

ST ANNE'S CHAPEL,
PATERNOSTER ROW, BARNSTAPLE, DEVON
TREE-RING ANALYSIS OF OAK TIMBERS
FROM THE ROOF AND CRYPT

SCIENTIFIC DATING REPORT

Martin Bridge



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Dr M C Bridge

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SUMMARY

Six samples from timbers from both the roof and the crypt were dated and appear likely to be coeval. None retained complete sapwood, but a combined likely felling date range of AD 1317–43 was derived for these timbers, supporting the expected early fourteenth-century date for the wagon roof and the spine beam structure in the crypt.

CONTRIBUTORS

Dr M C Bridge

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INTRODUCTION

This building in the heart of historic Barnstaple (Figs 1 and 2) was built as a chantry chapel, and later used as a grammar school. It is thought to have been built in the early fourteenth century, and a tower was added at the west end in the early/mid-sixteenth century. The roof is of a relatively simple wagon construction of 25 rafter pairs each having an arch-braced collar and ashlar pieces to an inner wall plate (Fig 3). This inner wall plate is connected to an outer wall plate by occasional ties with dovetailed ends. It is thought that the roof represents an early example of this form of roof in the region. The crypt has an unusual post and spine beam construction (Fig 4) with some obvious repairs and is reputed to be constructed of chestnut timber. It is thought that both elements were constructed at the same time.

The building was undergoing renovation in 2012 as part of a scheme to convert it into a cultural centre. Dendrochronological dating was requested by Francis Kelly, English Heritage Historic Building Inspector, to inform this work by enhancing the understanding of the building and in addition providing information relating to the chronology of this roof type in this region.



Figure 1: Map showing the location of St Anne's Chapel close to St Peter's Church and just to the east of the High Street. © Crown Copyright. All rights reserved. English Heritage 100019088. 2012

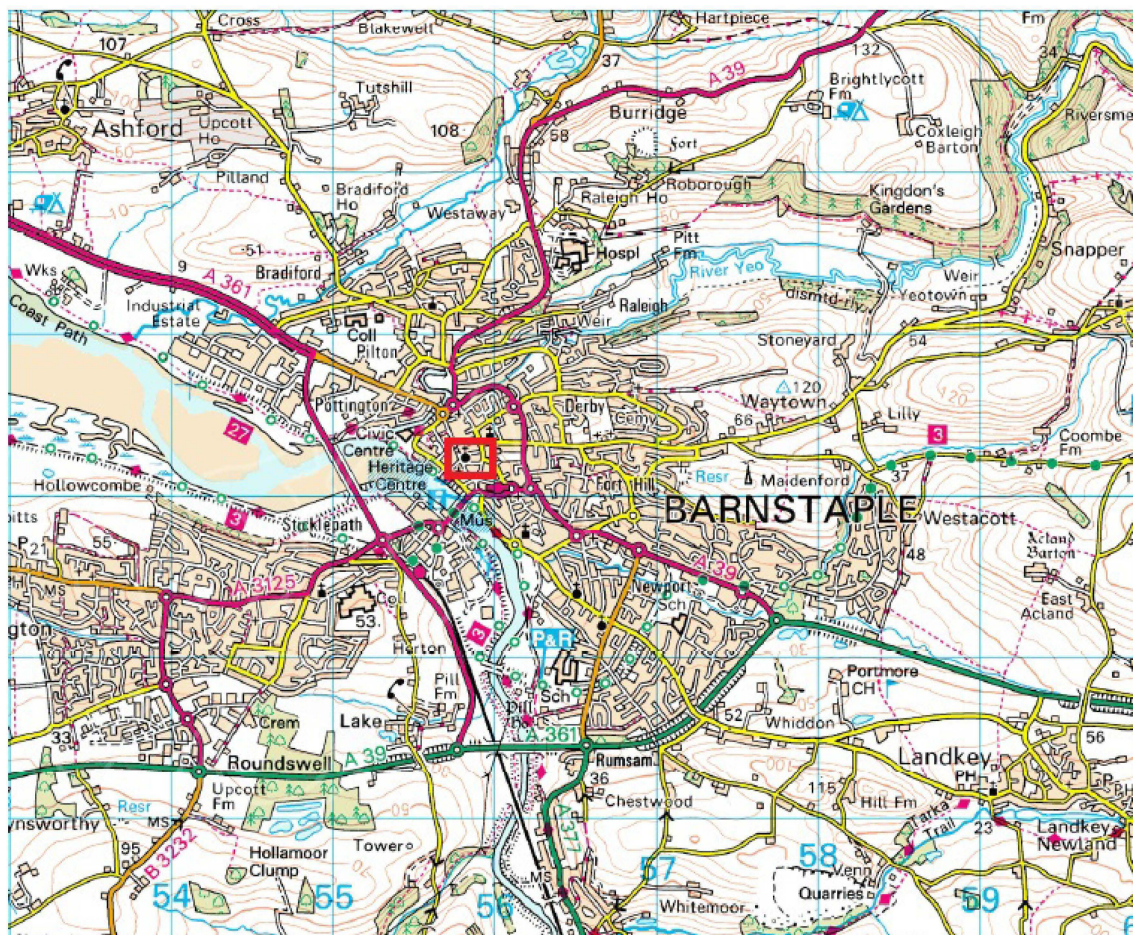


Figure 2: Map showing the location of St Anne's Chapel within Barnstaple. © Crown Copyright. All rights reserved. English Heritage 100019088. 2012

METHODOLOGY

In the initial assessment, accessible oak timbers with more than 50 rings and where possible traces of sapwood were sought, although slightly shorter sequences are sometimes sampled if little other material is available. Those timbers judged to be potentially useful were cored using a 15mm auger attached to an electric drill. The cores were labelled, and stored for subsequent analysis.

The cores were polished on a belt sander using 80 to 400 grit abrasive paper to allow the ring boundaries to be clearly distinguished. The samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (2004a). Cross-matching was attempted by a combination of visual matching and a process of qualified

statistical comparison by computer. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted on the computer monitor to allow visual comparisons to be made between sequences. This method provides a measure of quality control in identifying any potential errors in the measurements when the samples cross-match.

In comparing one sample or site master against other samples or chronologies, t -values over 3.5 are considered significant, although in reality it is common to find demonstrably spurious t -values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some t -value ranges of 5, 6, and higher, and for these to be well replicated from different, independent chronologies with both local and regional chronologies well represented, except where imported timbers are identified. Where two individual samples match together with a t -value of 10 or above, and visually exhibit exceptionally similar ring patterns, they may have originated from the same parent tree. Same-tree matches can also be identified through the external characteristics of the timber itself, such as knots and shake patterns. Lower t -values however do not preclude same tree derivation.

Ascribing felling dates and date ranges

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straightforward. Depending on the completeness of the final ring, ie if it has only the spring vessels or early wood formed, or the latewood or summer growth, a precise felling date and season can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an estimated felling date range can be given for each sample. The number of sapwood rings can be estimated by using an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* (tpq) or felled-after date.

A review of the geographical distribution of dated sapwood data from historic timbers has shown that a sapwood estimate relevant to the region of origin should be used in interpretation, which in this area is 9–41 rings (Miles 1997). It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure or object under study.



*Figure 3: View of the wagon roof to St Anne's Chapel, Barnstaple, looking east.
Photograph Martin Bridge*



Figure 4: View of the spine beam and supports in the crypt of St Anne's Chapel, Barnstaple, looking east. Photograph Martin Bridge

RESULTS AND DISCUSSION

The roof timbers had originally been assessed from a ladder in 2011, but with the subsequent easy access from scaffolding, it was found that more of the timbers had been the subject of a late Victorian refurbishment than was previously realised. The majority of timbers were unsuitable for analysis as they contained too few rings. Only seven samples were taken from oak timbers in the roof, and five oak timbers were sampled in the crypt. Although it was reputed that there were chestnut timbers in the crypt, only oak was found. Details of the timbers sampled are given in Table 1. The rafter couples were numbered from the east end.

Four of the samples had fewer than 40 rings and were not included in any further analysis (Table 1). The raw ring width from the eight measured samples is given in the Appendix. Six of these eight measured samples could be cross-matched with each other (Table 2). The intra-site cross-matching is relatively weak but is supported by independent dating of the individual samples to the dated reference material eg bsa07 (Table 3a). The six matched series were combined into a 142-year long site chronology, BRNSTPL1, which

was subsequently dated to the period AD 1175–1316, a selection of the strongest matches being shown in Table 3b. Neither of the unmatched individual ring series could be successfully dated.

The relative positions of overlap of the dated series are illustrated in Figure 5, along with the derived likely felling date range for each timber. The dated timbers from both the crypt and roof appear to be at least broadly coeval. There is however a thirty-year spread in the range of heartwood-sapwood boundary dates amongst the dated timbers which could suggest that the timbers were felled over a number of years. This is not uncommon, and does not rule out the possibility that all the trees were felled at the same, or a similar time. Oaks growing in the south-west region have previously shown a wider variability in the number of sapwood rings (Tyers pers comm). If it is assumed that the dated timbers represent a single felling period, as is thought to be the case from a structural perspective, then a mean heartwood-sapwood boundary date of AD 1302 is obtained, giving a likely felling date range of AD 1311–43. This felling date range can be modified, in the light of the outermost measured ring on bsa11 dating to AD 1316, to be AD 1317–43. This supports the expected date of the construction to the early fourteenth century, and hence provides independent dating evidence for both this unusual post and spine beam structure and this early wagon roof in this region.

As has been found at several other buildings of ecclesiastic or monastic origin eg Muchelney Abbey (Bridge 2002), the site master sequence produces some of the best matches with other ecclesiastic/monastic sites some distance away rather than closer secular sites. This may reflect different management regimes within woodlands held by religious bodies, and/or the movement of timbers from some distance away to build these constructions, although in this instance it would appear most likely that the timber used here was from this region.

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Table 1: Details of the samples taken from St Anne's Chapel, Barnstaple. The trusses are numbered from the east end. HW – heartwood; H/S – heartwood/sapwood boundary

Sample Number	Timber and position	No of rings	Mean HW ring width (mm)	Dates Spanning (AD)	H/S bdry AD	Sapwood rings	Mean sens	Felling date ranges (AD)
Roof								
bsa01	Rafter 7 north	<45	NM	-	-	-	-	-
bsa02	Ashlar piece 2 south	48	1.24	1253–1300	1300	h/s	0.24	1309–41
bsa03	Ashlar piece 3 south	88	1.04	1215–1302	1302	h/s	0.17	1311–43
bsa04	Rafter 12 south	62	2.01	-	-	h/s	0.20	-
bsa05	Rafter 11 south	<45	NM	-	-	-	-	-
bsa06	Collar 7	46	3.06	-	-	h/s	0.18	-
bsa07	Rafter 20 north	80	1.81	1213–92	1292	h/s	0.23	1301–33
Crypt								
bsa08	West pad supporting beam	120	1.57	1175–1294	1286	8	0.30	1295–1327
bsa09	East brace to west post	<45	NM	-	-	-	-	-
bsa10	West post	<45	NM	-	-	-	-	-
bsa11	Spine beam at east end	81	1.85	1236–1316	1316	h/s	0.17	1325–57
bsa12	Inner door lintel	71	1.82	1243–1313	1313	h/s	0.16	1322–54

Table 2: Cross-matching between the dated individual series from St Anne's Chapel, Barnstaple

	t-values				
Sample	bsa03	bsa07	bsa08	bsa11	bsa12
bsa02	7.7	1.6	4.5	3.8	3.6
bsa03		3.6	5.2	3.3	2.6
bsa07			3.3	1.9	1.4
bsa08				3.0	1.7
bsa11					4.5

Table 3a: Cross-dating evidence for the individual series bsa07, AD 1213–92

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	t-value
Devon	Rudge, Morchard Bishop	(Groves 2005)	RUDGE	1124–1315	80	6.4
Dorset	Hall House, Newland, Sherborne	(Bridge 1983)	NEWLAND	1190–1292	80	5.6
Devon	Bury Barton, Lapford	(Groves 2005)	LFBB-T16	1132–1323	80	5.2
Devon	Old Rectory, Cheriton Bishop	(Groves 2005)	CHERITON	1145–1299	80	5.0
Oxfordshire	St Giles Church, Oxford	(Miles <i>et al</i> 2006)	stgls6	1209–1268	56	5.0
Somerset	Garnivals Week, Milverton	(Miles and Worthington 1997)	GARNIVAL	1166–1286	74	5.0
Hampshire	Bere Farm, Warnford	(Miles and Worthington 2002)	RIVRSDWN	1074–1326	80	4.9
Devon	Exeter Cathedral	(Mills 1988)	EXCATH1	1137–1332	80	4.9
W Midlands	Manor House, West Bromwich	(Arnold and Howard 2009)	WBRASQ02	1107–1269	57	4.8

Table 3b: Dating evidence for the site chronology BRNSTPL1, AD 1175–1316.

County/region:	Chronology name:	Short publication reference:	File name:	Spanning: (yrs AD)	Overlap (yrs)	<i>t</i> -value
Devon	St Brannock Church, Branton	(Tyers 2004b)	BSB_NR	1215–1378	102	7.0
Devon	Bridford Barton, Bridford	(Tyers <i>et al</i> /forthcoming)	BFBB-T9	1228–1297	70	6.9
Devon	Rudge, Morchard Bishop	(Groves 2005)	RUDGE	1124–1315	141	6.5
Wiltshire	Salisbury Cathedral	(Miles <i>et al</i> 2004)	SARUM16	1229–1338	88	6.3
Devon	Thorne, Clannaborough	(Groves 2005)	THORNE	1200–1319	117	6.3
Wiltshire	Devizes Castle	(Miles <i>et al</i> 2006)	DEVHEADX	1213–1407	104	6.2
Gloucestershire	Ingleside, Hawkesbury	(Miles <i>et al</i> 2010)	INGLE1	1198–1417	119	6.2
Somerset	Muchelney Abbey	(Bridge 2002)	MUCHNEY	1148–1498	142	5.9
Kent	Boxley Abbey Barn	(Bridge 2005)	BOXLEY	1200–1382	117	5.8
Wiltshire	Burghope Manor, Winsley	(Miles <i>et al</i> 2006)	BURGHOP	1191–1316	126	5.7
Wiltshire	The Old Rectory, Yatton Keynell	(Hurford <i>et al</i> 2010))	YKORSQ03	1190–1293	126	5.7

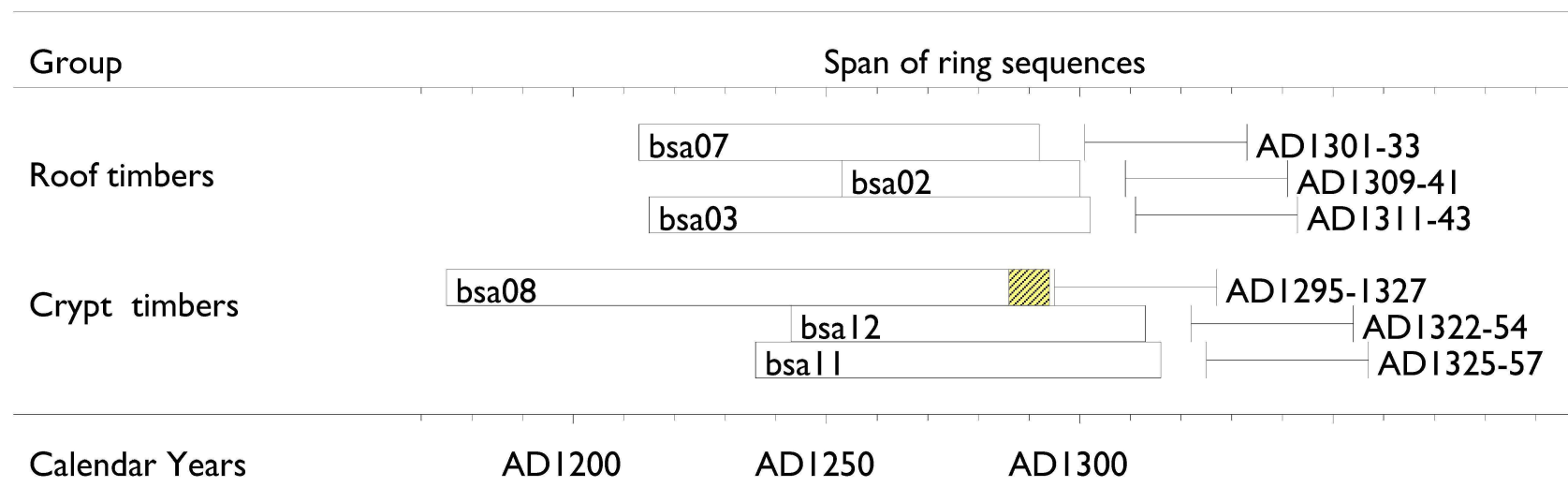


Figure 5: Bar diagram showing the relative positions of overlap of the dated series, along with their interpreted likely felling date ranges. White sections represent heartwood rings, and yellow hatched sections represent sapwood rings

APPENDIX

Ring width values (0.01mm) for the sequences measured

bsa02

221	148	229	192	144	163	213	172	151	136
110	155	171	194	149	150	114	119	136	85
137	142	79	69	110	67	77	132	106	92
78	146	107	126	86	72	84	129	100	151
91	102	88	91	99	78	85	87		

bsa03

99	123	113	108	101	108	117	113	130	161
155	149	106	138	129	153	129	142	176	150
159	122	154	136	159	137	106	115	152	143
145	158	113	102	130	108	122	118	99	132
103	114	78	100	123	89	89	107	86	90
110	128	119	106	69	102	101	64	88	83
54	61	65	50	62	78	78	60	56	85
70	85	76	59	54	84	77	111	92	77
80	67	60	51	65	57	78	78		

bsa04

343	270	258	271	261	301	273	180	179	167
209	238	258	149	142	252	208	182	213	129
122	129	166	186	258	266	216	159	225	294
275	199	200	173	228	259	222	195	196	279
252	257	139	76	115	101	176	146	187	224
179	213	188	165	150	177	173	181	107	124
182	194								

bsa06

305	277	281	294	322	360	340	261	301	226
245	329	297	354	332	244	309	471	380	374
314	445	577	411	312	353	355	377	259	261
161	210	236	211	210	223	229	434	359	307
360	312	215	202	252	183				

bsa07

481	318	254	342	420	218	256	338	280	179
218	242	278	332	109	179	189	162	135	138
123	102	87	46	64	57	76	79	54	52
66	69	55	52	53	41	40	66	80	90
66	103	168	146	165	180	270	148	196	295
179	179	246	256	273	504	337	263	267	258
224	200	202	176	131	137	145	250	211	171
102	110	136	163	153	156	182	234	220	237

bsa08

238	196	82	165	93	219	185	252	357	356
174	179	154	132	127	136	242	347	242	355
285	219	193	255	316	208	287	268	408	102

221	246	69	257	233	230	313	120	154	253
193	295	310	284	355	304	261	131	178	185
176	256	158	229	281	295	217	219	238	124
169	97	144	158	156	95	51	53	79	67
67	78	67	121	121	108	84	75	49	60
59	66	49	71	131	105	80	59	56	75
89	83	70	57	43	36	83	58	69	91
34	40	37	38	43	55	57	67	64	72
73	100	49	41	51	115	91	71	109	104

bsa11

166	297	296	305	325	227	299	312	290	244
272	310	337	324	311	261	162	240	192	239
267	276	274	291	218	227	266	160	155	158
171	142	142	143	155	210	169	207	221	142
117	145	142	153	180	194	207	171	157	177
206	165	96	130	110	99	166	117	147	130
114	94	93	87	87	108	101	71	53	76
100	129	126	151	175	147	201	176	168	162
163									

bsa12

322	273	257	265	288	293	264	210	217	150
143	223	272	250	266	308	236	251	222	232
195	206	221	236	235	240	218	270	239	255
236	147	98	103	116	106	130	173	144	133
146	150	133	132	109	93	123	138	106	137
95	132	135	153	132	121	153	161	168	201
103	69	96	125	147	128	122	161	169	211
218									



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