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Summary

Nine timbers were sampled from the main range of Cradley Village Hall, Cradley, Herefordshire. All nine samples dated and were combined to form the 184-ring site master ***CRADLEY***, spanning the years AD 1347 - 1530. Felling dates of the timbers used in the construction of the building range from spring AD 1530 to spring AD 1531.

The north wing was not suitable for sampling and therefore remains undated.

Keywords

Dendrochronology
Standing Building

Author's address

Oxford Dendrochronology Laboratory, Mill Farm, Mapledurham, Oxfordshire RG4 7TX.
Telephone: 0118 972 4074. Email : michael@dendrochronology.com, daniel.miles@rlaha.ox.uk

Description of building

Cradley Village Hall, Cradley, Herefordshire (SO 7366 4711; Fig 1), is an L-shaped building of two storeys with exposed timber framing on three sides and a plain-tiled roof. The jettied upper storey projects on the north, south, and west sides over original moulded bressumers, curved brackets, and octagonal shafts on the angle-posts. Although the first-floor interior has been removed, the dragon beams and transverse beams survive in the west end of the hall. The five-bay main range is generally assumed to have been built in the late fifteenth or early sixteenth century, possibly for use as a church ale house or manorial court, while the projecting north wing is a later addition, perhaps concurrent with repairs to the main range undertaken in AD 1674. The hall later became a boys' school and now functions as the parish hall; it is currently a Grade II* listed building.

Objectives of dating

The principal objective of the dendrochronology was to ascertain the primary date of construction of both the main range and the north wing to help understand the chronological development of the building and to inform its restoration under the Countryside Agency's Local Heritage Initiative.

The work to the building was commissioned by the Centre for Archaeology following a request from Mr John Yates, Historic Buildings Inspector for the English Heritage West Midlands Regional Team. This analysis formed part of a dendrochronology training programme at Oxford University, funded by English Heritage and supervised by the second author.

Methodology

The samples were taken using a 16mm hollow auger powered by an electric drill and were sanded on a linisher using 60 to 1000 grit abrasive paper. These were then measured to an accuracy of 0.01mm using a travelling stage attached to a microcomputer based measuring system (Reynolds pers comm 1998).

The samples were compared with each other using dendrochronological techniques as outlined in English Heritage (1998). This involved both visual comparisons using semi-logarithmic graphs as well as statistical cross-correlations using a computer. This utilised cross-correlation algorithms (Baillie and Pilcher 1973) which have been implemented using computer software written for Windows in Visual Basic by M R Allwright and P A Parker. In comparing two individual samples, a *t*-value of 3.5 or higher is usually indicative of a good match, whilst *t*-values of 10 and above often suggest that samples have originated from the same parent tree. All individual samples matching with consistently high correlation during cross-matching are averaged together to form a mean site master.

On comparing this site master with dated reference chronologies, *t*-values of 5 and above are normally expected. A conclusive match should usually exhibit the highest matches with reference chronologies of local origin as well as with well-replicated regional chronologies, unless the timber was imported. Matching positions suggested by computer are confirmed by satisfactory visual matching.

Once a ring sequence has been dated chronologically, the date of felling needs to be interpreted. When the sapwood is complete on a sample, the determination of a felling date is relatively straight-forward. Each growth ring is comprised of one or more rows of open spring vessels, or early wood, followed by a band of dense summer growth or late-wood. During the winter months the tree remains dormant. If both the spring and summer growth are present and complete, then the tree would have been felled during the winter period. If only the spring vessels are present beneath the bark, then the tree can be said to have died or been felled during the spring period. If only a few vessels are present, then it is possible to further refine the time of felling to *early spring*. If some dense wood or summer growth is present, then a *summer or autumn* felling period can be determined. However, as it is not known how wide the summer growth band should be for that particular tree, it cannot be stated conclusively whether the tree was felled in early or late summer, or if indeed it was felled at some point in the winter. For instance, a severe May frost can suddenly halt the tree's growth, which would produce a very narrow ring with little or no summer wood (Baillie 1982, plate 2c). Therefore, a certain degree of caution should be used in interpreting felling seasons between summer and autumn, or even winter seasons in some instances. Only apparently complete rings indicating felling during the winter months are measured. Samples exhibiting spring or summer growth give a felling date during the year following the last measured ring.

If the outermost rings are missing but the heartwood/sapwood boundary survives, then the number of missing sapwood rings can be estimated using an empirically derived sapwood estimate. The sapwood estimate used in this report is 11 to 41 rings, the 95% confidence range calculated by Miles (1997a) for Wales and the border counties.

It should be remembered that dendrochronology can only date when the tree died, not the date of construction for a building or artefact. The interpretation of a felling date relies on having a good number of precise felling dates rather than just one or two. Nevertheless, it was common practice to build timber-framed structures with green or unseasoned timber and construction usually took place within twelve months of felling (Miles 1997a).

Assessment

The aim of the assessment was to find a number of timbers, ideally six to ten per building phase, containing at least fifty annual rings. Samples with fewer than fifty rings are less likely to have a unique growth pattern to allow secure dating at one period in time, making them unsuitable for dendrochronological analysis. Samples with complete sapwood were also sought as these would allow precise felling dates to be assigned for these timbers.

Only main structural timbers that were definitely from the primary construction of the building were assessed. Most of these were suitable for analysis although there had been considerable alterations that resulted in large sections of the primary walls and floors being removed. Apart from some of the tiebeams having been replaced, the addition of the north wing necessitated the removal of the original roof from the east of truss A7. The rafters, despite appearing to be original, were unsuitable as they were hewn from fast-grown trees containing fewer than fifty annual rings.

Nevertheless, many of the primary phase timbers were found to be suitable, with good ring counts, and many with complete sapwood or a visible heartwood/sapwood transition.

The timbers used in the construction of the north wing were also very fast grown, none having more than about forty-five rings. Also, there were some reused timbers incorporated into the structure, which together with the quick growth of the timbers, made the north wing unsuitable for dendrochronological analysis. The attic of the north wing was inaccessible so the rafters could not be assessed.

Sampling

Following the preliminary assessment, the building was sampled on 26 February 2002. Because the north wing was unsuitable for tree-ring analysis, only the main range was studied. A number of these timbers were not sampled due to being inaccessible. Others were found to have been defrassed, a process where all the worm-eaten sapwood is removed.

The nine oak (*Quercus* spp.) timbers considered most suitable for dendrochronological analysis were sampled: front and rear dragon beams in bay 1, the transverse beams from trusses 2, 3, 4, and 5, the rear jetty bressumer in bay 4, and the lower posts from trusses 4 and 5 (Figure 3, Table 1). Secondary samples were taken from five timbers because primary samples broke during coring; each break brought about the possibility of losing a small section of wood and therefore secondary samples were needed to bridge these gaps.

The nine timbers were distributed throughout the building in order to confirm that the whole of the surviving primary structure was of one build. Six of the samples retained complete sapwood and the remaining three had the heartwood/sapwood transition present.

Cross-matching and dating

Samples ***crad6a*** and ***crad6b*** were found to match with a *t*-value of 8.39 and were combined to form the composite ***crad6***. Samples ***crad7a*** and ***crad7b*** were found to match with a *t*-value of 13.93 and were similarly combined to form ***crad7***.

Seven of the samples cross-matched and were combined to produce an interim site master (Fig 4, Tables 1 and 2). This interim site master was successfully dated to AD 1360-1530. The two remaining samples, ***crad4*** and ***crad5***, were compared with this site master chronology and produced t-values of 4.01 and 4.63 at end dates of AD 1529 and AD 1487 respectively. As the intra-site cross-matching for those two samples is relatively poor (Table 2) they were also compared individually to the reference chronologies. This confirmed the end dates of AD 1529 and AD 1487 (Tables 3 and 4). All nine samples were therefore combined to form the 184-year site master chronology ***CRADLEY*** which spans the years AD 1347-1530 (Tables 5 and 6).

Interpretation and discussion

All nine of the timbers sampled in this study have dated. Of the six samples from timbers retaining complete sapwood, five gave precise dates, the earliest being spring AD 1530 for sample ***crad7***. Sample ***crad4*** dated slightly later to the summer of AD 1530, whilst samples ***crad1*** and ***crad3*** dated to the winter of AD 1530/31. The latest felling date found was that for sample ***crad9***, dating to the spring of AD 1531 (Table 1). The sixth sample, ***crad2a***, could only be assigned a heartwood/sapwood boundary date of AD 1523-48 due to breaks in the core. The three other timbers gave felling date ranges that were consistent with AD 1530-31 felling dates.

The cross-matching of the site master ***CRADLEY*** with the reference chronologies was outstanding, with the highest values of t = 14.94, 14.15, and 13.21 being matches with large, well-replicated, composite chronologies. Two of these were large, not entirely independent, chronologies from Wales and Shropshire, and a further excellent match of t = 11.97 with the Hereford Cathedral Barn strongly suggests that the timber used to construct Cradley Village Hall is local in origin.

The dated timbers from this building were felled over a period of 12 months, which is not uncommon in buildings of this period (Miles 1997a). In this study, over 40% of dated complete sapwood within a phase of building was found to be felled in more than one year.

Acknowledgements

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Table 1: Summary of tree-ring dating

CRADLEY VILLAGE HALL, CRADLEY, HEREFORDSHIRE

Sample number & type		Timber and position spanning	Dates AD	H/S bdry	Sapwood complement	No of rings	Mean width mm	Std devn mm	Mean sens mm	Felling seasons and dates/date ranges (AD)
* ***crad1***	c	Front dragon beam bay 1	1445-1530	1514	16C	⊖86	2.57	0.81	0.203	Winter 1530/31
* ***crad2a***	c	Rear dragon beam bay 1	1391-1518	1507	11+4	128	1.05	0.41	0.187	1523-48
crad2b	c	ditto	-		17C	17	1.63	0.40	0.219	
* ***crad3***	c	Transverse beam truss 2	1361-1530	1492	38C	170	1.41	0.47	0.160	Winter 1530/31
* ***crad4***	c	Transverse beam truss 3	1358-1529	1503	26½C	172	2.01	0.83	0.141	Summer 1530
* ***crad5***	c	Rear lower post truss 4	1347-1487	1487	H/S	⊖141	1.01	0.71	0.188	1498-1528
crad6a	c	Transverse beam truss 4	1408-1473			66	1.85	0.61	0.185	
* ***crad6b***	c	ditto	1427-1502	(1509)[1]		79	1.83	0.44	0.195	
crad6		Mean of ***crad6a +6b***	1408-1502	(1509)[1]		95	1.85	0.50	0.180	1520-50
crad7a	c	Rear jetty bressumer bay 4	1377-1463			87	1.62	0.28	0.165	
crad7b	c	ditto	1425-1529	1499	30¼C	105	1.58	0.30	0.191	
* ***crad7***		Mean of ***crad7a +7b***	1377-1529	1499	30¼C	153	1.60	0.30	0.176	Spring 1530
* ***crad8***	c	Front lower post truss 5	1360-1500	1500	H/S	141	1.34	0.56	0.206	1511-41
* ***crad9***	c	Transverse beam truss 5	1368-1530	1506	24¼C	163	1.62	0.42	0.187	Spring 1531
*** CRADLEY Site Master**			**1347-1530**			**184**	**1.65**	**0.49**	**0.131**	

[1] There were 7 heartwood rings not measured to the heartwood/sapwood boundary on this sample, giving a h/s boundary date of AD 1509

Key: *, † = sample included in site-masters; c = core; ⊖ = pith included in sample; ¼C, ½C, C = bark edge present, partial or complete ring: ¼C = spring (ring not measured), ½C = summer/autumn (ring not measured), or C = winter felling (ring measured); H/S bdry = heartwood/sapwood boundary - last heartwood ring date; std devn = standard deviation; mean sens = mean sensitivity; +4NM number of unmeasured rings. Sapwood estimate used 11 to 41 years (Miles 1997a)

Table 2: Matrix of *t*-values and overlaps for components of ***CRADLEY***

Sample:	***crad2a***	***crad3***	***crad4***	***crad5***	***crad6***	***crad7***	***crad8***	***crad9***
Last ring date AD:	1518	1530	1529	1487	1502	1529	1500	1530
crad1	4.01	4.27	1.56	0.93	1.19	5.22	3.32	3.93
1530	74	86	85	43	58	85	56	86
	crad2a	5.33	1.78	1.54	3.92	6.39	4.00	5.87
		128	128	97	95	128	110	128
		crad3	3.87	3.23	4.26	5.55	5.06	7.09
			169	127	95	153	140	163
			crad4	1.99	3.32	2.45	4.50	4.15
				130	95	153	141	162
				crad5	3.20	2.44	4.87	2.41
					80	111	128	120
					crad6	3.90	4.00	5.64
						95	93	95
						crad7	5.54	6.86
							124	153
							crad8	5.35
								133

Table 3: Ring-width data for site master curve

CRADLEY AD 1347-1530, Cradley Village Hall, Cradley, Herefordshire - mean of samples ***crad1*** + ***crad2a*** + ***crad3*** + ***crad4*** + ***crad5***+ ***crad6*** + ***crad7*** + ***crad8*** + ***crad9***
184 rings, starting date AD 1347

ring widths (0.01mm)

078	061	102	147	258	200	233	303	306	336
284	415	398	271	261	276	258	296	205	247
213	213	269	207	175	221	217	230	227	210
192	183	230	162	162	156	161	158	164	211
181	175	171	144	198	153	121	116	122	148
120	137	152	175	161	135	161	157	153	150
151	170	192	160	146	174	158	150	173	153
157	151	104	150	155	144	178	177	173	128
128	154	151	134	132	188	148	133	178	140
133	131	103	113	130	117	124	147	129	124
142	147	130	134	163	132	135	145	155	154
179	178	143	172	140	148	160	120	130	142
151	157	170	176	173	146	141	146	196	170
131	125	146	151	190	151	159	156	145	168
162	158	144	163	155	135	139	135	144	193
132	126	173	160	126	166	139	155	169	161
142	136	156	142	150	148	145	129	140	131
112	135	193	137	152	171	147	150	136	139
151	148	117	108						

number of samples in master

1	1	1	1	1	1	1	1	1	1
1	2	2	3	4	4	4	4	4	4
4	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
6	6	6	6	7	7	7	7	7	7
7	7	7	7	7	7	7	7	7	7
7	8	8	8	8	8	8	8	8	8
8	8	8	8	8	8	8	8	8	8
8	8	8	8	8	8	8	8	8	8
8	8	8	8	8	8	8	8	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	8	8	8	8	8	8	8	8	8
8	8	8	8	7	7	6	6	6	6
6	6	6	6	6	6	6	6	6	6
6	6	5	5	5	5	5	5	5	5
5	5	5	3						

Table 4: Dating of *CRADLEY* against reference chronologies at AD 1530

	Reference chronology	Spanning	Overlap	t-value
	IGHTFELD *(Groves 1998)*	1341-1566	184	9.82
*†	KINGPYON *(Groves and Hillam 1993)*	1346-1480	134	9.89
*	**EASTMID** *(Laxton and Litton 1988)*	882-1981	184	9.87
*	**MC16** *(Fletcher 1978)*	1314-1636	184	9.99
	SOUTH *(Hillam and Groves 1994a)*	406-1594	184	10.05
	LONDON *(Tyers pers com)*	413-1728	184	10.33
♣	HEREFC *(Tyers 1996)*	1313-1640	184	10.33
	HIGHTOWN *(Boswijk and Tyers 1997)*	1302-1487	143	10.48
	SINAI *(Tyers 1997)*	1227-1750	184	10.57
	NORTH *(Hillam and Groves 1994b)*	440-1742	184	10.66
	SENG98 *(Bridge 1998)*	944-1790	184	10.92
	HANTS02 *(Miles 2003)*	443-1972	184	11.46
	WVT9 *(Nayling 2000)*	1364-1602	167	11.74
	ARELEY *(Bridge pers comm)*	1365-1535	166	11.82
♣	HERECB2 *(Tyers 1996)*	1359-1491	133	11.97
	WALES97 *(Miles 1997b)*	404-1981	133	11.97
	SALOP95 *(Miles 1995)*	881-1745	184	14.15
	MASTERAL *(Haddon-Reece and Miles 1993)*	404-1987	184	14.94

* = Component of MASTERAL
† = Component of SALOP95
♣ = Component of WALES97

Chronologies shown in **bold** are composites.

Table 5: Dating of *crad4* against reference chronologies at AD 1529

	Reference chronology	Spanning	Overlap	t-value
	bry2 *(Miles and Haddon-Reece 1996)*	1414-1614	112	4.81
	NORTH *(Hillam and Groves 1994b)*	44-1742	168	4.93
	DORE2 *(Tyers and Boswijk 1998)*	1363-1612	163	5.04
	WHITEHLL *(Miles and Worthington 1999)*	1352-1462	101	5.10
♣	HEREFC *(Tyers 1996)*	1313-1640	168	5.31
	HIGHTOWN *(Boswijk and Tyers 1997)*	1302-1487	128	5.36
	MYNDEt10 *(Nayling 2001)*	1392-1619	138	5.65
♣	neu1 *(Miles and Haddon-Reece 1996)*	1438-1506	69	5.78
	WALES97 *(Miles 1997b)*	404-1981	168	5.83
	WVT9 *(Nayling 2000)*	1364-1602	162	5.84
	SALOP95 *(Miles 1995)*	881-1745	168	5.96
	CALLGHTN *(Miles and Worthington 1997)*	1335-1569	168	6.07
†	GTBINNAL *(Miles and Haddon-Reece 1996)*	1321-1529	168	6.79
†	KINGPYON *(Groves and Hillam 1993)*	1346-1480	119	8.36

† = Component of SALOP95
♣ = Component of WALES97

Chronologies shown in **bold** are composites.

Table 6: Dating of ***crad5*** against reference chronologies at AD 1487

Reference chronology	Spanning	Overlap	t-value
* KINGPYON *(Groves and Hillam 1993)*	1346-1480	119	6.00
bn3 *(Miles and Worthington 2000)*	1386-1505	98	4.90
RODE *(Miles and Worthington 1999)*	1343-1428	78	4.99
WCCLOSE2 *(Miles et al 2003 forthcoming)*	1284-1443	97	5.08
* LEOMST *(Haddon-Reece unpubl)*	1353-1464	108	5.09
LEOMSTR2 *(Miles and Worthington 1997)*	1349-1499	135	5.0
STSWLLS1 *(Miles et al forthcoming 2003)*	1342-1462	116	5.10
STHELEN1 *(Miles and Haddon-Reece 1995)*	1297-1430	80	5.11
ALTON_t4 *(Hillam pers comm)*	1348-1555	140	5.13
NORTH *(Hillam and Groves 1994b)*	440-1742	137	5.19
wstn1 *(Miles and Worthington 1997)*	1343-1437	87	5.27
ASTNEYR3 (Miles and Worthington 1998)	1357-1612	127	5.28
* **EASTMID** *(Laxton and Litton 1988)*	882-1981	137	5.28
HIARDEN2 *(Miles and Worthington 2002)*	1293-1439	93	5.34
LIONTAP *(Miles and Haddon-Reece 1994)*	1353-1425	69	5.43
MASTERAL *(Haddon-Reece and Miles 1993)*	404-1987	137	5.55
HIGHTOWN *(Boswijk and Tyers 1997)*	1302-1487	141	6.16

* = Component of MASTERAL

Chronologies shown in **bold** are composites.

Figure 1: Map showing the location of Cradley Village Hall

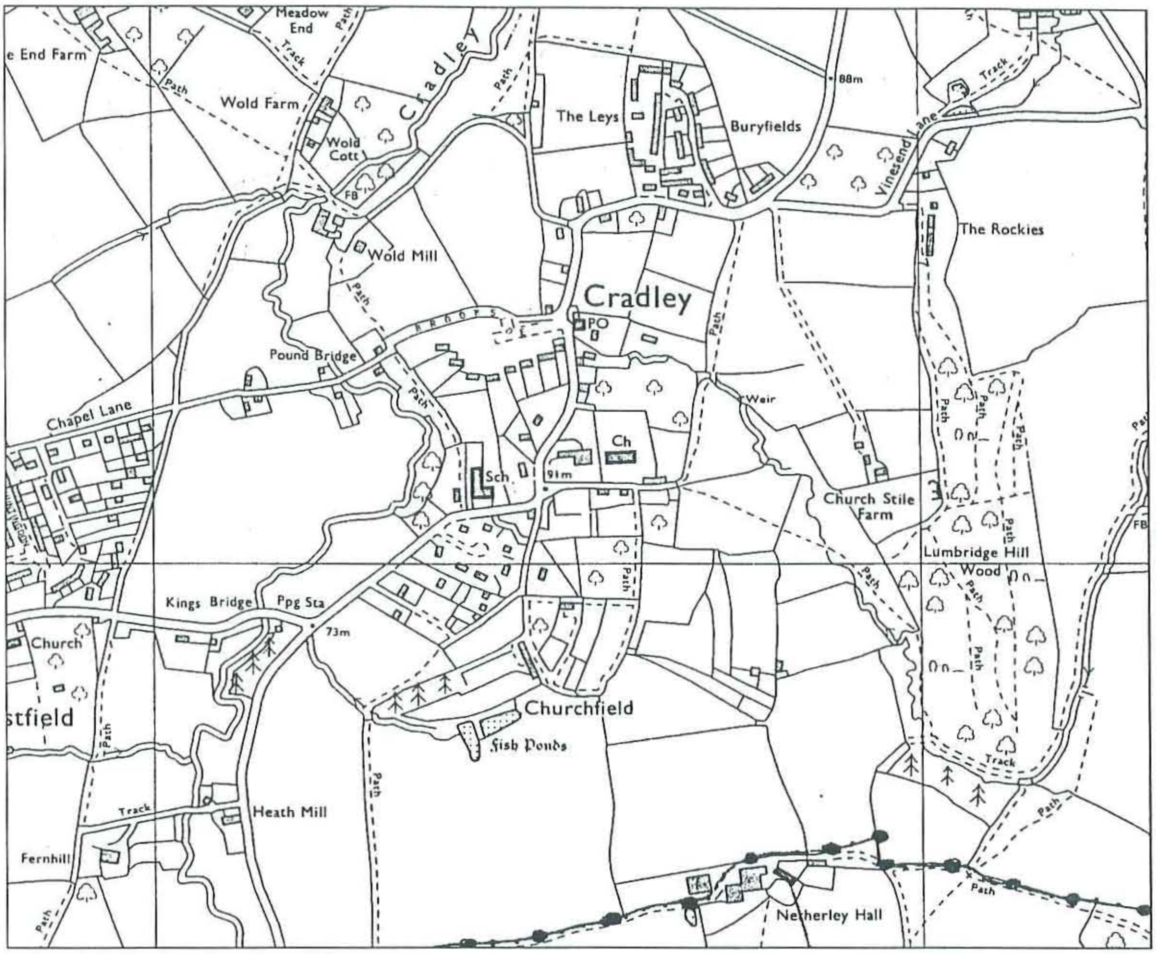

Figure 2: South elevation of the main range

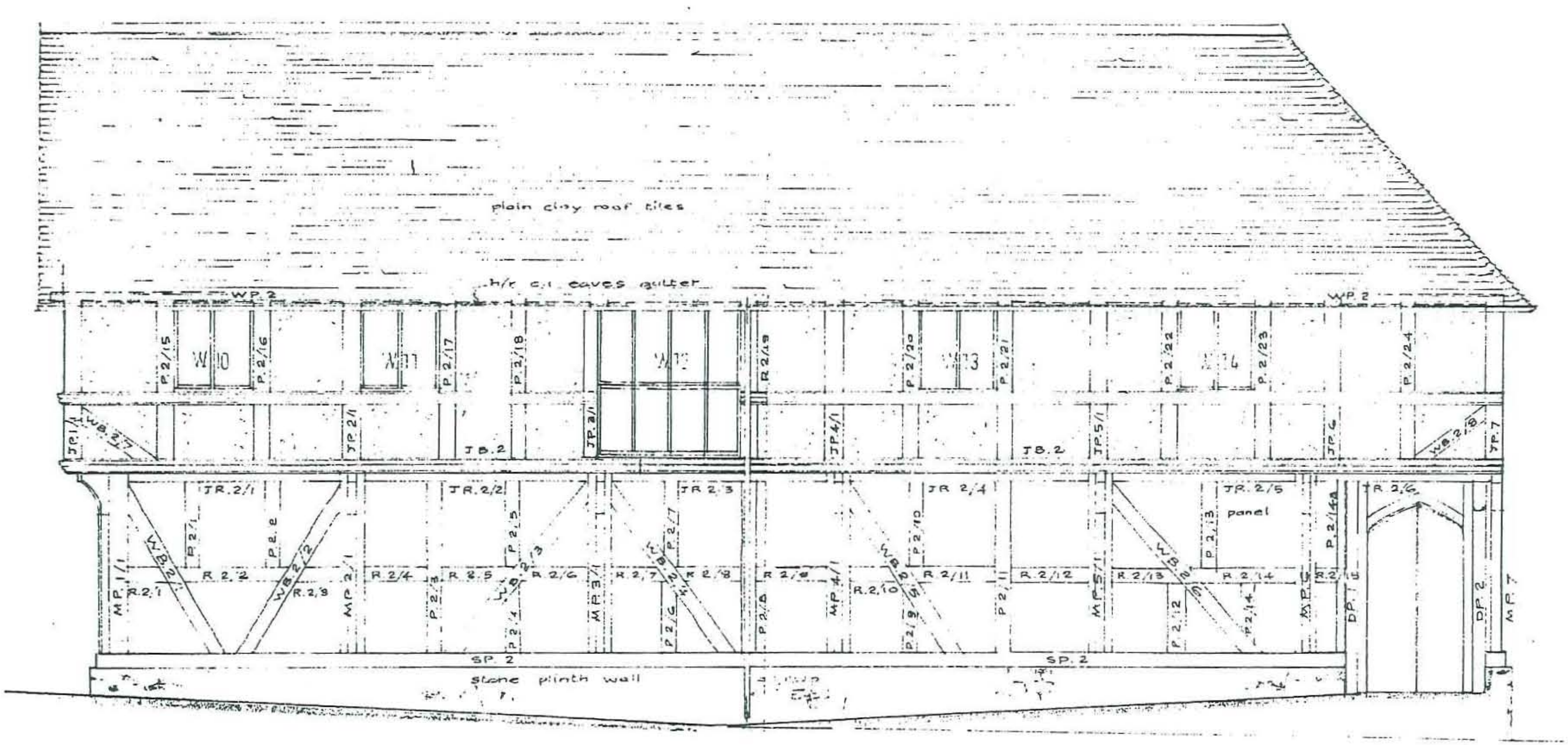

Figure 3: First floor plan showing locations of samples

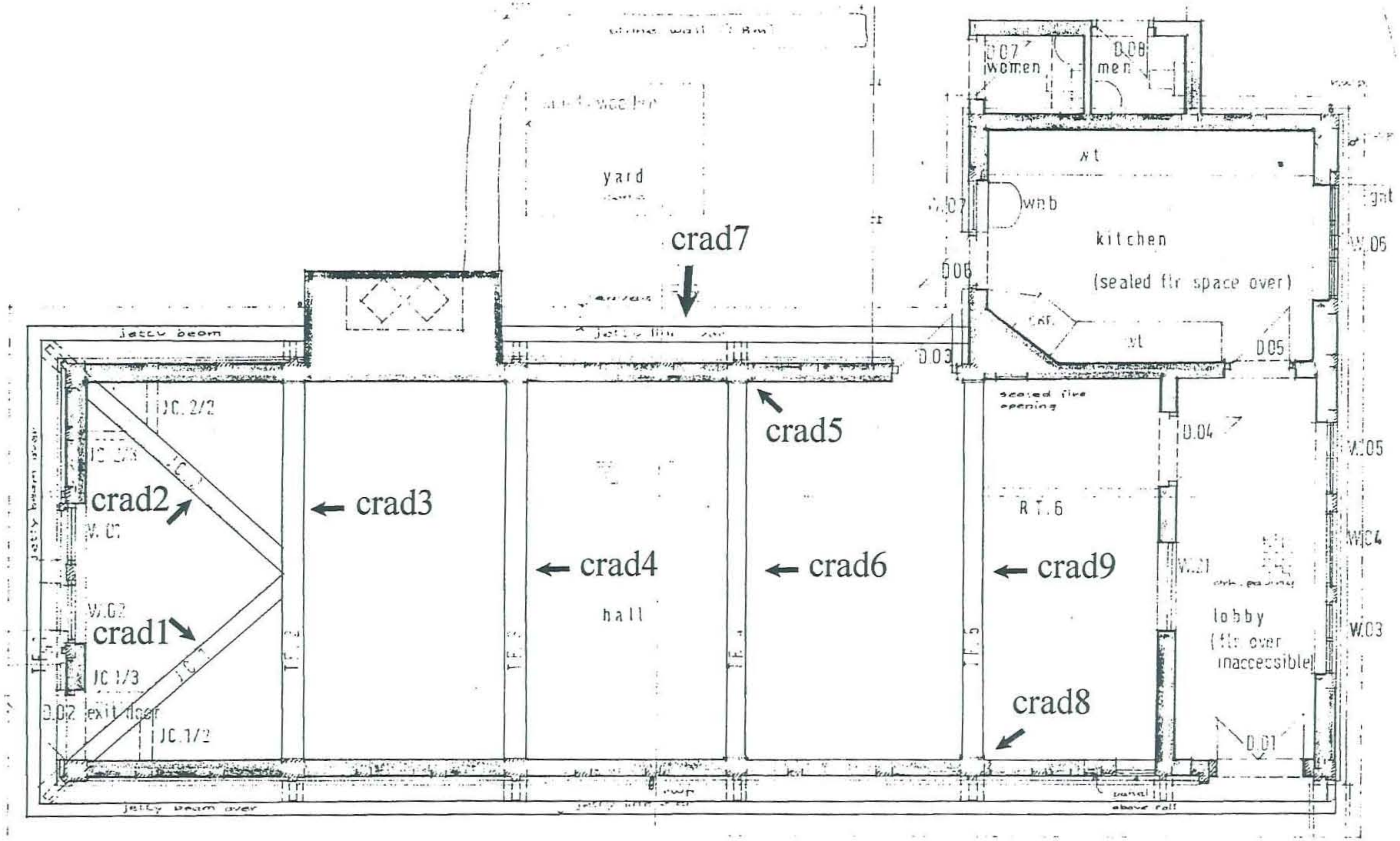

Figure 5: Bar diagram showing relative positions of dated samples