Oxford Dendrochronology Laboratory
Report 2016/33

DENDROCHRONOLOGICAL DATING OF TIMBERS AT THE RED LION HOTEL, HIGH STREET COLCHESTER, ESSEX (TL 9968 2521)

Summary

This report updates an earlier preliminary report (2016/29) with the addition of further timbers sampled. A number of areas within this building were looked at and some areas were sampled – namely the front west corner, the rear west range and parts of the east range. The bar area at first floor on the east range (potentially Phase II, linking the 'southern hall' and the front range [Stenning]) was sampled after the initial study, and although no complete sapwood was found – this area looks to be of very similar date to the other areas.

Many of the timbers had rather short sequences and some matching between timbers was poor. Two timbers from the front range (possible third phase of construction) did however date, two corner posts of the front west room. One timber was felled in **winter 1475/76**, and a second with detached sapwood was probably felled at the same time, or within a very few years of this date. A post from the 'southern hall' in the rear of the west range matched a corner post at the rear of the east range. These were subsequently dated and have a very similar felling date, the 'southern hall' timber having a last measured ring of **1475**, and although this looked like the final ring on the timber itself, this was uncertain on the core. Timbers from the east range and the section between the 'southern hall' and the front range on the west side also have similar felling date ranges, and it now appears that all sections were built within a very short timescale.

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BACKGROUND TO DENDROCHRONOLOGY

The basis of dendrochronological dating is that trees of the same species, growing at the same time, in similar habitats, produce similar ring-width patterns. These patterns of varying ring-widths are unique to the period of growth. Each tree naturally has its own pattern superimposed on the basic 'signal', resulting from genetic variations in the response to external stimuli, the changing competitive regime between trees, damage, disease, management etc.

In much of Britain the major influence on the growth of a species like oak is, however, the weather conditions experienced from season to season. By taking several contemporaneous samples from a building or other timber structure, it is often possible to cross-match the ring-width patterns, and by averaging the values for the sequences, maximise the common signal between trees. The resulting 'site chronology' may then be compared with existing 'master' or 'reference' chronologies. These include chronologies made by colleagues in other countries, most notably areas such as modern Poland, which have proved to be the source of many boards used in the construction of doors and chests, and for oil paintings before the widespread use of canvas.

This process can be done by a trained dendrochronologist using plots of the ring-widths and comparing them visually, which also serves as a check on measuring procedures. It is essentially a statistical process, and therefore requires sufficiently long sequences for one to be confident in the results. There is no defined minimum length of a tree-ring series that can be confidently cross-matched, but as a working hypothesis most dendrochronologists use series longer than at least fifty years.

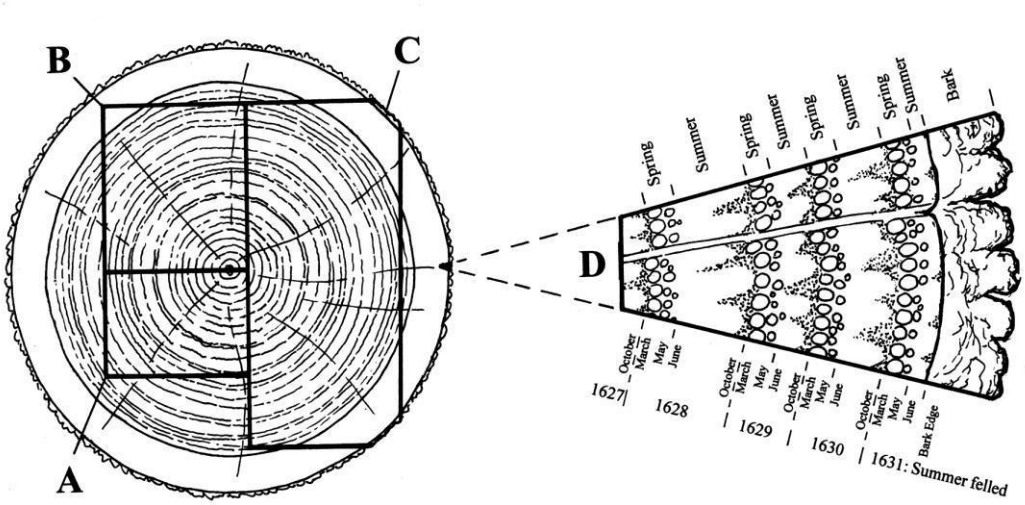
The dendrochronologist also uses objective statistical comparison techniques, these having the same constraints. The statistical comparison is based on programs by Baillie & Pilcher (1973, 1984) and uses the Student's *t*-test. The *t*-test compares the actual difference between two means in relation to the variation in the data, and is an established statistical technique for looking at the significance of matching between two datasets that has been adopted by dendrochronologists. The values of '*t*' which give an acceptable match have been the subject of some debate; originally values above 3.5 being regarded as acceptable (given at least 100 years of overlapping rings) but now 4.0 is often taken as the base value in oak studies. Higher values are usually found with matching pine sequences. It is possible for a random set of numbers to give an apparently acceptable statistical match against a single reference curve – although the visual analysis of plots of the two series usually shows the trained eye the reality of this match. When a series of ring-widths gives strong statistical matches in the same position against a number of independent chronologies the series becomes dated with an extremely high level of confidence.

One can develop long reference chronologies by cross-matching the innermost rings of modern timbers with the outermost rings of older timbers successively back in time, adding data from numerous sites. Data now exist covering many thousands of years and it is, in theory, possible to match a sequence of unknown date to this reference material.

It follows from what has been stated above that the chances of matching a single sequence are not as great as for matching a tree-ring series derived from many individuals, since the process of aggregating individual series will remove variation unique to an individual tree, and reinforce the common signal resulting from widespread influences such as the weather. However, a single sequence can be successfully dated, particularly if it has a long ring sequence.

Growth characteristics vary over space and time, trees in south-eastern England generally growing comparatively quickly and with less year-to-year variation than in many other regions (Bridge, 1988). This means that even comparatively large timbers in this region often exhibit few annual rings and are less useful for dating by this technique.

When interpreting the information derived from the dating exercise it is important to take into account such factors as the presence or absence of sapwood on the sample(s), which indicates the outer margins of the tree. Where no sapwood is present it may not be possible to determine how much wood has been removed, and one can therefore only give a date after which the original tree must have been felled. Where the bark is still present on the timber, the year, and even the time of year of felling can be determined. In the case of incomplete sapwood, one can estimate the number of rings likely to have been on the timber by relating it to populations of living and historical timbers to give a statistically valid range of years within which the tree was felled. For this region the estimate used is that 95% of oaks will have a sapwood ring number in the range 9 – 41 (Miles 1997).



Section of tree with conversion methods showing three types of sapwood retention resulting in **A** *terminus post quem*, **B** a felling date range, and **C** a precise felling date. Enlarged area **D** shows the outermost rings of the sapwood with growing seasons (Miles 1997, 42)

The Red Lion Hotel (Notes from Dave Stenning 1994)

The building is complex and is well-described in Stenning 1994, which should be read in association with this report. In brief however, the first phase of what exists on the site today is the 'southern hall' which has a long axis approximately north-south. This has a crown-post roof with thin, flat braces. The main posts do not have jowls. RCHME considered this range to be later than the range to the north of it (unsampled as yet), but DFS argues that it is probably earlier. The frontage range has jowless posts and tension ('Colchester') bracing pegged to studs rather than principal posts. The elaborate front facing the road appears to have been built as shops at ground floor level.

SAMPLING

Initial samples were taken in August 2016, with subsequent sampling undertaken in October 2016. The locations of the samples are described in Table 1, with some being illustrated in Figs 1 and 2. Core samples were extracted using a 15mm diameter borer attached to an electric drill. They were labelled (prefix **rlnc**) and were polished with progressively finer grits down to 400 to allow the measurement of ring-widths to the nearest 0.01 mm. The samples were measured under a binocular microscope on a purpose-built moving stage with a linear transducer, attached to a desktop computer. Measurements and subsequent analysis were carried out using DENDRO for WINDOWS, written by Ian Tyers (Tyers 2004).

RESULTS AND DISCUSSION

Details of the samples are given in Table 1. Many of the samples yielded rather short sequences and cross-matching between them was limited, with many not dating independently against the reference material either. In some instances (e.g. **rlnc13**) the lack of dating for long sequences was probably due to the presence of bands of very narrow rings.

Seven timbers were cross-matched (Table 2) and combined into a 189-year long site chronology (**REDLION**), which gave very strong matching against the database (Table 3) – with the distribution of sites matched suggesting the timber was of local origin.

One timber retained complete sapwood (**rlnc31**) – the corner post in the north-west corner, this being the front range parallel to the street. This was formed from a tree felled in winter 1475/76. A second timber (**rlnc02**), a west post in the 'southern hall', also retained complete sapwood on the timber, but this was not clear on the sample. Although it was thought that no rings were lost, the felling range is given as 1475-77 to take account of the possibility that there was some small loss. This date was a little earlier than stylistic evidence suggested, and this phase was thought to be later than the rear ranges.

The other dated timbers have similar likely felling date ranges (Fig 3). Without complete sapwood it is not possible to be more precise, but it would appear that all the ranges were built in rapid succession and may be considered near contemporaneous, with the rear 'southern hall' and front range being built in the 1470s.

This was something of a surprise result, it initially being thought that the front range was probably later than the 'southern hall', possibly by a few decades, with the front range thought to be younger than the dating has revealed.

ACKNOWLEDGEMENTS

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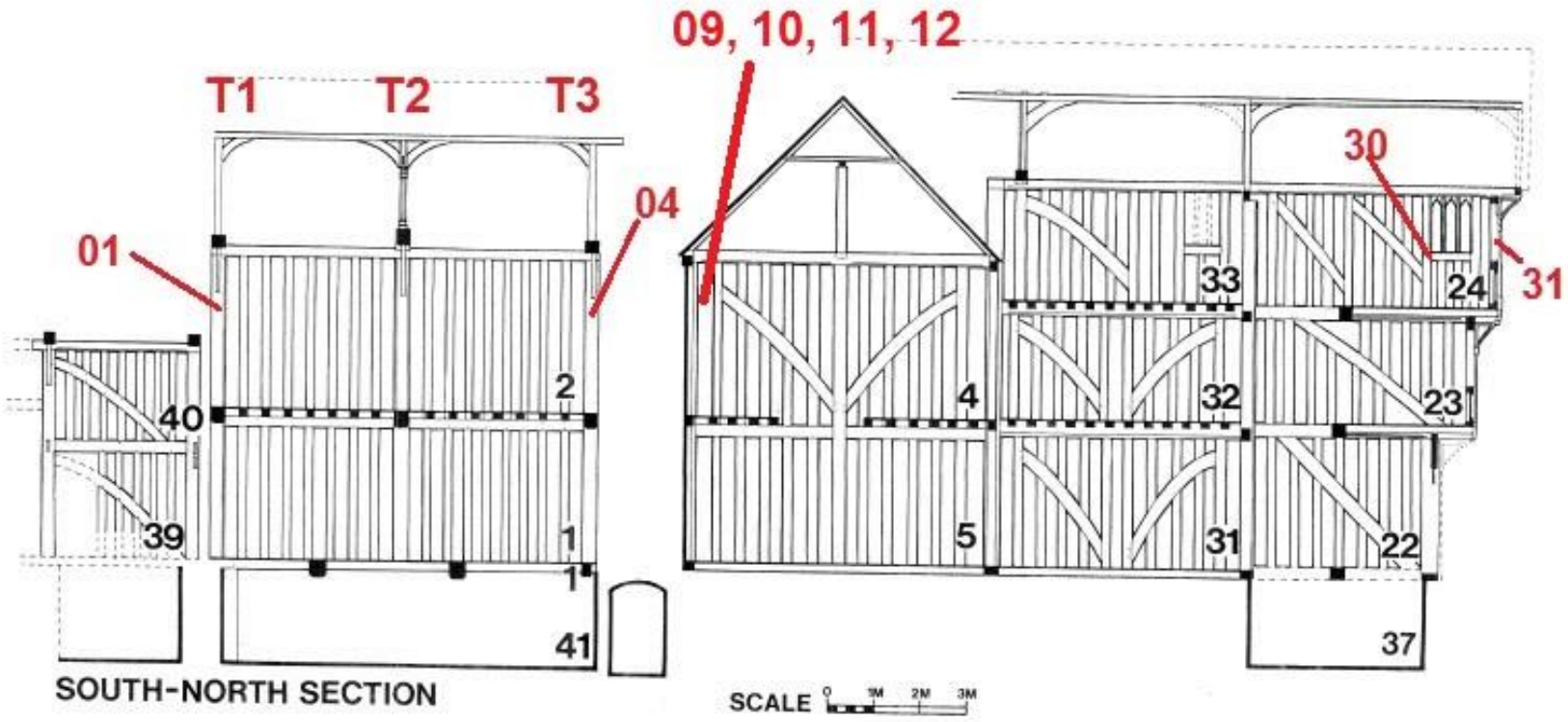

Figure 1: Cross-section of west and front ranges showing the west wall and some of the timbers sampled (adapted from original in Stenning 1994). Samples 09, 10, 11 and 12 are all from the same partition cross-frame (see Fig 2).

Figure 2: View of the east end of the cross-frame (from the north) between the 'southern hall' and the bar area (potentially Phase II), showing two of the timbers sampled (the other two from this frame being on the west side)

Table 1: Details of samples taken from the cellars, The Red Lion Hotel, Colchester.

Sample number	Timber and position	Date of series	H/S boundary date	Sapwood complement	No of rings	Mean width (mm)	Std devn (mm)	Mean sens	Felling date range
West range 'southern hall' at first floor level									
rlnc01	South-west corner post, truss 1	-	-	H/S	48	3.09	1.64	0.19	-
*** rlnc02**	Post in west wall, truss 2	1413–1475	1458	17 nrC?	63	2.29	0.94	0.17	1475–77
rlnc03	Post in east wall, truss 2	-	-	2	41	3.74	1.08	0.17	-
rlnc04	North-west corner post, truss 3	-	-	19C	78	1.72	0.96	0.18	-
East range, first floor level									
*** rlnc05**	South-west corner post at rear	1412–1459	1459	H/S	48	2.86	0.95	0.18	1468–1500
rlnc06	South-west corner to wider section	-	-	9	95	1.22	0.43	0.16	-
rlnc07	North-east corner post to 2nd room from south	-	-	?H/S	54	2.79	1.27	0.26	-
rlnc13	West post by entrance to Reception	-	-	H/S	110	1.44	0.88	0.21	-
West range second floor level									
rlnc08	Front corner of rear range? outside Rm 7	-	-	22C	66	1.27	0.40	0.19	-
West range between 'southern hall' and front range, first floor level									
*** rlnc09**	Mid-rail between eastern posts	1287–1458	1456	2	172	1.02	0.46	0.18	1465–1497
*** rlnc10**	West inner post	1368–1445	1445	H/S	78	0.83	0.28	0.23	1454–1486
rlnc11	East inner post	-	-	-	52	2.55	0.72	0.18	
*** rlnc12**	West outer post	1362–1438	-	-	77	2.04	0.54	0.18	After 1447
Front range facing High Street at first floor level									
rlnc30	West wall, inner window jamb	-	-	H/S	<40	NM	-	-	-
*** rlnc31**	North-west corner post	1299–1475	1462	13C	177	1.11	0.25	0.17	Winter 1475/76
*** rlnc32**	South-east corner post to west room	1392–1458	1458	H/S +17NM?C	67	1.82	0.44	0.21	1475–80
rlnc33	Central south post to mid-truss, west room	-	-	5	71	1.21	0.36	0.17	-
*** =** included in site master **REDLION**		**1287–1475**			**189**	**1.39**	**0.36**	**0.15**	

Key: H/S bdry = heartwood/sapwood boundary - last heartwood ring date; C = complete sapwood present, felled the following winter; std devn = standard deviation; mean sens = mean sensitivity; NM = not measured.

Table 2: Cross-matching between the dated samples
(*t*-values above 3.5 are significant)

	t-value					
Sample	**rInc05**	**rInc09**	**rInc10**	**rInc12**	**rInc31**	**rInc32**
rInc02	6.2	2.1	*	*	4.0	2.6
rInc05		2.1	*	*	4.2	3.9
rInc09			3.0	5.1	9.7	3.1
rInc10				4.9	4.6	2.5
rInc12					7.8	3.1
rInc31						6.3

* = overlap too short to calculate value

Table 3: Dating evidence for the site master **REDLION** **AD 1287–1475** against dated reference chronologies

County or region:	***Chronology name:***	***Reference***	***File name:***	***Spanning***	***Overlap: (yrs)***	***t-value:***
Regional Chronologies						
East Anglia	East Anglia Master Chronology	(Bridge 2003)	**ANGLIA03**	944–1789	189	10.3
Southern England	Southern England Master	(Bridge 1988)	**SENGLAND**	1083–1589	189	7.8
London	London Master Chronology	(Tyers pers comm)	**LONDON**	413–1728	189	7.7
Site Chronologies						
London	White Tower, Tower of London	(Miles 2007)	WHTOWR5	1260–1489	189	9.6
Essex	Thaxted Church Chancel	(Bridge 2005)	THXTDCH	1212–1404	118	9.2
Essex	Stow's Farm, Tillingham	(Miles and Bridge 2014)	STOWSFM	1323–1471	149	8.5
Essex	Falconer's Hall, Good Easter	(Bridge 1996)	FALCONER	1324–1457	134	8.5
Essex	St Mary's, Saffron Walden	(Bridge 2001a)	SAFFRON1	1305–1475	171	8.3
Essex	Upper Town Cottage, Nazeing	(Miles and Bridge 2014)	NAZEING	1323–1461	139	7.6
Suffolk	Panelling, Otley Hall	(Tyers 2000)	OTLEY_EN	1380–1555	96	7.4
Suffolk	Hengrave Hall, Hengrave	(Bridge 2001b)	HENGRAVE	1367–1512	109	7.3
Norfolk	Hales Hall, Loddon	(Arnold and Howard 2014)	HHBASQ01	1236–1494	189	7.2
Cambridgeshire	Soham Church	(Bridge 2008)	SOHAM	1306–1477	170	7.1

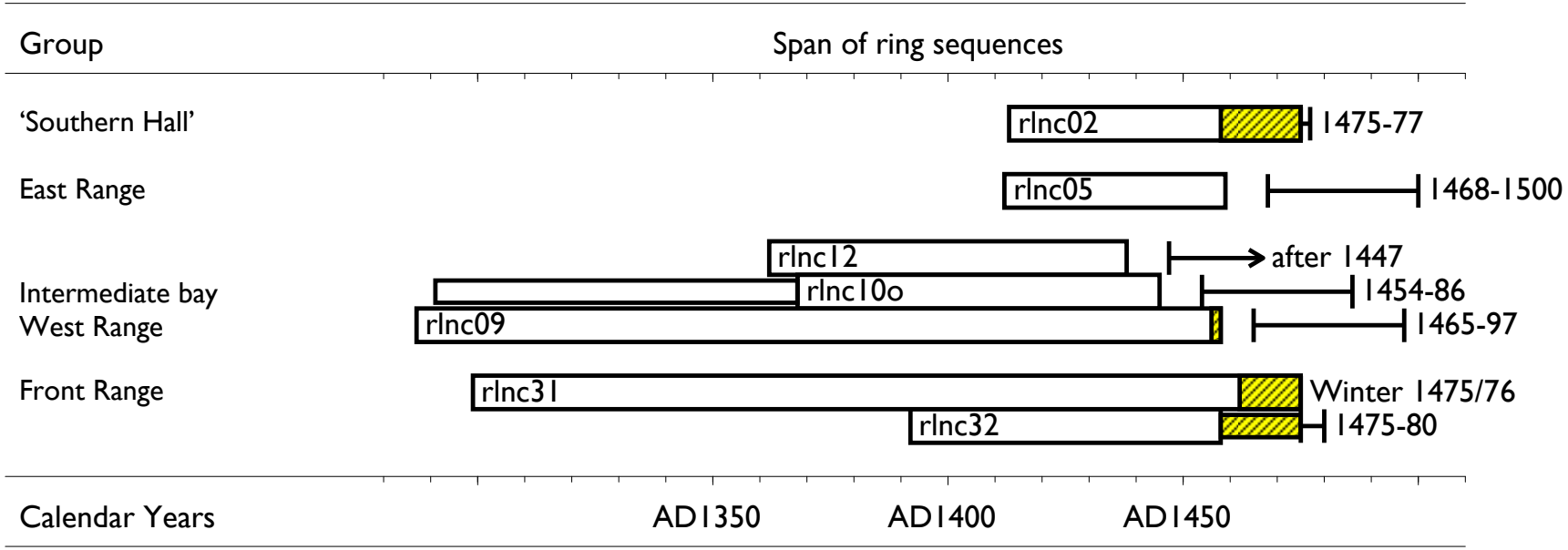

Figure 3: Bar diagram showing the relative positions of overlap of the dated samples, with their actual or likely felling dates / date ranges.
White sections represent heartwood rings and yellow hatched sections represent sapwood, with narrow sections of bar representing unmeasured rings.

REFERENCES

Arnold, A. and Howard, R. (2014) *Hales Hall, Litchmere Lane, Loddon, Norfolk: Tree-ring analysis of timbers from the hall range, barn and bothy*, **English Heritage Res Dept Rep Ser**, 58-2014.

Baillie, M.G.L. and Pilcher, J.R. (1973) *A simple cross-dating program for tree-ring research.* **Tree Ring Bulletin**, 33, 7-14.

Bridge, M. C. (1988) *The dendrochronological dating of buildings in southern England*, **Medieval Archaeology**, 32, 166-174.

Bridge, M. C. (1996) List 69 - Tree-ring dates, **Vernacular Architecture**, 27, 91-92.

Bridge, M. C. (2001a) List 115 - Tree-ring dates, **Vernacular Architecture**, 32, 70-74.

Bridge, M. C. (2001b) *Tree-ring analysis of timbers from Hengrave Hall, Hengrave, Suffolk*, **Centre for Archaeology Rep**, 111/2001.

Bridge, M. C. (2003) Compilation of master chronologies from East Anglia, unpublished computer file ANGLIA03, University College London Dendrochronology Laboratory.

Bridge, M. C. (2005) *Tree-ring analysis of timbers from the church of St John the Baptist, Thaxted, Essex*, **Centre for Archaeology Rep**, 35/2005.

Bridge, M. C. (2008) *The tree-ring analysis of timbers from the nave roof, Church of St Andrew, Soham, Cambridgeshire*, **English Heritage Res Dept Rep Ser**, 15/2008.

English Heritage (1998) *Guidelines on producing and interpreting dendrochronological dates,* **English Heritage, London.**

Miles, D. (1997) *The interpretation, presentation, and use of tree-ring dates*, **Vernacular Architecture**, 28, 40-56.

Miles, D. (2007) *The Tree-Ring dating of the White Tower, HM Tower of London (TOL99 and TOL100), London Borough of Tower Hamlets,* **English Heritage Research Dept Rep Ser**, 35/2007.

Miles, D. H. and Bridge, M. C. (2014) Tree Ring Dating Lists, **Vernacular Architecture**, 45, 115-119.

Stenning , D.F. (1994) *The Red Lion, Colchester,* **Essex Archaeology and History,** 25, 134-159.

Tyers, I, (2000) *Tree-ring analysis of panelling from Otley Hall, Otley, Suffolk*, **ARCUS Rep**, 550.

Tyers, I. (2004) *Dendro for Windows Program Guide 3rd edn*, **ARCUS Report,** 500b**.**