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Tree-ring Analysis of Timbers from Baguley Hall, Greater Manchester

Nigel Nayling

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Summary

Twenty-six samples were taken for tree-ring analysis from Baguley Hall. Two site chronologies were formed. The 357-ring chronology dates to AD 1013-1371 but the second chronology remains undated. However this does cross-match with an undated chronology produced during previous work on the building. In addition an individual sequence was dated to AD 1356-1432.

Sampling was severely restricted by difficulties of access, although this dating does suggest that the hall was constructed in the last quarter of the fourteenth century, and points tentatively towards work in the north wing occurring in the mid-fifteenth century.

Keywords

Dendrochronology
Standing Building

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from Baguley Hall, Greater Manchester (NGR SJ 8162 8874). This Grade I listed building is also a Scheduled Ancient Monument and a priority E building at risk. The building, comprising a two-bay open hall with timber-framed cross-wings and porch, has been the subject of considerable architectural and archaeological research (Smith and Stell 1960; Keen 1976; Dixon *et al* 1989). In particular, claims have been made, and refuted, for the presence of bowed wall lines in the hall range indicative of continuation of pre-conquest building traditions as exemplified by Trelleborg-type house plans in Scandinavia. Analysis of the surviving timbers was requested by Andrew Davison of English Heritage in advance of a new use being found for this presently unoccupied building.

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. In this case it is particularly likely that the conclusions may have to be modified in the light of subsequent work because difficulties of access restricted sampling.

Methodology

Methods employed at the Lampeter Dendrochronology Laboratory in general follow those described in English Heritage (1998). Details of the methods used for the dating of this building are described below.

The group of buildings making up Baguley Hall is now incongruously situated within the bounds of a large 1960s residential estate on the outskirts of the Manchester metropolitan area (Fig 1). At the core of this building complex is an extraordinary hall range built from massive timbers with the walls of 'plank construction' rather than more usual post-and-beam construction (Fig 2). Archaeological excavations have provided evidence for a precursor to this hall range of which no upstanding features remain. A spere truss separates a cross passage from the rest of the hall, which survives as two bays divided by a massive open truss. Archaeological evidence suggests that the hall originally extended further to the south but has been truncated by construction of the south cross wing. It has been argued that this wing dates to the seventeenth century and that elements within the roof including at least one tiebeam have been reused, possibly from the north wing. The latter wing has been refaced in brick but surviving elements of the original timber framing may be late medieval in date. A porch, which adjoins the north wing and hall range may have originally been built in the sixteenth century but was extensively rebuilt in the nineteenth century.

Tree-ring dating had previously been employed in an attempt to provide independent dating evidence for the hall range (Leggett 1989). During one of a number of phases of repair work, samples were taken from offcuts, and tree-ring sequences obtained from *in situ* and temporarily removed timbers. Two site masters were generated: **BAGI**, a five-timber, undated mean from rafters, and **BAGII**, a three-timber, 254-year

1

mean derived from two pieces of cornices and the 'base of the east screen of the spere truss'. This dated with the last ring at AD 1290 providing a *terminus post quem* but no felling ranges.

The present survey sought to refine the dating of the hall range, and also provide dates for the cross-wings and the porch. The site was assessed with the assistance of Richard Bond, and some variation made to the initial brief. The porch, seen as a later addition, did not have timbers with sufficient rings for measurement and was not sampled. A collection of timber offcuts held outside the building complex in a covered area were also assessed, and samples taken from a selection, principally to assist in chronology building as, although many retain labels, the records associated with these codes do not survive and hence their original location is unknown (John Birchenough pers comm). A single beam in the cellar was also sampled. Timbers with more than 50 annual rings and some survival of the original sapwood or bark-edge were sought. The dendrochronological sampling programme attempted to obtain cores from as broad a range of timbers, in terms of structural element types, scantling sizes, and carpentry features, as was possible within the terms of the request whilst also meeting health and safety requirements. This precluded extensive sampling of the roof (both rafters and scissor braces) which was beyond the reach of the ladders available. The use of a scaffold tower was considered impossible at the time due to the amount of building material and debris scattered across the floor surfaces.

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 (Tyers 1997a). 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 visually 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 satisfactory visual matching supports these positions. Timbers originally derived from the same parent tree generally have *t*-values greater than 10.0. Lower values from timbers obviously derived from the same parent tree (eg on morphological grounds) are however quite common. It is the visual similarity in medium term growth trends of the samples that is the critical factor in determining 'same tree' origin.

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 of 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

2

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 are 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. The sapwood estimates applied throughout this report are a minimum of 10 and maximum of 46 annual rings, where these figures indicate the 95% confidence limits of the range. These figures are applicable to oaks from the British Isles (Tyers 1998). Alternatively, if bark-edge survives, then a felling date can be directly utilised from the date of the last surviving ring. 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 re-use 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 26 samples was taken, comprising seven from the south wing roof, two from posts on the first floor of the north wing, 13 from the hall, one from the cellar, and three from timbers in the covered store (Table 1; Figs 3-8). Seven of these samples proved to have less than 50 rings or were so badly fragmented that they were not measured. The remaining 19 samples were measured and the resultant ring sequences compared.

Seven samples, five from the hall range and two from timbers held in the store, cross-matched and a 357-year mean sequence was calculated (**BAGT7**; Tables 2a and 5a). The date indicated by the relatively poor intra-site crossmatching for sample 22 was confirmed by comparison with reference chronologies. Two other samples, one from the hall range and one from the store, cross-matched and a 138-year mean sequence was calculated (**BAGT2**; Table 2b). These mean sequences and the sequences from unmatched, individual timber measurements were then compared with dated reference chronologies from throughout the British Isles and northern Europe. The seven timber mean **BAGT7**, and a single sequence from a timber in the north wing (sample **09**) exhibited significant correlations with dated series at the dating positions identified of AD 1015-1371, and AD 1356-1432 respectively (Table 3). These tree-ring sequences are listed in Table 5 and the relationships between the dated timbers are indicated graphically in Figure 9. None of the remaining sequences could be dated. No absolute date could be conclusively determined for the two timber mean **BAGT2.** A high computer correlation was identified against the dated site master for Chethams Library and School (Tyers 2002) but this cannot be replicated against sufficient other independent absolutely-dated sequences. It did show significant correlation against the undated, five timber mean **BAG1** produced by Leggett (Table 4). A new 151-year (**BAGBITS**) mean, calculated by combining these two means, was compared with dated reference chronologies from throughout the British Isles and northern Europe without identifying any significant, replicated correlations.

Interpretation

During the previous dendrochronological study (Leggett 1989, 404), samples from two pieces of cornice and from the base of the east spere truss were dated indicating construction of the hall after AD 1300. A further five samples from *in situ* timbers in this range have now been dated. These samples were derived from two storey posts in the north wall (**13** and **20**), a horizontal over the doors in the north wall (**19**), a sole piece at the base of the spere truss (**14**), and a cornice in the north-west corner (**22**). Whilst dated samples from the store of displaced timbers (**00** and **AB7**) may derive from the hall range, this cannot be confirmed. If all are assumed to be contemporary then combining the evidence for the felling date ranges from samples **20** and **22** suggests that the trees employed in the hall's construction were felled in the period AD 1382-95, indicating construction of the hall range in the last quarter of the fourteenth century.

A single sample from the north wing has been dated. This came from a post on the first floor (**09**) and gave a felling date range of AD 1442-78. Without a series of dated timbers from this wing, caution should be employed in the interpretation of this result. It could be concluded that this suggests construction of the north wing in the mid- to late-fifteenth century, supporting previous arguments for construction of this wing in the late medieval period.

Cross-matching was observed between the ring-width sequences from two samples (**10** and **U1**) from a rafter in the hall roof, and a timber in store respectively. The 138-year mean calculated from these sequences (**BAGT2**) cross-matched against the undated sequence **BAG1** produced by Leggett which was derived from five rafters (Leggett 1989), perhaps implying that U1 is also a rafter. These newly-produced sequences, and those included in **BAG1**, remain undated but support Leggett's suggestion that a number of timbers employed in the hall's construction were derived from trees growing in an area from which no dated sequences have yet been produced. The potential 'match' with the Chetham's Library and School chronology may be the first piece in the jigsaw and may hint at a group of timbers being derived from an area which has a localised signal dominating its ring sequence rather than a more general climatic signal.

In summary, dates have been produced for a single timber from the North wing, and several timbers from the wall frames and trusses of the Hall but not from the hall roof. Many of the timbers from this roof appear to be suitable for dendrochronology, but were inaccessible at the time of sampling. In particular, many of the scissor beams and rafters are quartered timbers with surviving sapwood, and possibly bark edge. Together, the results suggest a construction date in the range AD 1382-95 for the Hall (assuming that the cornice is not a later addition), and possibly AD 1442-78 for the North wing. The two dated samples without locations come from scraps of timber held in store outside the building. Even though one of these has a code number attached (**AB7**), it appears that the records relating these codes to original timber positions were lost in a fire.

Should safe access to timbers above wall-plate level become available in the future, it is strongly recommended that further sampling for tree-ring ring analysis be undertaken. This may confirm and

refine the dating of both the hall and the north range. It may also allow the difficulties associated with obtaining conclusive dating evidence for the currently undated rafter group to be addressed.

Acknowledgements

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Table 1

List of samples

Core No	Origin of core	Cross-section of tree	Cross-section size (mm)	Total rings	Sapwood rings	ARW mm/year	Date of sequence	Felling period
00	Unlabelled timber from covered store	Radial	195 x 90	158	-	1.20	AD 1116-AD 1273	after AD 1283
01	South wing roof, purlin	Whole	200 x 200	<50			Unmeasured	
02	South wing roof, purlin	Quarter	280 x 150	68	16+Bw	3.80	Undated	
03	South wing roof, reused(?) tiebeam	Whole	320 x 270	<50			Unmeasured	
04	South wing roof, purlin	Whole	210 x 180	<50			Unmeasured	
05	South wing roof, tiebeam	Whole	430 x 240	120	-	1.62	Undated	
06	South wing roof, purlin	Quarter	210 x 180	70	16+Bs	2.42	Undated	
07	South wing roof, purlin	Quarter	200 x 200	70	11	2.36	Undated	
08	North wing, first floor, post	Quarter	370 x 300	<50			Unmeasured	
09	North wing, first floor, post	Half	370 x 320	77	+HS	3.67	AD 1356-AD 1432	AD 1442-78
10	Hall, rafter	Quarter	210 x 190	138	+HS	1.44	Cross-match with U1	relative years 148-84
11	Hall, north-west corner post	Quarter	800 x 590	75+1H	-	4.09	Undated	
12	Hall, stud in north-west corner	Tangential	480 x 170	58	+?HS	2.07	Undated	
13	Hall, north wall, storey post	Tangential	530 x 130	108	-	1.70	AD 1122-AD 1229	after AD 1239
14	Hall, sole piece at base of spere truss	Quarter	450 x 200	265	-	1.02	AD 1015-AD 1279	after AD 1289
15	Hall, north wall, decorated brace	Half	580 x 175	62	+?HS	1.68	Undated	
16	Hall, east wall, sill beam	Quarter	213 x 180	<50			Sample badly fragmented, unmeasured	
17	Hall, wall plate (189) above porch	Half	490 x 175	56+5H	-	2.15	Undated	
18	Hall, west wall, post	Tangential	720 x 175	<50			Sample badly	

8

Core No	Origin of core	Cross-section of tree	Cross-section size (mm)	Total rings	Sapwood rings	ARW mm/year	Date of sequence	Felling period
							fragmented, unmeasured	
19	Hall, north wall, horizontal (280) over doors	Half	485 x 180	154+1H	-	1.15	AD 1138-AD 1291	after AD 1302
20	Hall, north wall, storey post (same tree as sample 13?)	Half	495 x 150	144	+HS	1.31	AD 1206-AD 1349	AD 1359-95
21	Hall, west wall, sill beam	Quarter?	280+ x 180+	<50			Sample badly fragmented, unmeasured	
22	Hall, cornice in north-west corner	Quarter	230 x 150	101+1H	-	2.42	AD 1271-AD 1371	after AD 1382
23	Cellar beam	Quarter	175 x 150	66	16+Bw	3.03	Undated	
AB7	Timber AB7, from covered store	Radial	185 x 138	172	-	1.25	AD 1100-AD 1271	after AD 1281
U1	Timber U1, from covered store	Radial	140 x 85	73	-	1.63	Cross-match with 10	after relative year 148

Total rings = all measured rings, +valueH means additional heartwood rings were only counted, the felling period column is calculated using these additional rings.
Sapwood rings = +HS heartwood/sapwood boundary, ?HS possible heartwood/sapwood boundary, +Bw = bark-edge winter felled, +Bs = unmeasured spring growth also present
ARW = average ring width of the measured rings

Table 2

a) *t*-value matrix for samples making up the 375-year mean sequence **BAGT7**. \ = overlap < 15 years, - = t-values less than 3.00, * = empty triangle

Samples	13	14	19	20	22	AB7
00	3.42	4.43	3.47	-	\	**11.81**
13	*	4.44	4.04	3.36	\	3.15
14	*	*	5.83	3.06	\	6.32
19	*	*	*	4.39	-	4.46
20	*	*	*	*	4.10	3.16
22	*	*	*	*	*	\

b) *t*-value matrix for samples making up the 138-year mean sequence **BAGT2**.

Samples	U1
10	6.24

Table 3

a) Dating the mean sequence **BAGT7**, AD 1015-1371 inclusive. *t*-values with independent reference chronologies

Area	Reference chronology	*t*-values
East Midlands	East Midlands (Laxton and Litton 1988)	7.58
Herefordshire	20 Church St, Hereford (Tyers 1996a)	6.16
Herefordshire	St John The Baptist Church, Mamble (Tyers 1996b)	6.51
Manchester	Baguley Hall 2 (Leggett 1989)	6.63
Merseyside	Eccleston Hall, St Helens (Groves 1993)	8.39
Staffordshire	Manor House, Abbey Green, Burton upon Trent (Howard *et al* 1998)	7.25
Staffordshire	Sinai Park (Tyers 1997b)	5.36
Worcestershire	Droitwich (Groves and Hillam 1997)	6.04

b) Dating the raw sequence **BAG09**, dated to AD 1356- 1432 inclusive

Area	Reference chronology	t-values
Herefordshire	16-18 Hightown/Booth Hall, Hereford (Boswijk and Tyers 1997)	6.46
Gloucestershire	Mercer's Hall, Gloucester (Howard *et al* 1996)	5.75
Lancashire	Lathom House (Nayling 2000)	6.02
Wales	Welsh Border (Siebenlist-Kerner 1978)	6.17
Yorkshire	Elland Old Hall (Hillam 1984)	5.32
Ireland	Belfast (Baillie 1977)	5.20
Herefordshire	Church Ale House, Colwall (Hillam 1991)	5.92

Mean			BAG1
	start	dates	1
	dates	end	151
BAGT2	1	138	7.10

Table 5

a) Ring-width data from site master **BAGT7**, dated to AD 1015-1371 inclusive

Date	Ring widths (0.01mm)										No of samples									
AD 1015					101	125	161	147	138	142					1	1	1	1	1	1
-	157	198	178	166	116	226	98	144	147	165	1	1	1	1	1	1	1	1	1	1
-	156	135	163	125	155	145	206	154	160	170	1	1	1	1	1	1	1	1	1	1
-	124	142	111	114	127	105	113	158	131	91	1	1	1	1	1	1	1	1	1	1
AD 1051	84	87	68	66	68	78	100	105	115	102	1	1	1	1	1	1	1	1	1	1
-	98	94	81	88	72	82	79	92	89	87	1	1	1	1	1	1	1	1	1	1
-	110	95	78	83	107	127	153	134	87	165	1	1	1	1	1	1	1	1	1	1
-	143	144	130	159	212	173	143	169	144	96	1	1	1	1	1	1	1	1	1	1
-	121	144	153	126	152	121	111	115	94	188	1	1	1	1	1	1	1	1	1	2
AD 1101	143	122	146	104	129	142	102	173	180	119	2	2	2	2	2	2	2	2	2	2
-	85	96	116	126	161	117	122	116	90	99	2	2	2	2	2	2	2	2	2	2
-	132	216	245	222	199	172	199	202	184	145	2	3	3	3	3	3	3	3	3	3
-	140	139	153	164	204	157	127	162	130	184	3	3	3	3	3	3	3	4	4	4
-	207	168	129	124	126	121	95	94	124	102	4	4	4	4	4	4	4	4	4	4
AD 1151	134	128	166	124	137	154	130	119	126	133	4	4	4	4	4	4	4	4	4	4
-	105	102	104	95	99	81	95	90	110	99	4	4	4	4	4	4	4	4	4	4
-	100	106	111	108	108	119	86	105	139	103	4	4	4	4	4	4	4	4	4	4
-	110	104	83	77	95	98	116	80	91	132	4	4	4	4	4	4	4	4	4	4
-	96	96	105	131	131	135	143	121	104	91	4	4	4	4	4	4	4	4	4	4
AD 1201	105	100	109	90	97	107	83	98	101	137	4	4	4	4	5	5	5	5	5	
-	140	152	152	99	84	86	90	85	79	89	5	5	5	5	5	5	5	5	5	
-	110	117	99	109	111	118	114	126	127	106	5	5	5	5	5	5	5	5	4	
-	65	84	67	90	103	82	124	110	125	119	4	4	4	4	4	4	4	4	4	
-	105	117	146	114	115	127	119	102	125	110	4	4	4	4	4	4	4	4	4	
AD 1251	110	92	98	100	119	115	118	111	88	82	4	4	4	4	4	4	4	4	4	
-	83	99	101	124	125	105	97	98	94	98	4	4	4	4	4	4	4	4	4	
-	166	115	135	138	141	151	201	132	172	205	5	5	4	4	4	4	4	3		
-	258	237	241	287	192	247	228	246	257	191	3	3	3	3	3	3	3	3	3	
-	213	277	258	213	161	175	189	166	203	208	3	2	2	2	2	2	2	2	2	
AD 1301	225	225	183	171	210	240	221	169	228	218	2	2	2	2	2	2	2	2	2	
-	251	216	219	216	254	258	204	209	201	191	2	2	2	2	2	2	2	2	2	
-	307	272	231	212	234	201	310	208	185	171	2	2	2	2	2	2	2	2	2	
-	153	159	208	200	246	189	202	224	245	271	2	2	2	2	2	2	2	2	2	
-	192	201	185	146	195	127	154	197	207	133	2	2	2	2	2	2	2	2	1	
AD 1351	154	136	151	159	175	150	195	146	121	94	1	1	1	1	1	1	1	1	1	
-	107	137	141	115	114	119	88	76	79	104	1	1	1	1	1	1	1	1	1	
-	62										1									

b) Ring-width data from single timber sequence **09**, dated to AD 1356- 1432 inclusive

Date	Ring widths (0.01mm)									
AD 1356						271	330	377	368	279
-	223	461	514	504	368	420	445	206	414	537
-	486	613	461	527	319	374	296	347	516	420
-	426	356	472	430	475	641	547	482	440	290
-	301	252	420	328	376	430	323	413	280	422
AD 1401	377	393	324	434	348	402	245	384	458	307
-	424	377	438	369	420	346	284	365	193	437
-	360	334	459	314	235	283	123	167	153	124
-	124	80								

Figure 1 Baguley Hall. Location
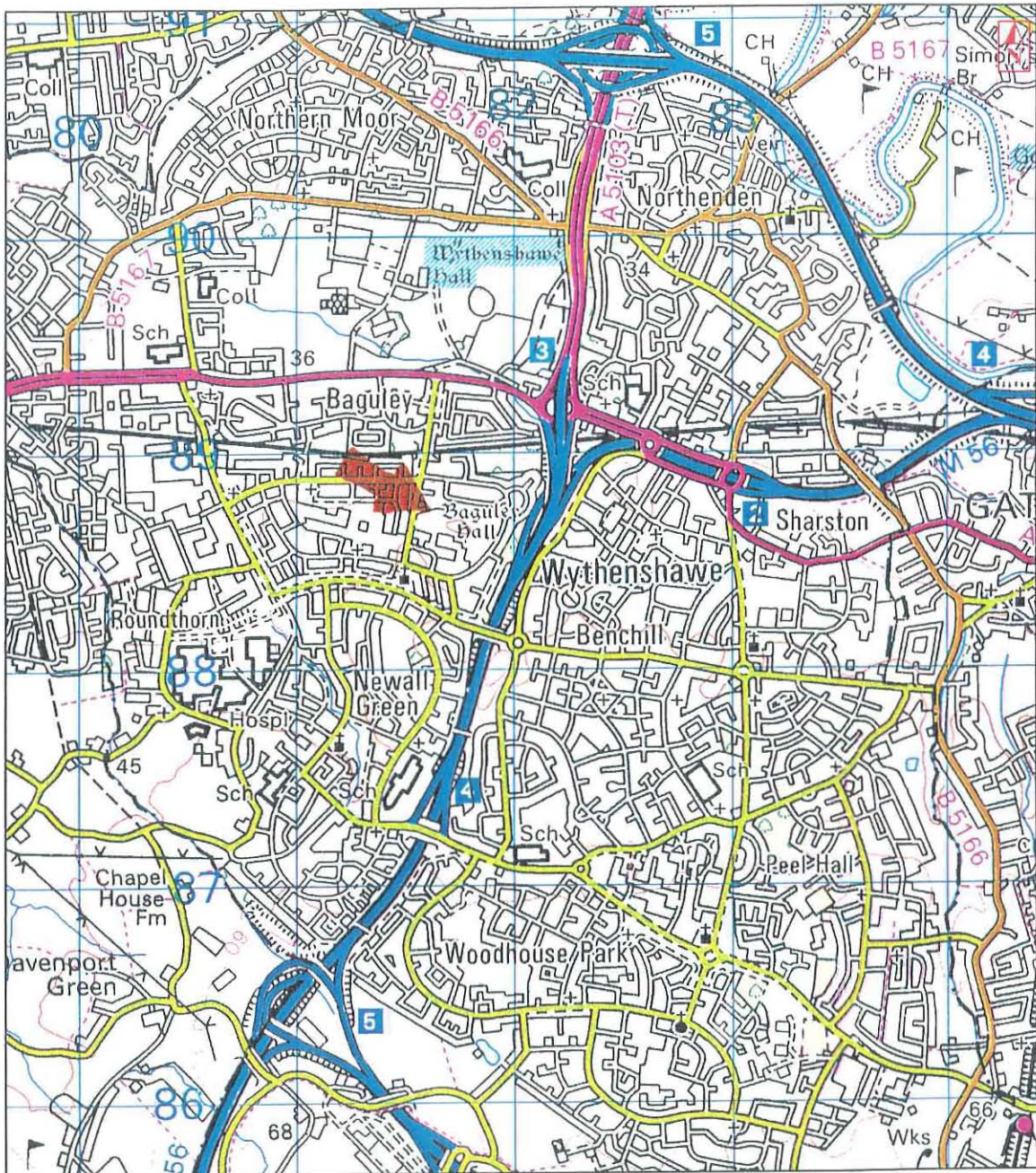
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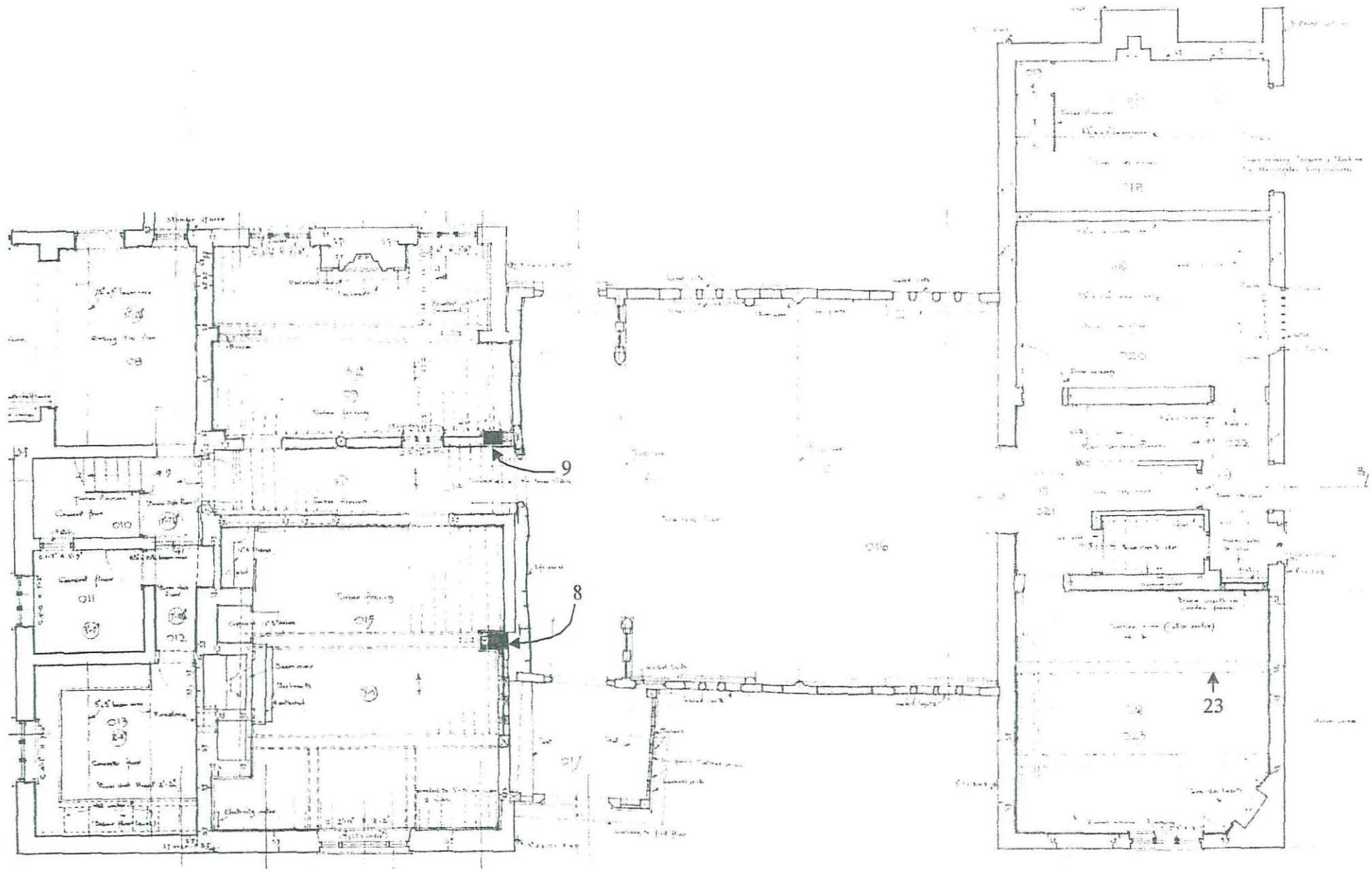
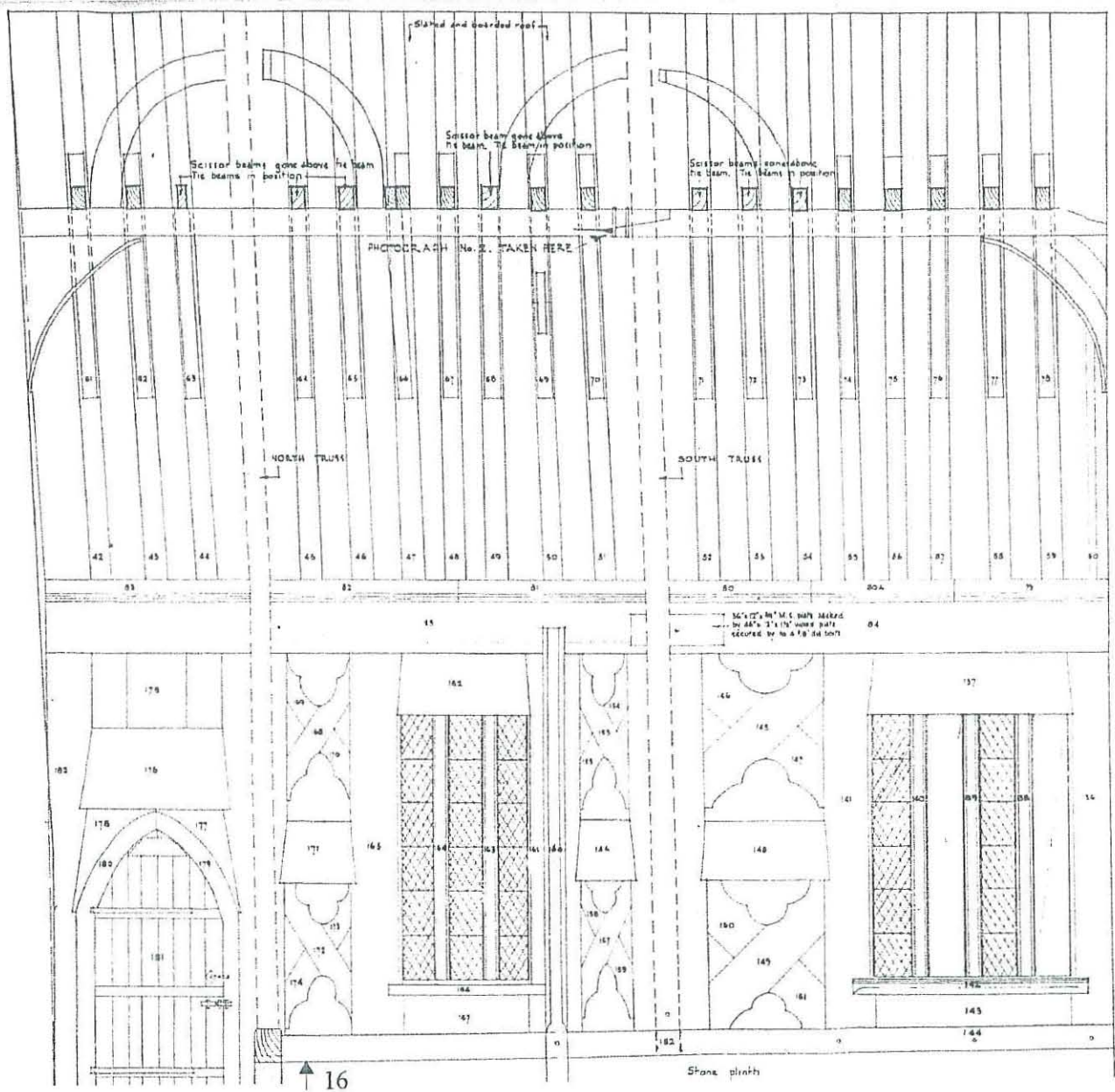**Figure 2** Baguley Hall. Plan at ground floor level showing location of samples **8**, **9**, and **23**

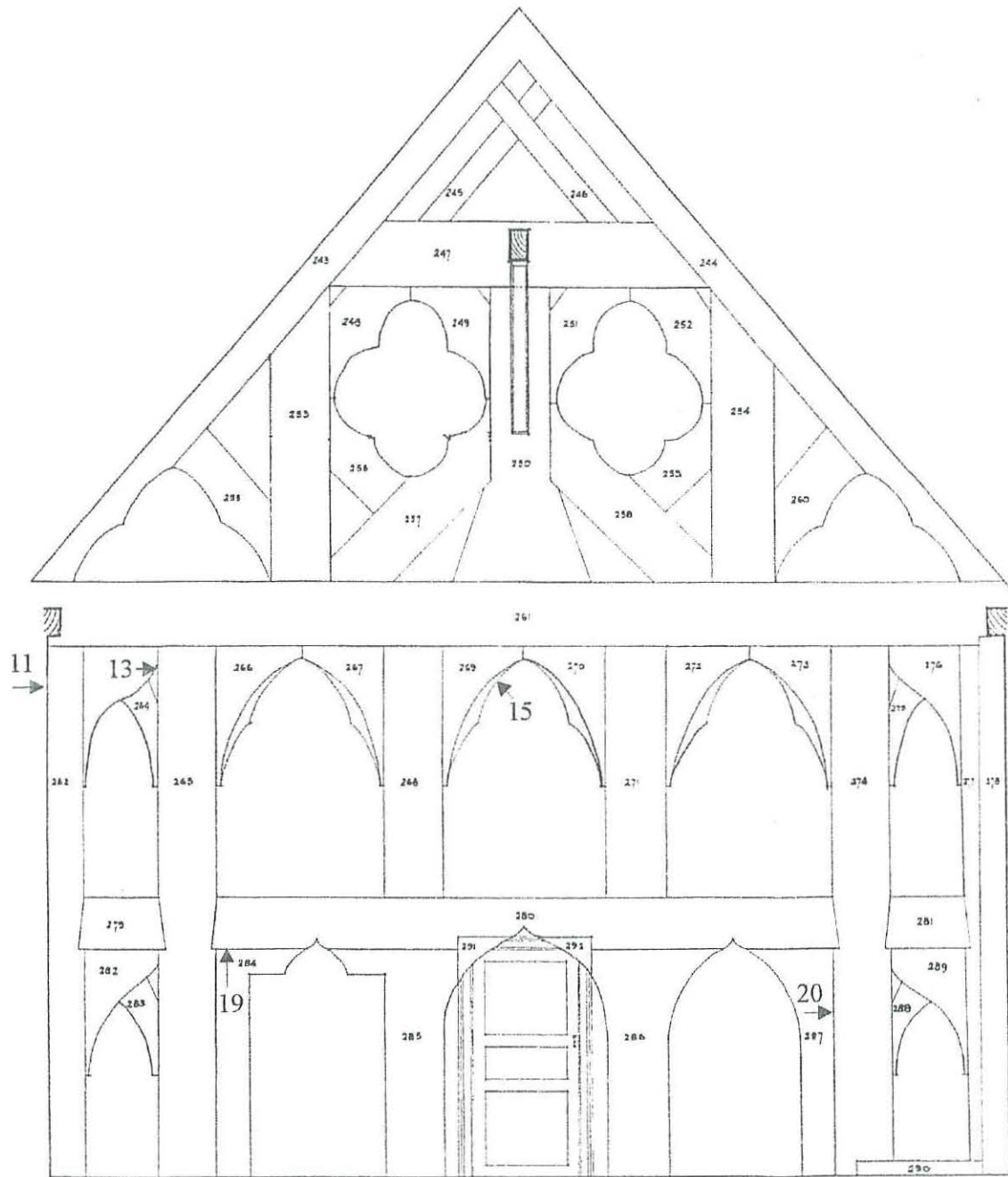**Figure 3** Internal elevation of east wall. Hall range, Baguley Hall. Location of sample **16**

Figure 4 Internal elevation of north wall. Hall range, Baguley Hall. Location of samples **11, 13, 15, 19,** and **20**
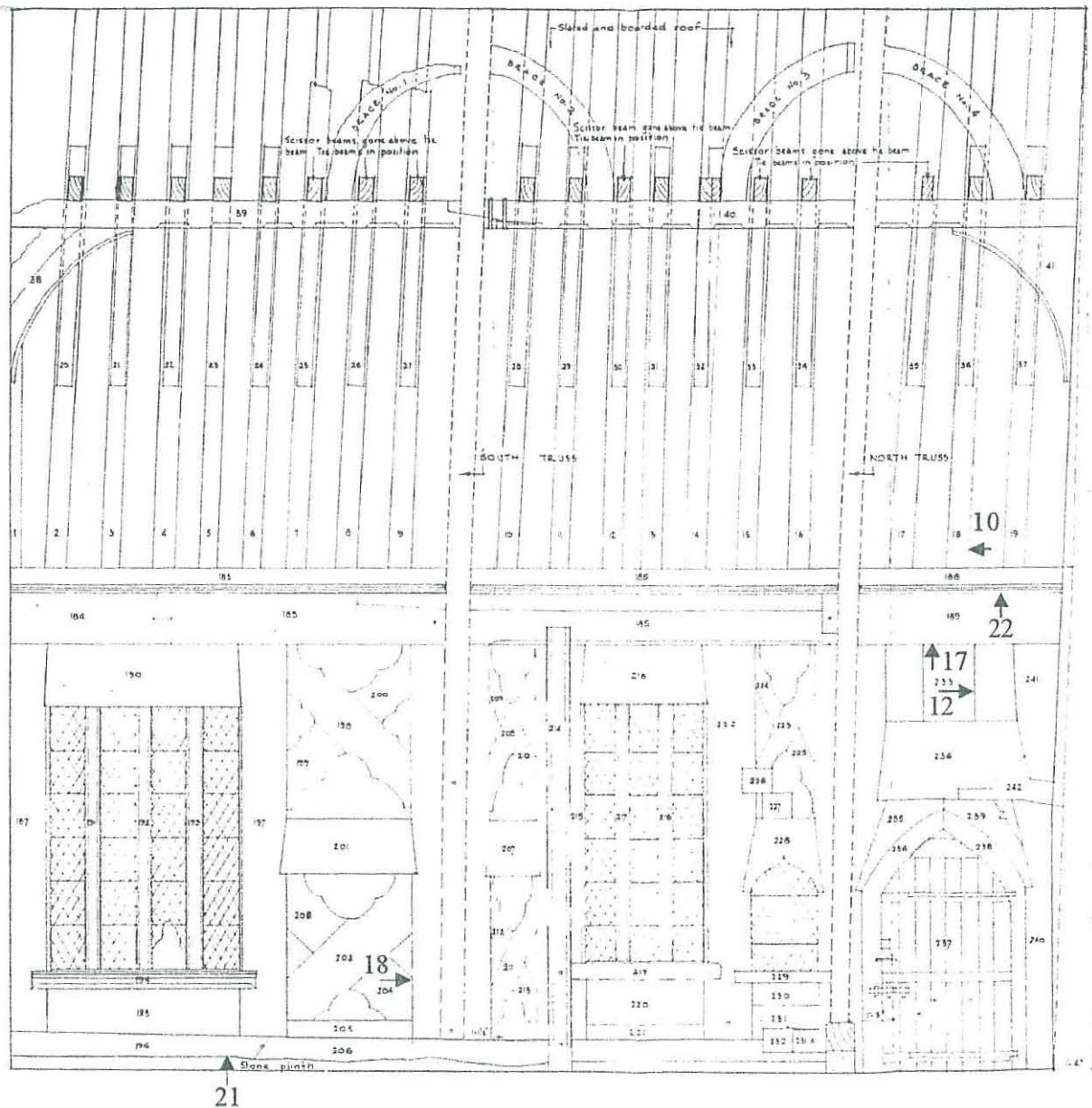
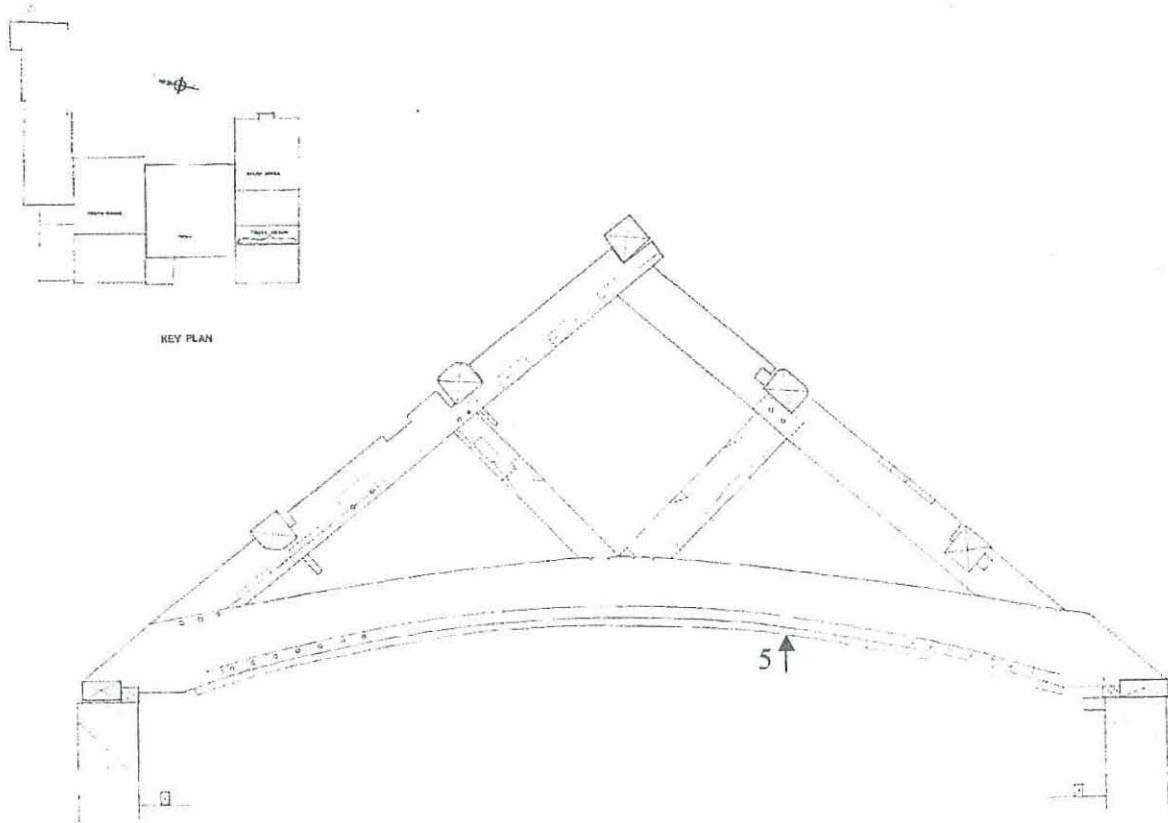**Figure 5** Internal elevation of west wall. Hall range, Baguley Hall. Location of samples **10, 12, 17, 18, 21,** and **22**

17

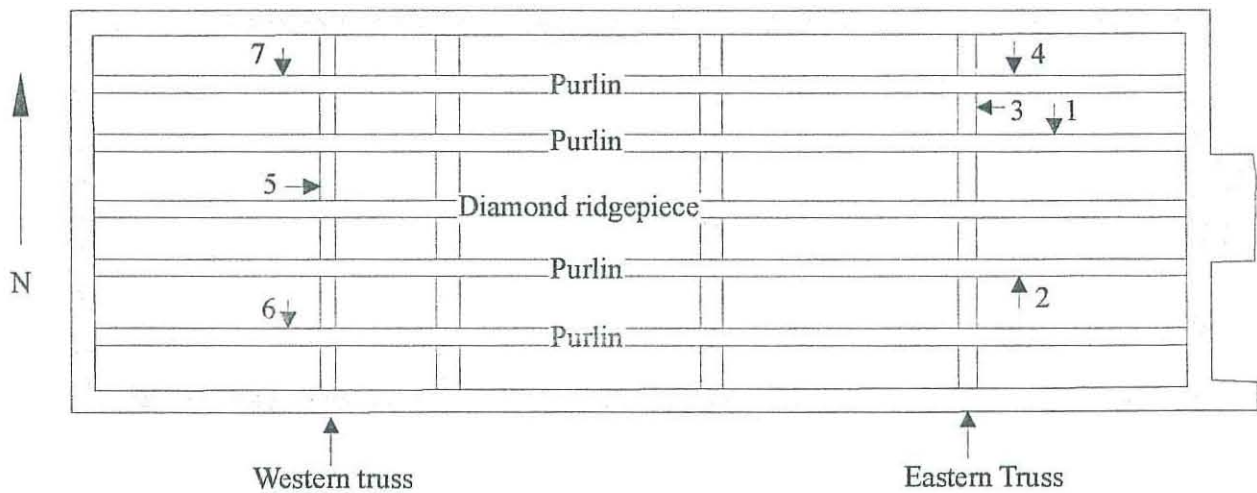**Figure 6** Elevation of western roof truss. South wing, Baguley Hall. Location of sample **5**

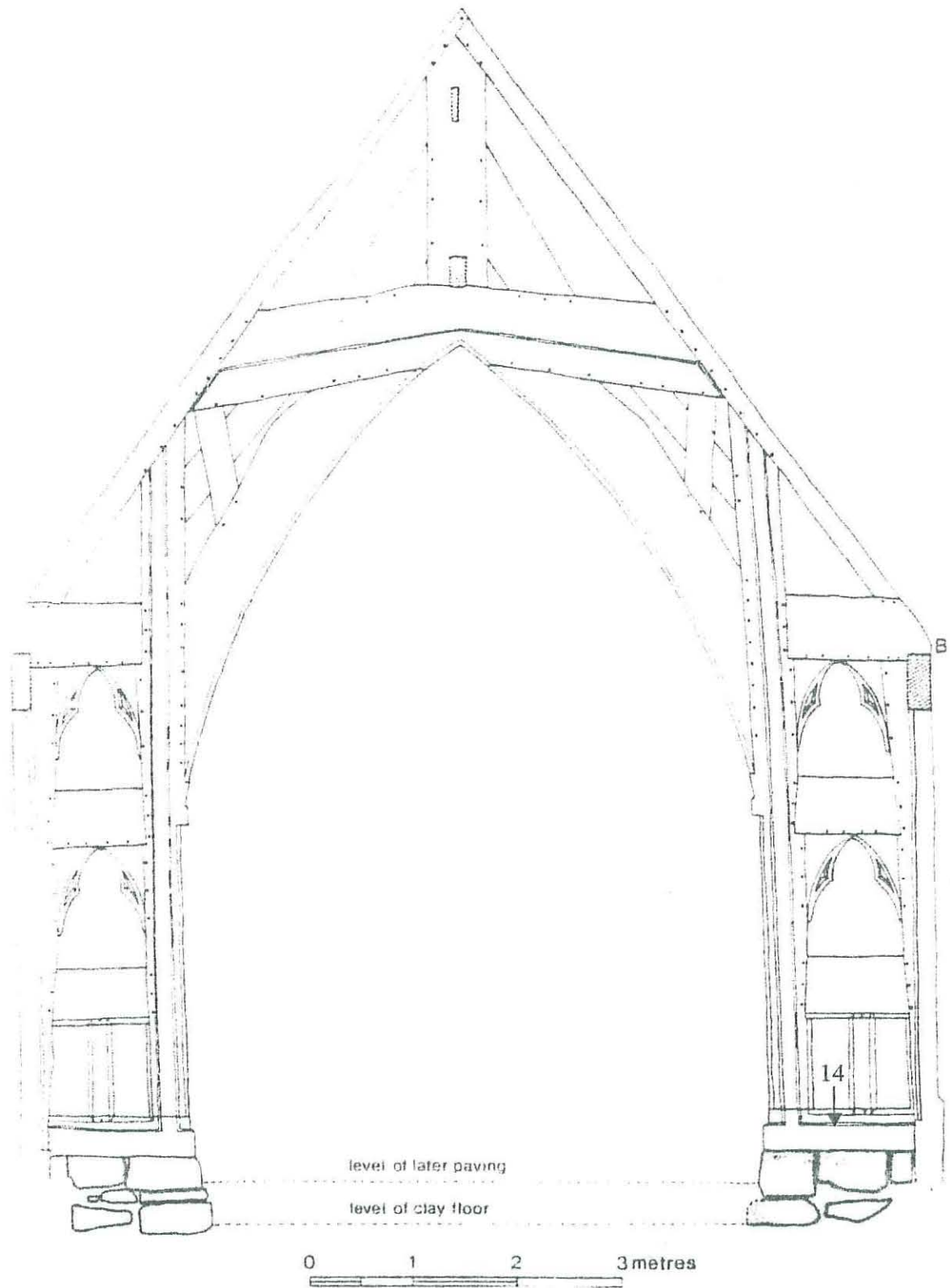**Figure 7** Diagrammatic roof plan of the South Wing, Baguley Hall. Location of samples 1-7

Figure 8 Elevation of the spere truss in the hall range, Baguley Hall. Location of sample 14. (based on figure 8: Dixon *et al* 1989)

Figure 9 Bar diagram showing the chronological positions of the dated timbers. The felling periods are also shown.