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Summary

Examination of timbers from, and associated with, the Hasholme Logboat which was found in North Humberside in 1984, resulted in the production of a 377-year tree-ring chronology. This was dated to 699-323 BC, giving a probable felling date of 322-277 BC for the massive oak trunk which was used to construct the boat. The size and age of the trunk are also discussed.

Author's address :-

Department of Archaeology & Prehistory
University of Sheffield
Sheffield
S.Yorks S10 2TN

0742 768555 x6082

Tree-ring dating of oak timbers from the Hasholme logboat

Introduction

Tree-ring samples from, and associated with, the Hasholme logboat (McGrail & Millett 1985) were examined at the Sheffield Dendrochronology Laboratory in 1986 (Table 1). All the timbers were oak (*Quercus* spp). Six of the samples were taken at the National Maritime Museum by staff of the Archaeological Research Centre: three from the logboat itself; two from the timbers found inside the boat (these may have been cargo and will be referred to as such throughout this report); and one from the repair timber at the stern of the boat (Figs 1, 2). Other tree-ring samples were collected by Martin Millett at the time of excavation. Two of these were from timbers associated with the logboat, and five were from bog oaks recovered during drainage operations adjacent to the boat. The final two samples were taken from the two large fittings at the bow end of the boat. These were sampled at Hull by Pete Sweeney after the other timbers had been examined.

The aims of the tree-ring work were firstly to date the tree used to construct the logboat; secondly, to date the "cargo" in order to indicate when the boat went out of use; and thirdly, to extract as much information as possible about all the timbers associated with the boat, such as size and age of tree used, or type of woodland. The bog oaks were sampled in the hope that they were broadly contemporary with the boat and would

therefore provide more material for constructing a replicated tree-ring chronology.

Methods

Methods of preparing, measuring and crossdating waterlogged wood are given elsewhere (Hillam 1985a), whilst a general introduction to tree-ring dating can be found in Baillie (1982). The samples from the boat, the "cargo" and the bow fittings were to be returned to Hull Museum for conservation and eventual display. They were usually v-shaped samples which could be slotted back into place after examination at Sheffield. These were gently pared with a sharp knife so as to remove the minimum amount of wood. Each sample to be returned was measured at least twice to ensure reliability of the ring sequence, and the replicated measurements averaged to produce a single tree-ring curve.

Results

1. The boat. The three samples (A7732, A7733, A7734) were selected so as to provide the maximum number of rings (Fig 2). They had 136, 205 and 154 rings respectively. These individual ring sequences synchronised to form a total sequence of 377 rings, the outer ten of which were sapwood rings (Fig 3).

The correlation between A7733 and A7734 gives a t-value of 6.9 for an overlap of 67 years (Table 2), whilst that between A7734 and A7732 gives $t = 8.5$ for a 51-year overlap. (Generally, values of t greater or equal to 3.5 indicate a match if the

visual match is acceptable.) The ring patterns of A7733 and A7732 do not overlap.

There is no doubt about the crossmatching outlined above, so that the outer part of the tree used for the construction of the boat had 377 annual growth rings. Using a sapwood estimate of 10-55 rings (Hillam et al 1986), there is a 95% probability that up to 45 rings could be missing from the outside of the trunk since ten sapwood rings are already present on A7732 (Fig 3).

2. The repair. This sample has 63 heartwood rings and its ring pattern correlates well with samples A7732 and A7734 giving t-values of 6.5 and 5.4 respectively (Table 2). The shortness of the ring sequence makes it impossible to determine whether or not the repair timber came from the same tree as the boat. The relative dating of the boat and repair (Fig 3) suggests that the repair was made either at the time of the boat's construction or shortly afterwards.

That it was not a piece of timber which was cut out of the boat and re-inserted can be rejected because its ring pattern is not the same as the inner part of the boat at this point. For this to be true, A7731 should have matched the inner portion of A7734. It should also be noted that the orientation of the growth rings in the repair is opposite to that in the logboat (Fig 2).

3. The bow fittings. A wedge was removed from the squared off edge of timber A969, whilst the sample from timber A1501 was a section of a fragment which had separated from the main element. The samples from timbers A969 and A1501 had 160 and 81 heartwood rings respectively. The two ring sequences match each other, and also show good agreement with the sequences from the boat and the repair (Table 2). The quality of the visual matching suggests that the timber for these bow fittings may have been cut from a different tree or trees to that used for the boat.

4. The "cargo". The two samples (A7735, A7736) had 105 and 108 rings respectively. The ring patterns from the two timbers crossmatched with a t-value of 8.5, whilst two radii from A7736, about 60mm apart, gave a t-value of 10.1. The two timbers were felled at the same time, and examination of the timbers themselves, as well as the tree-ring curves, suggests that the two pieces of timber were split from the same tree. Both timbers had bark, although it had been lost from the samples. The outer ring of A7736 seems to be bark edge and, if so, the tree was felled in winter or early spring since the outer ring is complete.

There was no match between the ring sequences from the boat and those of the "cargo".

5. Other associated timbers. Samples 150 and 467 had 94 and 99 heartwood rings respectively. Their tree-ring curves do not appear to match, either with each other or with the remaining Hasholme sequences.

6. The bog oaks. These are still to be examined. A sample from 118 has been sent to Harwell for radiocarbon dating. This bog oak has 336 heartwood rings, but its ring pattern does not appear to match other Hasholme curves. Further work will be carried out on the bog oaks once the radiocarbon result is obtained.

Dating

Radiocarbon analyses of three samples of sapwood from the logboat (that is, comparable to the outer rings of A7732) gave a mean calibrated date of 400-200BC (Millett pers comm). Comparisons were therefore made between the Hasholme sequences and all available Iron Age reference chronologies from north-west Europe. Initially no high correlations were obtained, but there were some similarities (t = 3.6) between the 377-year Hasholme boat sequence and a 167-year curve from Fiskerton in Lincolnshire (Hillam 1985b). The Fiskerton sequence had already been tentatively matched (t = 4.4) to a European reference curve which includes data from England, Ireland and Germany. If these two matches were correct, then the position of the Hasholme curve in relation to the dated European chronology was fixed (Fig 4), and the two sequences should give a positive correlation at this point. In fact, the comparison gave a weak match with a t-value of 3.3. Whilst this was promising, further proof was needed before the matches could be firmly accepted.

At this stage the samples from the bow fittings were examined, and a Hasholme master chronology of 377 years was produced using data from the boat, repair and bow fittings (Table 3). This, together with the Europe reference curve, was compared with the individual ring sequences from Fiskerton. Several of the Fiskerton curves matched with Hasholme and/or Europe at positions which were consistent with the above tentative dating (Table 4). When a new Fiskerton master chronology was constructed using data from the sequences in Table 4, this master gave t-values of 7.0 and 6.2 with Hasholme and Europe respectively (Fig 4). There is therefore now no doubt about the dating of Hasholme or Fiskerton. The Hasholme chronology dates to 699-323 BC. The date of its heartwood-sapwood transition is 332BC, so that the tree used to produce the logboat was probably felled between 322 and 277 BC (see above).

The repair timber (A7731) dates to 449-387 BC, whilst the bow fittings date to 599-429 BC (A969) and 489-409 BC (A1501). No tentative dating has yet been found for the other Hasholme sequences.

The timber

The outer shell of the logboat measures about 220mm and contains 377 annual rings. However the rings are not symmetrical within the logboat (Fig 2), so that the shell may contain only about 200 rings at any given point. The diameter of the tree could not be calculated from the tree-ring samples although it

has been estimated at about 1.9m by Veryan Heal at Greenwich (McGrail pers comm). The average ring width of the 377-year sequence is 1.05mm. This figure represents the outer rings of the tree which are likely to be narrower than those nearer the pith, so it cannot be used to estimate the age of the tree.

The only tree-ring data at Sheffield comparable to Hasholme comes from a tree which was felled near the Major Oak in Sherwood Forest (Morgan pers comm). The tree had a diameter of about 1.2m and was 519 year old when felled. Extrapolating from these data, the Hasholme tree would be about 820 years old when it died or was felled. This should be seen as a maximum value since Hasholme tends to have slightly wider rings than the Sherwood oak: a more realistic value would be 600-820 years old.

The "cargo" came from a tree of diameter about 450mm and age just over 108 years. Its average ring width is 1.82mm. It was not possible to make any deductions about the repair timber or the bow fittings because for conservation purposes, the samples were not complete sections through the timbers.

Conclusion

Examination of tree-ring samples from the Hasholme boat resulted in a 377-year ring sequence which was dated against chronologies from Europe and Fiskerton in Lincolnshire to 699-323 BC. Hasholme and Fiskerton become the first prehistoric structures from England to be dated dendrochronologically, and

their ring sequences provide a useful tree-ring chronology for the Iron Age period.

The tree for the logboat was probably felled in 322-277 BC. It had a diameter greater than 1.5m, and it is estimated that it was 600-820 years old when it died or was felled.

There was no tentative dating for the other Hasholme timbers, and there seems to be no match between the boat and the "cargo" sequences. It is not yet possible therefore to calculate for how long the boat was in use. The repair timber however does crossmatch, and the relative dating indicates that the repair was inserted at the time of construction or shortly afterwards. It is not possible to state whether the repair timber is from the same tree as the boat. The bow fittings, which also crossmatch, may have been cut from a different tree or trees.

The bog oaks have still to be examined, although initial analysis of 118 suggests that it is not contemporary with the boat. Further work will be carried out on the bog oaks when the radiocarbon date from 118 becomes available.

Acknowledgements

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members of the Belfast Tree-Ring Laboratory for providing data and for running the first computer comparisons between Fiskerton and Europe.

Rererences

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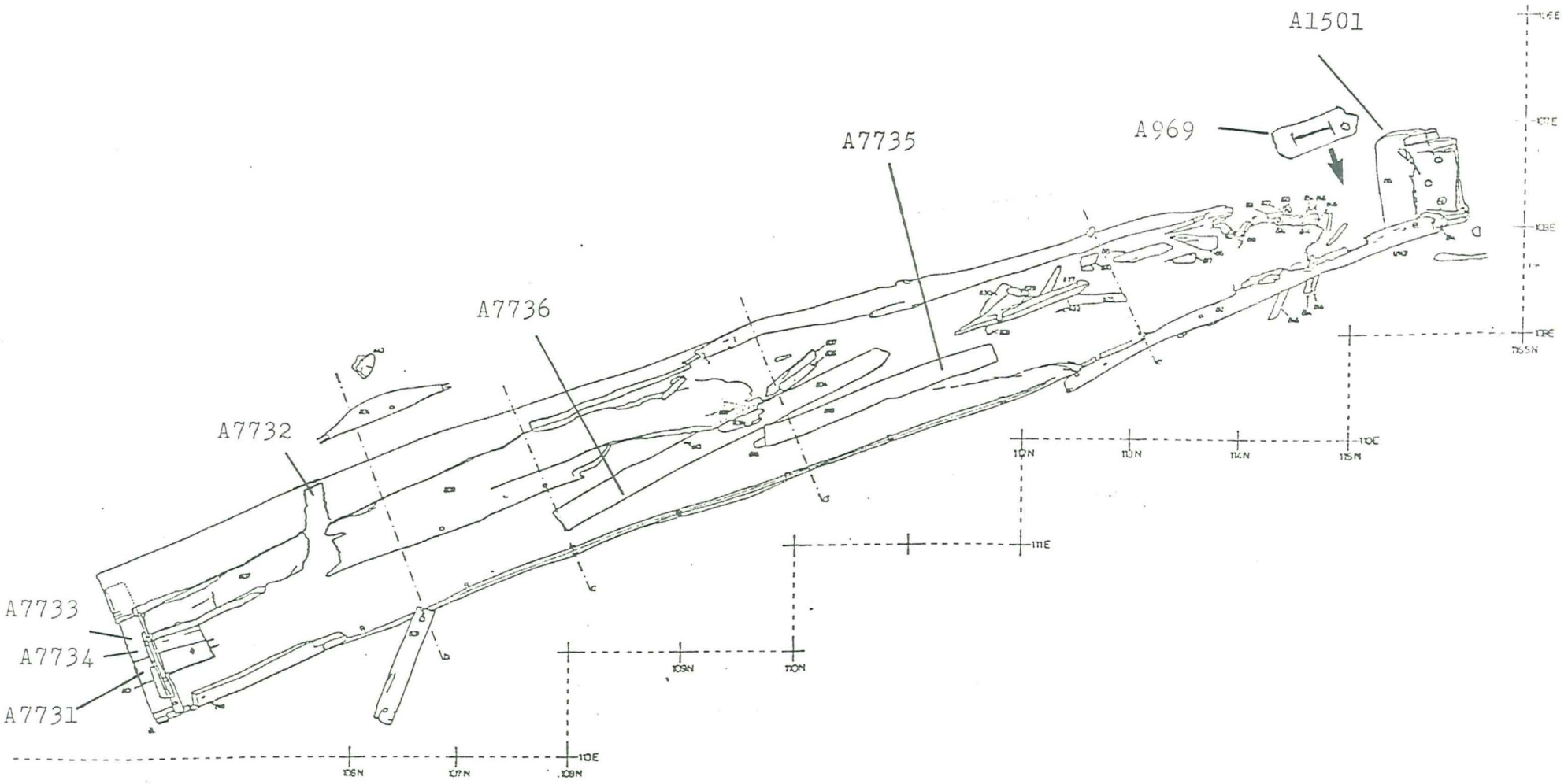


Fig 1: Plan of Hasholme logboat showing position of tree-ring samples.

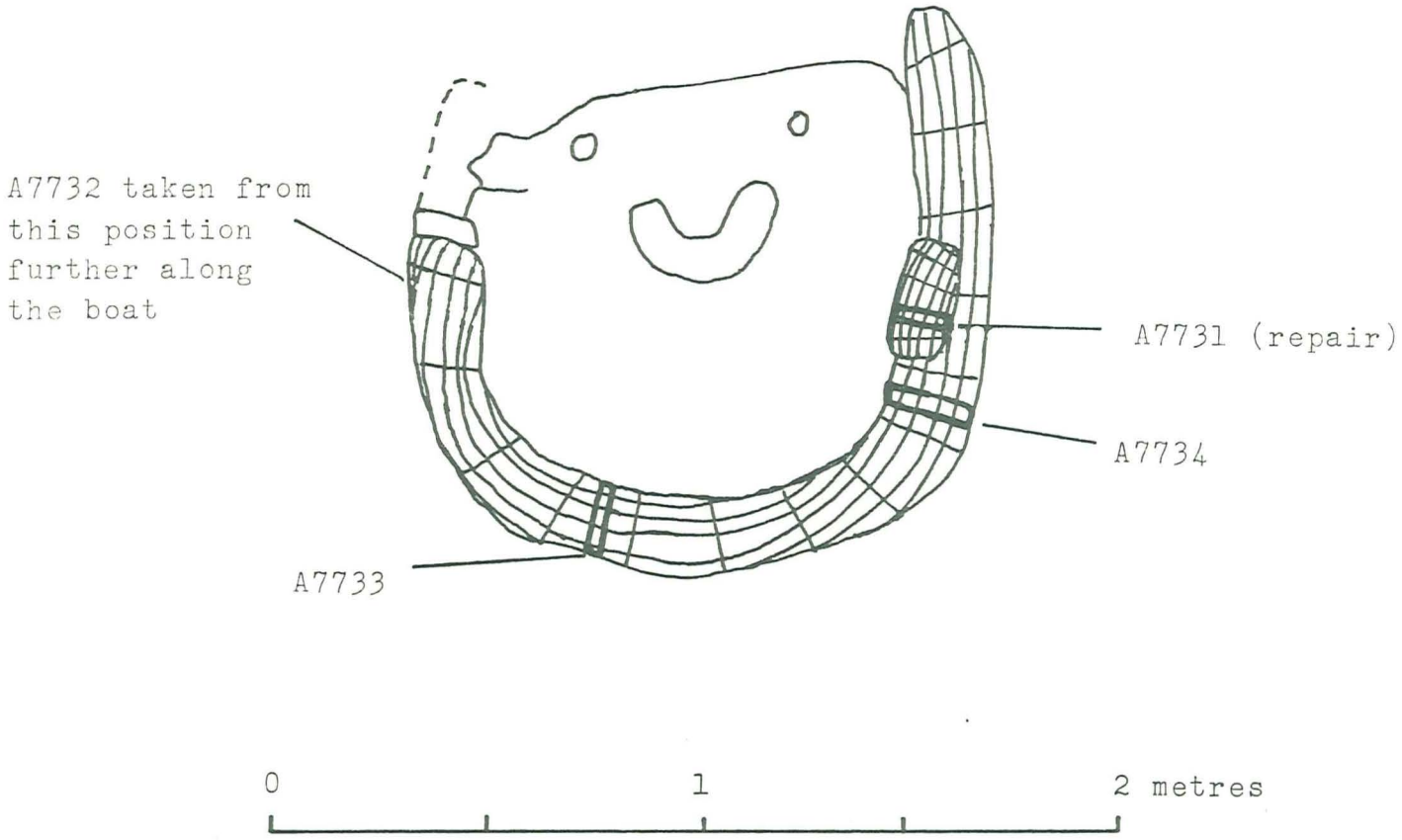


Fig 2: Close up of stern showing position of samples and rough orientation of rings. Note that the outer rings of 7733 are equivalent to the inner rings of 7734.

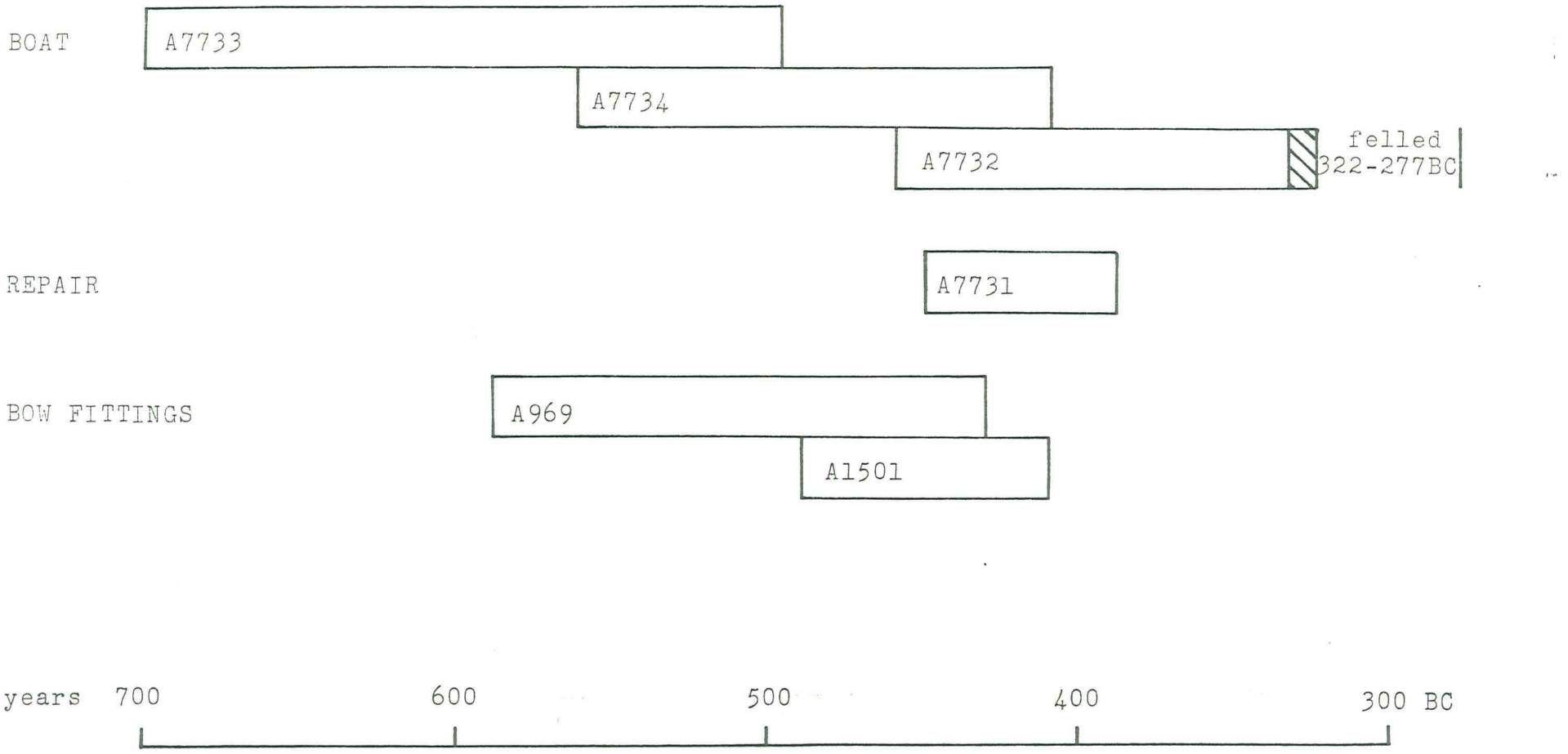


Fig 3: Bar diagram showing the relative positions of the dated Hasholme ring sequences.
White bars - heartwood rings; hatching - sapwood.

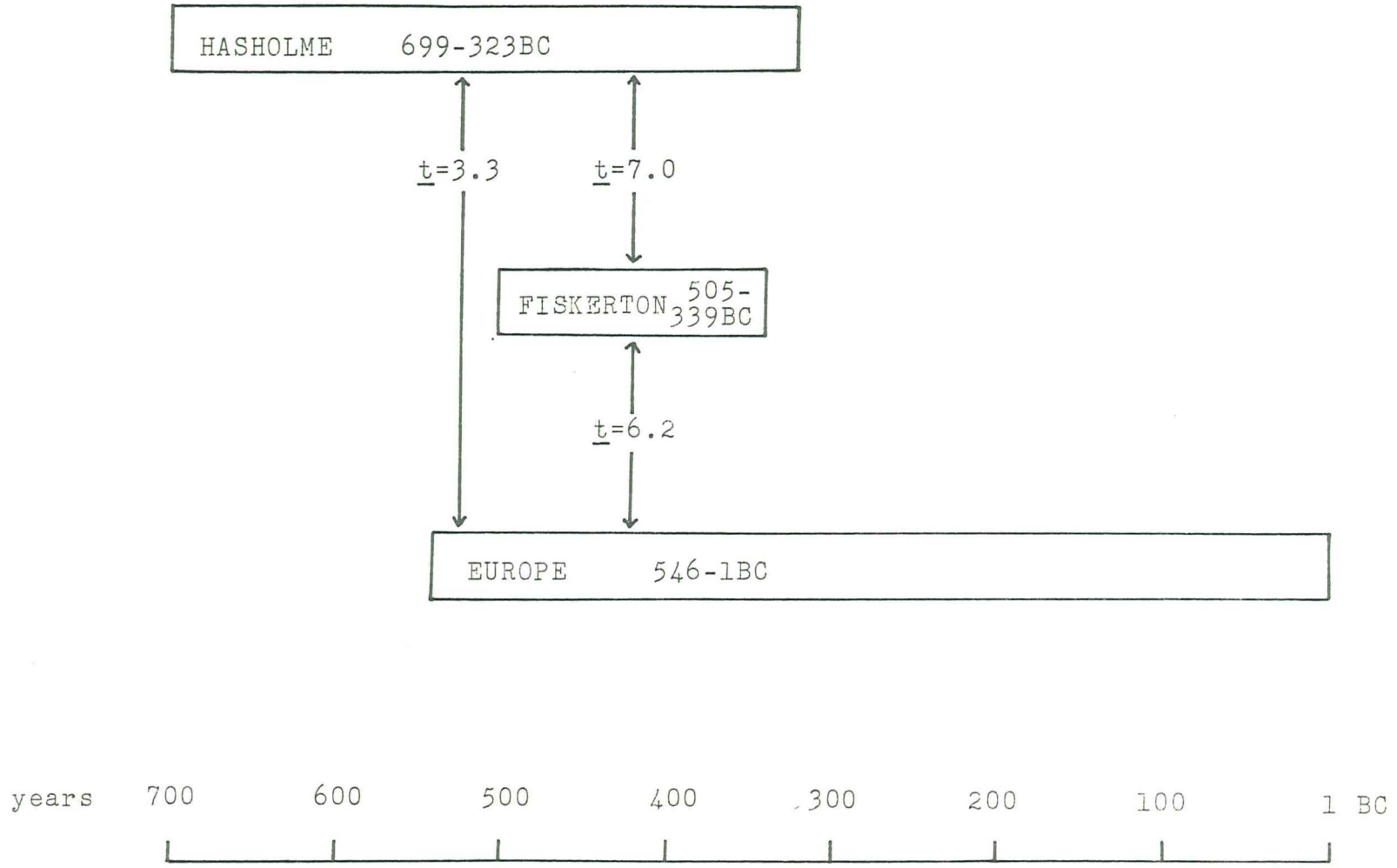


Fig 4: Dating the Hasholme tree-ring chronology. The Fiskerton chronology is made up from the ring sequences detailed in Table 4; Europe consists of various dated chronologies from England, Ireland and Germany.

Table 1: Details of tree-ring samples. Sketches not to scale; shading represents sapwood.

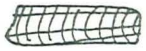
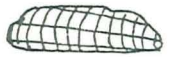
excavators no	NMM no	context	total no of rings	sapwood rings	average ring width (mm)	sketch	maximum dimensions (mm)
150	-	associated with boat	94	-	0.95		155 x 145
467	-	"	99	-	1.62		200 x 130
-	A7731	repair to logboat	63	-	1.83		125 x 35
800	A7732	logboat	136	10	1.02		130 x 110
800	A7733	"	205	-	0.97		210 x 55
800	A7734	"	154	-	1.34		220 x 60
-	A7735	'cargo' from timber A1422	105	17	1.96		215 x 40
-	A7736	" - from timber A1424	108	19	1.72		205 x 70
118	-	bog oak	336	-	1.30		590 - 660 diameter
-	A969	bow fitting	160	-	1.67		345 x 135
-	A1501	bow fitting	81	-	2.64		240 x 65

Table 2: Crossmatching between the Hasholme tree-ring sequences as expressed by values of Student's t. Asterisks indicate overlap lengths of 30 years or less.

	repair	logboat			bow fittings	
	A7731	A7732	A7733	A7734	A969	A1501
A7731	-	6.5	*	5.4	*	3.7
A7732		-	*	8.5	*	5.6
A7733			-	6.9	2.8	*
A7734				-	5.2	6.3
A969					-	.5.2
A1501						-

Table 3: Hasholme master chronology, 699-323 BC. Data from samples A7731, A7732, A7733, A7734, A969 and A1501 are included and rings widths are in units of 0.02mm.

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1	-	34	39	34	19	28	43	24	28	30	51
11	-	33	58	29	25	22	32	46	39	44	27
21	-	54	41	45	24	39	34	25	18	38	37
31	-	60	43	34	29	38	53	41	49	45	43
41	-	49	42	30	23	49	54	48	42	49	42
51	-	59	31	34	54	45	28	36	44	41	34
61	-	33	41	40	23	37	63	47	77	57	37
71	-	44	32	37	50	47	41	29	48	52	65
81	-	80	69	55	59	60	58	41	32	47	91
91	-	85	61	63	70	82	77	79	75	71	55
101	-	45	43	43	39	42	36	36	47	43	34
111	-	36	81	90	67	98	112	71	62	72	39
121	-	78	88	59	56	66	70	106	129	97	54
131	-	72	43	61	90	52	63	88	111	94	109
141	-	135	96	121	102	96	98	90	69	78	66
151	-	45	72	91	98	88	85	57	92	80	79
161	-	52	66	68	69	67	56	47	59	58	61
171	-	55	40	61	54	47	45	36	41	66	67
181	-	70	52	75	88	69	58	48	67	58	51
191	-	38	39	60	79	94	83	75	78	46	66
201	-	78	66	70	82	79	74	66	69	55	86
211	-	86	87	84	89	73	90	56	96	82	96
221	-	99	81	67	87	97	84	130	78	78	79
231	-	96	79	78	62	76	82	76	85	97	71
241	-	116	92	77	79	89	34	62	81	69	47
251	-	62	69	61	37	62	67	77	83	85	92
261	-	102	84	89	96	80	89	84	105	106	80
271	-	88	88	66	50	64	66	73	116	83	81

281	–	66	74	74	100	107	109	99	100	95	115
291	–	100	93	48	30	46	37	30	75	77	117
301	–	116	91	111	112	93	78	42	68	45	53
311	–	70	73	76	38	58	68	54	48	55	75
321	–	65	51	44	57	53	73	63	69	60	44
331	–	48	56	40	52	60	85	71	53	59	52
341	–	79	91	63	59	56	62	57	48	59	76
351	–	68	62	92	40	40	31	28	38	38	40
361	–	48	43	58	79	63	67	72	54	63	51
371	–	63	38	43	51	48	54	41			

Table 3/cont

Table 4: Crossmatching between Fiskerton ring sequences and the Hasholme and Europe chronologies.

Fiskerton no.	Fiskerton date BC	t-value with: Hasholme	t-value with: Europe
6	478-375	5.7	4.3
20	477-414	2.7	3.2
47	478-390	2.4	3.1
50	470-398	2.8	3.7
67	468-385	5.1	1.7
93	480-388	4.2	2.9
100	498-443	3.6	2.9
102	477-421	3.4	2.3
104	475-422	2.7	4.5
117	478-422	3.4	0.0
126	489-447	5.3	3.1
130	460-388	2.9	3.4
140	490-447	3.3	3.8
147	479-447	2.6	3.9
200	446-339	3.5	2.0
259	498-421	2.9	3.8
263	492-447	4.2	4.2
333	460-389	3.6	1.7
346	490-378	2.0	4.5