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Summary

Tree-ring analysis of samples from Lodge Farm House resulted in the production of a felling date for the primary phase timbers of circa AD1355-60, and a tree-ring chronology spanning the period AD1215-1335. The timbers from the 16th and 17th century phases could not be dated.

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Tree-ring analysis of oak timbers from Lodge Farm, Denton, Norfolk

Introduction

Lodge Farm lies 0.6 miles east of Denton (NGR: TM289886). It has recently undergone a survey carried out by Norfolk County Council. The architectural style of the farmhouse suggests a mid-14th century date for the original erection of the building. Later alterations are thought to date to the 16th and 17th centuries (Heywood & Stenning pers comm). Tree-ring analysis was undertaken during major building work in early 1993 to determine precise dates for the timbers, and hence provide more precise dating evidence for the construction of the building and the later alterations.

Method

All timbers were briefly assessed and those which looked most suitable for dendrochronological analysis were selected for study and sampled. Cores were taken from the timbers using a 15mm diameter hollow borer attached to an electric drill. Each core was polished with an electric sander and then by hand using fine silicon carbide paper so that the annual growth rings were clearly defined.

Any samples unsuitable for dating purposes were rejected before measurement but a note was made of the number of rings and the average growth rate. Unsuitable samples are usually those with unclear ring sequences or less than 50 rings. Ring patterns with fewer than 50 rings are generally unsuitable for absolute dating as they may not be unique (Hillam *et al* 1987).

The growth rings of the samples selected for dating purposes were measured to an accuracy of 0.01mm on a travelling stage. This is connected to an Atari microcomputer which uses a suite of dendrochronology programs written by Ian Tyers (pers comm 1992). The ring sequences were plotted as graphs using an HI-80 Epson plotter attached to the Atari. The graphs were then compared with each other to check for any similarities between the ring patterns which might indicate contemporaneity. This process, known as

crossmatching, is aided by the use of programs on the Atari microcomputer. The crossdating routines are based on versions of CROS (Baillie & Pilcher 1973, Munro 1984) and measure the amount of correlation between two ring sequences. The Student's *t* test is then used as a significance test on the correlation coefficient. All *t* values quoted in this report are identical to those produced by the original CROS program (Baillie & Pilcher 1973). Generally a *t* value of 3.5 or over represents a match, provided that the visual match between the tree-ring graphs is acceptable (Baillie 1982: 82-5).

Dating is usually achieved by crossmatching ring sequences within a phase or building and combining the matching patterns to produce a site master curve. All previously unmatched ring sequences from the site are compared with this master curve and if any additional patterns are found to crossmatch these are incorporated into the site master curve. This master curve and any unmatched ring sequences are then tested against reference chronologies to obtain absolute dates. A master curve is used for absolute dating purposes whenever possible as it enhances the common climatic signal and reduces the background noise resulting from the local growth conditions of individual trees.

The results only date the rings present in the timber and therefore do not necessarily represent the felling date. If the bark or bark edge is present on a sample the exact felling year can be determined. In the absence of bark surface the felling date is calculated using the sapwood estimate of 10-55 rings. This is the range of the 95% confidence limits for the number of sapwood rings on British oak trees over 30 years old (Hillam *et al* 1987). Where sapwood is absent, the addition of 10 rings (the minimum number of sapwood rings expected) to the date of the last measured heartwood ring produces a probable *terminus post quem* for felling. During timber conversion a large number of outer rings could be removed but as this is unquantifiable the actual felling date could be much later.

Once the felling date range or *terminus post quem* for felling has

been calculated, factors such as stockpiling, re-use, repairs and seasoning of timber must be considered since they might affect the interpretation of the tree-ring dates. Seasoning of timber is thought to have been a fairly rare occurrence until relatively recent times. Evidence indicates that timber was generally felled as required and used whilst green (eg Rackham 1990: 69). Construction which utilises primary rather than re-used timber is therefore likely to have occurred shortly after felling. Thus, whilst the date obtained for the measured tree-ring sequence is precise and has been achieved by a completely independent process, the interpretation of tree-ring dates can be refined by studying other archaeological and documentary evidence.

Results

During the initial assessment it was noted that the major structural timbers were all oak. Many timbers were rejected before sampling as unsuitable for dating purposes. This included most of those thought to be associated with the 16th and 17th century alterations.

The principal posts were generally shaped from whole trunks. The remaining structural elements also included timbers shaped from halved and quartered trunks as well as tangentially cut planks. Sapwood was present on only a few timbers, although the method of conversion suggests that many of the timbers, in particular the principal posts, may only have sapwood and a few heartwood rings missing. The samples, details of which are given in Figure 1 and Table 1, indicate that the majority of timbers used in the construction of the farmhouse were derived from trees under approximately 150 years when felled. It is however likely that those associated with the later alterations were generally derived from younger trees.

The ring patterns of seven samples crossmatched (Figure 2; Table 2). Although there is no precisely defined limit, studies on modern samples suggest that those samples which match with *t* values greater than about 10 are likely to have originated from the same tree. The ring width data from 01 and 02 (t = 10.5),

opposing principal posts from truss C-C, were averaged to produce a single sequence so as not to bias the master curve. The data from 12 and 14 (t = 9.5), opposing principal posts from truss E-E, were also combined to produce a single sequence. The visual similarity between the cores themselves suggests that, although the t value is below the arbitrary value of 10, these two timbers may also have been cut from the same tree. The sequences 01/02 and 12/14 were then combined with the data from the other three (04, 06, 07) matching patterns to produce a site master curve, LODGE/T5 (Table 3). This was dated to the period AD1215-1335 by comparison with numerous reference chronologies from the British Isles (Table 4). No consistent results were produced by any of the previously unmatched individual timbers so these, including all those from the later phases, remain undated.

Sapwood and bark edge were present on timber 06 but during sampling the core disintegrated at the heartwood-sapwood transition. The surviving core of sapwood contained 24 rings so, allowing for a few missing rings at the heartwood-sapwood boundary, it is likely that timber 06 was felled in the period AD1355-60.

None of the other six dated timbers had retained any sapwood so a *terminus post quem* for felling has been calculated for each (Table 5). However the method of timber conversion suggests that the outermost measured ring on these samples may be close to the heartwood-sapwood boundary (see above). The results suggest that these timbers may well be contemporary with timber 06 and were all likely to have been felled in the period AD1355-60. Tree-ring analysis therefore indicates a construction date for the farmhouse shortly after felling in AD1355-60.

Conclusion

Analysis of the timbers at Lodge Farm resulted in the production of a dated site chronology spanning the period AD1215-1335. There are relatively few reference chronologies available for the Norfolk area so this sequence is likely to prove useful in future dendrochronological studies carried out in this locality. The

tree-ring analysis shows that the seven dated timbers associated with the primary construction phase were all probably contemporary and were felled during the period AD1355-1360. This corresponds with the mid-14th century date indicated by the architectural style. Unfortunately no tree-ring dates could be obtained for the 16th and 17th century modifications to the medieval farmhouse.

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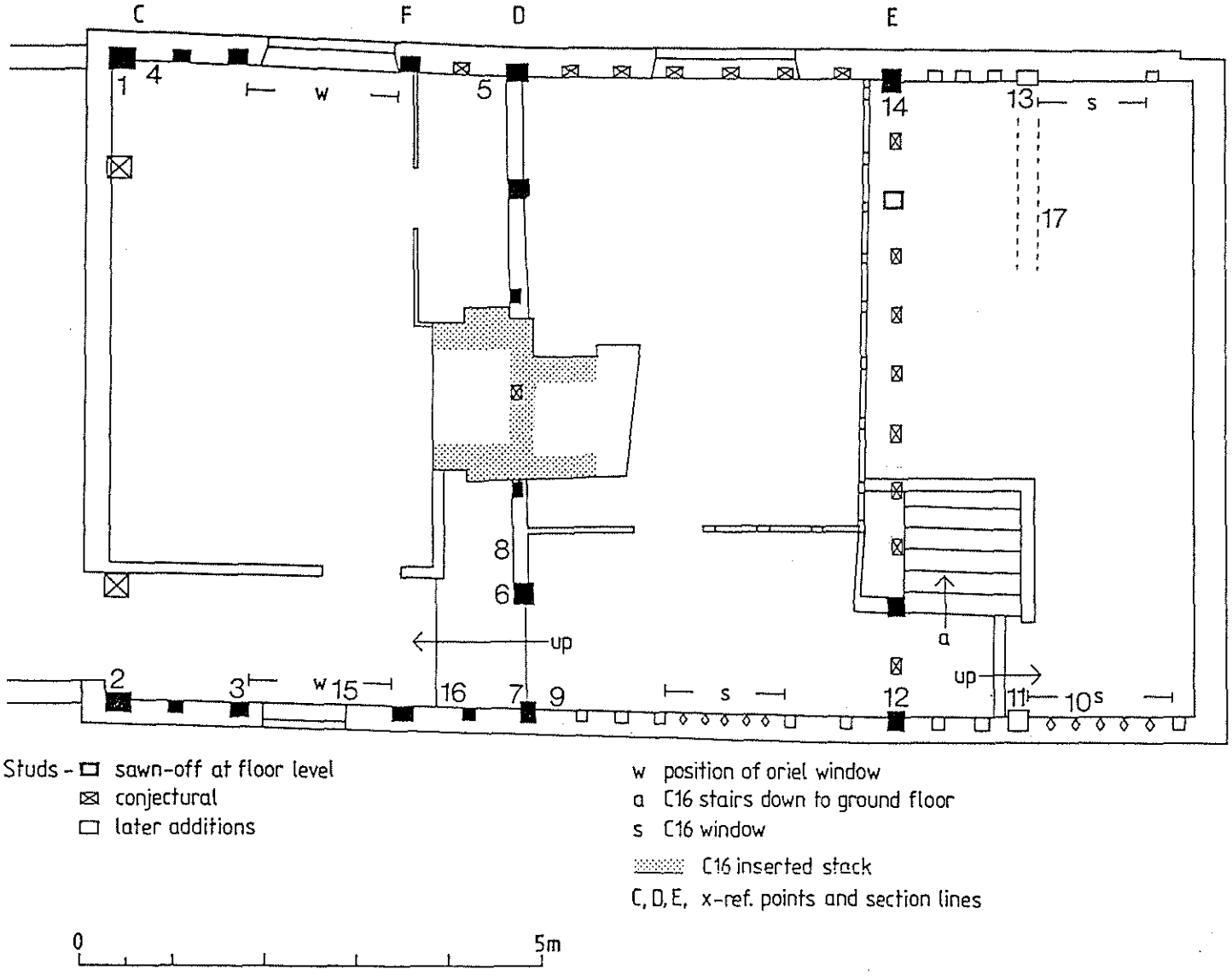

Figure 1: Plan showing the location of the cores (reproduced with permission from Stephen Heywood, Norfolk County Council). Samples 15-17 were taken at ground floor level; all other samples were taken at first floor level.

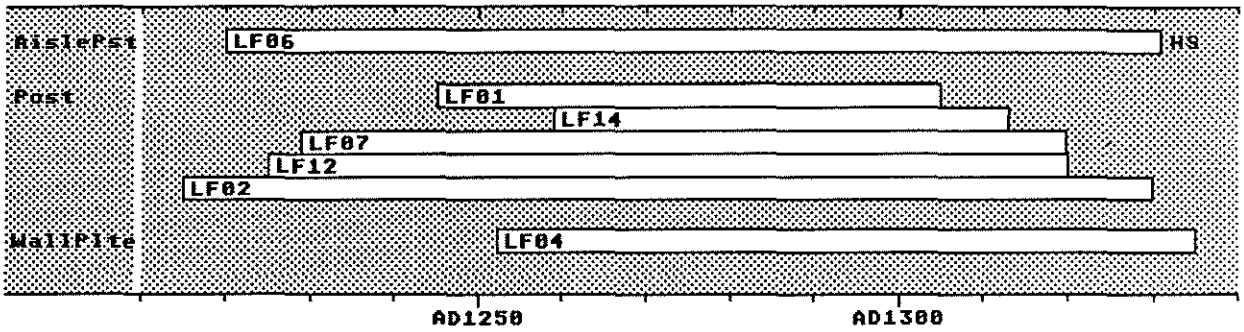

Figure 2: Bar diagram showing the relative positions of the dated ring sequences included in the Lodge Farm site master chronology. Timbers 01 and 02 are from the same tree, as are timbers 12 and 14. White bars - heartwood rings; HS - heartwood/sapwood transition.

Table 1: Details of the tree-ring samples from Lodge Farm, Denton, Norfolk. * - samples from 16th and 17th century alterations; hs - heartwood/sapwood boundary. G - more than 10 rings to the pith; F - more than 5 rings to the pith; V - less than 5 rings to the pith; C - pith; AGR - average growth rate (mm/year).

Sample	Location	Total no of rings	Sapwood rings	Pith	AGR	Comments
01	C-C; west principal post	61	-	F	2.0	-
02	C-C; east principal post	116	-	G	2.5	-
03	C-F; east oriel window; south post	17	-	F	3.5	rejected
04	C-F; west wall plate	84	-	G	2.0	-
05	F-D; west wall plate	40	-	C	2.3	rejected, knotty
06	D-D; raised aisle post	112	hs	G	1.9	+approximately 24 sapwood rings to bark edge
07	D-D; east principal post	92	-	G	2.0	-
08	D-D; east upper brace	17	-	G	2.8	rejected
09	D-E; east wall plate	19	9	G	5.0	rejected
10*	E-north wall; east wall plate	27	-	F	3.3	rejected, knotty
11*	E-north wall; east post south of C16th window	73	2	F	2.5	+15-20 sapwood rings lost during coring; knotty
12	E-E; east principal post	96	-	G	2.4	-
13*	E-north wall; west post	20	-	G	2.0	rejected
14	E-E; west principal post	55	-	G	2.3	-
15*	C-F; east window replacing oriel; north post	50	-	F	2.7	-

Table 1: (cont)

Sample	Location	Total no of rings	Sapwood rings	Pith	AGR	Comments
16*	D-F; east lintel; abuts principal post D-D	20	-	V	2.3	rejected
17*	E-north wall; tiebeam	73	-	C	1.5	-

Table 2: *t* value matrix for the seven matched samples. *t* values of less than 3.0 are not given.

	01	02	04	06	07	12	14
01	*	10.5	4.1		3.2	4.0	3.2
02		*	3.8		3.2		3.1
04			*	3.4	5.0	5.6	5.9
06				*	4.1	3.6	3.8
07					*	5.8	3.8
12						*	9.5

Table 3: Ring width data of the Lodge Farm site master chronology, AD1215-1335. The ring widths are in units of 0.01mm.

year	ring widths										numbers of trees per year									
AD1215					432	474	601	523	658	473					1	1	1	1	1	2
	502	411	415	526	496	678	668	584	584	404	2	2	2	2	3	3	3	3	4	4
	303	293	305	263	243	205	275	200	207	219	4	4	4	4	4	4	4	4	4	4
	266	272	358	257	280	206	204	147	136	156	4	4	4	4	4	4	4	4	4	4
AD1251	217	183	296	249	284	166	296	162	211	182	4	5	5	5	5	5	5	5	5	5
	162	256	172	196	192	181	161	234	214	179	5	5	5	5	5	5	5	5	5	5
	230	175	163	127	182	179	254	191	193	214	5	5	5	5	5	5	5	5	5	5
	225	262	200	222	175	159	139	175	281	262	5	5	5	5	5	5	5	5	5	5
	252	231	232	149	192	259	245	183	202	158	5	5	5	5	5	5	5	5	5	5
AD1301	173	175	169	201	151	143	183	160	232	217	5	5	5	5	5	5	5	5	5	5
	153	151	154	189	204	188	166	150	134	139	5	5	5	5	5	5	5	5	5	5
	144	109	135	113	111	82	117	132	175	162	3	3	3	3	3	3	3	3	3	3
	101	105	122	118	111						2	1	1	1	1					

Table 4: Dating the Lodge Farm site master chronology, AD1215-1335. All reference chronologies are independent.

reference chronology	*t* value
Baylolls Manor, Harwell, Oxon (Miles & Haddon-Reece pers comm)	4.00
Calverley Hall, West Yorkshire (Hillam 1982)	5.39
Church Farm barn, Lewknor, Oxon (Haddon-Reece *et al* 1990)	3.36
East Midlands (Laxton & Litton 1988)	5.72
Grimsby2 (Groves 1992)	3.74
London: Southwark (Tyers pers comm)	6.18
Oxford (Haddon-Reece, Miles, Munby & Fletcher pers comm)	3.44
Reading (Groves *et al* 1985)	4.84
Southern England (Bridge 1988)	5.45
Germany: South (Becker 1981)	3.57
Weser & Leine (Delorme 1972)	3.56

Table 5: Summary of the tree-ring dates. + - indicates unmeasured rings.

Sample	Date span of measured rings	Felling date
01	AD1245-1305	after AD1340 (same tree as 02)
02	AD1215-1330	after AD1340 (same tree as 01)
04	AD1252-1335	after AD1345
06	AD1220-1331+	AD1355-60
07	AD1229-1320	after AD1330
12	AD1225-1320	after AD1330 (same tree as 14)
14	AD1259-1313	after AD1330 (same tree as 12)