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THE OLD MANOR HOUSE,
1 WEST END,
LONG CLAWSON,
LEICESTERSHIRE;

TREE-RING ANALYSIS OF TIMBERS

ALISON ARNOLD
ROBERT HOWARD

MARCH 2014

NTRDL, 20 Hillcrest Grove, Sherwood, Nottinghamshire NG5 1FT
Telephone 0115 960 3833 (office); 07913 427987 (mobile)

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SUMMARY

Eight core samples were obtained from the timbers to the roofs of the front wing and rear range of the Old Manor House, Long Clawson, along with four samples from the ceilings to the first and ground floors of the rear range. Analysis by dendrochronology of these cores resulted in the production of a single dated site chronology comprising 11 samples, this site chronology being 162 rings long, these rings dated as spanning the years 1441–1602.

Interpretation of the sapwood on the dated samples would suggest that the timbers of the two roofs and the first floor ceiling of the rear range were felled as part of a single episode of felling undertaken at some point between, say, 1610 at the earliest and 1615 at the latest.

The ground floor ceiling beams of the rear range (ie, to the kitchen), however, would appear to be somewhat earlier, these having an estimated felling of circa 1580.

One sample remains ungrouped and undated.

NTRDL, 20 Hillcrest Grove, Sherwood, Nottingham, NG5 1FT
Telephone 0115 960 3833 (laboratory);
07980 305583 / 07913 427987 (Mobiles)
roberthoward@tree-ringdating.co.uk
alisonarnold@tree-ringdating.co.uk

Introduction

The Old Manor House at Long Clawson (SK 722 271, Fig 1a/b) is of L-shape plan, with a stair turret in the angle between the rear range and the front wing. It is constructed of ironstone ashlar beneath a Swithland slate roof with stone lateral stacks with brick flues, and is thought to have been built in two phases. The earlier phase, being the west end of the rear range, is believed to have been built around 1580 by Edward Hastings, who had sometime before this acquired the great tithes of Clawson. The remainder was finished by his son Henry, Sherriff of Leicester, who came to live there briefly in the 1620's, and may have intended it for his second son Richard, but the family appears to have sold up around 1630.

The main front faces south to the garden and has a single storey porch (possibly an earlier survivor as this appears to be more Gothic than Tudor) set slightly east of the centre of the south elevation with double-chamfered doorway to left side with imposts, a pointed arched head and hood mould, with decayed two-light hollow-chamfered stone mullion window to front and a similar window to right side, both with hood moulds.

The gable end of the front wing, facing north the street, has a two-light window to ground floor and a similar four-light window to the first floor, both with hood moulds. There are similar three-light windows to left side of the wing, that to ground floor innermost has mullions replaced by casements, both with hood moulds.

There is a gabled stair turret in the angle between the front wing and the main range, its door, facing street, with a stone Tudor-arched head. The gables of wing and main range are all now of red brick, probably replacing timber framing; that to stair turret is still timber-framed.

Within, particularly to the roofs, the building contains a substantial amount of timberwork, this forming principal rafter with tiebeam and collar trusses to the roofs of both ranges (Fig 2a/b), and the beams to the first and ground floor ceilings. The roof structure appears to be designed as a whole, originally with three full height gables on the south front, recent reroofing works revealing a complete numbering sequence for the principal trusses and spars.

Sampling

The Old Manor House at Long Clawson has already been the subject of a programme of tree-ring analysis, this being undertaken in July 1990 on the roof timbers only, with a total of eight core samples being then taken. This earlier work indicated that the timbers of the roof were felled in a single episode of felling some time between 1610–15. Since that time the Old Manor House has been bought by the present owners, the Reverend Simon and Mrs Sally–Ann Shouler, who have undertaken a certain amount of restoration and conservation work to the property. As the west end of the rear range appears stylistically different and earlier than the remainder, the present owners requested a further programme of sampling concentrating on that part, in particular the ceiling beams on each floor.

Thus, from the timbers, a further four core samples were obtained, two from the first floor ceiling beams and two from the ground floor ceiling in the kitchen. These additional four samples were then analysed in conjunction with the eight previously obtained. Each sample has been given the code LNG-C (for Long Clawson), and numbered 01–12. The positions of the sampled roof timbers are shown on a simple schematic sketch plan made at the time of sampling, given here as Figure 3, while the ceiling timbers are located on annotated photographs, given here as Figure 4a/b. In this report, the timbers and sample positions are located on a north–south or east–west basis as appropriate, the street entrance of West End deemed to be to the north side of the building. Details of the samples are given in Table 1, including the timber sampled and its location, the total number of rings each sample has, and how many of these, if any, are sapwood rings. The individual date span of each dated sample is also given.

The Nottingham Tree-ring Dating Laboratory would like to take this opportunity to thank the owners of the Old Manor House, the Reverend and Mrs Shouler, for their enthusiasm and interest in this programme of analysis, and particularly for their generous funding of this work.

Tree-ring dating

Tree-ring dating relies on a few simple, but quite fundamental, principles. Firstly, as is commonly known, trees (particularly oak trees, the timber most commonly used in building construction until the introduction of pine from the late eighteenth century onwards) grow by adding one, and only one, growth-ring to their circumference each, and every, year. Each new annual growth-ring is added to the outside of the previous year's growth just below the bark. The width of this annual growth-ring is largely, though not exclusively, determined by the weather conditions during the growth period (roughly March–September). In general, good conditions produce wider rings and poor conditions produce narrower rings. Thus, over the lifetime of a tree, the annual growth-rings display a climatically influenced pattern. Furthermore, and importantly, all trees growing in the same area at the same time will be influenced by the same growing conditions and the annual growth-rings of all of them will respond in a similar, though not identical, way (see Fig 5).

Secondly, because the weather over a certain number of consecutive years (the statistically reliable minimum calculated as being 54 years) is unique, so too is the growth-ring pattern of the tree. The pattern of a shorter period of growth, 20, 30**,** or even 40 consecutive years, might conceivably be repeated two or even three times in the last one thousand years, and is considered less reliable. A short pattern might also be repeated at different time periods in different parts of the country because of differences in regional micro-climates. It is less likely, however, that such problems would occur with the pattern of a longer period of growth, that is, anything in excess of 45 years or so. In essence, a short period of growth, anything less than 45 rings, is not reliable, and the longer the period of time under comparison the better.

Tree-ring dating relies on obtaining the growth pattern of trees from sample timbers of unknown date by measuring the width of the annual growth-rings. This is done to a tolerance of 1/100 of a millimeter. The growth patterns of these samples of unknown date

are then compared with a series of reference patterns or chronologies, the date of each ring of which is known. When the growth-ring sequence of a sample 'cross-matches' repeatedly at the same date span against a series of different reference chronologies the sample can be said to be dated. The degree of cross-matching, that is the measure of similarity between sample and reference, is denoted by a '*t*-value'; the higher the value the greater the similarity. The greater the similarity the greater is the probability that the patterns of samples and references have been produced by growing under the same conditions *at the same time*. The statistically accepted fully reliable minimum *t*-value is 3.5.

However, rather than attempt to date each sample individually it is usual to first compare all the samples from a single building, or phase of a building, with one another, and attempt to cross-match each one with all the others from the same phase or building. When samples from the same phase do cross-match with each other they are combined at their matching positions to form what is known as a 'site chronology'. As with any set of data, this has the effect of reducing the anomalies of any one individual (brought about in the case of tree-rings by some non-climatic influence) and enhances the overall climatic signal. As stated above, it is the climate that gives the growth pattern its distinctive pattern. The greater the number of samples in a site chronology the greater is the climatic signal of the group and the weaker is the non-climatic input of any one individual.

Furthermore, combining samples in this way to make a site chronology usually has the effect of increasing the time-span that is under comparison. As also mentioned above, the longer the period of growth under consideration, the greater the certainty of the cross-match. Any site chronology with less than about 50 rings is generally too short for reliable dating.

Having obtained a date for the site chronology as a whole, the date spans of the constituent individual samples can then be found, and from this the felling date of the trees represented may be calculated. Where a sample retains complete sapwood, that is, it has the last or outermost ring produced by the tree before it was cut, the last measured ring date is the felling date of the tree.

Where the sapwood is not complete it is necessary to estimate the likely felling date of the tree. Such an estimate can be made with a high degree of reliability because oak trees generally have between 15 to 40 sapwood rings. For example, if a sample with, say, 12 sapwood rings has a last sapwood ring date of 1400 (and therefore a heartwood/sapwood boundary ring date of 1388), it is 95% certain that the tree represented was felled sometime between 1403 (1400+3 sapwood rings (12+3=15)) and 1428 (1400+28 sapwood rings (12+28=40)).

Analysis

Each of the 12 samples obtained from the various timbers of both ranges have been prepared by sanding and polishing and the widths of their annual growth rings measured. The data of these measurements were then compared with each other as described in the notes above. This comparative process indicated that 11 of the 12 samples (all but sample LNG-C03) cross-matched with each other and could be formed into one single group, the length, relative position, and overlap of the samples being shown in the bar diagram Figure 6

(the bars being sorted into sample locations). These 11 samples were combined at their indicated off-set positions to form LNGCSQ01, a site chronology with an overall length of 162 rings. This site chronology was then satisfactorily dated by repeated and consistent comparison with a number of relevant reference chronologies for oak as spanning the years 1441 to 1602. The evidence for this dating is given in the *t*-values of Table 2.

Site chronology LNGCSQ01 was then compared with the single remaining ungrouped sample, but there was no further satisfactory cross-matching. The single remaining sample was then compared individually with the full corpus of reference material, but again there was no further cross-matching and it must, therefore, remain undated for the moment.

Interpretation

Interpretation of the sapwood on the dated samples, and the relative position of the heartwood/sapwood boundary on them, would strongly suggest that two phases of felling are represented amongst the timbers of the Old Manor House.

Later phase timbers – 1610–15

One phase is represented by all the dated timbers of the roof and by the two timbers of the first floor ceiling, ie, by samples LNG-C01–C10 (except for the undated sample, LNG-C03). None of these 10 samples actually retain the last ring produced by the trees represented before they were felled, and it is thus not possible to be absolutely certain as to precisely when they were cut. A number of samples, however, come from timbers which do have complete sapwood on them, but from which, due to the soft and fragile nature of this part of the wood, small portions of sapwood were lost from the samples in coring, this situation being denoted by lower case 'c' in Table 1 and the bar diagram, Figure 6.

In such circumstances it is possible, at the time of sampling, to note, in millimetres, how much of the sapwood has been lost from the sample in coring. On return to the Laboratory it is possible, using the extant sapwood rings still present on the core, to estimate how many rings the lost sapwood element might have contained. In this case, allowing for the relative position and dates of the heartwood/sapwood boundary on the relevant samples, and the date of the latest dated ring on any individual core, it is possible to estimate that the timbers represented by these 10 samples were felled as part of a single programme of felling at some point between, say, 1610 at the earliest and 1615 at the latest.

Earlier phase timbers – ca 1580

An earlier phase of felling, however, appears to be represented by the ground floor ceiling timbers, cored as samples LNG-C11 and C12. As may be seen from Table 1 and the bar diagram Figure 6, the heartwood/sapwood boundary on these two samples is at a much earlier relative position and date than on those believed to have been felled in 1610–15. As may be seen, the heartwood/sapwood boundary of the later samples all lie in the 1580s and 90s (the average boundary date being 1592), while that on the earlier samples is in the 1550s (the average being 35 years earlier at 1557). Were the two ground floor ceiling

timbers also to have been felled in, say, 1610, they would have required almost 60 sapwood rings at least, an almost unheard of number in tree-ring studies.

Indeed, the view that the two ground floor ceiling timbers are indeed earlier is supported by the fact that sample LNG-C11 is also from a timber with complete sapwood on it (that is, the beam has the last ring produced by the tree before felling), although again, a small amount of sapwood has been lost from the core in sampling. In this case it is estimated that the lost portion of core represents about 5–8 sapwood rings. Given that the last extant ring on sample LNG-C11 is dated to 1572, such a loss would suggest that these two timbers were felled in, or very close to, 1580. As such, this date would fit very well with the believed history of the house and its connection of about this time with Edward Hastings.

The dating of these timbers would suggest that either the earlier phase building was left incomplete and open to the skies in after 1580 (though this is unlikely considering the generally good condition of the ground floor ceiling), or that for some reason the roof, including the first floor ceiling beams which constitute the base of the triangular roof trusses, was replaced entirely when the second phase was built 35 years later.

Undated sample

One of the 12 samples obtained from the Old Manor House, LNG-C03, remains ungrouped and undated. With 60 rings, it would certainly appear to contain sufficient data for reliable analysis, and there appear to be no problems with its growth such as compressed or very narrow rings, or any distortion, which would make dating difficult. However, it is not uncommon in most programmes of tree-ring analysis to find that some samples are undated, many of them for no apparent reason.

Woodland source

In this instance it is not possible to be very precise as to the location of the woodland source for the timbers utilised for the construction of the Old Manor House at Long Clawson. However, as may be seen from Table 2, although site chronology LNGCSQ01 has been compared with reference chronologies from all parts of Britain, the highest *t*-values (or the greatest degrees of similarity), are found against those chronologies made up of material from other sites in in the surrounding locality, particularly from Preston in Rutland, about 20 miles to the south of Long Clawson, and from Welham in Leicestershire, about 25 miles to the south west. This could be taken as some indication as to the general area in which the source woodland was situated.

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Table 1: Details of tree-ring samples from the Old Manor House, 1 West End, Long Clawson, Leicestershire

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Heart/sap boundary (AD)	Last measured ring date (AD)
LNG-C01	North principal rafter, rear range, truss 2	74	h/sc	1525	1598	1598
LNG-C02	North purlin, rear range, truss 5 – 6,	77	18c	1526	1584	1602
LNG-C03	South purlin, rear range, truss 5 – 6,	60	h/sc	------	------	------
LNG-C04	North common rafter, rear range, truss 5	74	h/sc	1523	1596	1596
LNG-C05	West principal rafter, front wing, truss 2	78	h/s	1510	1587	1587
LNG-C06	West principal rafter, front wing, truss 3	102	h/s	1485	1586	1586
LNG-C07	West principal rafter, front wing, truss 1	57	h/sc	1538	1594	1594
LNG-C08	East principal rafter, front wing, truss 2	70	h/s	1523	1592	1592
LNG-C09	First floor ceiling, east beam	114	h/s	1483	1596	1596
LNG-C10	First floor ceiling, west beam	97	h/s	1496	1592	1592
LNG-C11	Ground floor ceiling, east beam	48	17c	1525	1555	1572
LNG-C12	Ground floor ceiling, west beam	118	h/s	1441	1558	1558

*h/s = the sample has the heartwood/sapwood boundary, i.e., only the sapwood rings are missing

c = complete sapwood is found on the sampled timber but a portion has been lost from the sample in coring

Table 2: Results of the cross-matching of site chronology LNGCSQ01 and the reference chronologies when the first ring date is 1441 and the last ring date is 1602		
Reference chronology	*t*-value	
Manor House, Preston, Rutland	8.7	(Arnold and Howard forthcoming a)
Church of St Andrew, Welham, Leics	8.3	(Arnold *et al* 2005)
East Midlands Master Chronology	8.3	(Laxton and Litton 1988)
Flore's House, Oakham, Rutland	7.5	(Hurford *et al* 2008)
Old Hall Cottage, Twyford, Leics	7.5	(Arnold *et al* 2008)
Old Hall Farmhouse, Mayfield, Staffs	7.1	(Arnold and Howard 2006 unpubl)
Ash Farm, Etwall, Derbys	7.1	(Arnold and Howard forthcoming b)
Manor House, Donnington-le-Heath, Leics	7.0	(Esling *et al* 1989)

Site chronology LNGCSQ01 is a composite of the data of the relevant cross-matching samples as seen in the bar diagram Figure 6 below. This composite data produces an 'average' tree-ring pattern, where the possible erratic variations of any one individual sample are reduced and the overall climatic signal of the group is enhanced. This 'average' site chronology is then compared with several hundred reference patterns covering every part of Britain for all time periods, cross-matching with a number of these only at the date span indicated, the table giving only a small selection of the very best matches as represented by '*t*-values' (ie, degrees of similarity).

It may be noticed from this Table that the resultant *t*-values are well in excess of the *t*=3.5 value usually taken as the minimum acceptable level for satisfactory dating. These values, along with the many other slightly lower, unlisted, cross-matches, indicate a very firm and reliable date for the timbers.

It may also be noted that the timbers used at the Old Manor House, although being compared to data from all over Britain match particularly well with reference chronologies made up of material from other sites in Leicestershire and Rutland. This similarity may help give some indication of the general area where the source woodland was situated.

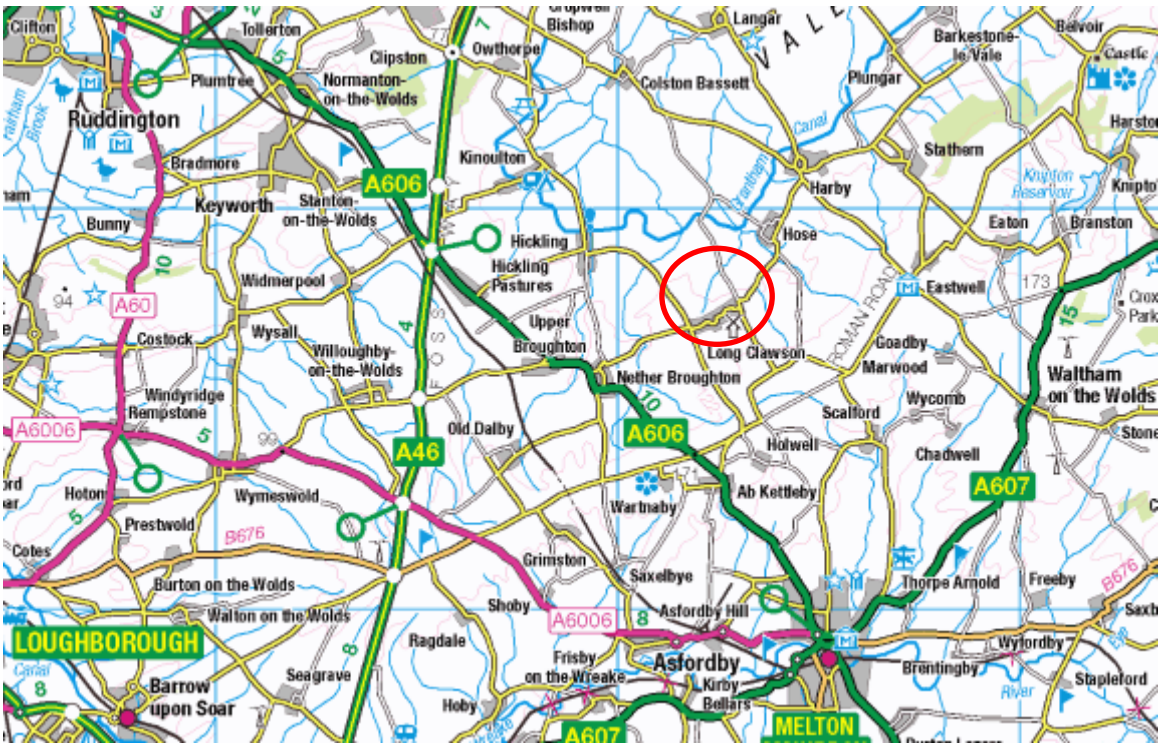


Figure 1a/b: Maps to show location of Long Clawson (top) and the Old Manor House (bottom)

Figure 2a/b: Views of roof to the front wing, looking north to south (top) and to the west end of the rear range, looking west to east (bottom)

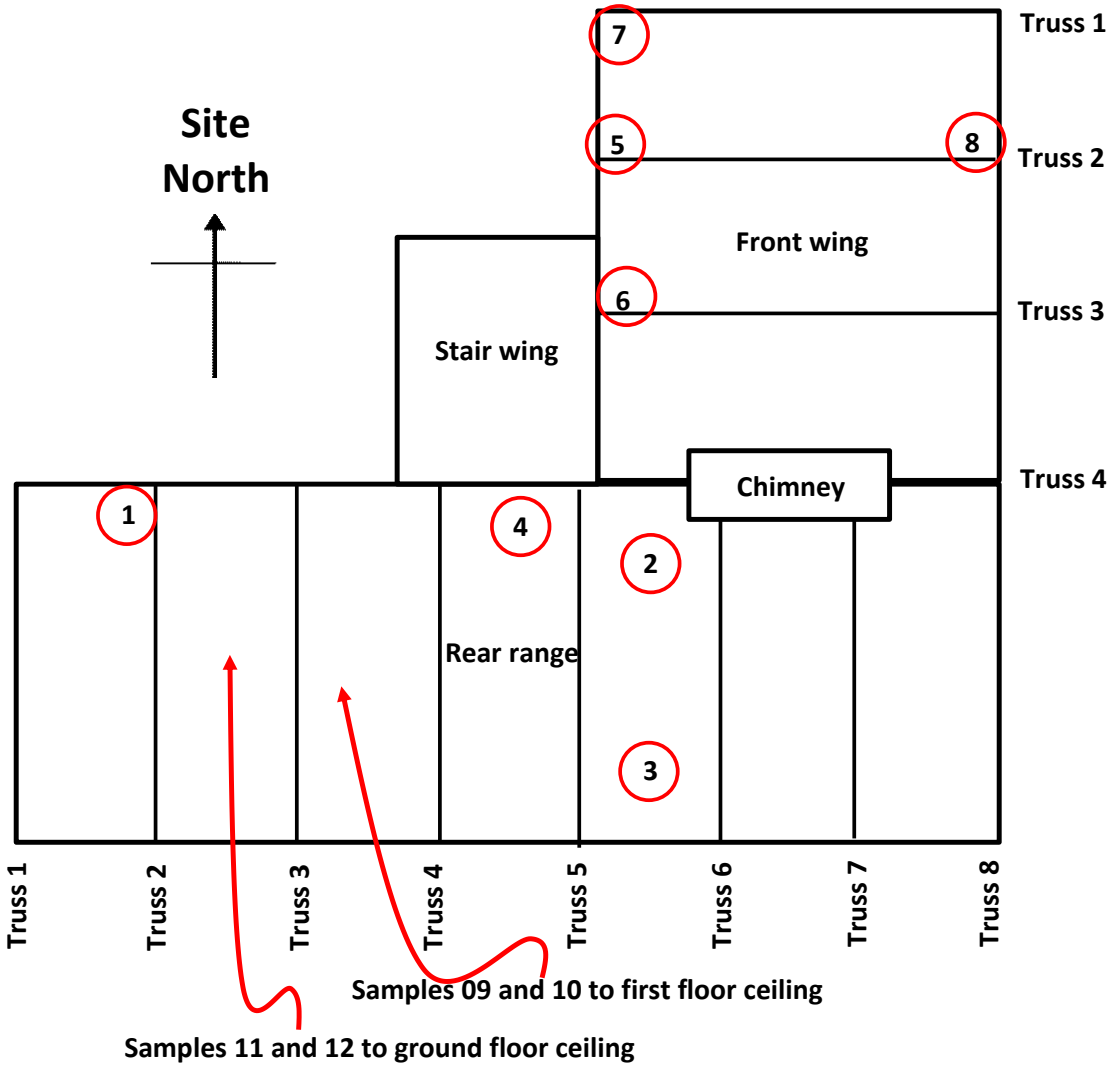


Figure 3: Simple schematic sketch plan showing the layout of the Old Manor House and the approximate arrangement of the roof trusses to the front and rear wings. The approximate positions of the sampled timbers are also shown (see Table 1)

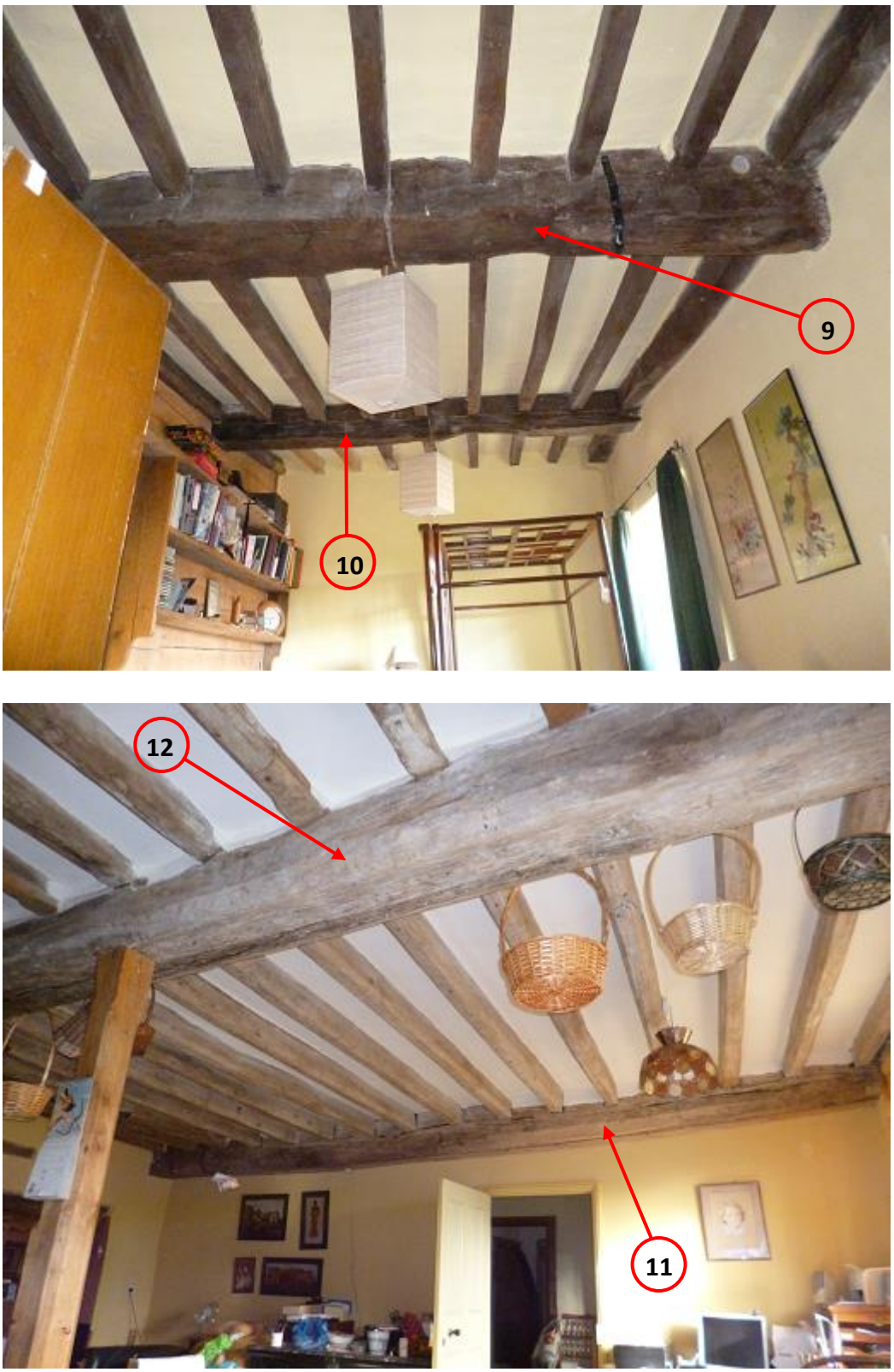


Figure 4a/b: Views of the first floor (top) and ground floor (bottom) ceiling beams to help locate the sampled timbers (see Table 1)

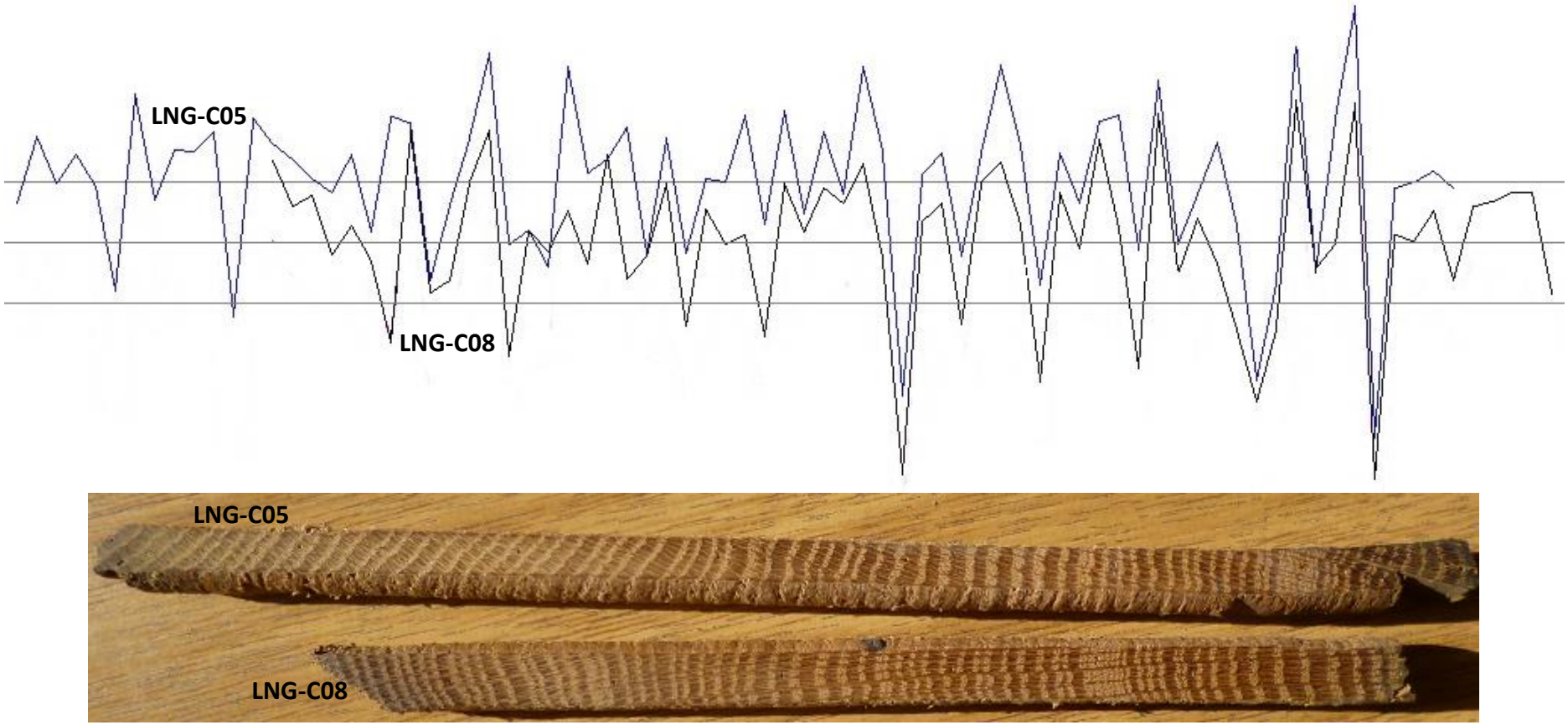
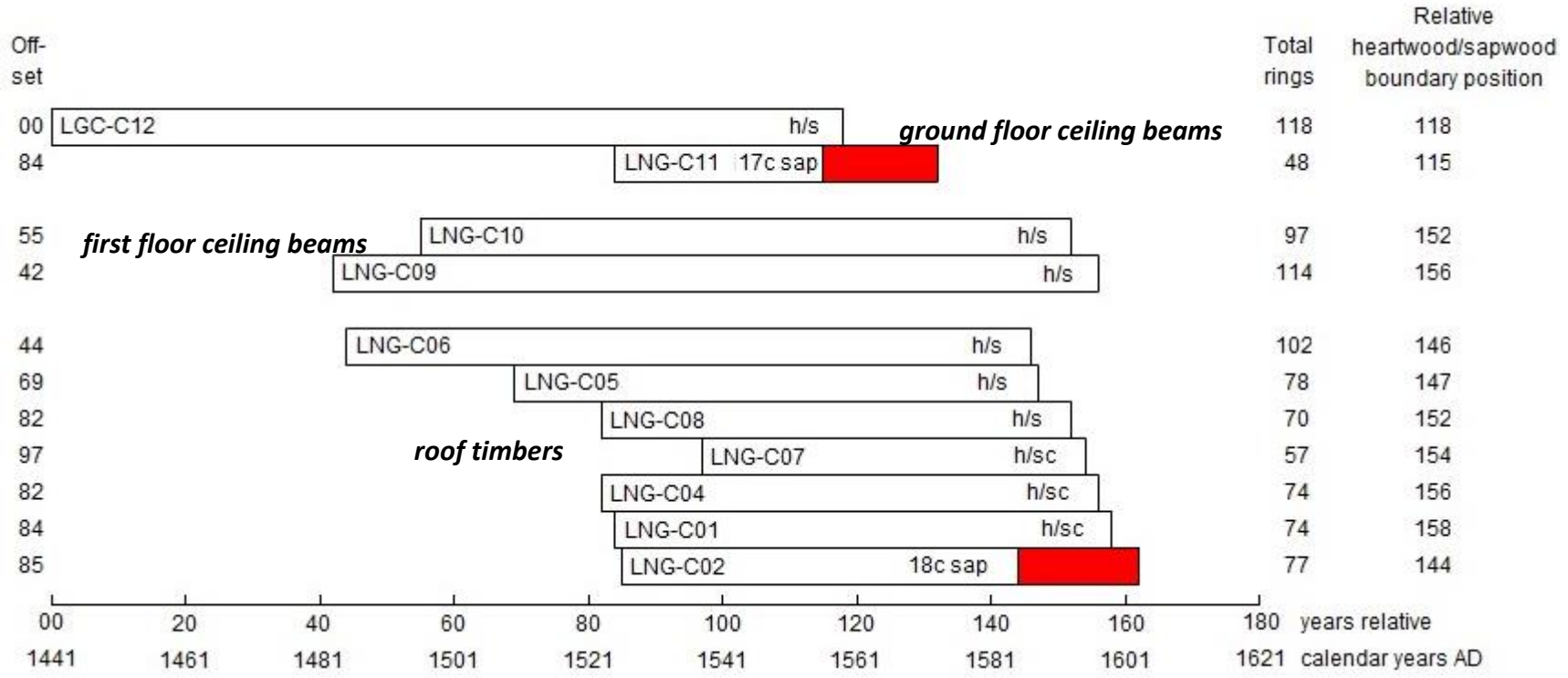


Figure 5: Graphic representation of the cross-matching of two samples, LNG-C05 and C08

When cross-matched at the correct positions, as here, the variations in the rings of these two samples (where they overlap) correspond with a high degree of similarity. As the ring widths of one sample increase (represented by peaks in the graph), or decrease (represented by troughs), so too do the annual ring widths of the second sample. This similarity in growth pattern is a result of the two trees represented having grown at the *same time* in the *same place.* The growth ring pattern of two samples from trees grown at different times would never correspond so well.



*h/s = the sample has the heartwood/sapwood boundary, i.e., only the sapwood rings are missing

c = complete sapwood is found on the sampled timber but a portion has been lost from the sample in coring

blank bars = heartwood rings, shaded bars = sapwood rings

Figure 6: Bar diagram of the samples in site chronology LNGCSQ01 at positions indicated by their grouping, and sorted by timber location. The samples are shown in the form of bars at positions where the ring variations of the samples cross-match with each other, this similarity being produced by the trees represented growing at the *same time* as each other in the *same place*. The samples are combined to form a 'site chronology', which is dated by comparison with the 'reference' chronologies (see Table 2).