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**TREE-RING ANALYSIS OF TIMBERS FROM
10 MAIN STREET,
(UPPER HALL),
HARTSHORNE,
SOUTH DERBYSHIRE**

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SUMMARY

Tree-ring analysis of 22 measured samples (three further samples having too few rings for reliable dating) from a range of locations within no.10 Main Street produced a single site chronology, HRNASQ01, comprising 16 samples, and having an overall length of 164 rings. These rings were dated as spanning the years 1448 – 1611. Interpretation of the sapwood on the dated samples indicates that it is possible that there are very slight differences in date, corresponding to small additions or changes to the main structure, but it is not possible to determine these dates with reliable precision.

It is estimated that the main range is constructed of timber felled in the period 1618 – 22, with the porch being added to it almost immediately, possibly as part of this phase of construction. The outshot at the north end may have been added to the main range a year or two later, with the west facing gable at the north end being added or changed a few years after that. It is very unlikely that any part of the building examined in this programme of analysis is later than, say, 1630.

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Introduction

After Philip Heath, Conservation Officer, South Derbys District Council (Heritage Open Days leaflet, 2000)

No 10 Main Street is the larger part of an impressive timber framed manor house formerly known as the 'Upper Hall', as distinct from another former manor house in Hartshorne still known as the Nether (lower) Hall. A manor was a large estate and a manor house was the principal house of the estate, usually with a good set of farm buildings, and occupied by the owner of the manor himself, or by a principal tenant

Although some research into the history of the house has been undertaken, much of it is inconclusive and many questions remain unanswered. The current state of knowledge suggests that the house was built shortly before 1629 for John Benskin, whose family seem to have been chief tenants of the upper manor in Hartshorne since the mid sixteenth century.

Whoever the builder of the Upper Hall was, he was clearly a prosperous man. The Benskins were yeomen graziers, i.e. owners of a freehold estate, making a living by feeding cattle on grassland ready to sell at market. But in the days before banking, it was exceptional for a yeomen grazier to accumulate enough capital to build a large, high quality, house like this in one go.

The average farmhouse of the early-seventeenth century had two or three rooms downstairs and only one or two fireplaces. There were the same number of rooms upstairs, although they were often dark and low, usually unheated, and used only for storage or as bedrooms for children.

Hartshorne Upper Hall, by contrast, had very generous accommodation. At the north end was a kitchen (see Fig 1) with two large bread ovens and access to the cellars. South of the kitchen there was a small room on each side of the staircase. The western one was an entrance hall; the eastern one could have been a scullery, pantry or small sitting room. South again was the "hall" or "houseplace", the seventeenth century equivalent of an everyday living room.

In the south wall of the houseplace are two blocked doorways leading into the parlours, which in grander houses were traditionally built at right angles to the rest of the house, as they are here. The parlour wing is now in separate ownership but originally had two parlours on the ground floor, each with its own fireplace. Parlour comes from the French "parler" = to speak, giving a clue to the role of parlours as sitting rooms.

The front parlour, facing the road, was lined with plain seventeenth century panelling (now removed) singling it out as the best room. It would be used by the head of the household as his private room, and for entertaining special guests, while the rear parlour would be used as a dining parlour by the family. A staircase alongside the chimneystack gave access to the bedrooms above the parlours, which were traditionally the best in the house.

Externally, the fashion for timber framed houses was to make them as elaborate and ornate as the owner's status afforded. Ornamental framing, an extravagant use of timber and a profusion of gables were reflections of wealth, and deliberate attempts were made to give the road frontage of the house a dramatic silhouette. Firstly, the house was given a porch - a typical status symbol, perhaps added a few years after the rest of the house was built. Secondly, the roof construction suggests that the northern gable on the road frontage was an afterthought added while the house was being built, to give it a more imposing profile. This is suggested by surviving joints in the roof trusses which were abandoned half way through due to a change of heart.

Today, however, the house is best appreciated from the back, as the original appearance of the front is obscured by rebuildings in brick, a brick extension and trees, lending an appropriate air of mystery to the house.

It appears that the upper manor, together with the upper hall, was bought by John Cantrell of Hartshorne in the 1680s. The Cantrells certainly occupied the house for a couple of generations before it was mortgaged to William Cant, gentleman, of Broughton, Leicestershire, who had married a Cantrell. The property is said to have passed into the hands of the Cant family, but whether by foreclosure, inheritance, or purchase is not known. Eventually the house became part of the Bretby Estate before being sold off by the Earl of Carnarvon in 1910, when the purchaser Mr. George Wilkinson paid £270.

By the early eighteenth century, timber framed houses were already outmoded. The new fashion was for plain brick boxes with refined proportions, quite the opposite of Hartshorne Upper Hall. From our point of view today, it is fortunate that the house was occupied by tenants for many years instead of owner occupiers, as it might otherwise have been completely rebuilt or altered beyond recognition long ago.

By the 1970s the house was in poor condition. Its original social prestige was long gone, and it had been divided into three separate dwellings. However, it remained in single ownership until 1977, when no. 6 was bought by one new purchaser, and nos. 8 and 10 by another. Considerable alterations were made inside no. 6, including a new staircase in a new position, and in 1979 nos. 8 and 10 were re-united as a single house by their owner Mr. Derek Worthington. This work included the removal of a gabled rear extension to no. 8, probably added after the sale of the property by the Bretby estate in 1910. The front door of no. 8, which had been inserted into the timber framing, was filled in, and the staircase was taken out. The architects for the work were Anthony Short and Partners of Ashbourne.

(Philip Heath with thanks to Joan Sinar, Barbara Hutton, Trent and Peak Archaeological Trust and Jeremy Jones, 2000)

Description

after Barbara Hutton (Derby Buildings Record 38, (1989))

This strikingly handsome timber framed manor house stands high above the street near the parish church, facing west. It is in two occupations, one to the main range whilst the parlour wing, which was not examined, is a separate dwelling. It stands on a stone plinth with a tiled roof and brick chimneys.

The street front, to the west side, has a tall stone plinth with a close-studded ground-floor wall; above this it is jettied out a short distance so that the jetty barely overhangs the plinth, from which the timber wall is set back. There is a big dragon post at the north end of the wall, with a down-brace to the sill plate. The sill is continuous, not interrupted, and the jowls on the dragon posts, as well as those on intermediate wallposts serving as jetty brackets, have a curious bulbous shape. At the north end of the west wall the first bay is carried up above the wallplate to form a dormer gable; here the first and second floor walling has been replaced by light coloured brick in Flemish bond. There are three-light windows with modern frames at all three levels. To the south of this, a brick-built extension covers the whole wall to the eaves and projects westward beyond the line of the porch which abuts it to the south.

This storeyed porch is also jettied all round, and gabled; the lower wall on its plinth is close studded, with upward braces from the corner posts to the wallplate on the west (entrance) front, and a down brace to the sillplate on the south side; the first-floor joists run north-south. The upper wall has two layers of square panels of diagonal studding, and the gable, which is infilled with brick, has a collar with angled struts below it and a pair of vertical studs above.

The next bay of the main building to the south has close studding with down braces below and two layers of panels with diagonal studding above, flanking a three-light window at each level, though not

immediately over each other. Under the first-floor window is a panel with three shaped vertical studs. The junction of the porch with the house does not come at a post in the house wall, so only the foot of the down brace from that post can be seen.

To the south of this bay the crosswing projects by 2 metres at ground level, built similarly with close studding on a stone plinth with a down brace from the dragon post; above are three panels of diagonal studding and a fourth that seems to contain a blocked window. The west end wall of the crosswing has close studding below and a jettied upper storey in brick, with jowls on four intermediate posts to support the jetty plate. The central ground floor window breaks into the sill plate, and its lintel appears to support the end of a ceiling beam.

The south side of the house, i.e. the flank of the separately occupied crosswing, is also built on a stone plinth with close studding below and diagonal studding in two layers of eight panels above. There are three down braces on the close studding, one each end and another on the west side of the central doorway, where the post is also jowled. There are two ground floor and two upper floor windows.

The east, gable end of the crosswing is particularly handsome. In the apex is a kingpost or king strut standing on a collar with upward braces to the principals on each side. Between collar and tiebeam are two layers of diagonal studding flanking a window which seems to have been built in an opening designed or adopted to take a pitching door. The first floor has panels of diagonal studding flanking a three-light window under which are three shaped vertical studs like those on the front wall. The ground floor has close studding with down braces and jowled intermediate posts flanking a splendid central oriel window whose original frame with three ovolo moulded mullions and transom is carried forward on a pair of moulded brackets. Above the window frame is the end of the ceiling beam. The original window is not glazed and there is a modern window frame behind it in the plane of the wall.

The crosswing projects two metres east of the house and on the north side the wing has been underbuilt in brick; above the jetty line are square panels of diagonal studding and above the wallplate a small dormer, again with diagonal studding on its north front but close studding on the east and presumably also the west side. There is a high blocked window and a pair of angled struts above it. The east wall of the main house has two rows of thirteen square panels with diagonal studding for the first floor. The panels are by no means of equal size and, oddly enough, the fifth lower panel from the south end has its studs going the wrong way to make a consistent pattern either of diamonds or 'V's'. Below at this end there is close studding with a downbrace in the corner, but over this part of the wall up to about ten years ago was a 'Victorian' extension in brick with an east-facing gable. This was removed and the timber frame which had been cut and become distorted was stabilised and repaired. The lower wall north of this is brick in stretcher bond, i.e., one brick thick, with brick piers at the northeast corner and flanking the back door. A modern porch has been built out over the door on a stone plinth matching that at the south end of the wall, and the thin brick wall behind it taken down leaving a sunny bay window. There are three modern dormers in the roof.

The north end of the house stands high above the driveway on a tall stone plinth rising the full height of the ground floor. The brick pier at the northeast corner covers the lower dragon post but the end of its jowl can just be seen. An original lean-to is built out over the kitchen ovens. It is stone, coursed in with the house wall up to two courses lower than the first floor, above which there is close studding on the north and west sides with a rail on the latter, and a doorway on the east side. Below this doorway is what seems to be a dog kennel. The upper storey of the main house has two layers of panels with diagonal studding and above the tiebeam the gable is divided by a collar into four panels below and two above. Again we cannot see if the vertical timber above the collar is a kingpost or king strut. A photograph taken about ten years ago when the house was being restored shows the infill between the studs is thin stone slabs.

The front door is approached by a flight of stone steps. Inside the porch the walls stand back from the stone sill and the timber sillplate; on the south side is a small window made between the studs, and on the north side a blocked window high up. Between the studs on the north wall is an

inscription scratched into the plaster reading 'W A 1669' with perhaps '28 JN' above. The jettied first-floor joists of the house project into the porch above the inner doorway, which has an ovolo moulded frame with a slightly cranked head; the moulding terminates in a plain stepped stop. The porch joists run north-south. The inner door leads into a small room, now the entrance hall, with the stairs going up on the opposite wall; however, the south end wall of the stairs is a blocked doorway so the present arrangement is not original.

To the north of the entrance a door in the west wall leads into the room added-on in brick. On the south side is the door into the sitting room which is the original hall; on the south wall opposite is a stone chimney with a plain-chamfered Tudor arched fireplace; on each side of this is a blocked doorway which originally led into the two ground floor parlours in the crosswing. The east and west walls of this room were damaged when the house was divided into three dwellings but the front door cut in the west wall and access to the Victorian brick wing have both been made good. The north wall has a blocked doorway next to that by which we entered and there is also a doorway in the northeast corner making five original doors in this room. The ceiling is carried on two ovolo moulded beams running north-south and has square-sectioned chamfered and stopped joists. The mouldings on the beams have runout stops at the south ends and at one of the north ends, the other being unstopped. The joists seem to be set in with soffit tenons.

Going through the door at the eastern end of the north wall we come into another small, narrow, room, now enlarged by the addition of the bay window beside the porch. There is a door on the west side leading to the cellar stairs underneath the main staircase, but these stairs, which run straight down towards the south, were formerly reached from the kitchen. Beyond the back porch and its doorway is the present kitchen, divided off from the original which occupied the full width of the house, by means of a partition under one of the ceiling beams. At the north end of the kitchen is a small pantry. The greater part of the original kitchen is now the dining room. It has a huge inglenook fireplace at the north end under a massive oak beam on stone jambs, but the inglenook is lined with brick. There is a cupboard recessed in the west side, an oven on each side of the hearth in the north wall, and a niche in the east wall of the fireplace; in the middle is a later brick fireplace and chimney built inside the inglenook.

The east wall of the room is a thin partition added under the beam; on the south side is the blocked cellar doorway and a doorway through into the front hall; on the west side is close studding on each side of a post braced downwards on both sides, and a window at the north end of the wall. From the top of this post another brace stretches up to the ceiling: it is supporting a beam laid between the joists whose purpose is to carry a brick pier at first floor level, and the brick pier has been put in to support the tiebeam above. All this is a later alteration, and probably dates from the time the original timber and plaster hood over the inglenook was taken out and the brick chimney built instead. To return to the ground floor: the dining room ceiling beams are plain chamfered and have stepped, 'Wernhir', stops at each end, and the common joists are neatly chamfered and stopped like those in the sitting room.

Opposite the head of the stairs on the first floor is the north end bedroom over the kitchen, and here is the brick pier supporting the tiebeam. In the brick chimneystack is a nice stone-framed fireplace with a brick relieving arch over the lintel. To the west of it and further back is the chimney shaft from the kitchen fire with a recess forming a small cupboard in its front wall, and behind is the diagonal studding of the north end wall.

On either side of the stairs which run up in the middle of the house is a narrow room, and from that on the west side is a door into the porch chamber. At the south end is another full width bedroom, with a stone framed fireplace set into a brick stack flush with the south wall. There does not seem to have been a door through into the crosswing at this level.

Up a further flight of stairs are the attics. At the north end is a bedroom lit by a window in the west dormer and by the much smaller modern dormer on the east side. The west dormer is built out in front of a roof truss, whose back can therefore be seen with carpenters marks on the principal and

on the short, straight windbraces which run up to the upper purlin (see Fig 2). There is no lower purlin this side, showing that the dormer is part of the original design. The roof truss has a collar tenoned across just below the ceiling, and much lower down short angle struts up from the tiebeam which is under the floor. The purlins are tenoned into the principals on each side. As the apex is above the ceiling we cannot see whether or not there is a ridge piece, but there is no need for one. On the east side of the room, and in the rest of the attic, there are lower purlins as well. Against the north end wall is the stack from the kitchen fire, stepped across to reach the roof centrally, and in front of it the separate straight brick stack of the first-floor fire.

At attic level there is a narrow unlit space on the east side of the stairs and a passage along the west side leading to the south bedroom which is lit by two modern dormers in the east side of the roof. There is a roof truss in the middle of this room too, with two pairs of purlins, windbraces, a collar, and angled struts down to the tiebeams just as in the northern rooms. This makes a total of six trusses: one in each end wall, one in each cross-wall and one in the middle of each bedroom. The south end wall is studded under the collar with rather poor vertical studs in front of the chimney stack.

Historical development

There has been an Upper Hall Manor in Hartshorne since very early times, but, according to Miss Joan Sinar, County Archivist, the lord of the manor did not live here himself but leased the demesne land and house to a tenant. From 1547 the tenancy ran in the Benskin family, and the churchwarden's accounts show that John Benskin paid 8 shillings church rate for his 'new house' in 1629. This is thought to be the present building, and the structure confirms that dating. It seems not to have replaced the old hall but to have been on a new site, since the old hall continued in use for some time

The house is large. If we include the south crosswing, which was not examined or measured, it was built with a central hall, two parlours in the wing, two central service rooms and the cellar north of the hall, and a large kitchen at the north end, all with chambers above and attics over the chambers. This accommodation would allow for a large household with plenty of servants and for gracious living at a high standard. When you look at the exterior with its bold decorative wall panels it is evident that the builder intended to maintain a style of life well above the average. Similar wall treatment is found at Long Whatton (Leics) where Keepers Lodge is dated 1580, but there the decorative panelling was reserved for those elevations visible from the street whereas here it goes all round the house. Such work is expensive and the house must have cost a lot to build; in those days before banking it was exceptional for a yeoman grazier (as the Benskins seem to have been) to be able to accumulate enough capital to build a large house of this quality in one phase. It is more usual to rebuild the old house in stages, living at one end whilst the other is reconstructed. There seems no evidence here of phased construction except that the porch, as usually happened, may be a couple of years later than the rest - the date and initials which do not belong to the occupier probably relate to replastering.

The plan of the house is interesting. The hall is reduced to a nominal space with a large but plain fireplace and moulded beams superior to those in the kitchen, though clearly a central marshalling space rather than a general living room as the hall was earlier. Next to it, the entrance leads to two small service rooms and the cellar beside the stairs: central service rooms have been linked to the earlier tradition of the longhouse, a type of farmhouse that could have preceded this building. Two major parlours would allow one to be the head of the household's private room and the other a family dining parlour when the rest of the household ate in the kitchen. Habitable attics are not found before the end of the sixteenth century and suggest live-in servants, whilst the attic above the hall, being unlit originally, retained the storage function traditional to the hall chamber. Not only does this fine house survive virtually undamaged, but it allows us to understand something of the Benskin family's way of life and standard of living in the early seventeenth century.

The kitchen fireplace was replaced by a much smaller one in brick with a brick chimney, probably in the later eighteenth century. Perhaps the fireplace itself has since been altered, because this is the natural position for a cast iron kitchen range. The brick chimney was no doubt built because the timber and plaster hood took up so much space in the room above. Later a second chimney was built to serve a fireplace in the bedroom and this was put in front of the kitchen chimney; the fireplace itself is a copy of the one at the south end of the hall chamber.

It was probably in the nineteenth century that the house was divided into three dwellings. Additions were made at the front and rear and doorways cut through the outer walls to reach them. A front door for the middle house was also cut through the front wall of the hall. At the back the lower walling was largely replaced in brick, as were the two front gables, at different times. Finally, in the late 1970s the house was restored, turning the two cottages, nos 8 and 10, into one house after removing the rear addition.

Sampling

Sampling and analysis of timbers from no.10 Main Street were commissioned by Philip Heath of South Derbyshire District Council. The building comprises a main north-south range of five bays formed by six principal rafter-with-tiebeam and collar trusses. There are two purlins to each slope of the roof, there being straight windbraces from the principal rafters to the purlins. The four internal trusses have slightly splayed queen struts from tiebeam to the collars; at the gable end trusses the struts are more vertical.

Attached to the south end of the north-south main range is a further east-west range forming a cross-wing. The relationship of this latter portion of the building, which is in separate ownership and is not considered in this programme of tree-ring dating, is uncertain. It is possible that the east-west range post-dates the main north-south range, though some elements of the north-south range suggest that it was connected to a building at its southern end.

Within the main north-south range, a number of original partition walls may be seen at both ground and first-floor level, along with several substantial bridging and bressummer beams to the ground-floor ceiling. Structurally, almost all the timbers of the main range itself appear integral to each other and part of the primary build, these appearing to be jointed and pegged, and set out with assembly marks. There are, however, elements of the building which, structurally, appear as later additions or alterations.

The gabled two-story timber-framed porch, for example, appears to have been added to the main range, as does an unusual two story structure attached to the north gable. This is constructed of stone to its ground floor but is timber-framed to its first floor (Fig 3). The function of this addition cannot be determined. Neither of these structures is fully integral with the main building. In addition, the northern end of the west side is gabled, perhaps designed to match the two-storey porch and the west gable end of the east-west range. The structural detail of the west purlin in the attic at this point, where the timbers do not appear to join together or run out from each other neatly, suggests that the gable is not a primary feature, but an alteration or afterthought.

Thus, from the timbers available a total of 25 core samples was obtained. Each sample was given the code HRN-A (for Hartshorne, site "A") and numbered 01 – 25. The great majority of samples, HRN-A01 – A13, were obtained from the roof or other structural timbers of the main north-south range, with additional samples, HRN-A14 – A19, being taken from the porch, a possible later gable alteration, HRN-A20 and A21, and an outshot or lean-to at the north end of the main range, samples HRN-A22 – A25

Where possible the positions of these samples have been marked on a simple schematic sketch plan made at the time of sampling, this being reproduced here as Figure 4 (only those of the main range being shown). Details of the samples are given in Table 1. In this Table, and on the plan, 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 the owner of no.10 Main Street, Mr Jeremy Jones, for his enthusiasm for and help with this programme of tree-ring analysis, and for allowing access to the building. The Laboratory would also like to thank Philip Heath, for arranging access and for help with the interpretation of this building, and South Derbyshire District Council for funding this programme of analysis.

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 of *all* the dated samples from each phase of a building and add 15 to 40 rings to get the overall likely felling date of the group.

Analysis

Each of the 25 samples obtained from no.10 was prepared by sanding and polishing. It was seen at this point that three samples, HRN-A12, A17 and A19 had too few rings for reliable dating, ie, less than 54, and they were rejected from this programme of analysis. The annual growth-ring widths of the remaining 22 samples were, however, measured, with all 22 then being compared with each other.

At a minimum value of $t=3.5$ a single group comprising 16 samples could be formed, cross-matching with each other at the positions indicated in the bar diagram Figure 5. The 16 cross-matching samples were combined at these indicated off-set positions to form HRNASQ01, a site chronology of 164 rings. Site chronology HRNASQ01 was then satisfactorily dated by repeated and consistent comparison with a number of relevant reference chronologies for oak as spanning the years 1448 to 1611. The evidence for this dating is given in the t -values of Table 2.

Site chronology HRNASQ01 was then compared with the six remaining measured but ungrouped samples, HRN-A06, A08, A15, A16, A20 and A23, but there was no further satisfactory cross-matching. These six single samples were then compared individually with the full range of reference chronologies but there was, again, no further cross-matching and these samples must, therefore, remain undated.

Interpretation and conclusion

Analysis by dendrochronology of 22 of the 25 samples obtained from a range of locations within no.10 Main Street (three samples having too few rings), has resulted in 16 of these being combined to form a single site chronology, HRNASQ01. This site chronology is 164 rings long, these rings being satisfactorily dated as spanning the years 1448 – 1611.

None of the samples in this dated site chronology retain complete sapwood and it is thus not possible to be precise as to the exact felling date of any of the timbers represented. Several samples do, however, retain some sapwood or at least the heartwood/sapwood boundary; at least one sample, HRN-A01, is from a timber which does have complete sapwood on it, but from which a small amount of sapwood was lost during coring. Taking the date of the heartwood/sapwood transition ring on the dated samples, and the amount of sapwood lost from sample HRN-A01, it is estimated that all the dated timbers were felled within a five year 'window' sometime between 1618 and 1623.

In general terms, it is very difficult to ascribe a difference in the likely felling date of timbers from any particular part of number 10 compared to any other part of the building with any reliability, but there is indeed a very slight indication of this being a possibility. This uncertainty is in part due to the low numbers of samples available or taken from some parts.

The main range, for example is represented by 6 samples which have the heartwood/sapwood boundary, the average date of this boundary being 1593. The average date of the heartwood/sapwood boundary on the two dated samples from the porch addition is a year later at 1594. The outshot, or lean-to, is represented by one sample with a heartwood/sapwood boundary, the boundary being dated 1599, with the gable alteration, also represented by one sample, with a heartwood/sapwood boundary, this boundary being dated to 1603.

These progressive differences could be taken to indicate very minor differences in the date of the various elements of the building, the main range being earliest, the porch being added first, with the lean-to being added slightly later, and then the west-facing gable being added or changed. However, it might be noted from Table 1 that amongst the samples from the main range alone, which is structurally certainly of a single date, the heartwood/sapwood boundary varies by up to 11 years (samples HRN-A02 and A09). If there is any variation in date it is perhaps only as little as ten years which without the benefit of complete sapwood is difficult to determine reliably.

Whilst, judging by the degree of cross-matching between some of the samples, it is possible, that some trees were growing close to each other, it would appear more likely that the trees were more widely dispersed about the original woodland source, and indeed it is possible that some trees were taken from different woods. Samples HRN-A11 and A14 for example cross-match with a value of $t=10.1$, suggesting the two trees represented were originally growing reasonably close to each other, as were the trees represented by samples HRN-A03 and A04, which cross-match with a value of $t=8.3$. Many of the other samples cross-match with values of $t=4.5$ and 5.0 , values which are indicative of trees with a wider distribution.

Indeed, it is not till a much lower t -value is reached that all the dated samples come together collectively to form the final site chronology, HRNASQ01. Such a low value is indicative of the use of tree from different woodlands and, although not conclusive on its own, this could again be taken as support for the view that the trees were felled at slightly different times (had they all been felled at once it might be expected that more of them would have come from the same wood).

Where this original wood, or woods, was cannot be determined with absolute precision. However, as indicated by Table 2, which shows the reference chronologies against which site chronology HRNASQ01 has been dated, the highest t -values are found against material from other fairly local sites. It may be seen from this Table that the t -values are unusually high against the reference material from Donnington-le-Heath, Shardlow, and Staunton Harold. This would suggest that the timbers used at these sites and at no.10 were from the same general area. Presumably this was somewhere just to the east of Hartshorne.

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Table 1: Details of samples from 10 Main Street, (Upper Hall), Hartshorne, Derbyshire

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Heart/sap boundary date	Last measured ring date
Main north-south range						
HRN-A01	West principal rafter, truss 2 (north)	55	6	1544	1592	1598
HRN-A02	West queen strut, truss 2	78	21	1531	1587	1608
HRN-A03	East principal rafter, truss 3	80	no h/s	1502	-----	1581
HRN-A04	West principal rafter, truss 4	80	no h/s	1507	-----	1586
HRN-A05	West purlin, truss 4 – 5	123	h/s	1469	1591	1591
HRN-A06	West principal rafter, truss 5	80	h/s	-----	-----	-----
HRN-A07	East queen strut, truss 5	117	no h/s	1468	-----	1584
HRN-A08	West wall post, truss 3 (first floor)	112	no h/s	-----	-----	-----
HRN-A09	Stud post, truss 4 – 5, west wall (first floor)	68	6	1531	1592	1598
HRN-A10	East wall post, truss 5 (first floor)	96	3	1502	1594	1597
HRN-A11	Jetty joist 1, bay 4	111	19	1501	1592	1611
HRN-A12	Jetty joist 2, bay 4	nm	---	-----	-----	-----
HRN-A13	Jetty joist 1, bay 5	67	no h/s	1514	-----	1580
Porch addition						
HRN-A14	First floor ceiling joist 3/middle (from east)	75	h/s	1522	1596	1596
HRN-A15	Ground floor ceiling joist 1 (from east)	67	no h/s	-----	-----	-----
HRN-A16	Ground floor ceiling joist 2 (from east)	59	h/s	-----	-----	-----
HRN-A17	Ground floor ceiling joist 4 (from east)	nm	---	-----	-----	-----
HRN-A18	West beam/plate (above front door)	77	h/s	1516	1592	1592
HRN-A19	South door jamb to front door	nm	---	-----	-----	-----

Table I: continued

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Heart/sap boundary date	Last measured ring date
	Gable addition, west side, north end					
HRN-A20 HRN-A21	North purlin South purlin	61 82	h/s 3	----- 1525	----- 1603	----- 1606
	Outhouse addition					
HRN-A22 HRN-A23 HRN-A24 HRN-A25	North sill beam East sill beam North-east corner post North wall plate	134 101 57 65	no h/s h/s h/s no h/s	1448 ----- 1543 1512	----- ----- 1599 -----	1581 ----- 1599 1576
*h/s = heartwood/sapwood boundary nm = sample not measured						

Table 2: Results of the cross-matching of site chronology HRNASQ01 and relevant reference chronologies when first ring date is 1448 and last ring date is 1611

Reference chronology	Span of reference	t-value	Reference
Donnington-le-Heath Manor House, Leics	1411 – 1618	13.4	(Esling <i>et al</i> 1989)
Moor Farm Cottage (south) Shardlow, Derbys	1434 – 1614	10.4	(Howard <i>et al</i> 1994)
Staunton Harold church pews	1508 – 1661	9.2	(Howard <i>et al</i> 1996)
Moat House, Appleby Magna, Leics	1449 – 1621	8.8	(Arnold <i>et al</i> forthcoming)
Coton Priory, Leics	1506 – 1597	8.6	(Howard 2003 unpubl)
Stoneleigh Abbey, Warwicks	1398 – 1658	7.9	(Howard <i>et al</i> 2000)
East Midlands Master Chronology	882 – 1981	7.7	(Laxton and Litton 1988)
England Master Chronology	401 – 1981	7.2	(Baillie and Pilcher 1982 unpubl)