TREE-RING ANALYSIS OF TIMBERS FROM LANGLEY HEATH FARM, FOX HOLLIES ROAD, WALMLEY, BIRMINGHAM

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The cart shed at Langley Heath Farm

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SUMMARY

Samples were obtained from 16 different timbers within the barn / stable block element of the west range of buildings at Langley Heath Farm on Fox Hollies Road, Walmley. Of these 16 samples, nine were analysed, the other seven having too few rings for reliable dating. These nine measured samples could be formed into a single site chronology having an overall length of 95 rings. These 95 rings span the years 1678 – 1772.

Allowing for small amounts of sapwood lost from the samples it is estimated that all the dated timbers were cut as part of a single programme of felling no later than 1775, the barn and stable block being constructed from these timbers virtually straight away.

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Introduction

The farm buildings at Langley Heath (see site plan Fig 1) comprise two ranges of buildings, one to the east side of the farmyard, the other to the west. These buildings are connected at their northern end by a wall which screens them and the yard from the farmhouse to the north.

The east range (Figs 2a/b) consists of an L-shaped nineteenth century cow house, with a twentieth century addition attached obliquely at it southern end. There is an in-fill piece between these two sections, and a further, shorter, animal shed on the east side at the north end. The west range, which is believed to be of early-eighteenth century date, comprises a combination barn and stable block/granary at one end (Fig 3a), with what is almost certainly a mid-nineteenth century cart shed addition at the south end (Fig 3b).

The west range

The west range clearly shows two main phases to its west elevation. To the left (north) is the Phase 1 barn and stable, and to the right (south) the Phase 2 cart shed with a markedly lower roof line (see plan Fig 4).

The Phase 1 range is built of 9in x 4¼in x 2½in red bricks laid in Flemish stretcher bond (three courses of stretchers between header bonded courses), and has a plain tile roof. The three-bay flail threshing barn, which occupies the southern end of the range, has central full-height doors, with strap hinges on sandstone hinge blocks, giving access to the threshing floor. The two flanking bays were each perforated by a lozenge-shaped arrangement of air vents; that to the left (north) survives, with a hatch above and below; that to the right (south) has largely been destroyed by the insertion of a mid window. The stable bay, to the left (north) of the barn, has a blocked doorway to the right-hand (south) side with flat arch composed of brick voussoirs, and an inserted mid window to the ground floor left (north). At first-floor level, the granary over the stable has a hatch to the left (north) and a blocked window to the right (south).

The Phase 2 cart shed to the right (south) is constructed of 8¾in x 4¼in x 2½ in red bricks laid in Flemish stretcher bond. At the junction of the two phases is a segmental-arched cart entry beneath a gable, and immediately above the arch a straight joint between the brickwork of the two phases.

The Barn

The barn, the main subject of this programme of tree-ring analysis (along with the stable/granary), contained three bays, the central threshing floor extending into the porch to the east under a separate roof. The bays are defined by stub walls carrying two fully jointed and pegged queen strut trusses (Fig 5a), which in turn support one pair of trenched purlins and straight windbraces. The east purlin supports the ends of the purlins that carry the porch roof.

The Stable

This is the 'three stall stable and harness room with loft over' of the auction catalogue of 1952. Formerly entered from opposed doorways in the east and west elevations, access is now only from the east. Owing to later alterations, including a new concrete floor and the plastering of the walls to half height, there is little evidence of original fixtures and fittings, though the positions of the doorways might suggest that they were ranged along the north wall, where there was room for three to four stalls. At the west end of the south wall are the stubs of a number of sawn-off wooden brackets, possibly bridle hangers. The floor above is supported on a pair of chamfered axial beams.

The granary above (Fig 5b) is similarly devoid of features. In the south wall is a hatch opening to the northern bay of the barn. The main roof is carried on a pair of purlins, the eastern one of which supports the purlins over the western gable.

Architectural / archaeological interpretation

The earliest part of the farm building complex at Langley Heath Farm is the west range, which we know was in existence by 1824, and which is likely to date from the early eighteenth century. The main piece of architectural evidence for this is the character of the roof trusses. The queen strut roof truss, properly jointed and pegged as it is at Langley Heath, was the principal category of roof structure used in West Midlands post-medieval timber-framed buildings, and is usually thought of as a seventeenth century type. Although it continued in use through the eighteenth century, examples became increasingly rare, and it was during this time that it was largely superseded by other types, notably the king post truss. The Langley Heath example does not appear to be reused, and the likelihood is that it was custom made for the barn at a time after timber-framing had been superseded by brick as the principal building material for West Midlands farm buildings. Generally, this transition occurred circa 1700, so a date in the early 1700s for the barn complex would not be unreasonable. The 2½in brick thickness could support an early eighteenth century date, but dating of bricks can be hazardous, and the fact that there seems to have been very little variation in thickness (or bond) between the bricks of the barn and those of later structures, means that this cannot be relied upon as independent testimony. However, the flat brick arches of the opposed stable doorways would also support a date of around 1700.

The west range was an integrated structure housing a barn, stable, granary, and loose box. The barn, of course, had been the staple farm building since the Middle Ages, and all the other components of this combination building were related to arable farming. Horses powered the plough, and the granary provided a more secure depository for grain than any ground level store could offer. The three-horse stable could suggest that at the time of construction the proprietor of Langley Heath Farm was using a light short plough, of the type introduced to Warwickshire from Yorkshire in the eighteenth century rather than the old fashioned heavy plough. The former could be drawn by three horses, whereas the latter needed a team of five or six.

The construction of the east range, probably during the third quarter of the nineteenth century relates to the period of 'High Farming' (*c.*1840 – *c.*1880) and the increased emphasis on stock rearing, which was accompanied by a corresponding expansion of accommodation for cattle. The new cow house at Langley Heath represents a major capital investment from which a comfortable return might be expected. In keeping with advanced thinking the

building was a single-storey structure, without the hay loft of many earlier structures. On the other hand, the only lighting in the byres appears to have been from the doorways. Wholesale improvement of the interior in the twentieth century means that the original layout of the building is to some degree uncertain, although the broad outline of three self-contained byres, containing space for some twenty to twenty-five beasts in total, is clear.

The cart sheds that were added to the west range at around the same time as the construction of the east range, were a product of the more business-like approach to farming that characterised the nineteenth century. Carts and other agricultural implements were items that needed to be preserved from the elements in order to protect the investment of capital they represented.

The farm buildings at Langley Heath Farm are typical of the eighteenth century agricultural vernacular of the West Midlands with their red brick walls, plain tile roofs, segmental arches, and, for the nineteenth century, bullnose brick openings. The most interesting element of the complex is, perhaps, the barn and stable block, which forms the early part of the west range. This has been tentatively dated by an architectural and stylistic survey to the early 1700s.

The timbers

Virtually all the timbers used in the roof of the barn and stable block are of oak, though amongst the common rafters one or two apparently original examples of some form of softwood may be found. The timbers appear to be of a high quality with few knots, splits or shakes, other than those caused by in-situ seasoning and drying. The beams have been converted from the original baulks, or trees, by mechanical sawing – the surface saw marks are even, regular, and at right-angles to the faces, rather than irregular and at an angle as on hand-sawn beams. The beams, however, have not been squared-up particularly well, with many of them showing rounded arrises (or edges), where the sapwood of the tree remains. Some of the timbers have been trimmed by light adzing or axing. The result is a slightly uneven set of timbers, though by no means a rough as some late oak roofs which often appear to reuses old timbers and are sometime very haphazard in their assembly. Here the timbers have been well carpentered, with many of the joints still being square and tight fitting. There is no clear evidence of any assembly marks (perhaps not necessary in a roof with only two trusses), and little evidence for the marking-out of joints with scribe lines. All in all, the roof gives the impression of quality in both its material and workmanship.

Sampling

Sampling and analysis by dendrochronology of timbers from Langley Heath Farm were commissioned by Merlin Homes, as part of the planning application process as stipulated by the local authority, Birmingham City Council, a full survey having already been undertaken by Birmingham Archaeology at The University of Birmingham (Hislop 2006). The initial proposal was for the possible sampling of the full range of farm buildings at Langley Heath. The purpose of this was to determine the date of these buildings in order to establish their relationship with each other and to some extent to determine the relationship of this site with other farms in the area, thus providing information for the West Midlands Regional Research Framework. The roofs of all the buildings of the east range, plus those to the cart shed at the south end of the barn/stable building, are constructed of pine, a material which

currently is not amenable to tree-ring dating, although research is continuing in this field. At the moment, only oak can be reliable dated by dendrochronology.

Thus, from the timbers available, exclusively within the roof of the barn/stable, a total of 16 core samples was obtained. Each sample was given the code LHF-A (for Langley Heath Farm, site "A") and numbered 01 – 16. In all cases the timbers sampled appearing to be primary and integral to each other and to be representative of the present building. There appeared to be no evidence for the reuse of timber or any evidence of major repair.

The positions of these samples were marked on a sketch plan made at the time of coring, these then being transferred to drawings made and kindly provided by Birmingham Archaeology, reproduced in this report as Figures 6 and 7. Details of the samples are given in Table 1. In this Table, all trusses and the individual timbers have been numbered and/or identified on a north – south, or east – west basis, as appropriate.

The Nottingham Tree-ring Dating Laboratory would like to take this opportunity to thank Mr Stephen Capper, Contracts Manager and Merlin Homes Ltd, for their help and enthusiasm in arranging this programme of sampling and for their generous funding of this project. The Laboratory would also like to acknowledge and thank Birmingham Archaeology at the University of Birmingham, particularly Malcolm Hislop, for the wholesale use of their notes in the introduction above and their plans elsewhere in this report.

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 most frequently used building timber in England) 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.

Secondly, because the weather over any number of consecutive years is unique, so too is the growth-ring pattern of the tree. The pattern of a short 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. 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 54 years or so. In essence, a short period of growth, anything less than 54 rings, is not reliable, and the longer the period of time under comparison the better.

The third principle of tree-ring dating is that, until the early- to mid-nineteenth century, builders of timber-framed houses usually obtained all the wood needed for a given structure by felling the necessary trees in a single operation from one patch of woodland, or from closely adjacent woods. Furthermore, and contrary to popular belief, the timber was used

"green" and without seasoning, and there was very little long-term storage as in timber-yards of today. This fact has been well established from a number of studies where tree-ring dating has been undertaken in conjunction with documentary studies. Thus, establishing the felling date for a group of timbers gives a very precise indication of the date of their use in a building.

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 relevant 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 55 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, 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)).

Given that in a timber-framed building the trees required for each phase are almost certainly to have been cut in a single felling operation especially for that building, it is usual to calculate the average date of the heartwood/sapwood boundary from *all* the dated samples from each phase of a building and add 15 to 40 rings to this average to get the likely overall felling date

of all the timbers used. In this calculation, wide variations in the position/date of the heartwood/sapwood boundary (possibly suggesting different felling dates) must be noted and taken into consideration.

Analysis

In the case of the 16 samples obtained from Langley Heath Farm, each was prepared by sanding and polishing. It was seen at this time that seven samples had less than 54 rings, too few for reliable dating, and they were rejected from this programme of analysis. The annual growth-ring widths of the remaining nine samples were, however, measured, and were then compared with each.

At a minimum value of t=4.5 a single group comprising all nine samples could be formed, cross-matching with each other at the positions indicated in the bar diagram Figure 8. The nine cross-matching samples were combined at these indicated off-set positions to form a site chronology, LHFASQ01, with an overall length of 95 rings. Site chronology LHFASQ01 was then satisfactorily dated by repeated and consistent comparison with a number of relevant reference chronologies for oak as spanning the years 1678 to 1772. The evidence for this dating is given in the t-values of Table 2.

Interpretation and conclusion

Analysis by dendrochronology of nine measured samples from the barn/stable element of Langley Heath Farm has resulted in all of them being combined to form a single site chronology, LHFASQ01. This site chronology is 95 rings long, these rings being satisfactorily dated as spanning the years 1678 – 1772.

Although some of the sampled timbers do have complete sapwood on them, this could not be retained on the samples, small portions of the sapwood being lost during coring. It is thus not possible to determine a precise felling date for the timbers with reliability. However, the amount of core lost was noted at the time of sampling, which in all relevant cases was a very small amount, perhaps amounting to two or three rings. This, along with the relative position of the heartwood/sapwood boundary, makes it possible to calculate a likely felling date range. In this case it is estimated that all the dated timbers of the roof were cut as part of a single programme of felling which is likely to have taken place some time between 1773 and 1775.

As such, a date towards the end of the eighteenth century is somewhat later than might have been expected on the basis of the architectural and fabric survey alone, and highlights the difficulty of dating on the basis of features such as brickwork or roof type. This, the Laboratory feels, demonstrates the usefulness of tree-ring dating and shows that the Langley Heath example is a slightly rare late example of a type more common in the seventeenth and early-eighteenth century.

Indeed in this respect Langley Heath demonstrates two interesting points at this date. Firstly it shows that, even at this relatively late date, oak continued to be used as a building timber despite, by this time, the increasing availability of pine or other softwoods. Secondly the Langley Heath timbers show the diminishing age at felling at which oaks were used for building timbers, and the speed at which, under the right conditions, oak trees could grow.

Given that most of the samples include rings towards the centre of the tree (ie they indicate the date at which they began to grow) and have almost complete sapwood (the date at which they were cut) it will be seen from Table 1 that no tree was more than 90 years of age when felled and some may have been only 60 or 70 years old when felled (relatively young by even late medieval standards), but still form substantial beams. As will also be seen from Table 1, some trees had so few rings that the samples they provided were not worth measuring (indicated by 'nm'). Although there are many exceptions, the decrease in age at felling is a general trend that is seen in many tree-ring samples from the fourteenth century onwards.

Judging by the cross-matching between a number of the analysed samples, it is likely that the trees they represent were growing fairly close to each other in the same copse or stand of woodland; samples LHF-A11 and A13, a tiebeam and principal rafter of truss 3, for example, which cross-match each other with a value of t=7.5, are possibly from two adjacent trees. Indeed, given that a value of t=8.2 is found between samples LHF-A9 and A10, both common rafters, it is possible that some timbers are derived from the same tree.

It has not been possible to determine, as is sometimes the case, approximately where the source woodland for the timbers used at Langley Heath was. As will be seen from Table 2, which indicates the reference chronologies with which site chronology LHFASQ01 cross-matches and dates, there is a fairly widespread distribution of matches, ranging from as far away as Kent. There are, however, cross-matches with slightly more 'local' reference material from Leicestershire and Staffordshire. One wonders from how far afield the timber used at Langley Heath farm might have come, given late-eighteenth century transport, and, given their size and age at felling, whether it was from a managed woodland plantation.

It has also not been possible to determine by dendrochronology the dates for the other buildings found here, particularly the cow sheds and the cart shed. This is primarily due to the fact that the timbers used in these buildings are of pine, a timber not yet commonly open to tree-ring dating. The use of this timber, however, and the method of its conversion and sawing, which has made it very square and regular, all support the view of the architectural and archaeological survey that the buildings are of nineteenth and twentieth century date.

It is hoped, therefore, that this tree-ring report not only demonstrates with great accuracy and reliability the date of the barn and stable/granary at Langley Heath Farm (showing that it is slightly later than perhaps expected), but shows that this type of roof continues in use for some time after its core date. It is hoped that this analysis also provides some other useful information about the timbers and their carpentry. Together this data may help inform the West Midlands Regional Research Framework, and help to fill the gaps in our understanding of Birmingham in the post-medieval period. Perhaps analysis on the timbers of the farmhouse, which was not available for sampling at this juncture, would provide additional worthwhile information and demonstrate its relationship with those of the farm yard.

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Table 1: Details of tree-ring samples from Langley Heath Farm, Fox Hollies Road, Walmley, Birmingham

Sample number	Sample location	Total rings	Sapwood rings*	First measured ring date (AD)	Last heartwood ring date (AD)	Last measured ring date (AD)
LHF-A01	East common rafter 2, granary	nm	---	------	------	------
LHF-A02	West common rafter 6, granary	nm	---	------	------	------
LHF-A03	West common rafter 7, granary	nm	---	------	------	------
LHF-A04	South valley rafter, granary	58	8	1707	1756	1764
LHF-A05	South common rafter 3 gable bay	nm	---	------	------	------
LHF-A06	South common rafter 5 gable bay	56	h/s	1703	1758	1758
LHF-A07	East common rafter 2, bay 1	62	19	1707	1749	1768
LHF-A08	East common rafter 3, bay 1	nm	---	------	------	------
LHF-A09	East common rafter 8, bay 1	70	5	1690	1754	1759
LHF-A10	East common rafter 9, bay 1	59	h/s	1693	1751	1751
LHF-A11	Tiebeam truss 1	73	18	1700	1754	1772
LHF-A12	East principal rafter, truss 1	---	------	------	------	---
LHF-A13	West principal rafter, truss 1	58	8	1708	1753	1761
LHF-A14	West purlin, truss 1 – 2	82	2	1768	1757	1759
LHF-A15	East principal rafter, truss 2	57	3	1707	1760	1763
LHF-A16	West principal rafter, truss 2	nm	---	------	------	------

*h/s = The last ring on the sample is at the heartwood/sapwood boundary

nm = sample not measured

Table 2: Results of the cross-matching of site chronology LHFASQ01 and relevant reference chronologies when the first-ring date is 1678 and the last-ring date is 1772

Reference chronology	*t*-value	Reference
Wheelwright's Shop, Chatham Docks, Kent	6.9	(Bridge 1998)
Stoneleigh Abbey, Stoneleigh, Warwicks	6.7	(Howard *et al* 2000)
Hampshire county chronology	6.2	(Miles, D 2003)
Catholme, Staffs	5.8	(Howard *et al* 1992 unpubl)
St John The Baptist, Grimstone, Leics	5.8	(Arnold *et al* 2005)
East Midlands Master Chronology	5.6	(Laxton and Litton 1988)
Basing, Hants	5.4	(Bridge 2000 unpubl)
England Master chronology	5.2	(Baillie and Pilcher 1982 unpubl)