Centre for Archaeology Report 75/2003

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ISSN 1473-9224

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Summary

A tree-ring dating programme was commissioned on timbers in a newly identified timber-framed building on a site in Church Street, Dronfield, Derbyshire, by English Heritage in AD 2003. The tree-ring results indicate that timbers felled in the winter of AD 1526/7 are present in the structure.

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 a newly identified timber-framed building in Church Street, Dronfield, Derbyshire (NGR SK 353 784). It is beyond the dendrochronological brief to describe the building in detail or to undertake the production of detailed drawings. 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.

Dronfield lies at the north end of Derbyshire, 8 km north of Chesterfield, and 9 km south of Sheffield (Figs 1 and 2). During preliminary works in advance of re-development of some parts of a former foundry site into craft workshops and licensed premises, an unlisted building hitherto thought to be a nineteenth-century town house (Fig 3) was found to contain an earlier timber-framed structure. The developer kindly agreed to halt works whilst a survey of the building was made and a dendrochronological sampling programme was undertaken. Tree-ring analysis was commissioned by Carol Pyrah, the local English Heritage Historic Buildings Inspector, to inform the redevelopment programme, and to inform a potential application for listing.

The following description is based on that of Adam Menuge (2003, 1). The extant timber structure is interpreted as three in-line bays parallel to Church Street with a fourth bay to the west forming a rear range or cross-wing. The three in-line bays appear to form a large two-bay open hall, with a short bay cross-passage adjacent to the cross-wing. This structure was entirely encased in later stone-work and was invisible within the later form of the building until the present re-development work began. Four jowled storey posts, and two sections of wall plates survive along the northern side (Fig 4). One storey post and the wall plate are visible on the southern side. Three tiebeams, two with open trusses (Fig 5) and one formerly with a king post, are extant, bracing survives in one truss, and there is evidence of former bracing elsewhere on the trusses and on the close-studded northern and southern walls. The eastern end of the building appears to be a closed truss and the western truss is now entirely missing. Menuge (2003, 1) suggests that seventeenth-century modifications produced a conventional three-unit domestic plan by insertion of a floor, a hearth, and dividing walls. At later stages the building was extended eastwards, a cellar created under the parlour, and the walls encased in stone. The building was functioning as an inn from at least AD 1875. In the twentieth century it was converted into offices for the adjacent foundry.

Methodology

The general methodology and working practises used at the Sheffield Dendrochronology Laboratory are described in English Heritage (1998). The methodology used for this building was as follows.

The site was initially visited and an assessment of the dendrochronological potential of the building was undertaken. This assessment aimed to identify whether oak timbers with suitable ring sequences for analysis existed in the structure. This assessment identified that the building contained suitable material.

A subsequent visit was made by members of the English Heritage Historic Research and Conservation Support team to identify whether the surviving structure was of architectural significance. The request to undertake a dendrochronological sampling programme was confirmed as a result of their observations. A further visit was arranged to allow for the final survey of the structure, by Adam Menuge and Ian Goodall of English Heritage, and this was the same day selected for the dendrochronological sampling. The dendrochronological sampling programme attempted to cover the suitable material by obtaining samples from as broad a range of timbers, in terms of structural element types, scantling sizes, carpentry features, and surface condition as was possible within the terms of the request.

The most promising timbers were sampled using a 15mm diameter corer attached to an electric drill. The cores were taken as closely as possible along the radius of the timbers so that the maximum number of rings could be obtained for subsequent analysis. The core holes were left open to allow for ventilation whilst the building works were still incomplete: they may be filled subsequently. The ring sequences in the cores were revealed by sanding.

The complete sequences of growth rings in the cores were measured to an accuracy of 0.01mm using a micro-computer based travelling stage (Tyers 1999). The ring sequences were plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition a cross-correlation algorithm (Baillie and Pilcher 1973) was 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 these positions are supported by satisfactory visual matching.

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

indicate the 95% confidence limits of the range (Tyers 1998a). These figures are applicable to oaks from England and Wales. 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, seasoning, 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

Thirteen timbers were selected for sampling from the apparently original structure. Following discussion with Adam Menuge, and with the agreement of Peter Marshall, a further sample from the inserted floor was also obtained. The samples were numbered **1-14** (Table 1). Adam Menuge had assigned Truss 1 to be the missing truss at the west end with Truss 5 at the eastern end (Fig 4), the sample locations throughout the structure were recorded using this scheme (Figs 4-5).

All the sampled timbers are oak (*Quercus* spp.). Two of the samples were found to be unsuitable for analysis since they contained series of irresolvable bands of narrow rings. The tree-ring series from the remaining twelve sampled timbers were measured and the resultant series were then compared with each other. Eleven were found to match together to form an internally consistent group (Table 2). A site mean chronology was calculated, named DRONFIELD. This site mean was then compared with dated reference chronologies from throughout the British Isles and northern Europe. A single well correlated position was identified for this sequence. Table 3 shows example correlations at its identified dating position against independent reference chronologies. Table 1 provides the chronological dates identified for each component sample by this process and their interpretation. Figure 6 graphically shows the chronological position identified for each component sample. Appendix 1 lists the individual sample series. The one unmatched sample (**14**) is derived from the inserted floor, which is of markedly different character to the original timbers. Unfortunately no other material suitable for sampling from this phase was identified on site, and no replicated matching location has been identified for this series. This material thus remains undated by the analysis reported here.

Discussion

The 183-year chronology DRONFIELD is dated AD 1344 to AD 1526 inclusive. It was created from eleven timbers. Three of the dated timbers are complete to the original bark surface. These timbers still retained their bark. There is therefore no interpretative problem with the site since all three are timbers felled within the non-growing period between autumn AD 1526 and spring AD 1527. All of the eight other dated samples retain some sapwood, or are complete to the heartwood/sapwood boundary, and all appear to be contemporaneous (Fig 6; Table 1).

The dated timbers that are all part of the original construction include the storey posts, wall plates, tiebeams, principal rafters, a diminished rafter, and a plain common rafter.

Conclusion

Assuming the timbers were felled for immediate usage, and this was normal practice in the medieval period (Charles and Charles 1995), the structure is likely to date from the winter of AD 1526/7, or shortly thereafter.

The property appears to have been a two-bay open hall, with a cross passage and service end. It is relatively austere, although the squaring up of the timbers during their encasing in stone walls may have removed decorative elements or features. The unusual form of this range has been pointed out (Menuge 2003). Its original purpose is somewhat obscure but there are sufficient features to suggest that it was a special purpose building. At the time of its construction Dronfield church was controlled by Beauchief Abbey, and the priests lived in the Chantry, now the Green Dragon Inn, on the opposite side of the churchyard. The Abbey was dissolved only a decade after the construction date identified for this building. The Chantry priests were removed by an act of Elizabeth I only forty years later.

The apparent absence of a contemporary accommodation block may have made the subsequent usage of the building awkward and this may be why it was so comprehensively remodelled, possibly more than once. No tree-ring dating has been obtained for any of these phases.

Acknowledgements

The sampling and analysis programme was funded by English Heritage. Adam Menuge and Ian Goodall discussed their observations on site, provided practical assistance, and helped determine nomenclature and numbering schemes. Peter Marshall from English Heritage put together the request documentation, and Cathy Groves provided useful discussion of the results. Mr Ron Harpham (Jarvale Construction) kindly provided access to a generator and discussed the circumstances of the discovery of the timber structure. He and Mr Roger Pigott (Marcpen Ltd) ensured the appropriate authorities were made aware this important discovery. Mr Flavell from Barlow Building Design gave permission to use the plan used in Figure 3.

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Figure 1 Location of Dronfield, Derbyshire, within England and Wales.

Figure 2 Location of the Lea Road Foundry site, Church Street, Dronfield, Derbyshire

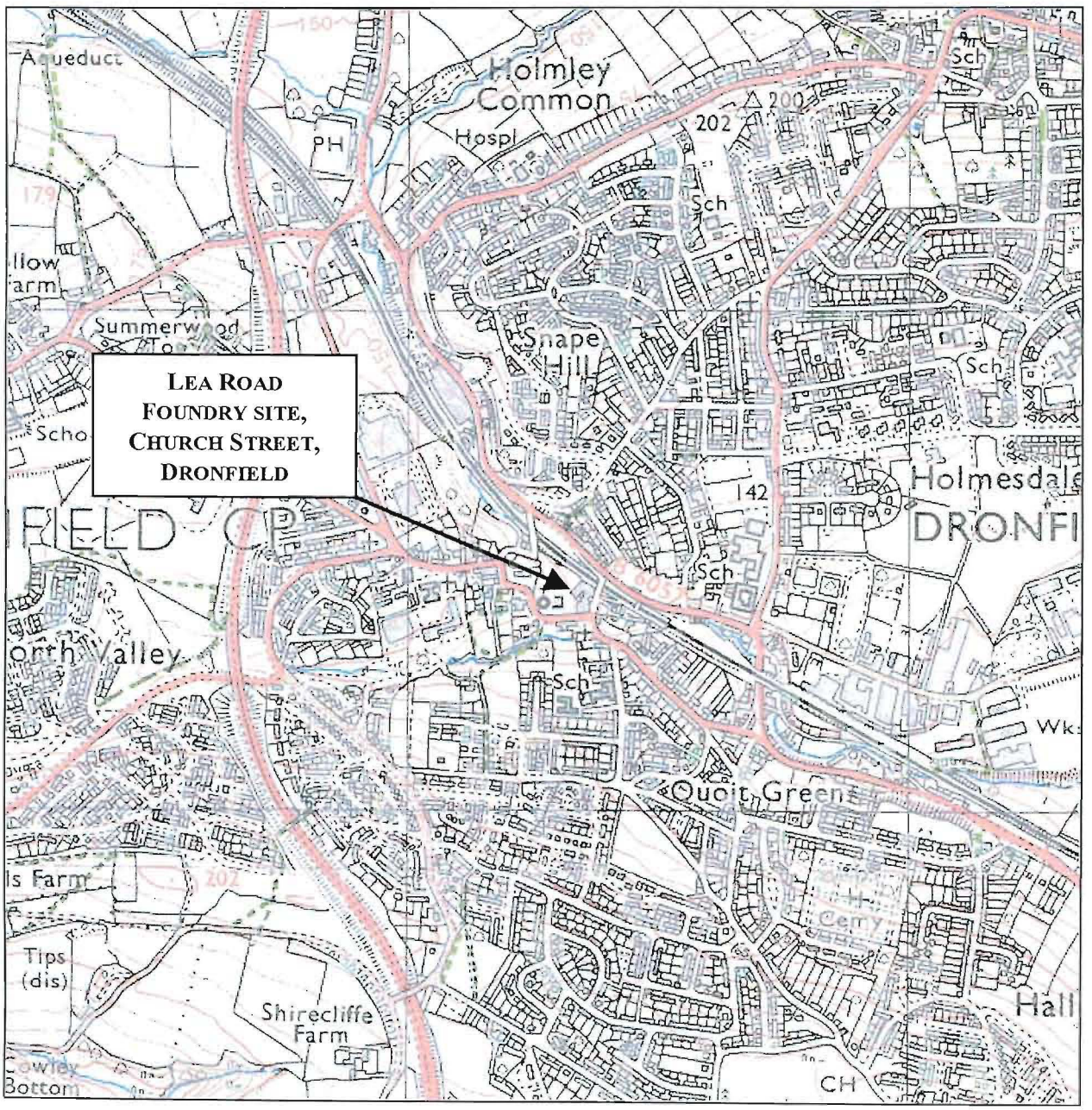


Figure 3 Location of the sampled building within the Lea Road Foundry site, Church Street, Dronfield, Derbyshire (based upon Barlow Building Design Plan 2111/01, supplied by English Heritage). The sampled building is along the south edge of the site

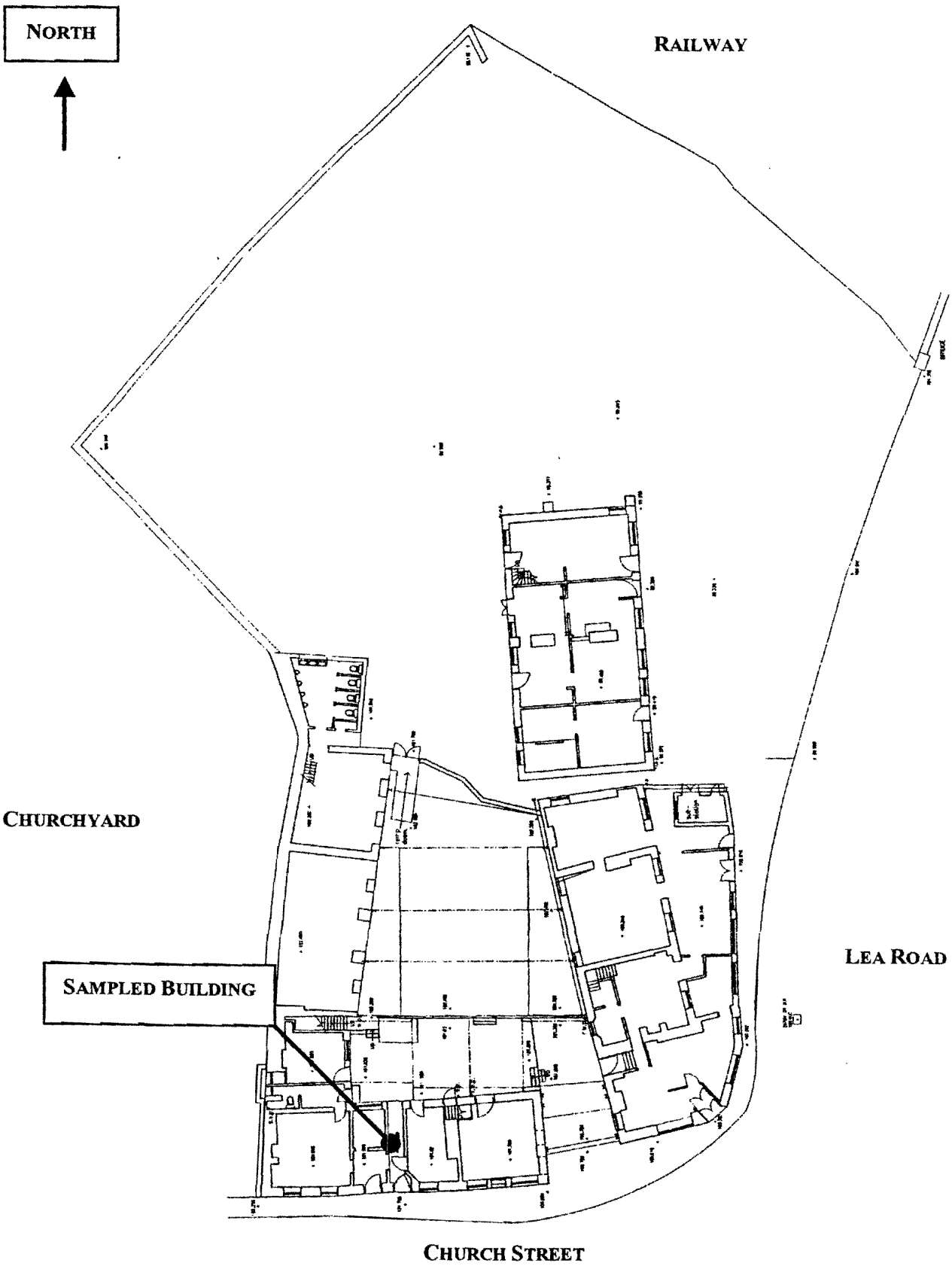


Figure 4 Elevation of the original part of the sampled building at the Lea Road Foundry Site, Church Street, Dronfield, Derbyshire. From the inside looking north showing the truss and bay numbering scheme adopted for this report (based on a figure supplied by English Heritage). The labelled arrows indicate the approximate locations of the sampled timbers visible on this elevation, labels 8, 9, and 10 indicate the approximate equivalent location of sampled timbers on the southern elevation. The timber from which sample 14 was derived is not visible on this section

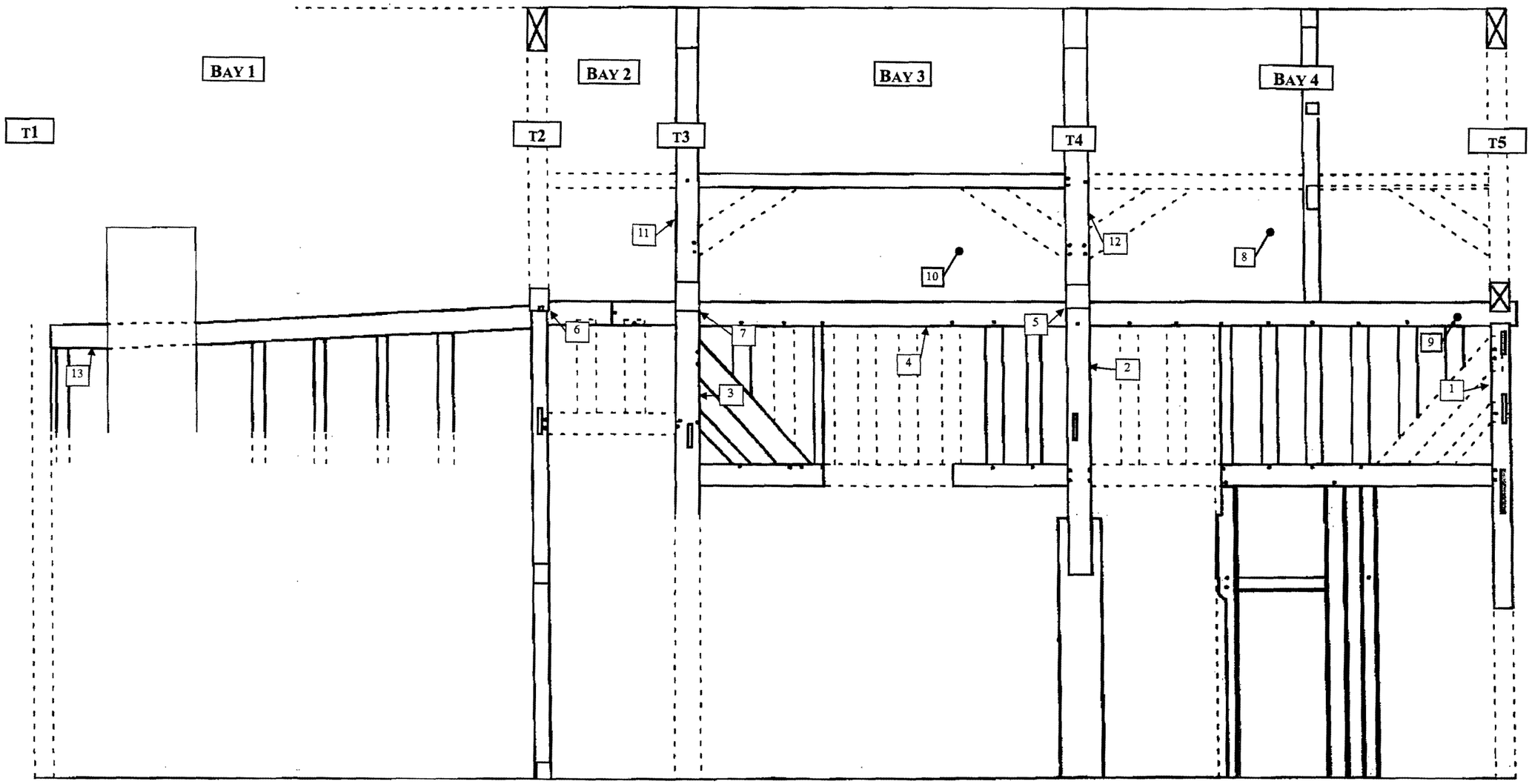


Figure 5 Elevation of Truss 3 looking west at the Lea Road Foundry Site, Church Street, Dronfield, Derbyshire. The labelled arrows indicate the approximate locations of the sampled timbers visible on this elevation, this section shows the location of the inserted floor and the timber from which sample 14 was derived. Based on a figure supplied by English Heritage

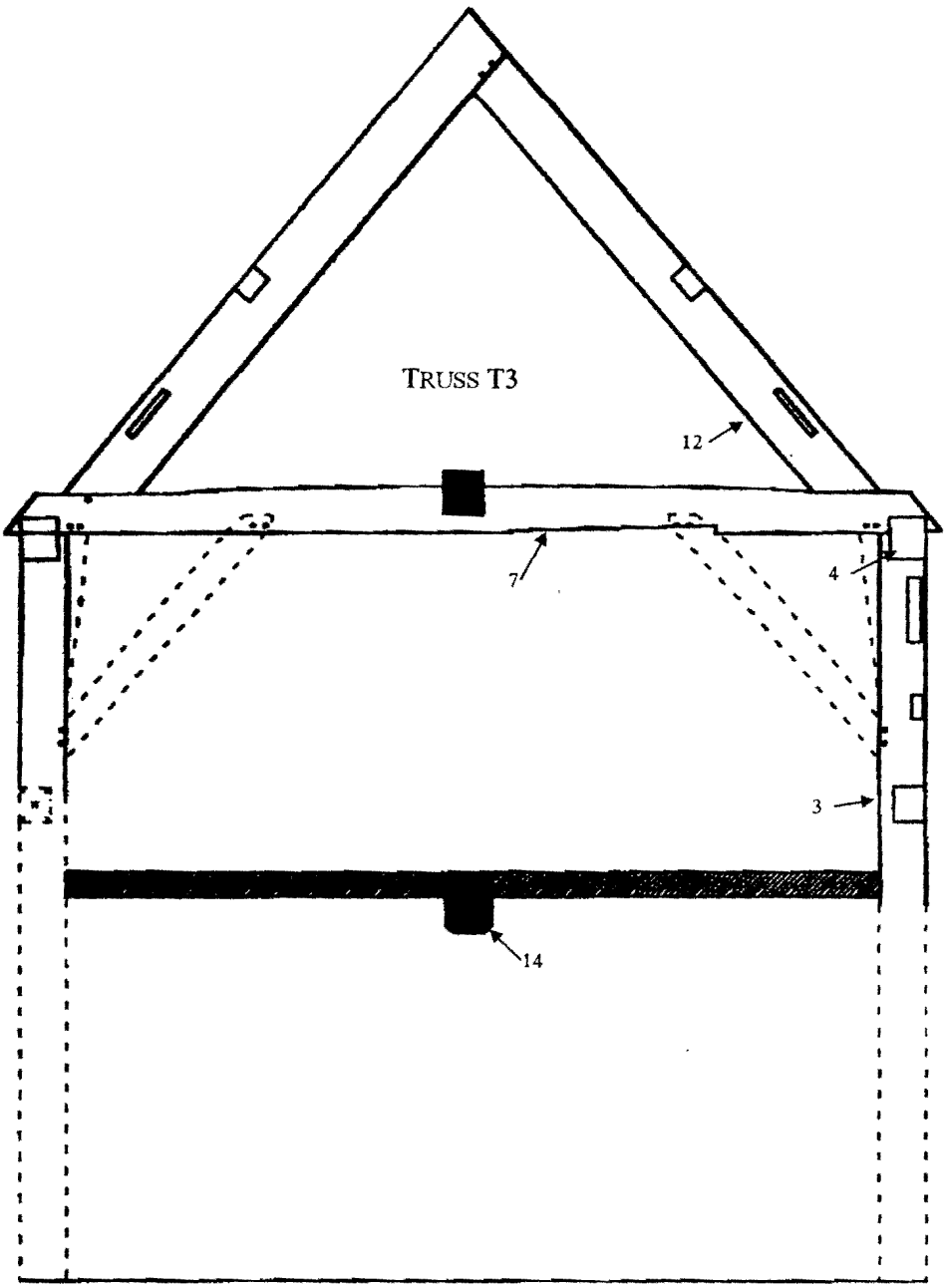
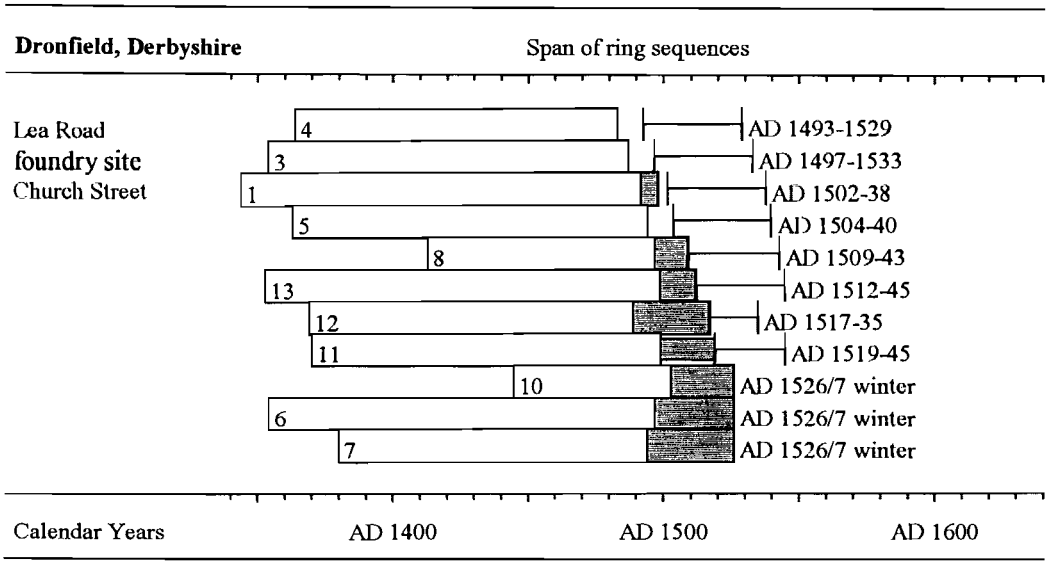


Figure 6 Bar diagram showing the chronological positions of the dated timbers from the building at the Lea Road Foundry Site, Church Street, Dronfield, Derbyshire. The estimated felling period for each sequence is also shown



KEY for figure 6

Table 1 List of samples from the building at the Lea Road Foundry Site, Church Street, Dronfield, Derbyshire

Core No	Origin of core	Cross-section size (mm)	Total rings	Sapwood rings	ARW (mm/year)	Date of sequence	Felling period
1	Truss 5 north storey post	290 x 180	155	6	1.27	AD 1344-1498	AD 1502-38
2	Truss 4 north storey post	280 x 220	-	-	-	unmeasured	-
3	Truss 3 north storey post	260 x 230	134	H/S	1.04	AD 1354-1487	AD 1497-1533
4	Bay 3 north wall plate	240 x 240	120	H/S	1.09	AD 1364-1483	AD 1493-1529
5	Truss 4 tiebeam	230 x 220	132	H/S	1.19	AD 1363-1494	AD 1504-40
6	Truss 2 tiebeam	280 x 170	173	29+Bw	0.79	AD 1354-1526	AD 1526/7 winter
7	Truss 3 tiebeam	240 x 190	147	32+Bw	0.92	AD 1380-1526	AD 1526/7 winter
8	Bay 4 south diminished rafter	180 x 120	97	12	1.35	AD 1413-1509	AD 1509-43
9	Bay 4 south wall plate	250 x 200	-	-	-	unmeasured	-
10	Bay 3 south common rafter	120 x 80	82	23+Bw	1.46	AD 1445-1526	AD 1526/7 winter
11	Truss 4 north principal rafter	260 x 160	130	H/S *+20s*	1.04	AD 1370-1499	AD 1519-45
12	Truss 3 north principal rafter	290 x 145	149	28	0.92	AD 1369-1517	AD 1517-35
13	Bay 1 north wall plate	220 x 220	160	13	1.12	AD 1353-1512	AD 1512-45
14	Bay 2 Ground-floor axial beam	350 x 280	83	26	2.29	undated	-

KEY for Table 1 Total rings = all measured rings. Sapwood rings: H/S heartwood/sapwood boundary, *+20s* an additional detached fragment of sapwood includes 20 unmeasured sapwood rings, Bw bark winter felled. ARW = average ring width of the measured rings

Table 2

t-value matrix for the timbers forming the chronology DRONFIELD

	3	4	5	6	7	8	10	11	12	13
1	6.30	3.47	6.14	3.92	-	-	-	-	4.87	3.68
3		5.80	5.24	3.67	-	-	-	3.94	6.00	4.08
4			3.75	-	5.80	3.17	-	5.24	5.07	6.37
5				4.86	3.27	6.22	-	4.50	3.80	6.55
6					5.41	3.16	-	6.96	4.70	6.25
7						5.64	3.64	9.69	7.37	6.05
8							5.99	5.47	6.22	6.16
10								-	5.37	6.82
11									6.21	6.00
12										8.07

Table 3

Dating the mean sequence DRONFIELD, AD 1344-1526 inclusive. Example *t*-values with independent reference chronologies

Area	Reference chronology	*t*-values
Derbyshire	Kent House, Ridgeway (Groves and Hillam 1990)	8.38
Gloucestershire	Gloucester, Mercers Hall (Howard *et al* 1996)	8.01
Nottinghamshire, etc	East Midlands regional master (Laxton and Litton 1988)	10.84
Shropshire	Ightfield, Hall Barn (Groves 1997)	8.98
Staffordshire	Sinai Park nr Burton (Tyers 1997)	10.05
Yorkshire, S	Sheffield, Bishops House (Morgan 1980)	7.71
Yorkshire, W	Elland, Old Hall (Hillam 1984)	9.46
Yorkshire, W	Nostell Priory nr Wakefield (Tyers 1998b)	7.86
Yorkshire, W	Ripon, Thorpe Prebend House (Boswijk 1998)	8.01
Yorkshire, W	Shibden Hall, nr Halifax (author unpubl)	7.89

Appendix 1 Ring width data for measured samples from the building at the Lea Road Foundry Site, Church Street, Dronfield, Derbyshire, 100 = 1mm

dron01

365	352	208	230	305	334	294	234	207	263
214	216	248	233	209	188	128	102	171	115
143	106	126	136	107	116	115	114	131	138
194	94	85	129	134	101	99	75	78	69
71	58	80	154	123	123	109	94	99	85
97	122	112	60	91	125	159	153	149	155
119	121	187	142	123	126	142	120	130	97
78	87	74	49	74	50	51	68	77	69
87	118	84	102	109	94	100	116	113	106
114	91	85	87	83	78	107	92	79	90
141	134	103	88	120	109	117	182	122	115
138	122	167	165	127	141	142	134	134	116
98	103	91	110	190	153	164	149	131	121
96	137	114	135	144	159	119	169	161	162
83	101	90	131	110	94	88	72	81	98
76	82	79	86	61					

dron03

130	148	133	147	136	116	107	93	201	147
191	211	237	218	162	158	164	130	137	198
345	121	211	187	173	133	104	125	100	80
110	92	132	185	119	89	76	85	122	121
101	132	133	82	98	105	152	110	108	94
84	78	76	57	55	66	61	51	78	61
52	45	54	80	114	88	94	104	94	84
96	86	102	118	103	94	107	118	133	71
96	80	75	86	90	75	91	114	63	83
100	74	70	69	55	46	38	39	47	50
60	44	44	47	38	44	58	56	38	44
45	49	47	56	69	76	79	67	62	67
109	146	93	86	109	170	112	99	169	125
116	192	124	231						

dron04

172	170	204	190	156	192	142	97	113	164
276	191	183	223	245	135	106	157	135	99
142	143	196	177	174	120	122	140	122	131
128	142	129	116	112	122	192	159	131	175
161	117	163	111	121	122	115	76	100	92
86	77	93	121	131	98	133	133	114	133
119	91	68	73	84	74	97	83	92	83
87	94	64	80	70	74	70	77	68	80
94	72	64	70	68	74	60	64	66	68
75	65	65	69	81	79	72	64	71	66
59	71	55	66	67	75	78	94	66	84
79	105	103	89	73	87	82	106	71	74

dron05

255	233	157	219	209	193	274	217	202	263
216	284	211	229	226	279	259	191	152	144
109	166	167	197	223	195	182	117	121	146
123	156	145	133	96	93	83	107	123	87
99	78	78	79	82	63	97	99	88	92
76	74	73	71	82	102	93	66	91	81
78	80	102	98	93	100	95	82	80	97
89	101	111	102	100	96	74	78	103	86
119	154	132	97	106	103	99	90	102	88
69	81	83	90	79	80	82	99	83	94
86	83	81	74	96	105	92	106	88	77
77	93	101	81	81	92	117	122	116	124
125	127	126	110	152	115	101	79	60	66
82	87								

dron06

164	133	133	128	187	136	88	80	68	81
70	73	80	77	62	87	82	78	114	102
91	62	75	84	78	76	58	53	67	59
97	65	85	67	48	54	52	33	43	35
46	50	57	59	57	61	76	82	61	78
82	77	78	60	68	68	63	56	61	57
62	58	53	48	58	52	54	61	55	64
70	64	60	60	68	56	62	82	134	100
135	124	117	107	83	67	100	98	77	95
107	87	67	72	79	102	98	116	110	87
100	81	114	95	99	90	105	85	83	83
59	66	63	67	77	78	49	58	75	69
75	83	68	72	59	75	88	100	107	78
86	97	80	93	84	74	82	86	72	77
75	62	80	63	73	94	73	57	48	53
69	84	97	79	81	108	82	86	85	116
82	73	93	82	66	56	51	81	86	71
74	84	67							

dron07

154	162	98	107	166	87	198	185	155	111
99	111	106	147	142	127	140	122	120	98
149	162	144	176	206	129	142	104	124	134
115	83	107	82	77	64	77	99	106	74
109	117	89	150	113	127	79	91	96	97
97	100	129	94	93	86	77	92	85	94
129	115	84	117	101	79	70	67	71	100
90	77	72	64	57	60	75	67	71	120
126	102	105	103	55	62	60	73	57	48
43	53	58	67	65	95	65	91	60	69
69	91	64	74	76	113	87	118	81	76
60	36	34	40	61	84	125	80	77	95
80	60	65	70	65	85	83	86	104	117
99	91	72	62	67	51	56	45	66	60
49	60	65	72	51	54	57			

dron08

71	63	55	57	79	82	61	62	79	63
92	104	99	105	91	115	125	103	99	106
89	96	78	70	84	91	79	123	125	113
110	151	138	110	123	128	138	128	146	101
89	154	152	198	144	144	158	199	166	168
166	115	107	136	156	156	177	223	164	134
135	195	307	245	247	165	191	256	245	202
312	354	345	224	300	177	126	99	61	66
97	104	116	125	115	87	119	121	101	83
89	79	97	127	116	109	150			

dron10

75	84	90	71	88	78	78	68	63	65
43	70	72	56	87	112	111	69	101	78
80	79	117	115	120	109	100	64	91	130
316	291	269	202	192	238	279	254	314	393
362	218	379	293	225	191	134	146	126	169
154	184	162	145	152	121	121	105	114	122
129	198	148	192	262	173	140	135	154	126
106	98	88	128	109	89	135	114	120	141
109	104								

dron11

170	126	141	173	144	124	154	169	163	164
171	172	172	118	215	132	192	179	150	175
119	145	126	141	120	126	106	96	109	126
146	146	115	146	158	116	110	75	84	99
80	63	83	72	56	64	63	71	82	55
68	95	58	94	84	81	71	83	100	78
90	83	134	76	104	87	78	87	66	74
89	91	63	85	106	78	67	71	83	89
97	98	80	74	77	76	97	88	85	99
92	75	78	84	59	64	77	108	93	78
61	63	61	71	74	111	80	98	84	95
110	122	104	96	167	120	146	137	100	116
83	76	93	88	89	102	139	111	81	96

dron12

266	251	200	167	188	240	141	164	200	144
167	151	150	136	131	151	109	140	159	108
85	70	95	83	75	71	80	89	55	60
83	115	83	77	101	80	88	74	46	55
75	64	46	66	46	43	42	51	59	82
49	85	87	65	79	76	82	63	64	89
91	64	79	100	88	85	85	60	79	72
55	102	74	68	85	101	90	94	94	74
95	58	78	66	61	59	59	86	79	56
72	69	80	66	64	62	73	80	86	57
101	92	74	81	88	77	135	105	98	93
110	84	122	85	115	125	133	99	150	129
86	74	50	56	74	88	108	112	80	81
88	70	68	63	78	80	78	81	70	77
103	78	79	84	79	81	59	81	94	

dron13

341	269	349	237	176	190	204	154	132	176
193	132	94	123	100	110	121	139	114	128
101	139	102	102	135	127	101	80	87	86
80	124	115	143	135	104	98	98	139	142
146	133	111	98	95	92	86	117	128	111
160	140	142	119	121	109	147	116	96	101
81	66	67	67	63	81	70	83	106	95
127	127	146	126	119	121	129	127	112	138
100	117	104	80	89	83	63	82	98	81
80	104	106	91	91	87	98	92	93	79
80	71	53	84	76	79	78	94	88	96
90	78	89	88	95	75	77	77	84	80
79	71	130	105	101	87	120	154	177	199
180	204	146	110	191	135	118	103	95	96
100	123	115	116	101	82	90	64	62	51
66	73	86	88	68	70	86	80	64	80

dron14

353	412	305	232	317	342	357	240	259	324
245	295	245	286	269	393	337	370	323	496
343	380	328	234	364	387	362	482	474	236
368	465	348	387	388	207	98	99	108	146
176	132	156	163	132	116	183	234	253	273
258	245	203	230	197	202	248	322	274	122
99	83	69	58	69	77	103	123	122	124
114	122	123	126	139	80	110	80	104	115
85	68	51							