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Summary

Eight timbers were sampled at Upper Lake, Westbury, Shropshire. All eight dated and were combined to form the 129-year site chronology ***UPPRLAKE***, spanning the years AD 1418-1546. Four of the samples retained complete sapwood giving precie felling dates of summer AD 1545, winter AD 1545/6, and summer AD 1547. Four other samples with incomplete sapwood gave felling date ranges consistent with these results.

Keywords

Dendrochronology
Standing Building

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THE TREE-RING DATING OF
UPPER LAKE, WESTBURY,
SHROPSHIRE

1. INTRODUCTION AND OBJECTIVES

This report details the dendrochronologicalanalysis of eight timbers from the cruck range at Upper Lake, Westbury, Shropshire (NGR SJ 371 068; Fig1). The building consists of a northern primary cruck-built range and a multiphase complex of box frame construction to the south (Fig 2). This report describes the analysis of the cruck-built range.

This range consists of three cruck trusses forming two unequal bays. Visual inspection indicated that each pair of crucks were fashioned from single trees. The building contains a number of unusual features that does not conform to the usual Shropshire cruck tradition. These include the tops of the cruck blade of the northern truss (Truss A) which do not meet at the apex but on a king-post which rises from a yoke (Fig 3). This is classified as a 'Type G' and is found more commonly distributed west of the Severn and Dee (Alcock 1981). On the other two surviving trusses the tops of the cruck blades meet on a straight line and are then divide to support the ridge purlin, classified as a 'Type L2' (Fig. 4). The wall-plates are chamfered out beyond the external wall face to such a degree that it makes them almost of quadrant section. Another unusual feature is the arrangement of the wind braces, as they do not rise from the cruck blades or packing pieces but instead rise from the lower purlin. These features are not known on any other building in Shropshire.

The north truss (truss A) has empty mortises suggesting that the structure originally extended further north. This possibly formed a service end housing a buttery and pantry. The remaining two bays of cruck range originally formed an open hall, the centre truss at B being an arch-braced open truss. This truss has evidence for a 'low' or mantel beam.

The analysis formed part of a dendrochronology training programme at Oxford University, funded by English Heritage and supervised by the second author. The sampling of this building has been undertaken in consultation with Mrs Madge Moran, FSA, who has directed the Shropshire Dendrochronology Project. This project commenced in 1992 and has thus far selectively targeted and dated over 100 individual phases of building. The results of this project have been published annually in *Vernacular Architecture* and are to be presented in an overall omnibus report on conclusion of the project.

2. METHODOLOGY

Following a preliminary assessment, the sampling was carried out in December 1999. Only timbers with more than 50 rings identified as being from the primary construction phase were sampled. Another sampling requirement was the presence of complete sapwood or at least evidence of the heartwood-sapwood transition.

The samples were taken using a 16mm hollow auger powered by an electric drill. The samples were sanded on a linisher using 60 to 1000 grit abrasive paper. These were then measured to an accuracy of 0.01 mm using a travelling stage attached to a microcomputer based measuring system (Reynolds pers comm 1998).

The samples were compared with each other using dendrochronological techniques described in English Heritage (1998). This involved both visual comparisons using semi-logarithmic graphs as well as statistical cross-correlations using a computer. This utilised cross-correlation algorithms (Baillie and Pilcher 1973) which have been implemented using computer software written for Windows in Visual Basic by M R Allwright and P A Parker. In comparing two individual samples, a *t*-value of 3.5 or higher is usually indicative of a good match, whilst *t*-values of 10 and above often suggest samples having originated from the same parent tree. In comparing a site master made up of a number of individually matching samples

with dated reference chronologies, *t*-values of 5 and above are normally expected. A conclusive match should also exhibit the highest matches with reference chronologies of local origin as well as with well-replicated regional chronologies. Matching positions suggested by computer are confirmed by satisfactory visual matching.

Once a ring sequence has been dated, the felling date of the timber needs to be interpreted. When the sapwood is complete on a sample, the determination of a felling date is relatively straight-forward. Each growth ring is comprised of one or more rows of open spring vessels, or early wood, followed by a band of dense summer growth or late-wood. During the winter months the tree remains dormant. If both the spring and summer growth are present and complete, then the tree would have been felled during the winter period. If only the spring vessels are present beneath the bark, then the tree can be said to have died or felled during the spring period. If only a few spring vessels are present, then it is possible to further refine the time of felling to *early spring*. If some dense wood or summer growth is present, then a *summer or autumn* felling period can be determined. However, as it is not known how wide the complete summer growth band should be for that particular tree, it cannot be stated conclusively whether the tree was felled in early or late summer, or if indeed it was felled at some point in the winter. For instance, a severe May frost can suddenly halt the tree's growth, producing a narrow ring with little or no summer wood (Baillie 1982, plate 2c). Therefore, a certain degree of caution should be used in interpreting felling seasons between summer and autumn, or even winter seasons in some instances. Only complete rings felled during the winter months are measured, samples exhibiting incomplete spring or summer growth would give a felling date during the year following the last measured complete ring.

If the last ring is missing but the heartwood sapwood boundary survives, the number of missing sapwood rings can be estimated using an empirically derived sapwood estimate. The sapwood estimate used in this report is 11 to 41 rings, the 95% confidence range calculated by Miles (1997a) for Shropshire and the Welsh Marches.

It should be remembered that dendrochronology can only date when the tree died, not the date of construction for a building or artefact. The interpretation of a felling date relies on having a good number of precise felling dates rather than just one or two. Nevertheless, it was common practice to build timber-framed structures with green or unseasoned timber and that construction usually took place within twelve months of felling (Miles 1997a).

3. RESULTS

Eight samples were taken from oak (*Quercus* spp.) timbers identified as belonging to the primary construction phase of the cruck-built range. No samples were taken from truss 4 as none of the timbers had sufficient rings for dendrochronological analysis. Four of the samples retained complete sapwood and six of the samples had over 100 annual rings, giving good dating potential. Details of the samples and their locations can be seen in Table 1 and Figs 3-4.

The eight samples were compared against each other, all eight were found to have consistently high correlations. Two samples, ***upl2*** and ***upl7***, matched extremely well with a *t*-value of over 12 (Table 2). One would generally consider these to have originated from the same tree. However, as one was a cruck with a bent trunk, and the other was a purlin converted from a straight tree, it is unlikely these were from the same tree, but instead probably were woodland neighbours. For this reason, the series from the two samples were not averaged together prior to the formation of the site master.

The tree-ring series from all eight samples were averaged together to form a 129-year master chronology ***UPPRLAKE*** (Table 3,). This was then compared with over 700 dated reference chronologies, from the British Isles, Ireland and Northern Europe. It was found to date, spanning the years AD 1418 - 1546 (Table 4).

4. INTERPRETATION

Of the eight samples, four retained complete sapwood giving precise felling dates of summer AD 1545, winter AD 1545/6 and summer AD 1547. Four other samples with incomplete sapwood gave felling date ranges consistent with all the timbers being from one period of felling (Fig 5).

It must be re-emphasised that dendrochronology can only date when the trees were felled, not the date when the timber was used to construct the structure under study. Variation by a year or two between felling dates is by no means unusual, and may instead suggest either stockpiling or windfalls (Miles 1997a). The consistency of the felling dates produced by the tree-ring analysis suggests that the cruck-built range was initially constructed in the summer of AD 1547 or shortly thereafter.

The dating here has identified a cruck structure with a number of unusual or unique features such as the wind braces and wall plates. The date of AD 1547 is one of the latest examples of full-cruck construction in Shropshire, and one of only a handful dated between AD 1500 and AD 1550. Upper Lake clearly exhibits innovative features which herald the transition from the mediaeval to the post-mediaeval timber-framing tradition.

5. ACKNOWLEDGEMENTS

We would like to thank Mrs Madge Moran for her help in interpreting the building's construction phases. Acknowledgements are also given to English Heritage and Sheffield Dendrochronology Laboratory for both published and unpublished data. Alex Bayliss and Cathy Groves both provided useful comments on the first draft of the report. The owners Mr Gordon Potter and Mrs Frances Potter, kindly allowing access to the building.

6. REFERENCES

Alcock, N W, 1981 *Cruck construction: an introduction and catalogue*, CBA Res Rep, No. **42**

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

Bridge, M C, 1998 Compilation of master chronologies from the South, unpubl computer file SENG98, University Collage London Dendrochronology Laboratory

English Heritage 1998

Fletcher, J M, 1978 Oak chronologies for eastern and southern England: principles for their construction and application: their comparison with others in north-west Europe, in *Dendrochronology in Europe* (ed J M Fletcher), BAR **51**, 139-56

Groves, C, 1997 *Dendrochronological analysis of Ightfield Hall Farm Barn, Ightfield, Whitchurch, Shropshire*, Anc Mon Lab Rep, **91/98**

Haddon-Reece, D, and Miles, D H, 1993 *Working compilation of 190 British reference chronologies supplied by various researchers*, unpubl computer file *MASTERAL*, Oxford Dendrochronology Laboratory

Hillam, J, and Groves, C, 1994 *Compilation of master chronologies from the North*, unpubl computer file *NORTH*, Sheffield Dendrochronology Laboratory

Laxton, R R, and Litton, C D, 1988 *An East Midlands Master Tree-Ring Chronology and its use for dating Vernacular Buildings,* Univ Nottingham, Dept of Classical and Archaeol Studies, Monograph Ser, **3**

Miles, D H, 1995 *Working compilation of 71 reference chronologies centred around Shropshire by various researchers*, unpubl computer file *SALOP95*, Oxford Dendrochronology Laboratory

Miles, D H, 1997a The interpretation, presentation, and use of tree-ring dates, *Vernacular Architect*, **28**, 40-56

Miles, D H, 1997b *Working compilation of 58 reference chronologies centred around Wales by various researchers*, unpubl computer file *WALES97*, Oxford Dendrochronology Laboratory

Miles, D H, and Haddon-Reece, D, 1993 List 54 - Tree-ring dates, *Vernacular Architect*, **24**, 54-60

Miles, D, H, and Haddon-Reece, D, 1994 List 56 - Tree-ring dates, *Vernacular Architect*, **25**, 28-36

Miles, D H, and Haddon-Reece, D, 1995 List 64 - Tree-ring dates, *Vernacular Architect*, **26**, 60-74

Miles, D H, and Haddon-Reece, D 1996 List 72 - Tree-ring dates, *Vernacular Architect*, **27**, 97-102

Miles, D H, and Worthington, M J, 1997 Tree-ring dates, *Vernacular Architect,* **28**, 159-81

Miles, D H, and Worthington, M J, 1998 Tree-ring dates, *Vernacular Architect,* **29**, 111-29

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, **51**, 157-61

Tyers, I, 1997 *Tree-ring analysis of timbers from Sinai Park, Staffordshire*, Anc Mon Lab Rep **80/97**

Table 1: Summary of tree-ring dating

Upper Lake, Westbury, Shropshire

Sample number & type		Timber and position	Dates AD spanning	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
* ***upl1***	c	Tiebeam Truss C	1424-1542	1532	10	119	1.23	0.64	0.14	AD 1543-73
* ***upl2***	c	East cruck Truss C	1452-1543	1526	17	92	2.04	0.93	0.21	AD 1543-67
* ***upl3***	c	East cruck Truss A	1441-1546	1523	23½C	106	2.15	0.70	0.20	Summer AD 1547
* ***upl4***	c	Collar Truss A	1464-1545	1534	11C	82	0.93	0.39	0.17	Winter AD 1545/6
* ***upl5***	c	East purlin bay 2	1427-1544	1516	28½C	118	1.10	0.69	0.18	Summer AD 1545
* ***upl6***	c	West wallplate bay1	1418-1517	1516	1	100	1.35	0.43	0.16	AD 1527-57
* ***upl7***	c	West purlin bay 2	1431-1545	1512	24C	115	1.60	0.61	0.19	Winter AD 1545/6
* ***upl8***	c	East cruck stud Truss A	1446-1545	1526	19	100	1.27	0.64	0.14	AD 1545-67
* =***UPPRLAKE*** **Site Master**			**1418-1546**			**129**	**1.55**	**0.56**	**0.14**	

Key: * = sample included in site-master; c = core; ½C, C = bark edge present, partial or complete ring: ½C = summer/autumn (ring not measured), or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity

Table 2: *t*-values and overlaps for components of ***UPPRLAKE***

	upl2	***upl3***	***upl4***	***upl5***	***upl6***	***upl7***	***upl8***
upl1	4.09 91	3.18 102	9.51 79	4.80 116	4.95 94	4.25 112	5.44 97
	upl2	6.86 92	4.26 80	2.85 92	4.62 66	12.69 92	5.89 92
		upl3	2.57 82	4.46 104	3.48 77	5.99 105	6.50 100
			upl4	4.02 81	4.23 54	5.32 82	4.80 82
				upl5	2.12 91	3.46 114	4.34 99
					upl6	4.08 87	3.73 72
						upl7	5.63 100

Table 3: Ring-width data for site master curve

UPPRLAKE AD 1418-1546, Upper Lake Shropshire - mean of samples **upl1 - upl8**
129 rings, starting date AD 1418

ring widths (0.01mm)	**number of samples in master**
201 140 266 227 233 206 208 232 270 303	1 1 1 1 1 1 2 2 2 3
323 257 240 312 283 206 269 208 158 147	3 3 3 4 4 4 4 4 4 4
130 112 160 198 167 175 175 152 144 165	4 4 4 5 5 5 5 5 6 6
238 220 233 258 258 238 273 244 260 255	6 6 6 6 7 7 7 7 7 7
212 190 214 150 164 166 129 145 150 193	7 7 7 7 7 7 8 8 8 8
159 173 162 130 117 122 135 156 132 131	8 8 8 8 8 8 8 8 8 8
117 141 146 192 126 112 131 135 151 194	8 8 8 8 8 8 8 8 8 8
146 135 136 129 095 124 137 128 153 122	8 8 8 8 8 8 8 8 8 8
106 125 111 102 095 096 128 124 125 091	8 8 8 8 8 8 8 8 8 8
078 136 122 121 136 132 121 114 089 094	8 8 8 8 8 8 8 8 8 8
103 142 113 130 138 123 111 088 104 116	7 7 7 7 7 7 7 7 7 7
128 117 099 145 093 112 108 097 111 119	7 7 7 7 7 7 7 7 7 7
109 113 121 123 082 084 091 111 109	7 7 7 7 7 6 5 4 1

Table 4: Dating of ***UPPRLAKE*** against reference chronologies at AD 1546

	Reference chronology	Spanning (AD)	Overlaps	*t*-value
*♣	HABBERLY *(Miles and Haddon-Reece 1995)*	1386-1554	129	7.63
	DISCOED1 *(Miles and Worthington 1998)*	1375-1535	118	7.61
	SENG98 *(Bridge 1998)*	944-1790	129	7.69
	NORTH *(Hillam and Groves 1994)*	440-1742	129	7.94
*	**MC16** *(Fletcher 1978)*	1314-1636	129	7.92
†	ASHWOOD *(Miles and Haddon-Reece 1994)*	1419-1619	128	8.00
	BEARSTP2 *(Miles and Worthington 1997)*	1478-1607	69	8.12
†	OLDHLLFM *(Miles and Haddon-Reece 1996)*	1379-1630	129	8.23
	CALLGHTN *(Miles and Worthington 1997)*	1335-1569	129	8.38
	MASTERAL *(Haddon-Reece and Miles 1993)*	404-1987	129	8.43
	WALES97 *(Miles 1997b)*	404-1981	129	8.43
	EASTMID *(Laxton and Litton 1988)*	882-1981	129	8.62
	SINAI *(Tyers 1997)*	1227-1750	129	8.66
	IGHTFELD *(Groves 1997)*	1341-1566	129	9.02
*†♣	**GIERTZ** *(Siebenlist-Kerner 1978)*	1341-1636	129	9.48
	MALPAS1 *(Miles and Worthington 1998)*	1389-1588	129	9.66
	SALOP95 *(Miles 1995)*	881-1745	129	10.49
*†	BROOKGT (*Miles and Haddon-Reece 1993*)	1362-1611	129	11.70

* Component of MASTERAL
† Component of SALOP95
♣ Component of WALES97

Chronologies shown in **bold** are composite chronologies

Figure 1: Map showing location of Upper Lake, Westbury, Shropshire

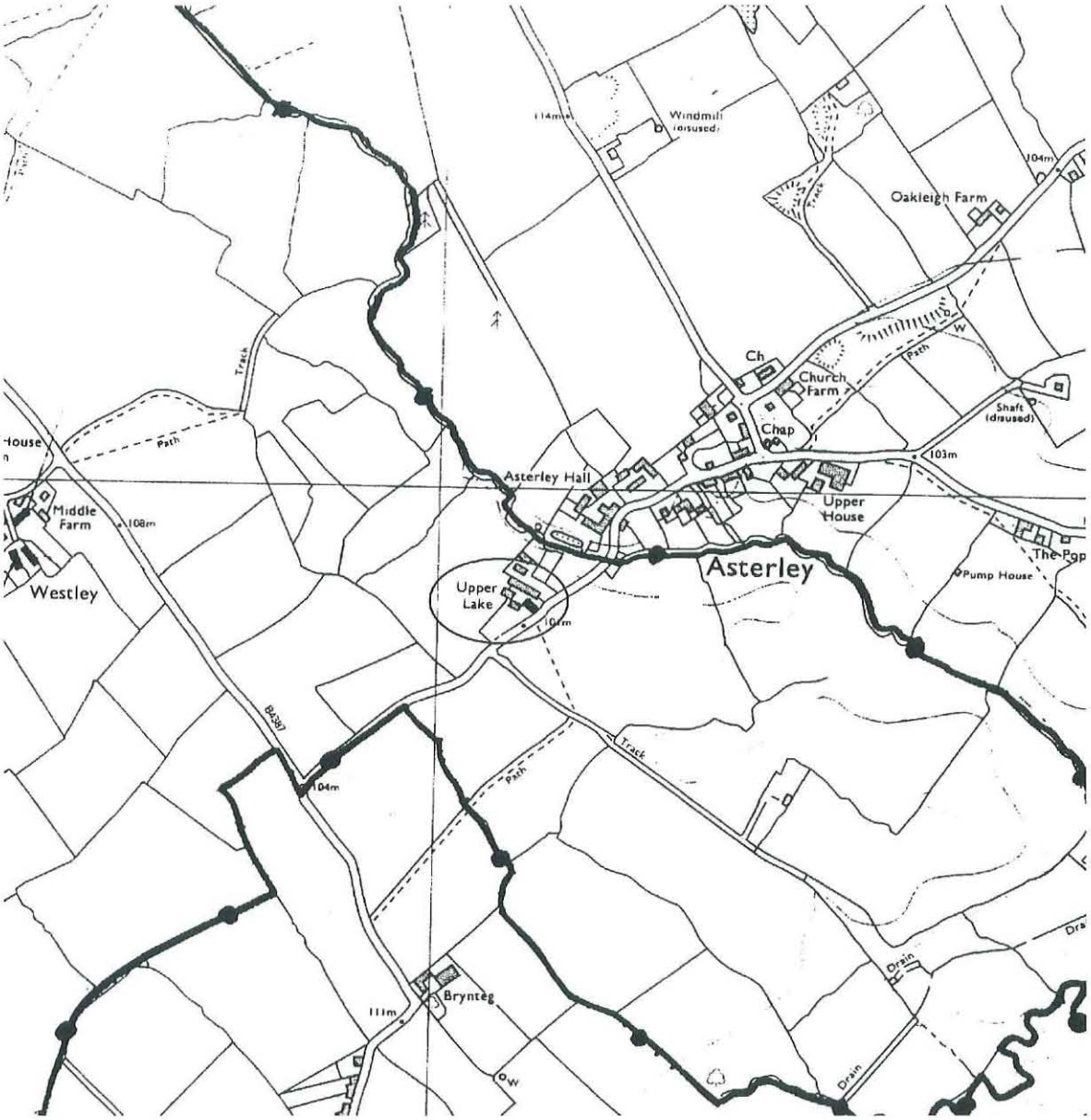

Figure 2: Upper Lake sketch from the North -West *(after P, Gates et al, Shrewsbury, 1999)*

Figure 3: Truss A looking south *(after P Gates et al, Shrewsbury, 1999)*

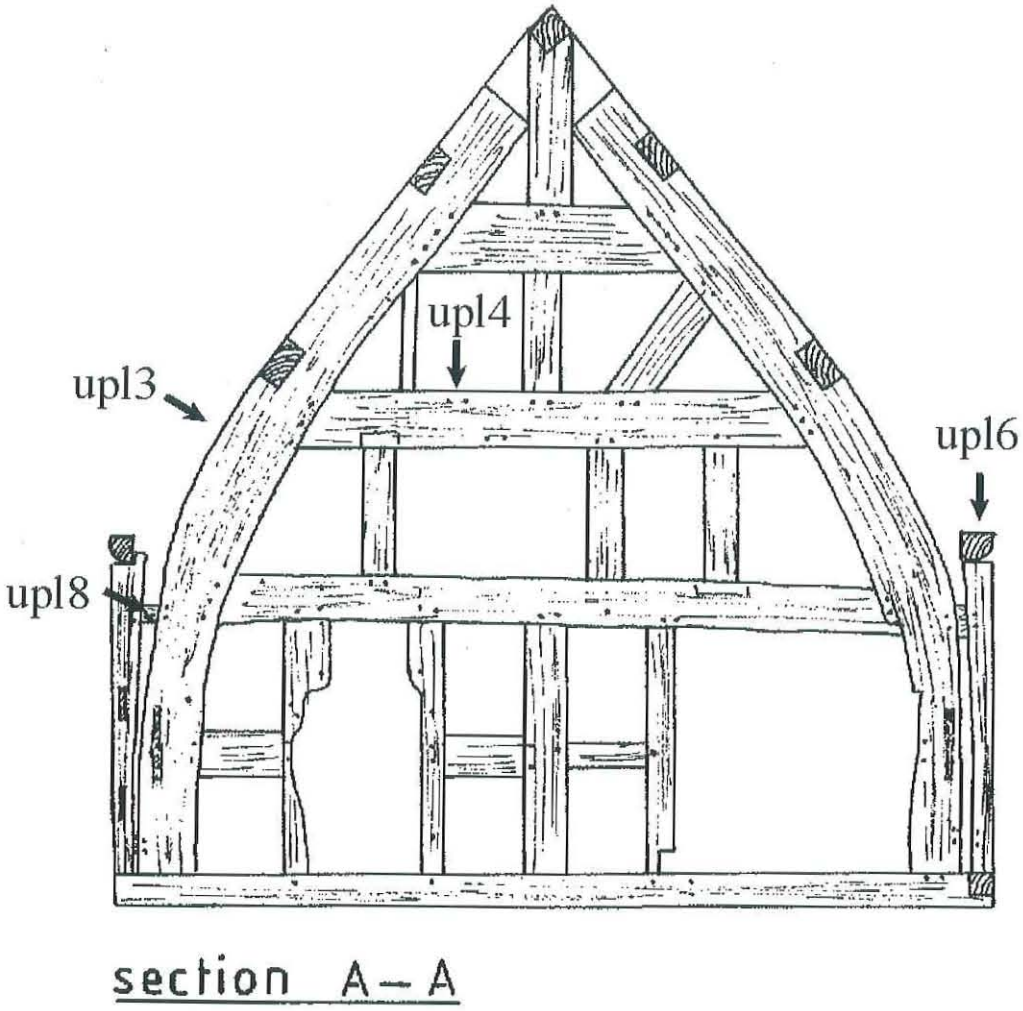

Figure 4: Truss C looking south *(after P Gates et al, Shrewsbury, 1999)*

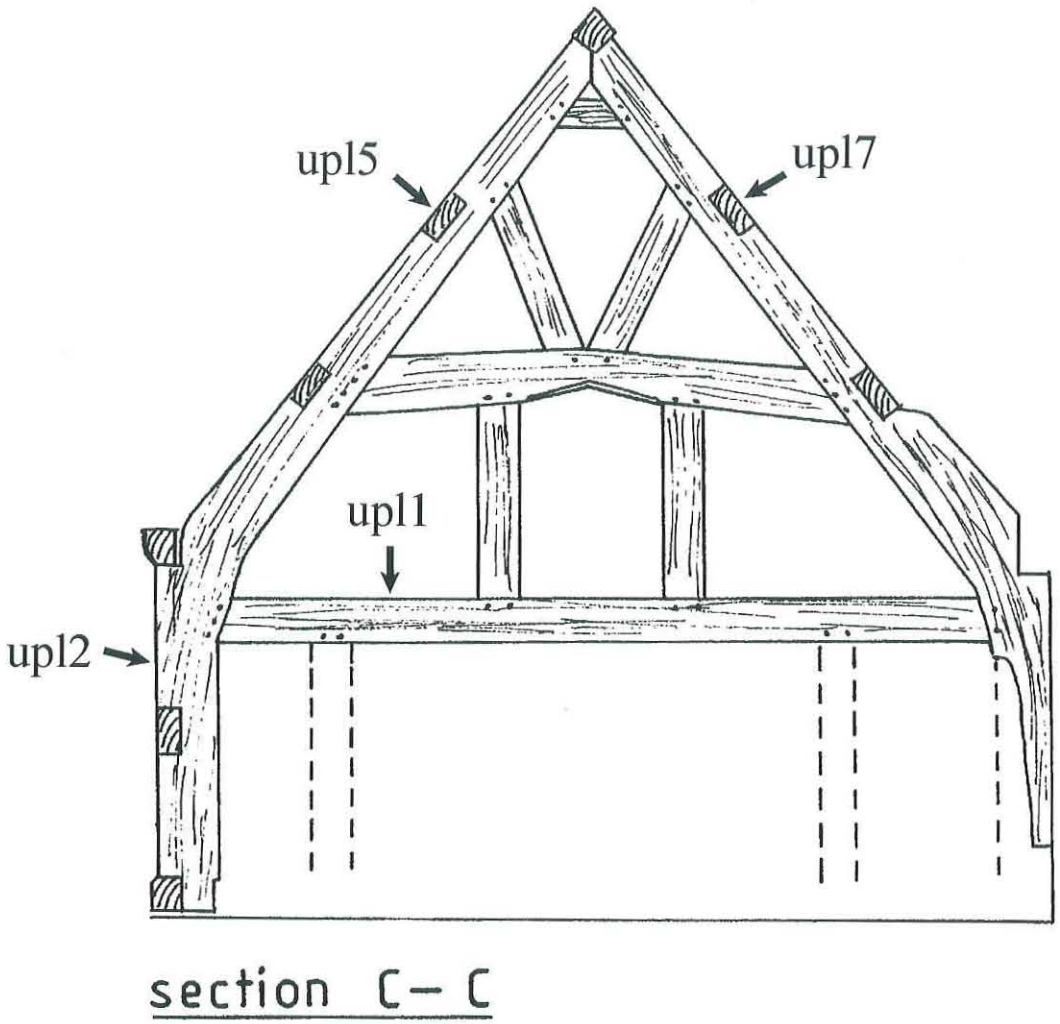

Figure 5: Bar diagram showing relative positions of dated samples and felling dates.