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9 West Street
Chipping Norton
Oxfordshire

Tree-ring Analysis of Oak and Elm Timbers

Martin Bridge and Cathy Tyers

Discovery, Innovation and Science in the Historic Environment

Research Report Series no. 165-2020

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NGR: SP 31294 26979

ISSN 2059-4453 (Online)

SUMMARY
Three roofs were sampled, the primary phase in the front range, parallel to the street, the west short rear range of the house, and another roof over the long rear range at the west end of the property. Ten oak timbers from the roofs of the front and west short rear range of the house were cross-matched forming two sub-groups. Two site master chronologies were formed, each having similar felling dates, supporting the idea that the two roofs were constructed at the same time. Two precise felling dates were found, summer AD 1726, and winter AD 1728/9, and two further timbers with very degraded outer rings appear to have similar felling dates, with a further six having felling date ranges that incorporate these dates. It seems likely that construction of the roofs took place in AD 1729 or within a year or two after this date. The roof at the far west end of the property remains undated.

CONTRIBUTORS
Martin Bridge and Cathy Tyers

ACKNOWLEDGEMENTS
We are grateful to the owners for allowing this work to be carried out. The site was one of several examined as part of the Historic Fabric in Historic Towns: Chipping Norton project, and we thank Rebecca Lane for managing the project on behalf of Historic England. We are indebted to members of the Oxfordshire Buildings Record and Chipping Norton Buildings Record, especially Victoria Hubbard for her extensive input on coordinating the project, and her friendly encouragement, and Jan Cliffe for permission to reproduce her drawings in Figure 2. We'd also like to thank Shahina Farid for commissioning the work, and her input into preparing this report.

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INTRODUCTION

The Early Fabric in Historic Towns: Voluntary Group Projects, funded by Historic England, have been developed in the recognition and acknowledgement of the excellent work being undertaken by local vernacular groups in the study of local architectural trends and fabrics. The intention of these projects is to encourage this type of study through the provision of support and facilitate training of more people in building analysis and recording. The local projects were coordinated by Rebecca Lane (Historic England South West Region: Architectural Investigation).

Early Fabric in Chipping Norton Project

Whilst Chipping Norton features in a study on historic towns in Oxfordshire (Rodwell 1975), and some buildings have been recorded and published in detail (eg Simons and Phimester 2005), no systematic research had been undertaken on the buildings of the town before this project.

The project examined vernacular historic buildings in the centre of Chipping Norton, aiming to improve understanding of the morphology and development of the historic town plan and to understand this within the framework of economic and social change. It aimed to identify early plan forms and to understand the dates of the introduction of vernacular architectural details (eg in materials, carpentry, fenestration, and decorative features), thus mapping the survival of early (pre-1900) fabric and revealing the architectural evolution of the town's buildings.

Initially, 21 properties were identified that were thought to be key to understanding the town's architectural development for a programme of comprehensive investigation. These properties were assessed for their suitability for dendrochronology and 12 that contained oak timber considered suitable for analysis were initially sampled and analysed. Oak timbers from seven of these buildings could be dated by ring-width dendrochronology, whilst radiocarbon wiggle-matching was undertaken for one of the buildings where the ring-width dendrochronology had produced an undated site master chronology.

The results of the project are presented by Rosen and Cliffe (2017). The reports produced on the historic buildings recorded as part of this project by the Chipping Norton Buildings Record/Oxfordshire Buildings Record (OBR) will be deposited in the Oxfordshire Historic Environment Record.

9 West Street

This grade II listed building (LEN 1198029) sits on the western side of West Street in the centre of Chipping Norton (Fig 1). It consists of three ranges: a front range, running parallel to the street, a short rear range to the west, and a longer range at the west-end of the property. As an important building in the town, to the south of the Market Square, and with questions as to how it developed, it was a natural candidate for dendrochronological investigation as part of the *Early Fabric in Historic Towns: Chipping Norton* project. Investigations by the OBR could not determine whether the building was of seventeenth-century origin and had been re-

fronted in the early eighteenth century, or was an original eighteenth-century building. The short rear range to the west appears contemporaneous, but the longer rear range at the west-end is of indeterminate age and perhaps represents agricultural or commercial buildings, updated in the Victorian period and brought within the function of the house itself.

METHODOLOGY

Fieldwork for the present study was carried out in early September 2015, following an initial assessment of the potential for dating a few weeks beforehand, and consultation with those involved in the project. 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 16mm 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 (2004). Cross-matching was attempted by a process of qualified statistical comparison by computer, supported by visual checks. 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*-values in the range 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.

RESULTS AND DISCUSSION

A total of 22 timbers were sampled from the roofs of (a) the primary phase in the front range, parallel to the street, (b) the west short rear range of the house, and (c) the long range at the west end of the property. Details of the samples are provided in Table 1, and their locations are indicated on Figure 2. Figure 3 shows part of front-range roof. Three timbers had two cores taken from them (labelled a and b) to try to maximise the length of the sequence obtained, and one core broke into two parts, measured separately as i and ii. The samples from four oak (*Quercus* spp) timbers were rejected as having too few rings for analysis, but the elm (*Ulmus* spp) sample from the roof at the west end of the property (cn9wst36) was measured. The ring width data for all the measured samples are given in the Appendix.

Ten ring-width series from oak timbers in the front-range roof and the west short rear-range roof cross-matched forming two sub-groups (Table 2; Fig 4). Samples cn9wst01, cn9wst02, cn9wst03, cn9wst04, and cn9wst07, combined to make site master CN9WST1, and the second group of samples cn9wst08, cn9wst20, cn9wst23b, cn9wst24 and cn9wst25, combined to make a second site master CN9WST2. These appear to have very similar felling dates and support the idea that both roofs were constructed at the same time (Fig 4). Comparison of these two site master chronologies with the oak reference database resulted in the successful dating of both CN9WST1 and CN9WST2. The strongest matches for these two masters are shown in Tables 3a and 3b. Two precise felling dates were obtained, summer AD 1726, and winter AD 1728/29, both from the front-range roof, with two other timbers (one from the front-range roof and one form the west short rear range roof) having levels of decay making the outermost rings difficult to distinguish, but with very similar felling date ranges, and six more timbers from both roofs with wider likely felling date ranges also incorporating these felling dates (Fig 4).

It seems likely therefore that construction took place in AD 1729, or within a year or two after this date, using locally-sourced timber. There were two theories concerning the likely construction of this house, one that it was of seventeenth-

century construction, re-fronted in the early eighteenth century, and a second, now supported by the dendrochronological evidence, that the house was constructed in the early eighteenth century.

One interesting feature of the front-range roof are the posts supporting the front (east) principal rafters (Fig 3). It may be the presence of these unusual features that prompted individuals to speculate that the roof had been reset when the front walls were made, suggesting the presence of an earlier roof. The post to the northern truss was assessed as having too few rings for dating, but that to the southern truss retained complete sapwood and was sampled (cn9wst05 a and b). Unfortunately the ring width series from these two samples did not cross-match with the other roof timbers, nor did they date independently.

The series from the roof of long range at the west end of the property were found mostly to be rather short, and there was little cross-matching between them. One pair of samples did match each other, cn9wst34 and cn9wst37 (t = 5.6 with 46 years overlap), and these were combined into a new series (cn9wst3437) for further analysis. The longest series, cn9wst32 (109 rings), and cn9wst33 (71 rings) appeared to be potentially derived from the same tree, but both ring series had bands of very narrow rings and cross-matching was inclusive. Neither cn9wst3437, nor any of the other unmatched series could be independently dated when compared against the oak reference database. One core (cn9wst36) was of elm (*Ulmus* sp.) and this did not cross-match the other series from this roof or any other series from this site, nor the database of oak reference chronologies. It was also subsequently compared to the elm series obtained during the HE funded elm project (Bridge and Tyers forthcoming) but again without success. Thus none of the timbers from this roof could be securely dated.

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TABLESs

Table 1: Details of samples taken from the primary phase of 9 West Street, Chipping Norton, Oxfordshire.

Sample number	Timber and position	No of rings	Mean ring width (mm)	Dates spanning (AD)	h/s boundary (AD)	Sapwood rings	Mean sensitivity	Felling date ranges (AD)
Roof of the front range, parallel to street								
cn9wst01	West principal rafter, south truss	67	1.78	1645–1711	1702	9 (+*c* 16–18C NM)	0.26	*c* 1727–29
cn9wst02	West principal rafter, north truss	64	1.96	1643–1706	1706	h/s (+12 NM)	0.24	1718–47
cn9wst03	West purlin, north bay	40	1.85	1667–1706	1706	h/s	0.27	1715–47
cn9wst04	East principal rafter, south truss	81	1.72	1648–1728	1707	21C	0.30	winter 1728/29
cn9wst05a	East post supporting principal rafter, south truss	76	1.19	-	-	30C	0.25	-
cn9wst05b	ditto	75	1.29	-	-	15	0.33	-
cn9wst06	West purlin, middle bay	<40	NM	-	-	15 (+6C NM)	-	-
cn9wst07	East principal rafter, north truss	90	1.52	1636–1725	1696	29½C	0.30	summer 1726
cn9wst08	East purlin, north bay	75	1.68	1651–1725	1709	16 (+2 NM)	0.26	1727–50
Roof of the west short rear range, perpendicular to street								
cn9wst20	South-east purlin	70	1.51	1638–1707	1703	4 (+*c* 19–21C NM)	0.28	*c* 1726–28
cn9wst21i	South principal rafter	58	1.53	-	-	-	0.29	-
cn9wst21ii	ditto	43	0.52	-	-	-	0.21	-
cn9wst22	North principal rafter	84	1.15	-	-	?h/s	0.27	-
cn9wst23a	South-west purlin	26	1.15			9	0.25	-
cn9wst23b	ditto	63	1.01	1660–1722	1713	9	0.27	1722–54
cn9wst24a	North-east purlin	45	1.15	1656–1700	1700	h/s	0.22	
cn9wst24b	ditto	72	1.62	1631–1702	1702	h/s (+14 NM)	0.26	
cn9wst24	Mean of 24a and 24b	72	1.60	1631–1702	1701	h/s (+14 NM)	0.26	1716–42
cn9wst25	North-west purlin	53	1.48	1663–1715	1715	h/s	0.29	1724–56

Continued overleaf

Table 1: continued:

Roof of the long rear range at the west end of property								
cn9wst30	North purlin, east bay	<40	NM	-	-	5 (+4NM)	-	-
cn9wst31	South purlin, east bay	<40	NM	-	-	-	-	-
cn9wst32	North principal rafter, east truss	109	1.50	-	-	22C	0.24	-
cn9wst33	South principal rafter, east truss	71	1.46	-	-	6	0.26	-
cn9wst34	Collar, east truss	52	2.62	-	-	11 (+5NM)	0.22	-
cn9wst35	Tiebeam, middle truss	<40	NM	-	-	-	-	-
cn9wst36*	Tiebeam, west truss (elm)	57	2.05	-	-	C	0.19	-
cn9wst37	North purlin, middle bay	46	2.39	-	-	10 (+2NM)	0.26	-

Key: NM = not measured; h/s = heartwood/sapwood boundary; C = complete sapwood, winter felled; ½ C = complete sapwood, felled the following summer; * elm (*Ulmus* spp)

Table 2: Cross-matching between individual timbers (values of t above 3.5 are significant)

	t-values								
Sample number	cn9wst02	cn9wst03	cn9wst04	cn9wst07	cn9wst08	cn9wst20	cn9wst23b	cn9wst24	cn9wst25
cn9wst01	8.5	5.4	3.8	4.9	2.9	3.9	3.2	2.0	2.1
cn9wst02		5.9	4.3	4.7	1.8	3.1	1.8	2.0	1.6
cn9wst03			6.2	9.2	1.2	1.0	1.3	1.1	0.7
cn9wst04				8.7	1.1	2.4	2.3	2.8	2.1
cn9wst07					1.1	2.2	1.9	2.1	2.2
cn9wst08						4.4	5.6	3.8	4.5
cn9wst20							7.0	5.2	7.6
cn9wst23b								6.8	9.6
cn9wst24									5.3

The different grey shades highlight timbers from the same sub-group

Table 3a: Dating evidence for the site master, CN9WST1, as spanning AD 1636–1728

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	t-value
Leicestershire	Kibworth Harcourt	(Arnold *et al* 2004a)	KIBASQ01	1582–1773	93	6.1
Bedfordshire	Chicksands Priory	(Howard *et al* 1998)	CHKSPQ02	1611–1814	93	5.5
Worcestershire	Croome Court	(Arnold *et al* 2004b)	CRMASQ01	1639–1753	90	5.3
Hertfordshire	Clothall Bury Farmhouse, Wallingford	(Arnold *et al* 2003)	CLBBSQ01	1636–1753	93	5.3
Essex	Cressing Temple Barns	(Tyers and Hibberd 1993)	CRBCR2	1661–1737	68	5.2
Oxfordshire	New College Oxford	(Miles *et al* 2014)	NWCOLLG8	1587–1724	89	5.1
Norfolk	Thrigby Post Mill	(Fletcher 1984)	THRIGBY	1674–1790	55	5.1
Oxfordshire	Old Clarendon Building, Oxford	(Worthington and Miles 2006)	CLRNDNOX	1539–1711	76	5.0
Buckinghamshire	Claydon House	(Tyers 1995)	CLAYDON	1613–1756	93	5.0
Wiltshire	Salisbury Cathedral spire and tower	(Miles *et al* 2004)	SARUM17	1556–1695	60	5.0
London	Eastcote House, Hillingdon	(Arnold and Howard 2012)	ECTASQ02	1569–1697	62	4.9
Warwickshire	Stoneleigh Abbey	(Howard *et al* 2000)	STOISQ04	1646–1813	83	4.9

Table 3b: Dating evidence for the site master, CN9WST2, as spanning AD 1631–1725

Source region:	Chronology name:	Publication reference:	File name:	Span of chronology (AD)	Overlap (years)	t-value
Worcestershire	Croome Court	(Arnold *et al* 2004b)	CRMASQ01	1639–1753	87	7.9
Yorkshire	Nostell Priory	(Tyers 1998)	NOSTELL2	1535–1743	95	7.6
Northamptonshire	Apethorpe Hall, Apethorpe	(Arnold *et al* 2008)	APTASQ02	1574–1749	95	6.4
Bedfordshire	Clophill House, Clophill	(Miles *et al* 2007)	CLOPHILL	1646–1748	80	6.2
Essex	Cressing Temple Barns	(Tyers and Hibberd 1993)	CRBCR3	1661–1737	65	6.1
Buckinghamshire	Claydon House	(Tyers 1995)	CLAYDON	1613–1756	95	6.0
Buckinghamshire	Easington Farmhouse, Chilton	(Miles *et al* 2005)	EASNGTN	1640–1726	86	5.9
Hampshire	Church Cottage, Basingstoke	(Miles *et al* 2007)	BSNGSTK2	1635–1746	91	5.8
Yorkshire	Cusworth Hall, Doncaster	(Hillam unpubl)	CUSWORTH	1665–1740	61	5.7
Worcestershire	Hartlebury Castle Bell Cupola	(Tyers 2008)	HARTCABC	1658–1745	68	5.7
Bedfordshire	Bushmead Priory	(Groves and Locatelli 2004)	BUSHMEAD	1599–1709	79	5.6
Oxfordshire	Oriel College Tennis Court	(Miles and Haddon-Reece 1994)	ORIEL1	1534–1776	95	5.5

FIGURES

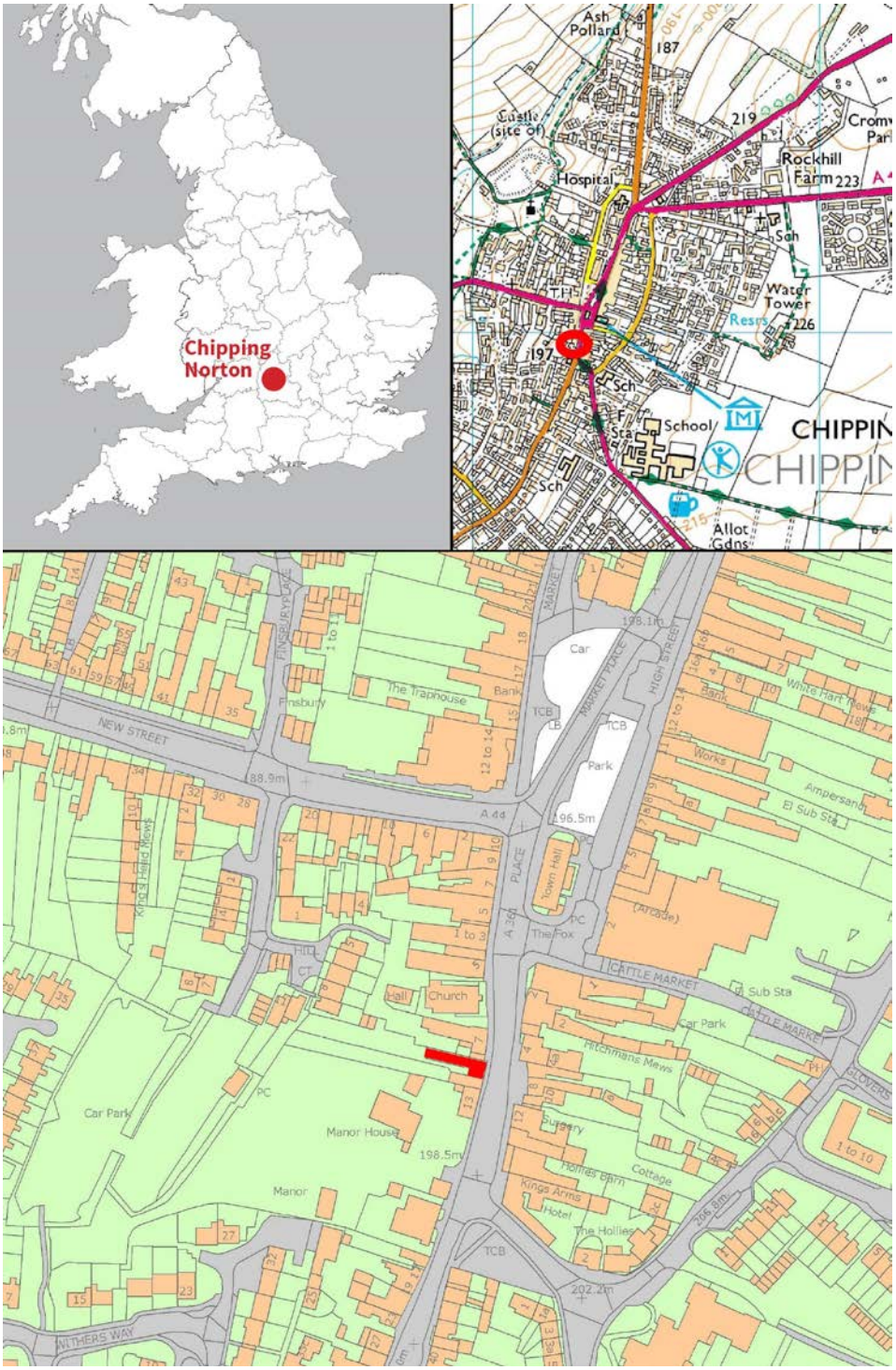

Figure 1: Maps to show the location of 9 West Street in Chipping Norton, marked in red. Scale: top right 1:15000; bottom 1:2000. © Crown Copyright and database right 2020. All rights reserved. Ordnance Survey Licence number 100024900. © British Crown and SeaZone Solutions Ltd 2020. All rights reserved. Licence number 102006.006. © Historic England

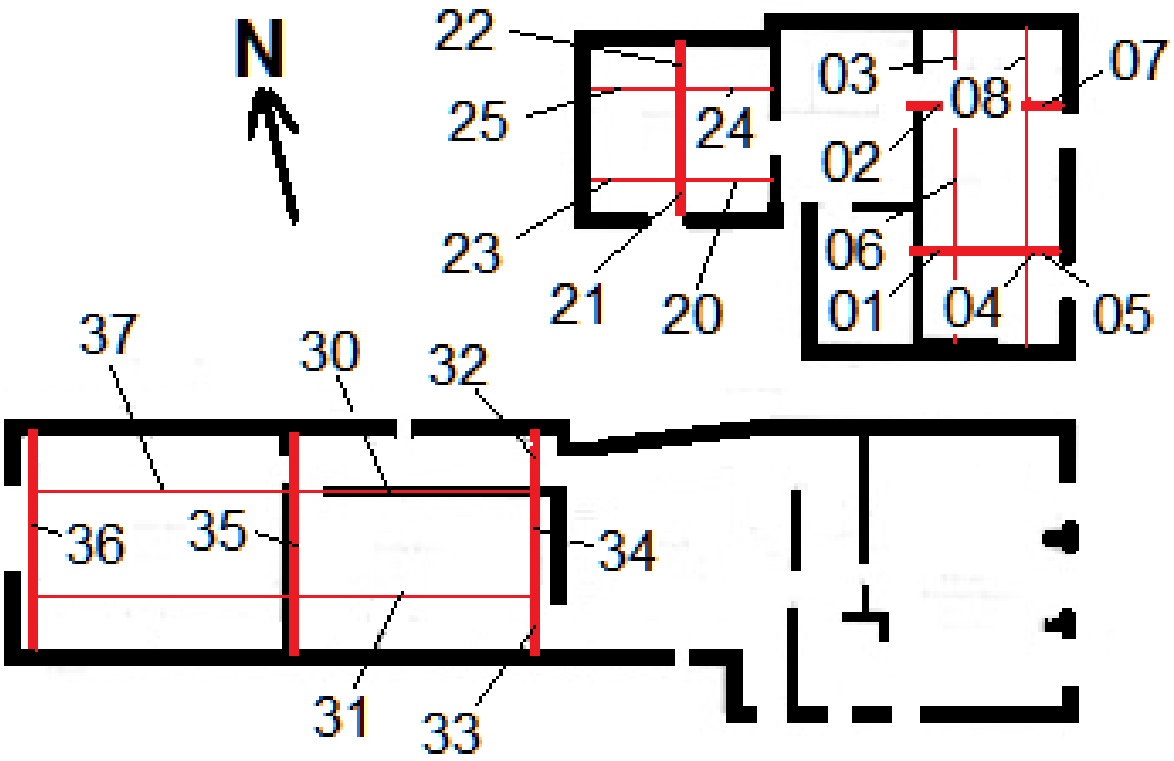

Figure 2: Plan of the upper floor (top) and first floor (below) showing the approximate positions of the trusses and purlins (red) and the timbers sampled for dendrochronology (adapted from original drawings by Jan Cliffe, Chipping Norton Buildings Record working with the Oxfordshire Buildings Record)

Figure 3: View of the post supporting the east rafter of the south truss of the front range, which produced samples cn9wst05a–b (photograph Martin Bridge)

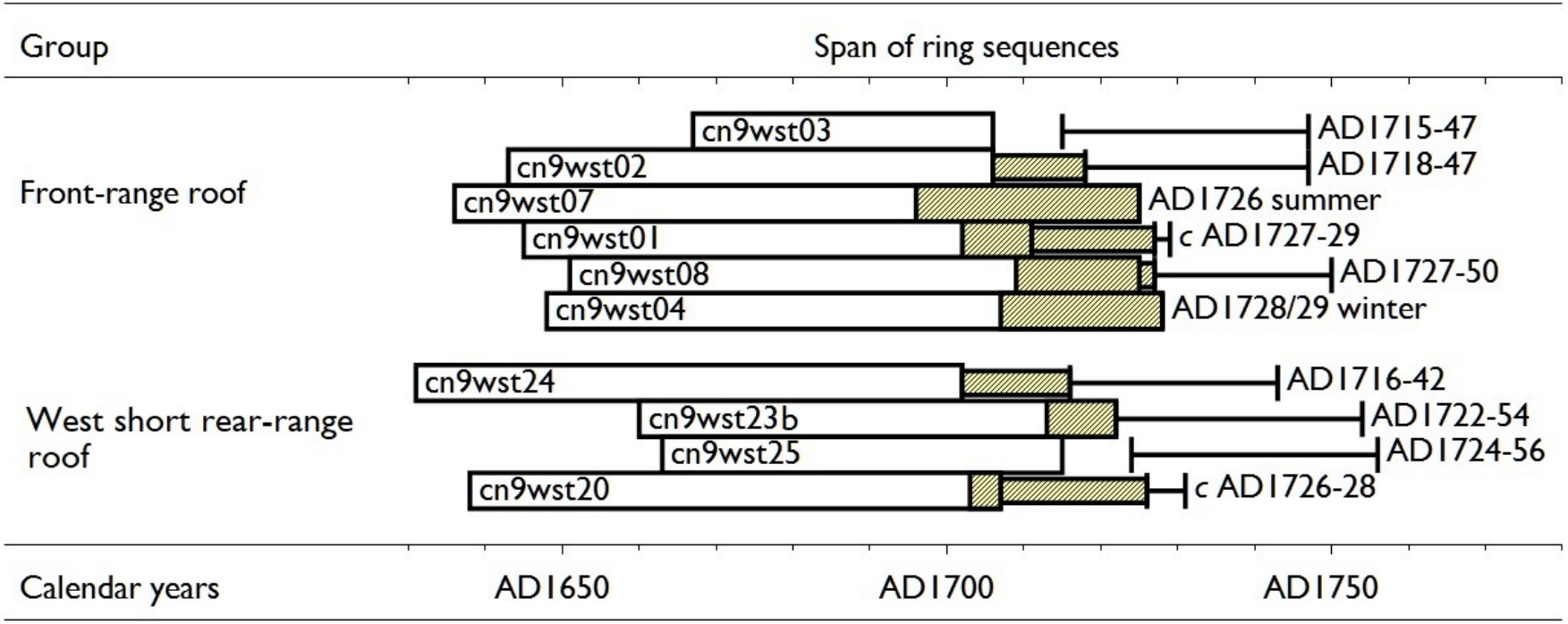

Figure 4: Bar diagram showing the relative positions of overlap of the dated samples and their individual felling dates / date ranges from 9 West Street, Chipping Norton, Oxfordshire. White bar – heartwood; yellow hatched bars – sapwood; narrow sections of bar – additional unmeasured rings

APPENDIX

Ring width values (0.01mm) for the sequences measured

Oak

cn9wst01

139	378	341	505	274	285	243	219	195	226
337	245	201	252	182	314	230	262	306	239
120	81	88	117	158	151	218	131	177	184
156	127	203	191	201	247	192	183	186	148
114	132	89	99	126	95	156	102	187	92
122	180	217	200	123	109	84	119	146	149
137	121	84	64	64	78	123			

cn9wst02

302	280	199	381	340	463	265	345	194	167
164	180	295	243	226	280	198	340	253	232
289	211	161	115	131	248	218	186	248	175
193	203	165	155	208	178	179	193	141	161
145	127	105	164	91	56	96	105	131	122
146	104	152	237	233	212	163	153	136	156
213	162	120	118						

cn9wst03

190	207	330	267	352	220	333	220	217	199
289	225	198	339	336	279	248	167	168	177
75	61	63	67	93	85	170	89	126	207
171	134	125	139	93	125	190	190	98	122

cn9wst04

493	266	442	280	344	271	269	531	347	373
350	301	464	359	348	197	59	57	70	108
79	170	183	249	214	276	192	185	143	248
164	163	315	171	310	237	148	118	167	89
52	57	67	102	95	144	87	164	203	196
175	90	93	78	92	149	174	101	118	77
60	74	75	62	102	89	74	56	81	80
72	77	73	120	135	122	62	84	125	119
99									

cn9wst05a

84	79	107	87	172	187	156	142	105	182
167	200	111	130	121	130	88	125	123	145
122	163	165	115	128	139	135	192	132	242
157	287	193	136	119	193	190	110	100	116
101	80	96	75	122	121	100	90	83	99
123	143	121	82	98	43	40	62	35	45
45	49	62	39	75	81	128	88	103	157
122	141	141	85	88	79				

cn9wst05b

114	39	28	48	36	59	86	57	81	142

90 189 211 196 119 91 168 89 49 81
84 152 164 223 266 228 219 148 199 207
230 122 153 156 126 102 115 123 145 123
166 156 28 94 106 111 159 129 228 148
285 207 144 113 196 77 121 124 95 104
76 76 85 75 110 114 106 94 120 84
139 194 159 99 132

cn9wst07
541 221 224 177 184 239 234 272 221 110
134 249 312 168 259 194 251 163 208 339
252 311 257 213 380 278 288 193 64 57
64 93 68 129 176 162 149 181 151 162
136 189 113 100 202 177 215 202 110 85
128 55 44 48 51 77 65 153 51 87
179 108 126 86 93 87 103 178 145 70
103 85 59 44 54 93 105 101 67 104
90 87 109 114 146 100 93 81 94 119

cn9wst08
178 181 135 125 259 418 290 265 237 262
266 211 368 319 247 215 221 296 301 219
271 216 280 252 308 192 244 290 170 304
233 337 173 174 76 51 42 73 80 66
61 67 69 82 92 116 150 183 113 156
130 116 194 217 131 172 95 85 76 51
65 59 68 58 54 73 81 88 87 127
100 161 73 118 178

cn9wst20
369 284 186 109 155 215 204 241 256 202
295 232 275 166 143 99 106 163 101 112
86 82 133 170 165 234 186 180 146 120
171 91 127 132 80 91 113 134 80 138
155 144 322 139 253 200 105 39 51 58
87 107 69 99 97 111 103 115 160 136
180 154 161 158 125 185 169 116 93 101

cn9w21i
480 460 389 340 295 251 148 319 273 242
96 84 143 144 165 163 191 222 181 191
128 122 109 97 112 105 87 59 93 81
128 60 59 77 54 158 86 203 146 286
196 244 251 151 124 121 120 118 64 77
86 49 47 25 40 30 46 33

cn9w21ii
67 70 71 125 85 79 80 103 61 65
62 50 42 36 46 36 23 35 23 28
39 40 33 31 27 36 24 32 31 35
58 65 68 45 56 53 64 46 57 63
50 47 68

cn9wst22

435 402 252 170 323 296 218 70 87 179
132 212 129 182 220 227 196 109 135 188
156 167 114 80 79 119 104 117 59 58
111 111 110 114 380 189 306 245 149 155
125 107 106 114 95 61 78 78 70 57
39 28 33 60 41 96 94 124 113 77
50 49 48 41 55 61 38 43 34 39
35 30 37 36 32 41 34 25 29 27
50 43 40 72

cn9wst23a

176 104 113 130 136 114 125 39 46 39
53 48 79 99 98 62 91 89 110 111
105 169 269 250 230 92

cn9wst23b

275 184 166 182 168 138 136 131 167 132
92 93 86 120 103 140 68 97 111 79
117 53 121 78 38 26 28 36 59 66
49 81 54 64 55 75 114 117 132 124
122 86 96 104 145 100 117 86 39 44
39 57 100 119 75 62 81 78 87 89
150 197 136

cn9wst24a

143 166 176 147 173 189 128 157 109 113
97 103 129 103 111 103 89 112 126 121
89 132 124 91 180 104 182 184 113 50
49 54 93 115 76 99 93 102 84 98
106 112 97 76 89

cn9wst24b

189 135 92 119 149 125 196 172 201 203
246 322 445 368 316 344 450 116 164 389
263 279 189 223 347 194 201 172 150 201
214 124 189 133 153 156 155 218 133 143
117 84 114 118 118 89 117 111 74 154
73 126 146 78 52 49 54 79 85 74
87 87 96 96 87 130 109 112 71 86
76 123

cn9wst25

218 287 191 187 196 228 177 167 164 180
193 211 226 125 123 230 218 346 122 303
167 91 39 57 61 110 144 89 115 83
109 84 141 170 168 162 209 182 154 142
180 162 87 111 68 58 57 44 79 92
118 75 122

cn9wst32

146 186 168 241 255 284 400 241 366 307
338 293 300 241 352 251 208 300 268 330
283 339 448 365 247 134 181 211 184 289
210 174 276 197 40 37 44 50 35 23
41 42 35 41 43 41 77 103 90 120
140 92 177 131 130 121 127 187 214 171
233 242 272 245 205 131 98 150 117 129
102 46 43 44 35 49 58 54 63 73
76 66 72 111 137 105 128 157 135 135
115 154 186 130 139 119 87 35 36 32
28 37 37 48 49 45 61 47 64

cn9wst33
322 320 349 413 335 233 136 220 221 199
290 231 152 289 247 113 49 31 31 59
50 53 63 58 73 119 135 155 155 175
107 268 195 150 178 151 210 247 177 226
198 224 191 158 108 94 104 106 115 58
46 40 50 42 35 41 35 52 48 61
76 58 97 196 172 112 112 191 127 131
122

cn9wst34
239 323 388 382 296 322 285 401 415 325
269 373 315 409 340 342 334 434 487 316
275 251 347 429 381 259 314 124 78 51
60 79 90 157 182 180 182 166 140 162
192 203 220 210 196 233 384 321 192 153
266 174

cn9wst37
111 83 130 180 340 180 313 230 262 253
296 237 265 293 258 203 240 324 496 475
305 404 136 63 72 49 76 134 178 258
199 204 175 195 212 295 343 349 290 264
272 282 332 244 231 272

Elm

cn9wst36
240 230 180 194 299 288 303 285 268 191
228 260 192 263 218 225 196 274 318 200
303 284 312 237 270 295 277 282 292 231
334 269 328 176 133 124 130 127 139 190
185 251 256 146 97 86 98 110 97 175
125 86 76 65 84 90 100

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ISSN 2059-4453 (Online)