carried out at the site and any conclusions derived within it should be assessed in conjunction with the results of these other studies.

The development of Broomfield House (TQ3045 9265) is a complex one. It is described by Lea and Westman (1985) and Lea (1994), from which the following information is derived. At the heart of the building is a timber-framed house of modest size, remarkable for elaborative decorative framing on one remaining gable. This framing with its quadrant bracing is of a style relatively common in the west Midlands, but unusual in the London area. This gable was thought to be mid-sixteenth century, and was the major feature of interest for dendrochronological dating. In addition it was hoped that tree-ring studies might date what were thought to be later changes to the structure.

The property has suffered very serious fire damage and many of the internal fittings have been destroyed or stripped out. There are plans to restore the building but access to the surviving timbers was relatively easy at the time of sampling in March 1997. All timbers were smoke blackened and some had clearly been more extensively damaged during the fires.

Methodology

The building was visited on 13th February 1997 when an initial assessment of the timbers was made. Many timbers had been removed and stacked in the porch of the building. These were investigated to see if any might be suitable for sampling, but none were thought suitable for subsequent analysis as they appeared to contain few rings. At the same time access to the timbers and equipment needs were assessed. Sampling of the *in situ* timbers took place on 4th March 1997. Samples were removed using purpose-made 15mm diameter corers attached to an electric drill (a system developed from commercially available corers by Don Shewan at London Guildhall University).

Although bark was clearly visible on one timber, most were so damaged or blackened after the fires that it was difficult to determine the presence of sapwood on the timbers at the time of sampling and subsequently. The fragility of some of the timbers also meant that some cores broke during the drilling process. In these cases, second cores were taken from the same timber if it looked as though the timber was likely to be useful for further analysis. The holes were filled using softwood dowels glued with Evostick wood adhesive.

The cores were glued to wooden laths, labelled, and stored for subsequent analysis. The cores were prepared for measuring by sanding using an electric belt-sander with progressively finer grit papers down to 400 grit. Any further preparation necessary, eg where bands of narrow rings occurred, was done manually. Those samples with more than 50 annual rings had their sequences measured to an accuracy of 0.01 mm using a specially constructed system utilizing a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to an Atari desktop computer. The software used in measuring and subsequent analysis was written by Ian Tyers (pers comm 1992).

Suitably long ring sequences (those in excess of 50 rings) were plotted on translucent semi-log graph paper to allow visual comparisons to be made between sequences on a light table. This activity also acts as a measure of quality control in identifying any errors in the measurements. Statistical comparisons were made using standard dendrochronological software employing the use of Student's *t* (Baillie and Pilcher 1973; Munro 1984). Any internal site mean sequences produced are then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date them. The *t*-values quoted below were derived from the original CROS program (Baillie and Pilcher 1973) in which *t*-values in excess of 3.5 are taken to be indicative of acceptable matching positions provided that they are supported by satisfactory visual matches (Baillie 1982, 82-5).

The dates thus obtained represent the time of formation of the rings available on each sample; interpretation of these dates then has to be undertaken to relate these findings to the likely felling dates of the trees used and then relate these in turn to the construction date of the phase under investigation. Where only heartwood is found on the sample, one can make allowances for the expected number of sapwood rings on the tree and add this to the date of the last available ring to give a date after which felling took place; one does not know how many heartwood rings may be missing in these cases. Where the heartwood/sapwood boundary is found, or some sapwood rings survive, a felling date range can be calculated using the best available estimate of the number of sapwood rings likely to have been on the original tree (Baillie 1982).

In this report, the sapwood estimate employed is a minimum of 10 rings and a maximum of 55 rings, representing the 95% confidence limits derived by Hillam *et al* (1987). Where bark is present, the year of felling will be the date of the last surviving ring. In such cases it is often possible to determine the season of cutting by looking at how much of the ring has been formed.

The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the roof. Evidence suggests that, except in the re-use of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

Results

The samples are listed in Table 1 along with details about their origin within the structure, and other details relating to the ring sequences. Only three of the phases described by Lea (1994) were sampled, the others were judged unsuitable for dendrochronological study at present. These phases were the primary phase including the gable with the decorative framing (Figs 1 and 2), the floor inserted into the cross-wing, and the floor inserted into what is now the entrance hall to the building. In addition an individual timber resting on brickwork (Fig 1) was sampled (BFL13).

Many of the timbers on which the rings could be seen on initial inspection were too small to be of use, for example the collars to the trusses of the primary phase and many of the floor joists in all phases.

Samples BFL01 and BFL02 were from the same timber (a boxed-heart conversion) and were combined to give a single sequence of 105 years with bark on the outer edge. Similarly the sequences from BFL06 and BFL07 (a halved timber) came from the same timber and were combined to give a single 92-year long sequence. Sample BFL08 had approximately 80 rings, but these were so narrow in many places, often consisting of a single broken row of vessels, that individual ring-widths could not be determined and the sample was not used further in any analysis. BFL05 was from an unsquared D-shaped half-trunk. BFL11 and BFL12, the secondary floor beams were halved timbers, and BFL13 was quarter-sawn. The conversion of other timbers from the original trunk could not be determined.

All sequences over 60 years were compared with each other to see if they crossmatched. Samples BFL09, BFL06+07, and BFL01+02 all crossmatched (Table 2) and were combined to form a single sequence (BROOMFIELD) which represents timbers from the primary phase of the building (Table 4). Sample BFL13 did not crossmatch with any other samples from the building, but did crossdate against a number of reference and site-master chronologies . This ring-width sequence is also listed in Table 4.

Interpretation

Table 3 lists some of the stronger crossmatches between the site master BROOMFIELD and the single timber BFL13, and a number of regional and site-master chronologies. These firmly date the BROOMFIELD sequence to the period AD 1446 to 1562. There are only three timbers in the sequence, although one timber had bark on it. If one assumes that they form a single batch of timbers, this dates the felling of the timbers to AD 1562. This places the date of construction of this primary phase with the decorative bracing at AD 1562 or within a very few years after this date.

Amongst the comparisons with other site masters, a very good match was obtained against the BRUCE 2 chronology (Bridge 1997) from a building only a few kilometres away. It is tempting to assume that both these two groups of timbers are likely therefore to have come from very local sources, and documentary evidence does mention the felling of trees on the estate for the construction of parts of Bruce Castle in the appropriate time period. Studies in living oaks (Bridge forthcoming) suggest however that provenancing timbers on the basis of their degree of crossmatching may in many cases be misleading.

Sample BFL13 was dated. The lack of apparent sapwood means that the felling date for this sample is after 1733, allowing for a minimum 10 rings after the last heartwood ring. It should be noted however that in these badly burned timbers the sapwood could not always be distinguished even when known to be present because of the presence of bark. This means that this timber cannot be part of an expansion of the building thought to have been added around 1600 (Lea 1994) and may have been part of the extensive rebuilding which took place *c*1820.

Three samples were taken from the floor inserted in the hall range to the south of the dated timbers, and several others were assessed as being unsuitable for dendrochronological dating. Although these timbers could not be dated, their generally wide rings suggest that this floor was not constructed from the timbers from the same batch as those successfully dated and this information is at least consistent with the view that this floor was probably constructed at a different time.

Conclusion

Previous studies based on observations of the stylistic characteristics of the primary phase of Broomfield House suggested a construction date of about AD 1550. This study shows that the trees used in this phase were felled in AD 1562 and construction is very likely to have taken place in this year or within a very short period thereafter. Only one other single timber was dated, this coming from a much later phase.

Acknowledgements

I would like to thank Mr Richard Lea of English Heritage for making available background information about the site from which the figures have been derived. Mr Peter Riddington of Donald Insall and Associates arranged for access to the property.

Thanks are also due to those dendrochronologists who continue to allow their unpublished chronologies to be used in work such as this.

References

Baillie, M G L, and Pilcher, J R, 1973 A simple cross-dating program for tree-ring research, *Tree Ring Bulletin,* **33**, 7-14

Baillie, M G L, 1982 *Tree-Ring Dating and Archaeology*, London

Barefoot, A C, 1975 A Winchester dendrochronology for 1635-1972 AD - its validity and possible extension, *Journal of the Institute for Wood Science*, **7**(1), 25-32

Bridge, M C, 1988 The dendrochronological dating of buildings in southern England, *Medieval Archaeol,* **32,** 166-74

Bridge M C, 1997 *Tree-ring analysis of timbers from Bruce Castle, Tottenham, London,* Anc Mon Lab Rep, **69/97**

Bridge, M C, forthcoming The concept of regionality in British dendrochronology, *Proc of the Anthropology and Archaeol Section, British Association for the Advancement of Science,* University of Keele, September 1993

Groves, C, and Hillam, J, forthcoming Tree-ring analysis and dating of timbers, in *Multiperiod saltmaking at Droitwich, Hereford and Worcester - excavations at Upwich 1983-4* (ed J D Hurst), CBA Res Rep

Hillam, J, 1984 *Tree-ring analysis of timbers from Elland Old Hall, West Yorkshire,* Anc Mon Lab Rep, **4165**

Hillam, J, Morgan, R A, and Tyers, I, 1987 Sapwood estimates and the dating of short ring sequences, in *Applications of tree-ring studies: current research in dendrochronology and related areas* (ed R G W Ward), BAR Int Ser, **333**, 165-85

Hollstein, E, 1965 Jahrringchronologische von Eichenholzern ohne Walkande, *Bonner Jahrb,* **165,** 12-27

Laxton, R R, and Litton, C D, 1988 An East Midlands master tree-ring chronology and its use for dating vernacular buildings, University of Nottingham, Dept of Classical and Archaeological Studies, Monograph Series III

Laxton, R R, and Litton, C D, 1989 Construction of a Kent master chronological sequence for oak, 1158 - 1540 AD, *Medieval Archaeol,* 33, 90-98

Lea, R, and Westman, A, 1985 *Broomfield House, Enfield, Middlesex: An archaeological Survey,* Museum of London Archive Rep, **BRM85**

Lea, R, 1994 *Broomfield House, Enfield The structural development of the house,* London

Mills, C M, 1988 Dendrochronology of Exeter and its application, unpubl PhD thesis, Sheffield University

Munro, M A R, 1984 An improved algorithm for crossdating tree-ring series, *Tree Ring Bulletin*, **44**, 17-27

Salzman, L F, 1952 *Building in England down to 1540*, Oxford

Siebenlist-Kerner, V, 1978 The chronology, 1341-1636, for certain hillside oaks from Western England and Wales in *Dendrochronology in Europe* (ed J M Fletcher), BAR Int Ser, **51**, 157-61

Table 1. List of samples taken from Broomfield House, Enfield, London

Sample No.	Origin of sample	Total number of years	Sapwood details	Average growth rate (mm yr^{-1})	Date of sequence	Felling date of sequence
Primary phase						
BFL01	tie of remaining primary phase truss	88	?h/s	1.78	1458 - 1545	1562*
BFL02	as above	99	17	0.70	1464 - 1562	1562*
BFL03	floor joist	45		not	determined	
BFL04	floor beam	35		not	determined	
BFL05	north-east corner post	45		not	determined	
BFL06	wall plate	52		1.54	1446 - 1497	after 1547**
BFL07	as above	91		1.23	1447 - 1537	after 1547
BFL08	floor joist	*c*80		not	determined	
BFL09	mid-rail on east side	65		1.15	1465 - 1529	after 1539
First floor, thought to be inserted into hall range.						
BFL10		34		not	determined	
BFL11		25		not	determined	
BFL12		47		not	determined	
Miscellaneous						
BFL13		83		2.14	1641 - 1723	after 1733
Floor in present entrance hall						
BFL14		57	2	2.35	-	-
BFL15		20		not	determined	

Notes

* The felling date for BFL01 is derived from BFL02 which is from the same timber. The bark was noted on the timber at the time of coring, but bark does not survive on the core

** The earliest felling date is derived from BFL07, taken from the same timber

Table 2. Correlation between the dated series from the primary phase of Broomfield House, Enfield, London. The values are *t*-values derived from CROS 73 (Baillie and Pilcher 1973).

	BFL01+02	BFL06+07	BFL09
BFL01+02	-	4.9	4.2
BFL06+07	-	-	5.4

Table 3. Dating of the site master chronology for oak timbers from the primary phase of Broomfield House, Enfield, London.

Dated reference or site master chronology	BROOMFIELD PRIMARY PHASE AD 1446 - 1562	
	t-value	Overlap (yrs)
Oxon93 (Miles unpubl)	8.0	117
London 1175(Tyers unpubl)	7.4	117
Hereford and Worcester (Siebenlist-Kerner 1978)	6.7	117
Kent (Laxton and Litton 1989)	5.5	95
Brittany3 (Pilcher unpubl)	5.4	117
East Midlands (Laxton and Litton 1988)	5.3	117
Southwark (Tyers unpubl)	5.2	117
Southern England (Bridge 1988)	4.5	117
Bruce Castle2 (Bridge 1997)	10.4	99
Elland Hall (Hillam 1984)	7.0	117
Windsor Castle Kitchen (Hillam unpubl)	6.9	117
Mary Rose 'original' (Bridge unpubl)	6.1	58
Trees2 (Miles unpubl)	6.0	104
Upwich3 (Groves and Hillam forthcoming)	5.8	109
Fenny (Bridge unpubl)	5.3	93
	BROOMFIELD BFL13 AD 1641 - 1723	
Oxon93 (Miles pers comm)	5.5	83
East Midlands (Laxton and Litton 1988)	5.4	83
London1175 (Tyers pers comm)	4.9	83
Oriel1 (Miles pers comm)	5.3	83
Exeter Cathedral post-medieval (Mills 1988)	5.2	83
H.M.S. Victory (Barefoot 1975)	4.7	83
Mapledurham barn1 (Miles pers comm)	4.7	66
Thaxted3 (Tyers pers comm)	4.3	80

Table 4. Ring-width data for the site chronology Broomfield, for oak from the primary phase of Broomfield House, Enfield, London and the single timber BFL13.

BROOMFIELD

Year	ring widths (0.01mm)										number of trees per year									
AD1446						184	237	234	201	169						1	1	1	1	1
AD1451	190	146	145	176	140	179	172	131	164	198	1	1	1	1	1	1	1	2	2	2
	149	140	157	105	149	146	125	157	145	142	2	2	2	2	3	3	3	3	3	3
	114	126	111	122	161	119	109	93	131	134	3	3	3	3	3	3	3	3	3	3
	154	114	123	126	136	116	123	118	129	118	3	3	3	3	3	3	3	3	3	3
	100	109	92	94	95	127	134	91	125	118	3	3	3	3	3	3	3	3	3	3
AD1501	87	99	97	126	152	91	105	90	110	107	3	3	3	3	3	3	3	3	3	3
	123	135	163	157	164	109	79	135	146	93	3	3	3	3	3	3	3	3	3	3
	87	118	105	170	128	126	117	134	117	99	3	3	3	3	3	3	3	3	3	2
	125	90	109	118	172	163	132	110	186	133	2	2	2	2	2	2	2	1	1	1
	128	101	174	207	227	57	54	63	85	66	1	1	1	1	1	1	1	1	1	1
AD1551	85	49	82	81	115	71	71	55	51	64	1	1	1	1	1	1	1	1	1	1
	61	54									1	1								

Sample BFL13 AD 1641 - 1723

Year	ring widths (0.01mm)									
AD1641	159	161	136	144	166	163	120	216	211	273
	191	146	152	155	318	230	240	267	241	289
	256	257	328	305	232	216	200	275	206	147
	232	170	161	155	255	133	215	197	159	195
	154	292	265	167	216	232	205	165	156	171
AD1691	204	223	269	170	217	345	236	270	147	177
	160	165	178	186	135	165	199	248	258	215
	209	195	407	163	269	237	266	227	210	282
	364	269	171							

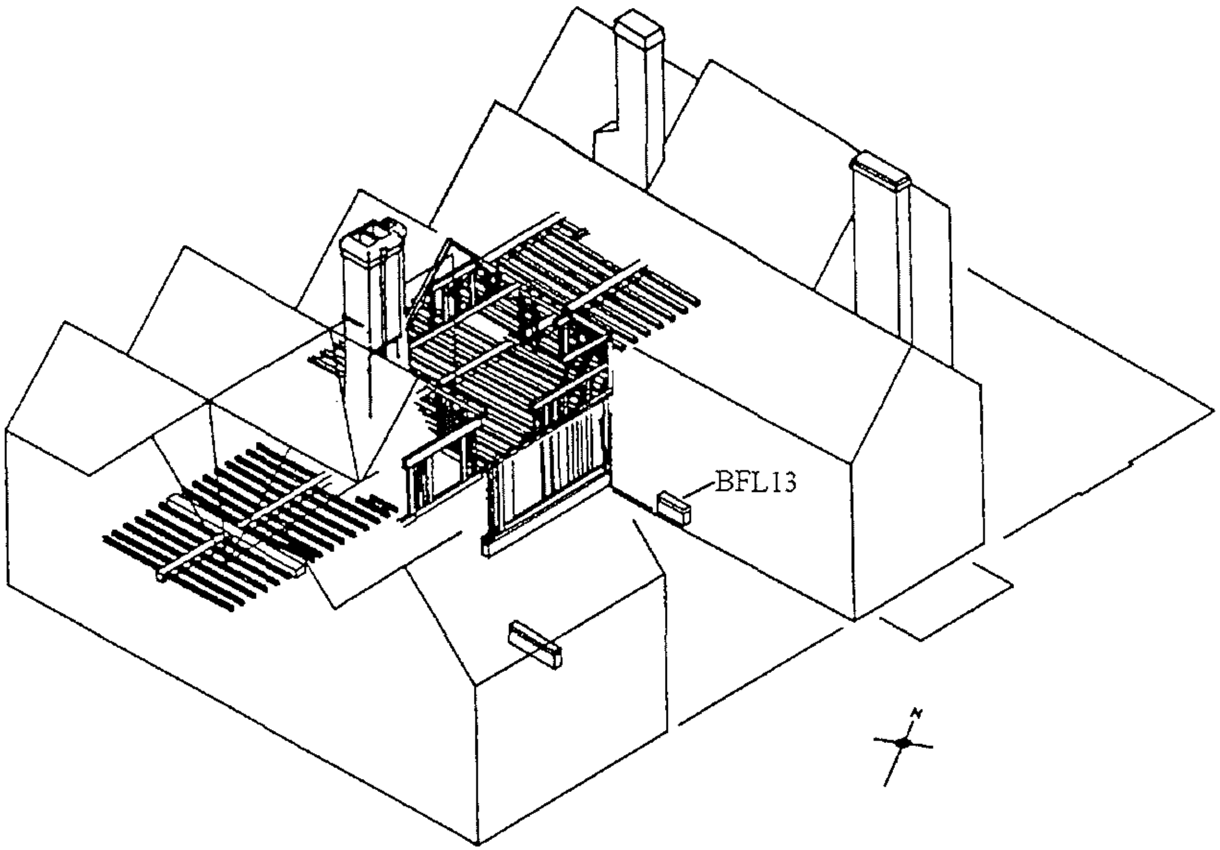

Figure 1. Isometric projection showing the phases sampled for dendrochronology (Based on drawing 173/0005, Lea 1994)

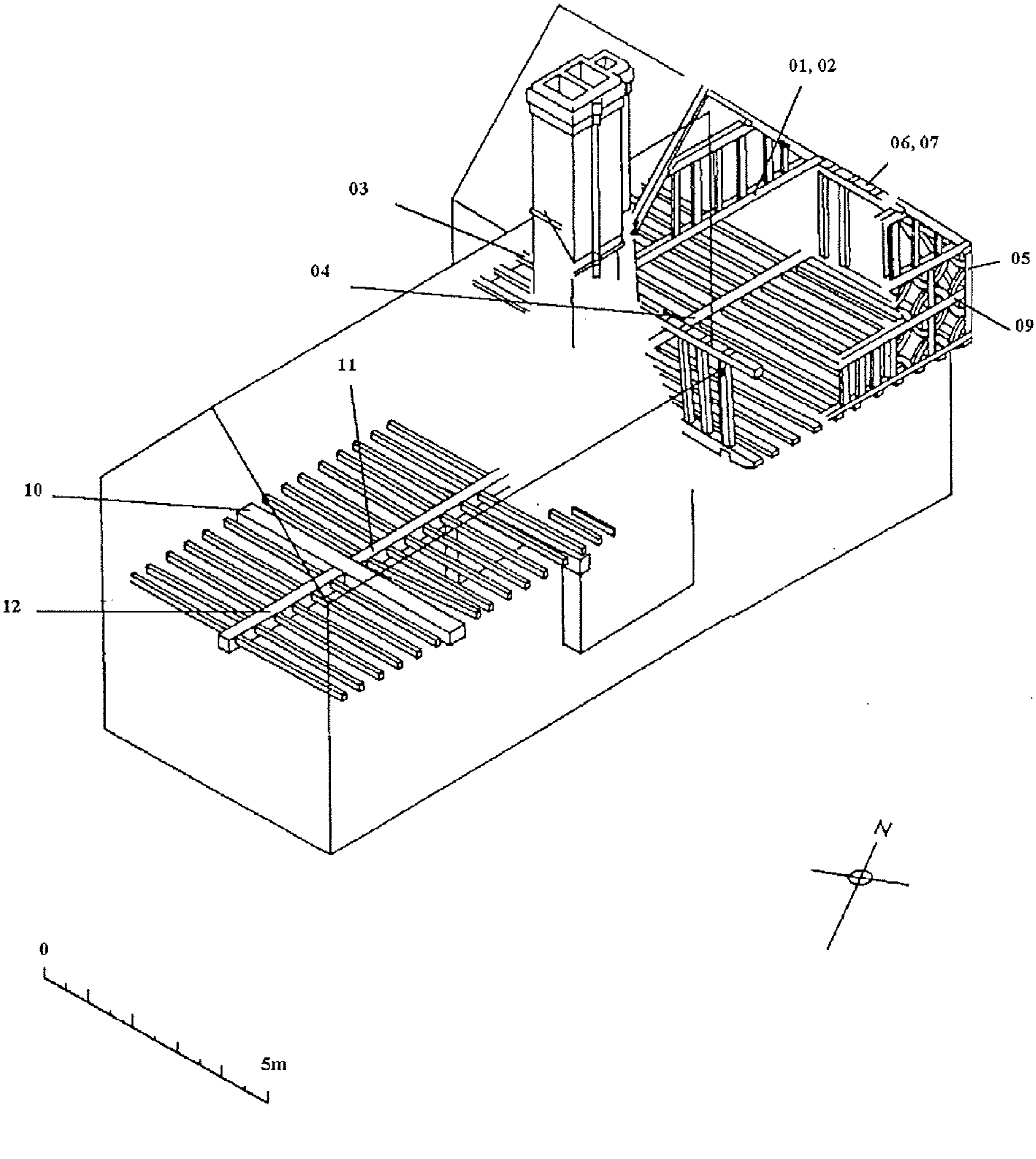

Figure 2. Location of the samples taken for dendrochronology. Based on drawing 1736/0003 (Lea 1994)