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TREEARING DATING IN LONDON: THE MERMAID THEATRE SITE (THE79)

Interim Report

by Jennifer Hillam, December 1979.

In 1979, excavations at the site of the Mermaid Theatre offered a further opportunity to examine oak timbers * from a waterfront context in London. Other sites along the north bank of the Thames, such as New Fresh Wharf, had already produced large quantities of wood which yielded much information about the dating of the waterfront revetments and about the timber itself (Hillam & Morgan, 1980).

There were several objectives to the present analysis. Primarily, it was hoped to provide accurate calendar dates for the timbers; secondly, to produce a tree-ring chronology which might extend or consolidate other London curves and so help in the dating of future timbers from the London area. Finally, examination of the wood would add to existing knowledge about the use of this important raw material in the past.

The timber

Details of the size of the timbers and the way in which they were cut are set out in Table 1. With the exception of 241, all relate to the same reveted structure which was dated architecturally, by a study of the carpentry, to the late 13th-early 14th centuries. The timbers examined dendrochronologically were base-plates; no substantial timbers survived from the upper part of the structure. 241 was a principal vertical pile which had been driven into the ground at some unknown medieval date. All the timbers were considered to be in their primary usage.

The trees used to produce the wood at this site were immature oaks, probably less than 100 years of age when felled. They had been roughly hewn into squared or rectangular shapes. Usually the whole trunk was used (eg 90, 104), but sometimes it was first halved (eg 83a) or quartered (eg 106) before being shaped. This seems to depend on the size of the tree and has no relation to function ie whether the timber was intended for a principal-, subsidiary- or bracebase-plate. Such deductions, however, are limited by the absence of the upper timbers for study.

The average width of the rings, mostly 2-3mm, indicates that the trees were fairly fast-grown, ie grew under favourable conditions. This is in contrast to modern British oakwoods on the steep slopes of the north and west, where the poor soils, exposure and lack of light due to crowding all contribute to trees with narrow, sensitive rings. Here, a tree of similar dimensions (diameter <u>c</u> 0.25-0.50m) would have up to 200 annual rings. Instead, with fewer limiting factors, the tree-rings from the Mermaid Theatre site were wide and rather complacent. That mature oak timber from slow-grown trees was also available in medieval London is known from sites such as Seal House where many fine quality boards of this type have been found (Hillam & Morgan, 1980).

The Mermaid Theatre chronology

The samples were frozen and cleaned with a surform plane so that the annual rings could be identified and measured under a low power binocular microscope. The ring widths were read off a digital panelmeter which was attached, via a Finear transducer, to a travelling stage supporting the wood sample. The patterns of wide and narrow rings were represented graphically on transparent semi-logarithmic recorder paper. Crossdating is found by sliding one graph over another and searching for the position of best fit. 1n addition, a computer program is available (Baillie & Pilcher, 1973) which indicates possible crossmatching by calculating the value of Student's 't' at each position of overlap between two sets of data. A value higher than 3.5 is of statistical significance but must always be checked visually, ie by the first method, before the match is accepted.

The samples had between 50 and 90 rings (Table 1) due to the fast growth of young trees mentioned above. At one time it was thought that no sample with less than 100 rings could be reliably dated but work at Sheffield has done much to disprove this (eg Hillam & Morgan, 1979). Many hours work are spent in crossmatching such sequences, involving numerous checks and crosschecks before a match is accepted; only a simplified account can be given here.

All the curves were compared with each other visually and by computer. The results from a typical computer run are included in Table 2 where t-values between 98 and the remaining Mermaid samples are given. In several cases, crossmatching seems poor but its existence has been verified by other comparisons. By selecting those samples which agree well and averaging together their ring widths, it was possible to construct a working master curve for the site. The unmatched

samples and the chronologies of Dublin and Germany (Hollstein, 1965). They varied from very high agreements to no match at all (Table 2). Generally, if a curve matched well with Dublin, it also matched with western Germany. Those that did not match, matched poorly with other Mermaid individuals, eg 90; presumably these had been exposed to more extreme local growth conditions. It is an encouraging sign for future tree-ring work that an individual London curve with only 65 rings (see " 112, Table 2) will give t-values of 4.19 and 4.67 with Germany and Dublin respectively. In a further example, the Mermaid curve (103) agreed slightly better with Germany and Ireland than it did with the Mermaid sample, 98. These results indicate that, for some periods at least, trees growing in the area which extended from Ireland across to Germany, were responding to a common climatic signal. Often, especially in the low-lying English regions, this signal may be obscured by local site conditions (see Baillie, 1978, and Hillam & Ryder, . 1979. for further discussion).

The dating of 241 was not as obvious as that of the mean but, considering that it represents only one sample whereas the mean is made up of 15, the crossdating was acceptable. It showed a close agreement with the Seal House curve from London (Morgan, forthcoming) but a surprisingly poor one with the Mermaid mean over the 55 years of overlap. This suggests that the timber for 241 and that for the other Mermaid samples came from different woodlands.

The date ranges of the two Mermaid sequences are AD 1143-1234 for the mean (Figure 1) and AD 1116-1197 for 241 (Figure 1, Table 5). In order to equate these dates with the felling dates or with construction dates, it is necessary to examine the amount of supwood on each sample. Since the

quantity of sapwood remains relatively constant, the number of missing sapwood rings can be estimated, provided that the transition between heartwood and sapwood is present. Many of the Mermaid timbers do show this boundary (Figure 1), but its date; given in Table 2, fluctuates over 14 years. This may be accounted for by the fact that the heartwood-sapwood boundary does not follow a single ring around the circumference of a tree but varies so that a trunk could have 15 sapwood rings on one side and 28 on the other. Thus the timbers from the revetment could have been felled at the same time and probably were.

As the samples are wide-ringed, they are unlikely to contain more than 30 years of sapwood and may have considerably less. The outer rings of 94, 106 and 108 vary by only one year and are probably very close to the bark edge, giving a felling date of 1235 or just after. This would necessitate THE 90 having 28 sapwood rings, a figure within the limits of $32^{\pm}9$ years given by Baillie (1973) for the amount of sapwood. In a waterfront situation, the felling date is very close to the construction date since seasoning of the timber would be unnecessary. Hence it can be postulated that the revetment was constructed between 1235 and 1240.

This mid-13th century date makes the Mermaid structure the earliest back-braced revetment in the country and, as such, is of national importance as well as being extremely interesting from the point of view of London archaeology. The discrepancy between the tree-ring date, which must be regarded as the true date, and that given on architectural grounds is not difficult to explain. The latter derives from Hewett's study (1969) of carpentry in the Essex

area. It is quite possible that the chase mortise and secret notched half lap joint, by which the revetment was dated, was in use for some 50 years in the London area prior to its introduction in Essex.

The exact date of 241 is difficult to determine because of the absence of the heartwood-sapwood transition; there is no way of distinguishing how much, if any, heartwood was removed during conversion of the timber. All that can be said is that the tree must have been felled sometime after <u>c</u> 1215. It could easily be contemporary with the other reveted structure or it could be up to 25 years earlier; it is unlikely to be later than the main revetment as this would involve an unnecessary waste of timber.

Conclusion

The main aims of this study were to date the timbers at the Mermaid Theatre site, to contribute additional data which might serve to construct a tree-ring chronology for the London area and to gather information about uses of timber in the medieval period. By closely dating the reveted structure to 1235-1240, the first object has been achieved. In addition, sample 241 has a <u>terminus post quem</u> of 1215 and may be of the same age as the main revetment.

The absence of samples with more than 90 annual rings was disappointing in that it prevented the construction of a lengthy tree-ring chronology. Nevertheless, the

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resulting 92 year long curve is firmly dated and extends the London Seal House sequence produced by Morgan (forthcoming) by 42 years. It may also be useful in dating unmatched London timbers such as those from New Fresh Wharf. The similarity between the curves from Dublin, Germany and the Mermaid is important, especially as the Mermaid samples did not look particularly suited to tree-ring dating, and offers hope for future dendrochronology elsewhere in the British Isles.

Finally, more information about medieval timber has been added to the wealth of data already accumulated from examination of London's many timbers.

Acknowledgements

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Legends to figures and tables

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Figure 1: Block diagram illustrating the relative positions of the Mermaid Theatre tree-ring curves. Arrows indicate the earliest likely felling dates.

Figure 2: Matching tree-ring curves: the Mermaid mean with the corresponding section of the Dublin chronology. The vertical scale is in indices. Additional vertical lines are included to aid visual comparison.

Table 1: Details of the individual timbers; the sketches are not drawn to scale.

Table 2: The first two columns represent the date span of each sample and the date of the heartwood-sapwood transition (H/S); absence of the latter is denoted by a plus sign against the date of the sample's outer ring. The t-values are the result of comparisons between the individual Mermaid curves and a sequence from the same site (98), from western Germany (Hollstein, 1965) and from Dublin (Baillie, 1977).

Table 3: Index values of the Mermaid Theatre tree-ring chronology, AD 1143-1234.

Table 4: The dating of (a) the Mermaid mean and (b) 241. The reference curves are Dublin (Baillie, 1977), Germany -Munich area (Huber & Giertz-Siebenlist, 1969), Germany - west of Rhine (Hollqtein, 1965), Hull - Chapel Lane (Hillam, 1979) and London - Seal House (Morgan, forthcoming).

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Table 5: Ring width values in 0.1mm of THE 241, covering the period AD 1116-1197.



NO.	No.of rings	Sapwood rings	Average width(mm)	Sketch	Dimensions (mm)		
83a	56	-	2.71		270 x 140-150		
90	51	71	3.04		260 x 240		
9 2	62	-	1.58		24 0 x 190		
93	53	2	2.01		190 x 160 🔹		
94	60	4	3.14		250 x 220-250		
98	76	16	3.05		250 x 240		
100	63	7	2.47		230 x 140-190		
101	61	-	2.88		230 x 110-120		
102	60	4	3.57		260 x 260		
103	63	15	2.41		240 x 190		
104	51	-	3.08		250 x 220-260		
106	90	17	2.86		250 x 220		
108	90	15	2.19		260 x 230		
110	60	. –	3.15		270 x 190		
112	65	-	2.36		24.5 x 170-190		
24 1	82	~	1.85		240 x 210		

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£		Date span	Date of		t-value	
	(THEIS)	(AD)	H/S	THE 98	German y	Dublin
	83a	1148 - 1203	1203+	3.36	0.00	0.00
	90	1168 - 1218	1208	1.69	0.00	0.00
	92	1144 - 1205	1205+	4.59	2.37	1.67
	93	1162 - 1214	1213	5.31	3.23	3.00
i ,	94	1166 - 1225	1222	5.14	2.93	. 2.05
	98	1159 - 1234	1219		1.61	2.25
	100	1158 - 1220	1214	5.14	2.86	1.49
	101	1143 - 1203	1203+	5.88	3.69	4.75
	102	1165 - 1224	1221	4.89	2.69	4.11
	103	1165 - 1227	1213	4.03	4.27	4.29
	104	1169 - 1219	1219+	0.17	0.00	0.00
	106	1 1 44 - 1233	1217	4.09	1.26	3.16
	108	1145 - 1234	1220	4.51	3.90	2 •59
	110	1157 - 1216	1216+	4.80	3.12	3.69
	112	1149 - 1213	1213+	4.96	4.19	4.67
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(H)	Reference curve	Mermaid mean (AD 1143-1234)	Years of overlap
	Dublin	5.10	92
	Germany - Munich	3.46	92
а. А	Germany - west of Rhine	4 • 1 '7	92
	Hull - Chapel Lane	3.28	92
	London - Seal House	2.41	51
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Reference curve	THE241 (AD 1116-1197)	Years of overlap
Dublin	1.32	82
, Germany - Munich	2.72	82
Germany - west of R	hine 2.46	82
Hull - Chapel Lane	3.10	72
London - Seal House	4.16	78
London - THE mean	1.21	55
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TABLE 4

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Year				ł	{ing v	width				
	0	1	2	3	4	5	6	7	8	9
1116					•		15	12	35	41
1120	32	25	35	43	3 8	36	26	22	19	18
1130	25	27	25	33	20	24	22	24	25	28
1140-	55.	55	28	25	24	19	19	16	20	18
1150	18	15	. 9	13	12	10	17	19	14	15
1160	22	24	21	25	24	18	9	7	7	6
1170	8	8	10	7	10	11	10	12	14	13
118 0	10	9	10	. 9	8	10	16	13	16	12
1190	11	13	8	8	6	8	9	7		

TABLE 5

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