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Summary

The arch-braced collar trusses of the nave roof of this church are suffering from localised wet rot and the church has been categorised as a "priority B" building at risk (English Heritage 1999). A dendrochronological survey was requested, whilst access was possible via an internal scaffold constructed to prevent further collapse of the principal rafters, to inform a major programme of grant-aided repairs and to test whether the roof dates to AD 1577, as indicated by inscriptions carved on collars and timber corbels. The results of the survey indicate construction of the nave roof after AD 1559, with a single purlin dating to after AD 1599 and one principal rafter felled after AD 1646. The timbers which post-date AD 1577 may reflect documented repairs made to the church in the mid-seventeenth century following a fire and prior to the churches' reconsecration in AD 1658.

Author's address :-

Mr N Nayling
LAMPETER DENDROCHRONOLOGY LABORATORY
Heritage and Archaeology Research Practice
University of Wales
Lampeter
CEREDIGION
SA48 7ED

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Introduction

This document is a technical archive report on the tree-ring analysis of oak timbers from the nave roof of the church of St Mary the Virgin, Bromfield, Shropshire (NGR SO482768; Fig 1). Analysis of the surviving timbers was requested by Nick Reading of English Heritage to inform a major programme of grant-aided repairs to this 'priority B' building at risk (English Heritage 1999). The survey focused on the nave roof, as specified in the brief, where localised wet rot has required the construction of internal scaffolding to prevent further structural collapse of the northern ends of the roof trusses, providing safe access to a proportion of the roof timbers for sampling. Further dendrochronological work may be requested should a second phase of repairs be carried out on the chancel roof to the east and when access is possible to the south side of the nave. Access to these parts of the roof was not possible at the time of sampling the north side of the nave.

The nave roof comprises six arch-braced collar trusses, with each principal rafter carrying three trenched purlins with cusped wind braces (Figs 2, 3, and 4). Carved dates on many of the timber corbels, and inscribed into the collar of truss 3 (Fig 5; 'TN3' on Fig 2) indicate primary construction in AD 1577 - a rather late date for a roof of this form. Although nothing in the form of the roof suggests major alteration or repairs, a date of AD 1658 carved into the timber corbels and collar of truss 2 (Fig 5; 'TN2' on Fig 2) could reflect repair following a fire documented in the mid-seventeenth century prior to the churches' reconsecration in AD 1658.

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 may therefore have to be modified in the light of subsequent work.

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 survey was limited to those timbers accessible from the internal scaffolding erected along the northern side of the nave to support the weakened roof trusses. An assessment survey identified those oak timbers with the most suitable ring sequences for analysis. Those with more than 50 annual rings and some survival of the original sapwood edge were sought. The moulding of the majority of timbers had often removed the majority of sapwood, and deep mortises within the principal rafters complicated sampling. In a number of

instances, multiple cores were taken from principal rafters to ensure the recovery of as complete a ring sequence as possible.

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: 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 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 11 and maximum of 41 annual rings, following sapwood estimates given by Miles (1997). 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

Ten samples were taken in total, numbered **1-10** inclusive (Table 1). The majority of samples (six) were taken from principal rafters with two samples each coming from carved timber corbels and purlins (Figs 2 and 3). Other timbers such as collars were not accessible due to the localised extent of the internal scaffolding. None of the timbers sampled retained sapwood or the heartwood sapwood boundary. In part this was a function of the deep moulding carved along the edges of the timbers and a reflection of the level of craftmanship exhibited in the roof's construction.

Nine of the ten samples had sufficient rings to merit measurement, after which the resultant ring sequences were compared. Crossmatching was identified between six samples (Table 2). A mean sequence calculated for these timbers (BROMT6) and the sequences from unmatched, individual timbers were then compared with dated reference chronologies from throughout the British Isles and northern Europe. Table 3 shows the correlation of the mean sequence BROMT6 with dated series at the dating position identified of AD1389-1588 and also correlations for an individually dated sample (BROM08) from the principal rafter in truss 2. Table 4 lists this dated mean chronology and dated individual tree-ring sequence, and the relationships between the dated timbers are indicated graphically in Figure 6. None of the remaining sequences could be dated.

Interpretation

The absence of surviving sapwood on the accessible timbers within the roof limits the resolution of the dating obtained by this survey. Nonetheless, it is clear that the roof dates to the later sixteenth and/or seventeenth centuries. Hence it has been constructed in a form which might be considered archaic given that collar arch-braced roofs are more commonly fourteenth-century in date. The results of the survey are consistent with the construction of the majority of the roof after AD 1559, possibly in AD 1577 as indicated by a number of inscriptions on carved timber corbels and the date inscribed on the collar of truss 3 (Fig 5). Sampled and dated timbers which could form part of this group comprise the principal rafters of trusses 3, 4, and 6, the timber corbel of truss 6, and the lower purlin running between trusses 5 and 6 (Figs 1 and 6). Felling dates derived from the lower purlin between trusses 2 and 3 (**9**, after AD 1599), and the principal rafter of truss 2 (**8**, after AD 1646) clearly post-date any construction in the sixteenth century and could relate to alterations or repairs following a documented fire in the early part of the seventeenth century or in advance of reconsecration of the church in AD 1658. This event would appear to be commemorated in the carving of the timber corbels and collar of truss 2 (Fig 4).

Further work on timbers from the southern side of the nave roof, access permitting, might refine the results if any sapwood or bark survives on these timbers.

Acknowledgements

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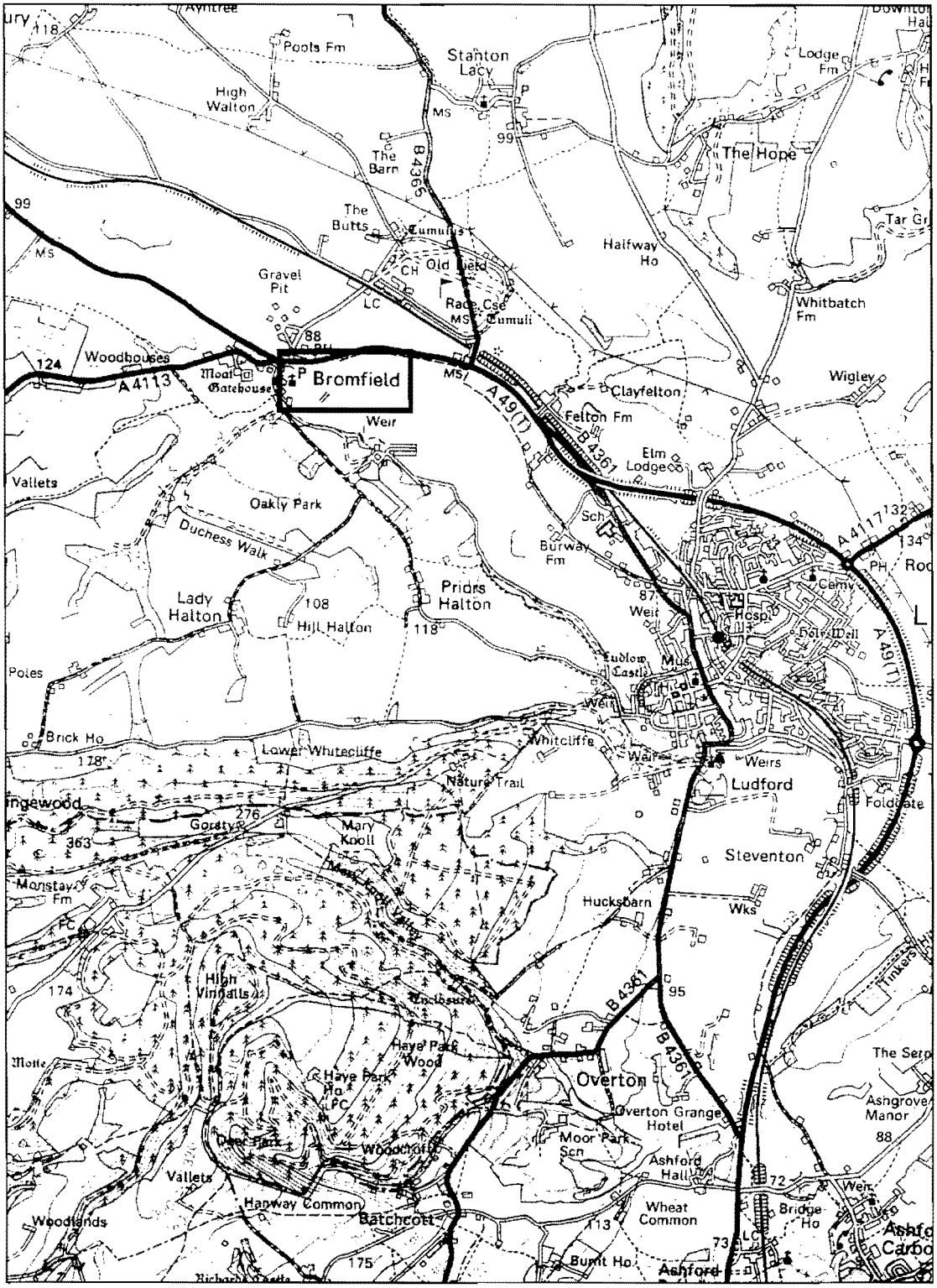

Figure 1 The Church of St. Mary the Virgin, Bromfield, Shropshire.

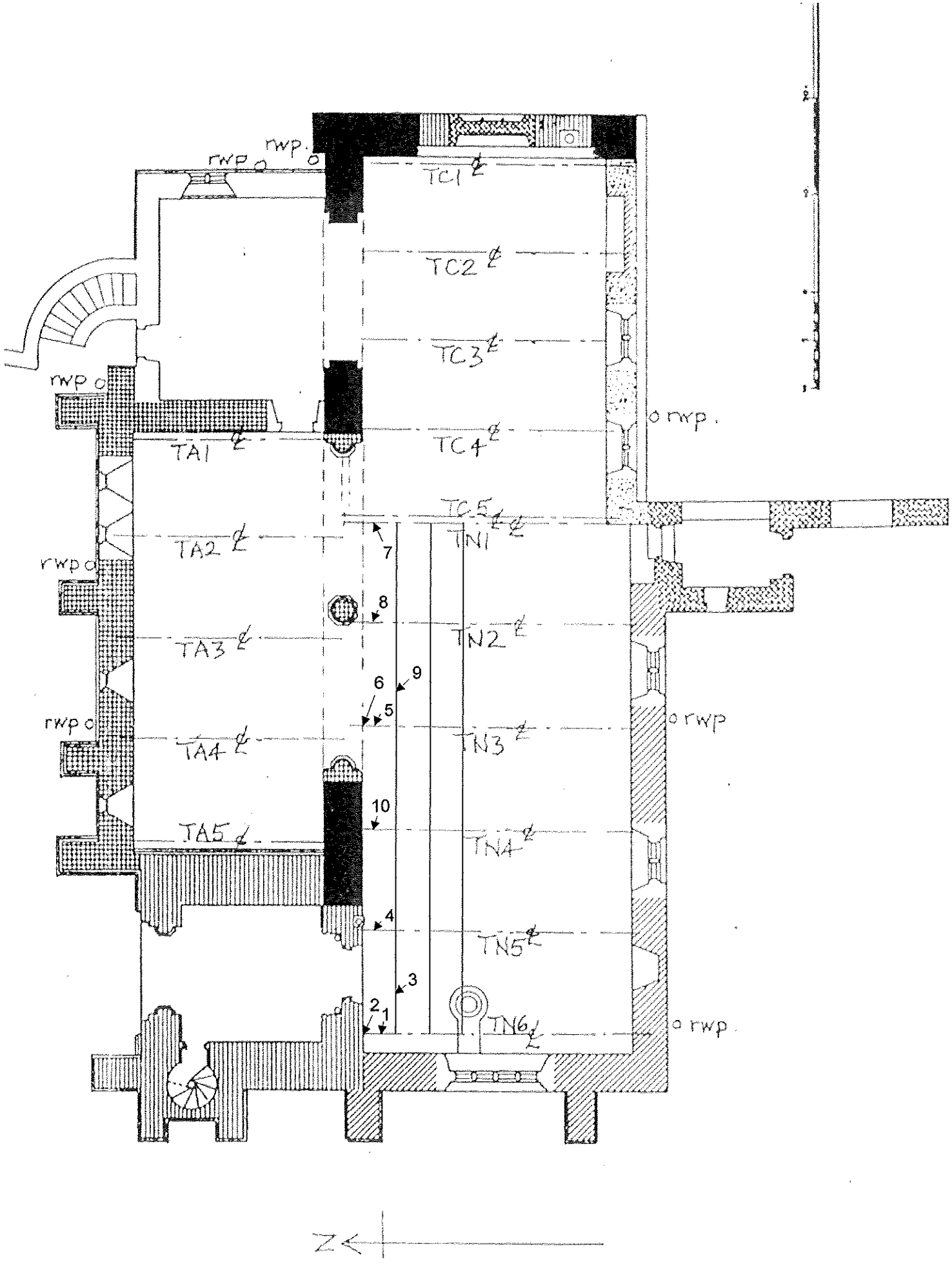

Figure 2 The Church of St.Mary the Virgin, Bromfield, Shropshire. Plan indicating sample locations in the nave roof. (after Wheatley Lines Chartered Architects)

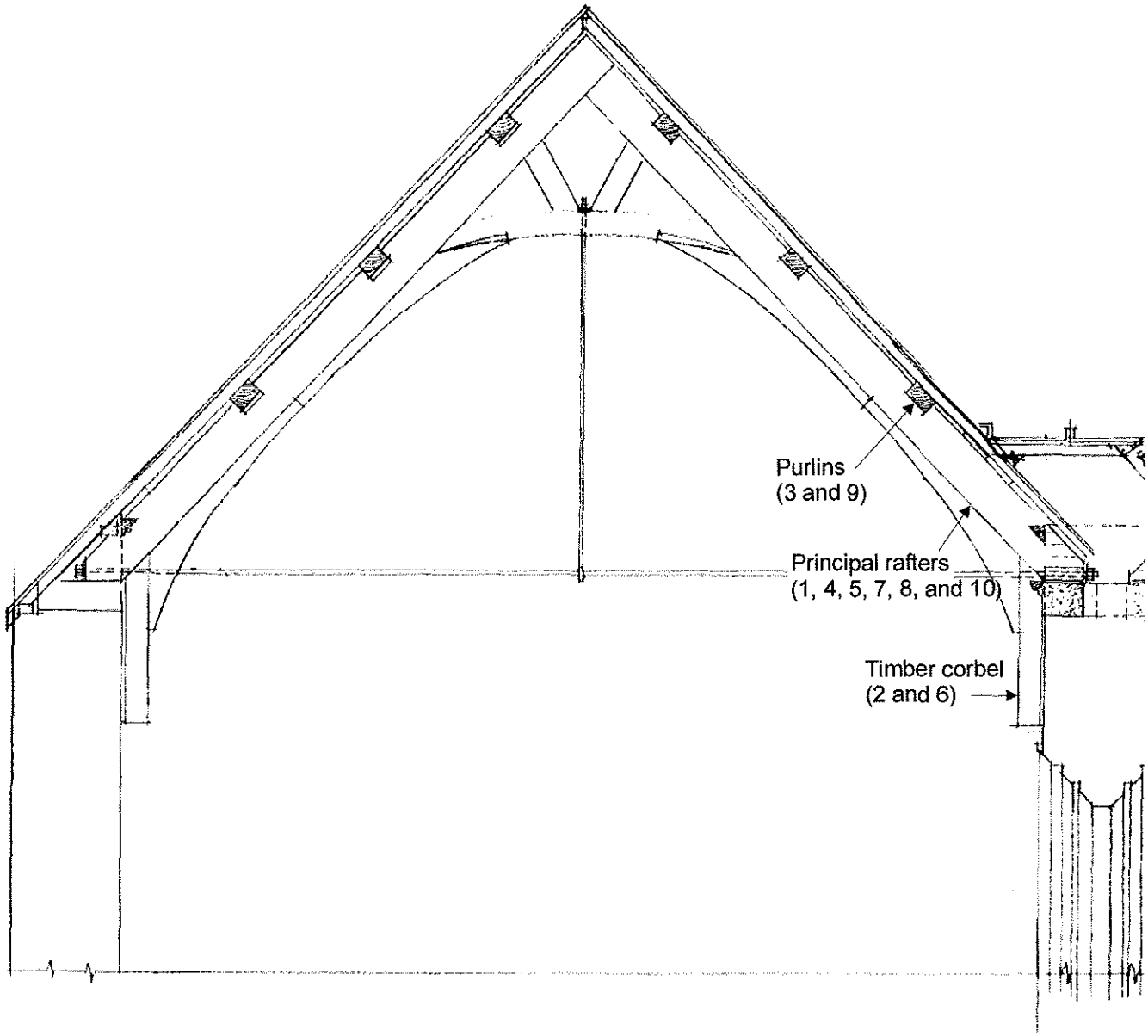

Figure 3 The Church of St.Mary the Virgin, Bromfield, Shropshire. Idealised section of roof trusses in the nave roof indicating sample locations. View towards west (after Wheatley Lines Chartered Architects)

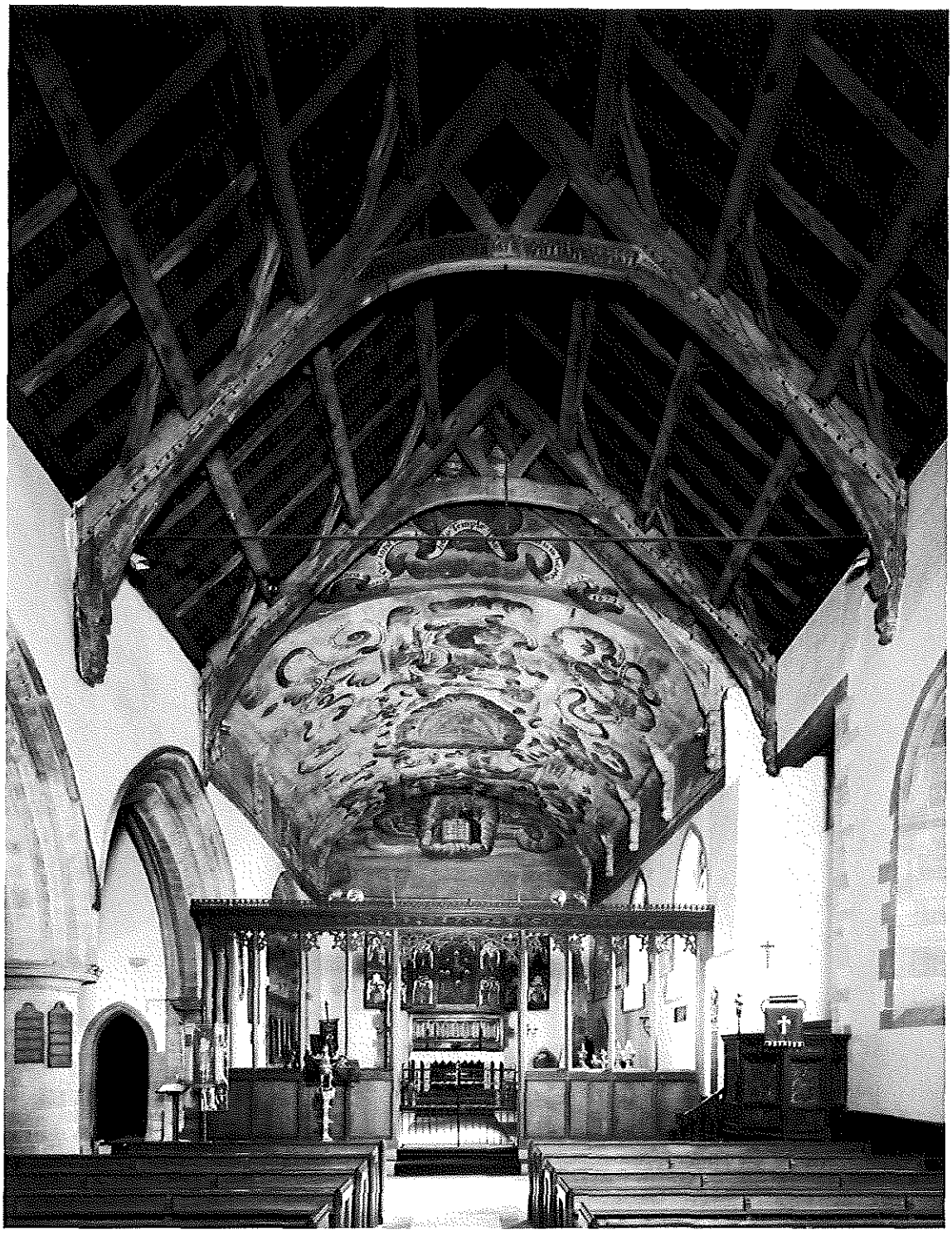

Figure 4 The Church of St. Mary the Virgin, Bromfield Shropshire. The nave roof viewed from the west (© Crown Copyright). Note the carved collar and corbels dated by inscriptions to AD 1658

Figure 5 The Church of St. Mary the Virgin, Bromfield Shropshire. Detail of the collar in the nave roof dated by inscription to AD 1577 (© Crown Copyright)

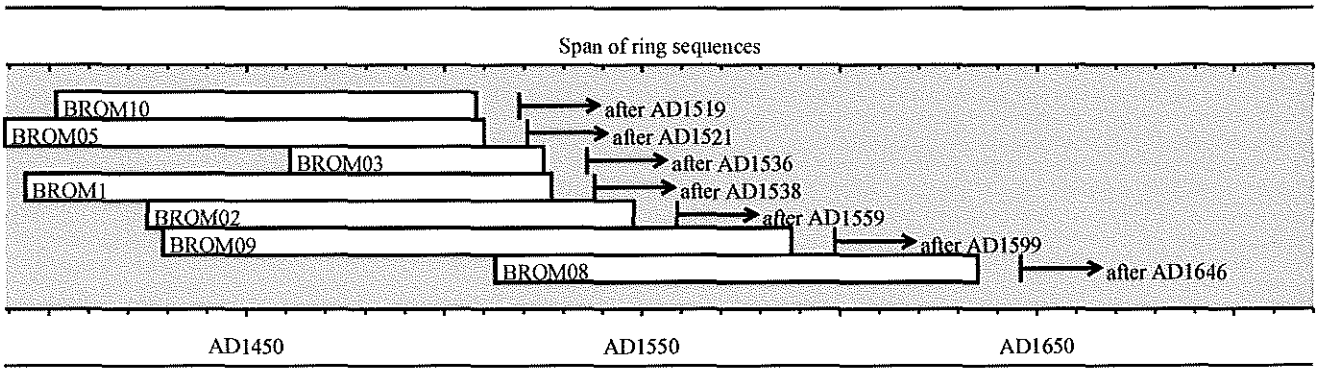

Figure 6 The Church of St. Mary the Virgin, Bromfield Shropshire. Bar diagram of dated timbers

Table 1

List of samples; all are from the north side of the nave roof

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
01	Principal rafter, truss 6	Half	330 x 170	134	-	1.91	AD1394-AD1527	after AD1538
02	Corbel, truss 6	Quarter	215 x 165	124	-	1.57	AD1425-AD1548	after AD1559
03	Lowest purlin between trusses 5 and 6'	Half	215 x 125	65	-	1.86	AD1461-AD1525	after AD1536
04	Principal rafter, truss 5	Half	340 x 155	<50	-	-	Not measured	
05	Principal rafter, truss 3	Half	315 x 165	122	-	2.07	AD1389-AD1510	after AD1521
06	Corbel, truss 3	Quarter	195 x 180	56	-	2.14	Undated	
07	Principal rafter, truss 1	Half	350 x 160	92	-	1.66	Undated	
08	Principal rafter, truss 2	Half	315 x 165	123	-	1.92	AD1513-AD1635	after AD1646
09	Lowest purlin, west of truss 2	Quarter	250 x 190	160	-	1.48	AD1429-AD1588	after AD1599
10	Principal rafter, truss 4	Half	345 x 165	107	-	2.21	AD1402-AD1508	after AD1519

Total rings = all measured rings. ARW = average ring width of the measured rings. All timbers were oak (*Quercus* spp.)

Table 2

t-value matrix for samples **1**, **2**, **3**, **5**, **9** and **10**. - = *t*-values under 3.00

	02	**03**	**05**	**09**	**10**
01	4.50	3.60	7.80	4.11	6.47
02	*	-	5.22	5.03	4.33
03	*	*	-	4.36	3.97
05	*	*	*	4.41	6.89
09	*	*	*	*	4.14

Table 3

Dating the mean sequence BROMT6 and single sample BROM08 dated to AD 1389-AD 1588, and AD 1513-AD 1635 inclusive, respectively. *t*-values with independent reference chronologies

Area	**Reference chronology**	***t*-values**	
		brom08	bromt6
East Midlands	East Midlands (Laxton and Litton 1988)	8.04	8.81
Gloucestershire	26 Westgate Street Gloucester (Howard *et al* 1998)	7.56	6.38
Staffordshire	Sinai Park (Tyers 1997c)	5.86	7.01
Herefordshire	Penrhos Court, nr Kington (Tyers 1998)	5.16	9.52
Herefordshire	Lower House Farm Tupsley, nr Hereford (Tyers 1997b)	4.22	5.60
Welsh Border	Welsh Border (Siebenlist-Kerner 1978)	6.69	10.10
Worcestershire	Droitwich (Groves and Hillam 1997)	7.55	6.47

Table 4

a) Ring-width data from site master BROMT6, dated to AD 1389-AD 1588 inclusive

Date	**Ring widths (0.01mm)**										**No of samples**									
AD1389									312	263									1	1
-	339	286	250	225	172	244	282	318	258	321	1	1	1	2	2	2	2	2	2	2
AD1401	396	443	456	340	376	352	329	301	303	370	2	3	3	3	3	3	3	3	3	3
-	256	289	256	280	240	235	232	247	173	294	3	3	3	3	3	3	3	3	3	3
-	266	187	245	241	248	208	250	238	234	197	3	3	3	3	4	4	4	4	5	5
-	224	266	181	245	241	215	209	199	146	184	5	5	5	5	5	5	5	5	5	5
-	197	137	178	214	172	152	164	187	180	173	5	5	5	5	5	5	5	5	5	5
AD1451	191	178	177	175	169	197	169	136	114	156	5	5	5	5	5	5	5	5	5	5
-	156	170	186	117	129	132	179	165	156	158	6	6	6	6	6	6	6	6	6	6
-	162	140	138	175	224	206	186	170	195	166	6	6	6	6	6	6	6	6	6	6
-	165	135	180	236	173	169	193	151	129	148	6	6	6	6	6	6	6	6	6	6
-	111	96	127	149	141	191	156	128	163	151	6	6	6	6	6	6	6	6	6	6
AD1501	171	171	152	175	171	181	182	196	181	168	6	6	6	6	6	6	6	6	5	5
-	168	185	168	163	172	167	158	162	137	165	4	4	4	4	4	4	4	4	4	4
-	170	176	133	157	136	136	134	134	136	126	4	4	4	4	4	3	3	2	2	2
-	178	160	150	149	173	180	192	128	142	146	2	2	2	2	2	2	2	2	2	2
-	142	108	102	111	130	82	98	117	162	155	2	2	2	2	2	2	2	2	1	1
AD1551	134	106	119	90	97	97	112	107	137	175	1	1	1	1	1	1	1	1	1	1
-	159	175	103	111	107	100	96	118	141	148	1	1	1	1	1	1	1	1	1	1
-	102	133	126	114	92	100	149	105	126	152	1	1	1	1	1	1	1	1	1	1
-	188	132	119	162	144	134	129	144			1	1	1	1	1	1	1	1		

b) Ring-width data from ring sequence BROM08, dated to AD 1513-AD 1635 inclusive

Date	Ring widths (0.01mm)									
AD1513			292	183	216	245	162	206	234	163
-	205	251	197	198	188	229	168	211	183	194
-	260	188	211	183	210	186	162	161	143	138
-	170	124	138	142	136	121	139	199	196	194
AD1551	204	145	169	201	248	200	219	196	220	265
-	222	192	171	200	163	167	164	162	247	214
-	186	163	174	167	142	139	168	128	114	224
-	212	223	175	157	183	151	177	164	176	121
-	158	145	166	255	247	184	259	280	225	190
AD1601	199	225	250	255	186	188	206	168	139	192
-	223	164	265	193	213	202	218	276	182	215
-	234	268	263	168	140	143	202	190	249	168
-	133	205	235	159	180					