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THE TREE-RING DATING OF EASTLEIGH MANOR, WESTLEIGH, DEVON

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Summary

Twelve timbers were sampled at Eastleigh Manor, Westleigh, Devon (SS 488 280) from both the principal upper chamber and the north-west wing. Of these, only one sample from the principal upper chamber dated conclusively with a last measured ring date of AD1474. With a last heartwood ring date of 1473, an estimated felling date range of 1483-1528 is given. The wing remains undated. Of the other samples taken, there was no other internal matching and one or two samples which visually appeared to be from the same tree also failed to match significantly.

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Table 1: EASTLEIGH MANOR - SUMMARY OF TREE-RING DATING
[for abbreviations see key below]

Sample number		timber & position	dates spanning	H/S bdry	sap-wood	no of rings	mean width mm	std devn mm	mean sens
Hall									
* e01	c	W princ rafter T4	-		h/s	96	1.68	0.56	0.246
* e02	c	E princ rafter T4	-			68	2.07	0.75	0.243
* e03	c	Collar T3	-		4	57	4.08	1.46	0.221
* e04	s	Purlin ex-situ	-			75	1.44	0.70	0.306
* e05	f	W arch-brace	-			56	3.48	1.01	0.261
* e06	c	E purlin bay II	AD1405-1474	1473	1	70	2.01	0.76	0.232
North-west Range									
* e11	s	N purlin bay III	-		2	55	1.78	0.92	0.198
* e12a	c	S princ rafter T2	2-67		h/s	66	2.53	0.89	0.193
* e12b	c	N princ rafter T2	1-68		h/s	68	2.80	1.10	0.219
* e13a	c	Ridge bay I	1-62		17	62	1.71	1.01	0.374
* e13b	c	(matched t=24.72)	6-75		31½	70	1.54	1.01	0.383
* e14a	c	S princ rafter T1	-		h/s	55	3.03	0.82	0.183
* e14b	c	N princ rafter T1	-			58	3.51	1.61	0.160

Key: * = sample included in site-master;
c,s,f = core, slice, face measured;
¼,½,C = bark edge present, partial or complete ring: ¼ = spring (ring not measured), ½ = summer/autumn, or C = winter felling (ring measured);
H/S bdry = heartwood/sapwood boundary - last heartwood ring date;
std devn = standard deviation;
mean sens = mean sensitivity

THE TREE-RING DATING OF EASTLEIGH MANOR, WESTLEIGH, DEVON

1. Introduction and objectives

Eastleigh Manor is a Grade II* listed house of stone rubble with ashlar dressings. The North- range consists of a three-bay first floor principal chamber over a parlour or Hall, and the staircase. The parlour ceiling beams have elaborate rolls flanked by hollow-ogee mouldings and the north ground-floor window retains some late medieval heraldic stained glass. The roof has moulded arch-braces to collars which rise from a timber corbel table. There are two tiers of threaded purlins, both originally with wind-braces. The roof over the stairs is of much simpler design and evidently not intended to be seen. The North-west wing appears to have predated the parlour range as the chimney stack truncates the wing's roof structure. This roof is again of arch-braced collar construction with two tiers of purlins.

The dendrochronology was to be used to firmly date each of the two early phases, the first floor principal chamber and the NW wing. The roofs were being re-slated and repaired at the time and the access scaffolding was used to gain access to the trusses.

2. Methods of sample collection, preparation and dating

Normal practice in tree-ring sampling offers a choice of three possible methods: measurements in situ on a well-polished beam end (normally by sanding); cores drilled with a hollow auger; or slices cut from the timbers. At Eastleigh Manor, a combination of all three methods were used. One of the arch-braces, sample e05, had a series of very distinct rings on its quarter-sawn surface and these were read in-situ. Sections were obtained from a couple of purlins discarded in the course of the repairs, and cores were used to sample the other timbers.

The main problem with this site was the few number of rings in the remaining timbers and the lack of sound sapwood. The principal chamber had no sapwood left intact at all save some very loose sections on the upper parts of T2 and T4 which were impossible to sample. However, several samples did have a heartwood-sapwood boundary intact. In the North-west wing one sample was obtained with complete sapwood from a ridge piece, and the other three samples had a heartwood/sapwood transition. In each of the wing trusses, the principal rafters were found to be paired halves of trees, each tree having been cut down the centre with both halves being used. This was clearly visible from the matching pattern of knot, shakes and saw marks. Here samples were taken from each half to ensure as long a sequence as possible and to obtain as representative a sample from the timber as possible. Despite clear visual evidence that each pair was from a single tree, the tree-ring dating failed to prove this, with a t-value of 6.47 for e12a against e12b while the overlap was not sufficient between e14a and e14b to combine these with certainty. The ridge piece was twice sampled, here the sapwood broke up on the first coring attempt and a second core was taken to obtain an intact sample. All timbers sampled were of oak, Quercus sp.

As all timbers were dry, the samples could therefore be sanded without pretreatment on a linisher through several grades of abrasive paper ranging from 60 grit to 1200 grit. This prepared a sufficiently clean view of the transverse section of the wood for the ring boundaries to be distinguished and for the ring-widths to be measured. Once polished, all samples were measured under a x10/x30 microscope using a travelling stage electronically displaying displacement to a precision of 0.001mm. Where they contained breaks, cores were measured in sections for eventual alignment against other samples.

Dendrochronology is based on the principal that the annual growth rings of trees reflect regional climatic conditions and because of this it is possible to match a sequence of growth rings from a sample of wood against regional reference chronologies to establish the date of the last measured ring in calendar years. If the sample has its sapwood complete, ie to the underside of the bark, then the date of when the tree was felled can be determined to the year and in many instances the season. The usual procedure is to match two or more individual samples from a phase together, make a mean of these, and then try to match any other matched samples, repeating the process of intermediate means until all of the samples from a phase have either been dated together relatively into a floating chronology or have failed to match. The resulting site master or sub-master is then compared with other reference chronologies which have been unequivocally dated in time, thereby dating the floating chronology or sample.

This is accomplished by using a combination of both visual matching and a process of qualified statistical comparison by computer. The ring-width series are recorded on an Amstrad PC2386 computer for statistical cross-matching using a variant of the Baillie and Pilcher (1973) CROS program. A version of this and other programs were written in BASIC by D Haddon-Reece, late of the Ancient Monuments Laboratory. The programs measure the amount of correlation between two sequences and the Student's 't' test is then used as a significance test on the correlation coefficient. Generally a 't'-value of 3.5 or over represents a match, provided that the visual match between the tree-ring graphs is acceptable. In addition to our own databank, the site data has been compared against the databank at the Dendrochronology Laboratory of Sheffield University.

After measurement, the ring-width series for each sample are drawn in the usual fashion as a graph of width against year on log-linear graph paper. This paper is translucent so that graphs ("curves") can be visually compared by overlaying. Samples which originated from the same tree are first combined into a single sequence for the purposes of the analysis. Although there is no precisely defined limit, studies on modern samples suggest that those which cross-match with 't' values over approximately 10.0 are likely to have been derived from the same tree. All pairs of tree-ring curves in the group are then compared visually at the positions indicated by the computer matching and, if found satisfactory and consistent, are averaged to form a mean of the

two. This operation removes 'noise' due to the individual behaviour of the trees such as their response to pollarding or thinning out of their woodland neighbours, and reinforces the common climatic signal.

As previously mentioned, once a tree-ring sequence has been firmly dated in time, a felling date needs to be ascribed. With samples which have sapwood complete to the underside or including bark, this process is relatively simple. In measuring, if the whole ring is complete, ie both spring-wood and summer-wood has been fully formed, then the tree was felled in the winter from the October of the last measured ring date to the March of the following year. If the spring vessels only have formed, signified by a '¼' (this is not measured), then the tree was felled from between March and May of the year following the last measured ring. If there is some summer-wood but this is not complete, then this is signified by a '½' (this is measured) and the tree was felled between June and September of the year of the last measured ring date (Baillie 1982, 46-51). Care must be taken to not misread the 'dates spanned' or 'last measured ring' as a felling date. These are two very different things. Also, months can only be used a guide, as there is considerable variation in the complex relationships between climate and the changes in wood growth.

If the sapwood is partially missing, or if only a heartwood/ sapwood boundary survives, then an estimated felling date range can be given for each sample. The number of sapwood rings can be estimated by using the accepted national sapwood estimate of between 10 and 55 rings. This is within the 95% confidence range for British oaks as determined by J Hillam et al, 1987. If more than one estimated felling date range has been given for a phase, than the area of common overlap of these ranges might be given to effect a reduced felling date range. However, this relies on the assumption that the samples have a common felling year, which may or may not be true. Whilst most structural phases tend to have trees which have been felled within a year or two of each other, this is not always the case and examples of some timbers having been felled ten or fifteen years previous to the main felling date have been known. It should also be noted that no probability estimate can be advanced for such a reduced felling date range.

As it was common practice to build timber-framed structures with green or unseasoned wood, it therefore follows that construction would generally commence within a year or so of felling. However, dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure which is being sampled. But apart from reuse, a timber can generally be identified as having been fashioned green by the distinctive shakes and deformed surfaces which would have been straight and square when initially cut by the saw. When these characteristics are present, one can be reasonably certain that construction would have taken place prior to seasoning which is generally accepted to be one year per inch in thickness.

3. Timbers sampled and analysis

The samples from Eastleigh Manor are designated as e01, e02, etc, samples e01-e06 being from the first floor principal chamber and samples e11-e14 being from the North-west wing. The cores were drilled with a 5/8" hollow auger with hardened steel teeth. Figure 1 shows the location of timbers sampled in situ. The principal chamber was sampled on the 13th of February and the Wing on the 26th of March 1992. A summary of the timbers sampled and their dating is shown in Table 1.

3a. Principal chamber (samples e01 - e06)

Six samples were taken from the first floor principal chamber, two from the purlins, two from the principal rafters, one from a collar and one, read on the face, of an arch-brace. None of the samples matched each other conclusively. Each sample was then individually tested against the regional and national reference chronologies and only sample e06 dated with a last measured ring of AD1474 with one ring of sapwood (see Appendix). None of the other samples matched well enough to enable their positive dating.

3b. North-west Wing (samples e11 - e14)

Seven samples were taken from six timbers from the wing. Unfortunately there were few timbers and what remained was generally very wide ringed and therefore unsuitable for dendrochronology. Of the seven samples, six of these related to three separate trees, each providing two samples. While samples e13a and e13b were taken from the same timber, the other four samples, e12a and e12b as well as e14a and e14b, were clearly pairs from the two trees on archaeological grounds. While samples e14a and e14b were too short to match conclusively, samples e12a and e12b matched with a t-value of 6.47 and were therefore combined to produce a mean curve for this truss. The ridge, however did match both of its cores with a t-value of 24.72 (probably having been sampled from the same radius improved its match) and this sample had the added advantage of retaining complete sapwood. This was compared against the other samples from the site as well as the national and regional reference chronologies but there was no consistent match at any date. The other samples were similarly tested but again yielded no conclusive result.

4. Dating results and conclusion

Of the twelve timbers sampled, only one, sample e06 from the principal chamber, dated conclusively. This had a last measured ring of AD1474, with a last heartwood ring date of 1473. By applying the national sapwood estimate of 10-55 rings, a felling date range of 1483-1528 with 95% confidence can be offered for this sample. Further local material will be necessary before there can be any hope of dating any other samples from this site.

Table 2: Dating Eastleigh Manor e06 <1405-1474> at AD1474.

Reference chronology	Spanning	Overlap	t-value
EASTMID	< 882-1981>	70	4.04
BISHOP	<1359-1591>	70	4.06
KITCHEN	<1389-1484>	70	4.07
QUEEN2	<1352-1454>	50	4.57
MC16	<1314-1636>	70	4.57
EXMED	<1367-1616>	70	4.72
EX198HS	<1408-1529>	67	4.74
SCOTLAND	< 946-1975>	70	4.92
MDM11	<1355-1471>	67	5.18
SENGLAND	<1083-1589>	70	6.01

5. Acknowledgements

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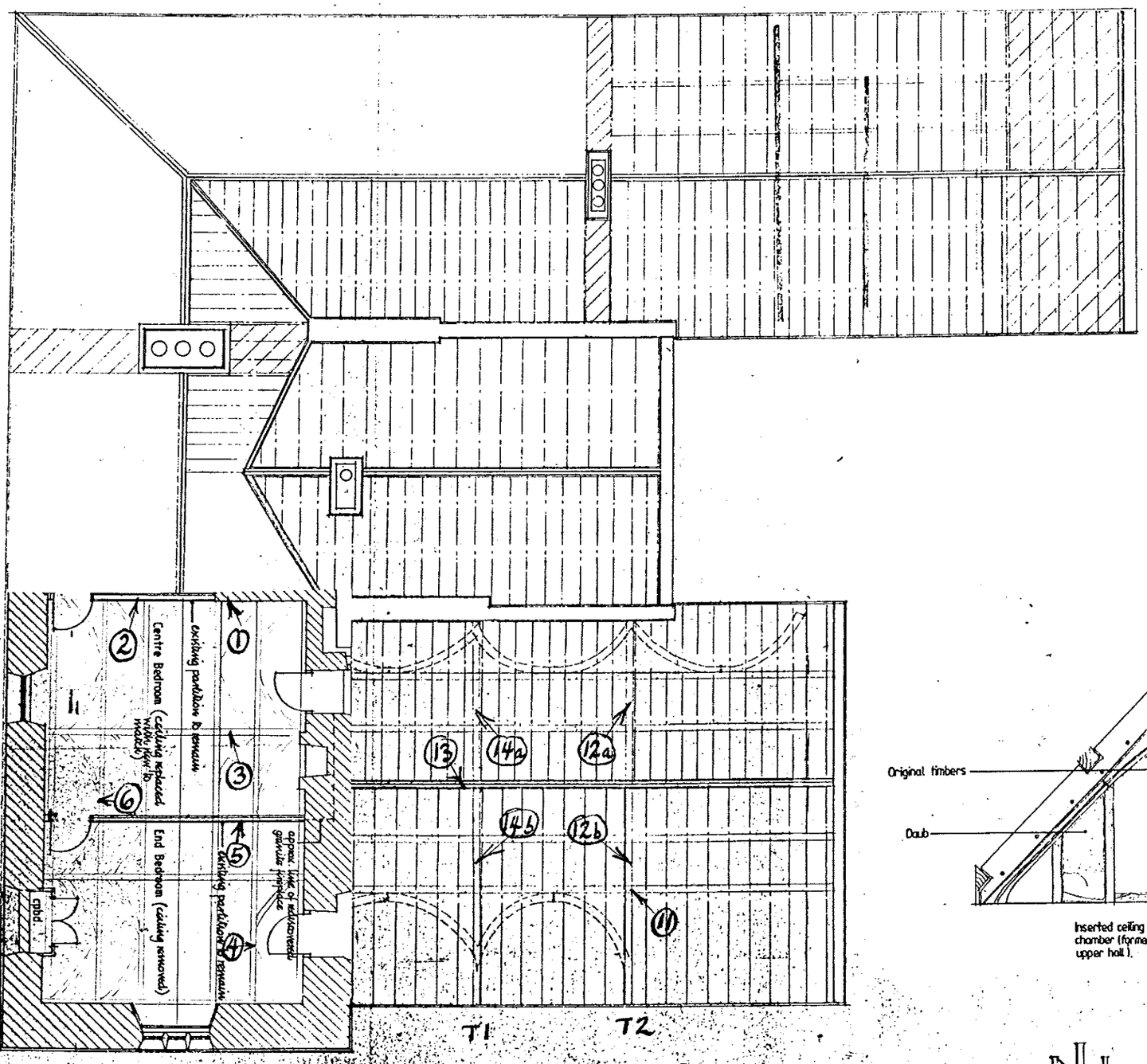
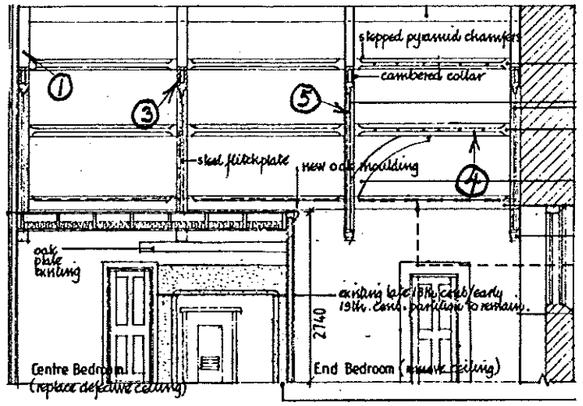
APPENDIX - RING WIDTH DATA (0.01mm)

e06 <1405-1474> Eastleigh Manor Hall front purlin bay II
70 rings starting year AD1405

154	197	140	215	193	184	197	223	212	228
204	186	229	300	172	334	156	238	540	447
312	253	157	229	164	197	178	328	182	281
241	237	235	178	133	142	266	208	215	274
254	289	269	263	234	168	217	156	173	180
118	169	160	144	105	102	098	120	152	152
185	165	182	156	087	105	106	128	154	142



EXISTING ROOF PLAN



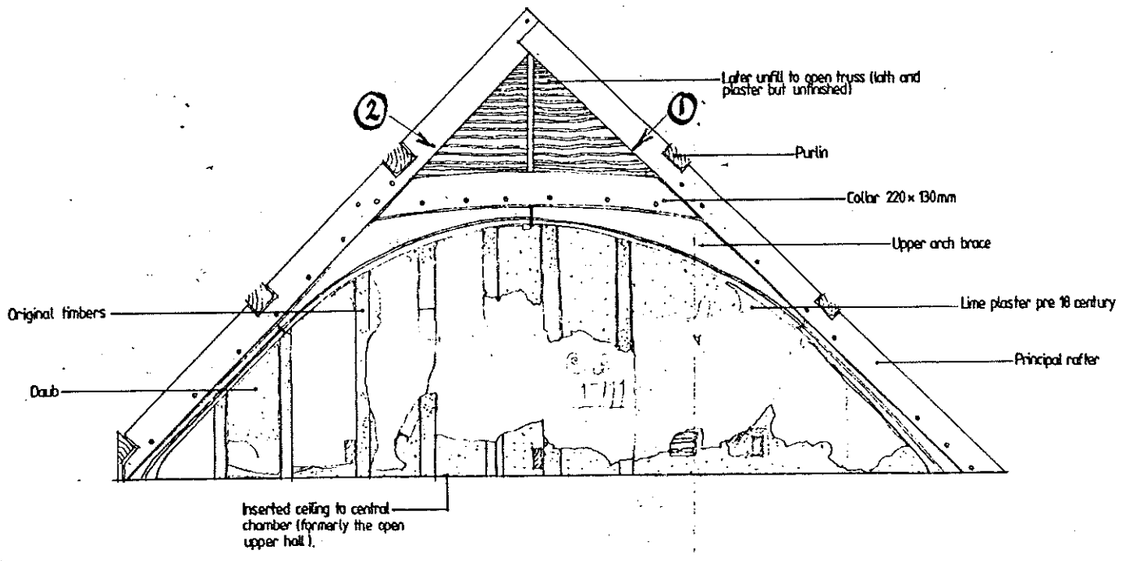


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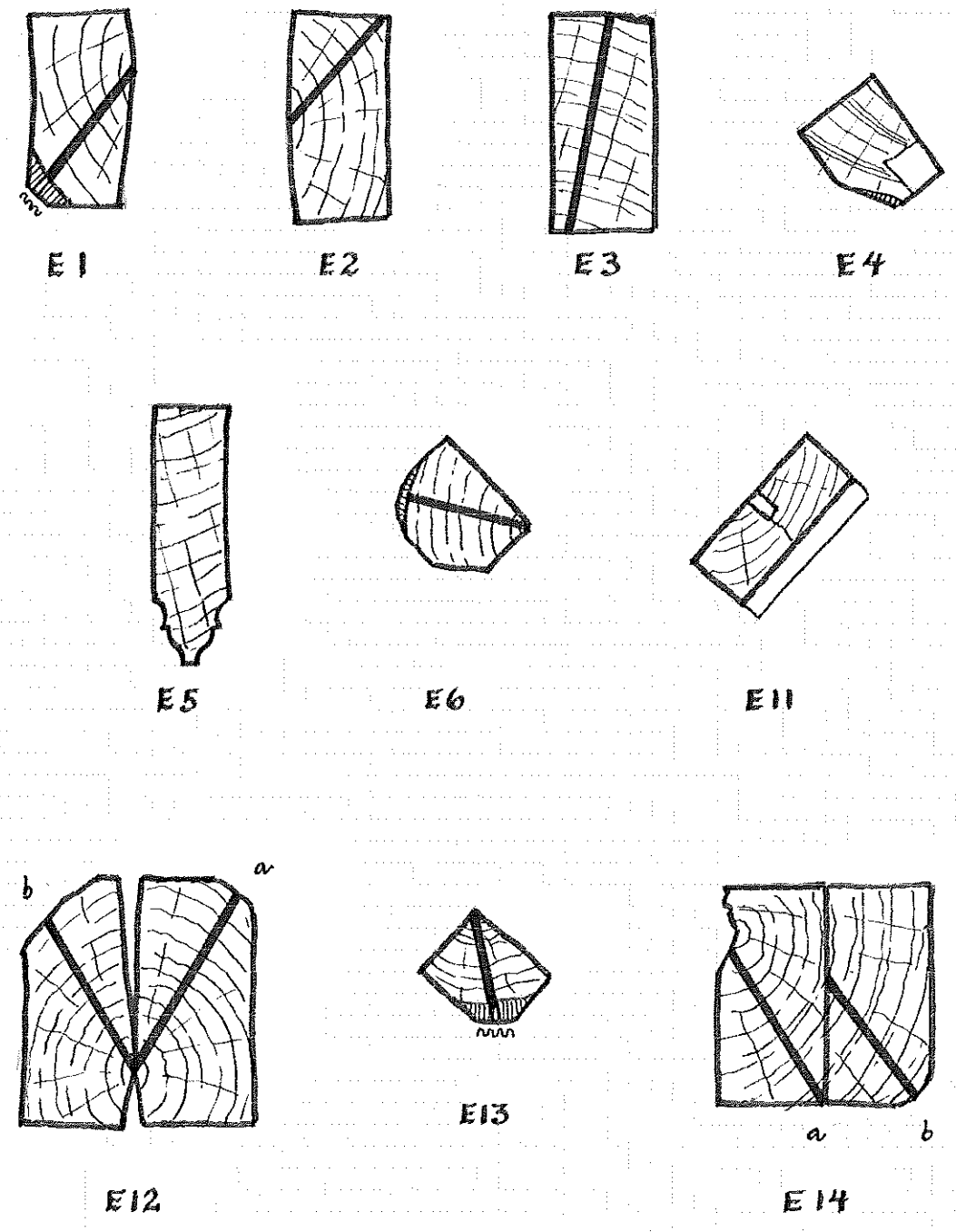
Figure 2: Sections of timbers sampled at scale of 1:8



Key: Sapwood Bark edge