Report 2943

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Papers 7 in amended form

The Meare Heath track - summary of tree-ring results 1974-1978

Through large-scale excavations (Coles & Orme, 1976; 1978) and field collection during peat-cutting and surveys, a large body of oak material from the Meare Heath track has now been accumulated and analysed dendrochronologically. Hitherto, reports have considered only the timber from the current excavations (cf. Morgan in Coles & Orme, 1976; Morgan, 1978) due to lack of time; it has now been possible to examine all the material together in order to consider certain aspects of the contemporary tree growth, of quantities of timber required and of conversion methods used, and to perhaps add further to interpretation of the track's construction.

The main points on which summary work on such a large body of material may be useful are:

1) Are the average ring-widths and quality of cross-matching consistent with a common woodland source or do they suggest more widespread collection from varied environements?

2) Why were some of the timbers used in this track split radially and some tangentially? Could it be related to growth rate, tree diameter and function in the track?

3)Do the estimates of number of trees required to build the track (Coles & Orme, 1976. p.311) need revising?

Cross-matching

So far 100 ring-width curves from radial and tangential boards as well as stakes have been matched together in a framework extending over 150 years (Table 1). Only a very few of those which could be measured were not matched, usually because of too few or unsuitable rings (as well as the bog oak from MHF 4 with 210 rings which predates the track's construction). So it can be concluded that virtually all the wood involved in the track was primary in origin and deliberately cut to build it.

About 10 samples start at or very close to the pith of the tree, with arbitrary starting dates of between year 8 and 47; none of these have sapwood as well, but they suggest a maximum tree age of about 130-140 years (radii 9-24cm, ave. 16cm). However this is difficult to determine with so much thoroughly split wood such as stakes; cf. later on the problems of interpreting Fig. 1 .

Five timbers have some sapwood preserved, of between 19 and 33 years the latter extending right to the bark edge. Godwin (1960) noted the presence of bark on the under surface of many transverses made from split trunks, in the southern area of the track; this would appear to be a sporadic feature as no timbers retained sapwood in the lengths excavated in 1974-5 - all occurred in the northern stretch of MHF.1/2/TA (1977). The five timbers consisted of one longitudinal (MHF 2.33), 2 transverses (MHF 1.139, 2.74) and 2 of unknown function (77 TA10F, 77.17); two are radial splits, one tangential and 2 split radially representing about 1/3 of the trunk. The ring-width patterns of 4 could be definitely matched (Fig. 2) with final rings 1, 3 and 6 years in from the bark edge of 2.33. 1.139 shows a satisfactory match slightly later and is uncertain, but there is a certain amount of evidence for different felling dates (board 77C could be later, also TA10E) and so this tree could have been cut down about 30 years after the others; its use as a transverse however makes this unlikely. The corresponding sapwood transition zones of the other four indicate the same felling year or felling within a year or two of each other. The outer rings of 2.33, which has a wide sapwood zone for an immature oak, are very narrow and it is impossible to determine in what season the tree had been felled from the stage of growth of the outermost ring.

The distribution of the curves within the 150 year time scale is as difficult of interpretation as the pattern shown by the Sweet Railway curves (Morgan, 1976 Fig. 46) although the circumstances there were rather different. They have in common a constant fall-off in finishing years of each individual curve (Fig. 1) in contrast to the vertical distribution in the Sweet Drove curves, where each ends at much the same time. Curves from the Swiss Neolithic settlement timbers also show this vertical pattern (Huber & Merz, 1963, Fig. 1). These distributions are interpreted respectively as indicating a common source in a few trees, and an independent source in many different and probably younger trees.

While this interpretation is reasonable for the Meare Heath stakes, which probably often came from the inner parts of the tree, the many radial and tangential boards might be expected to extend almost to the sapwood edge of these fairly immature trees of 100-150 years old. The Sweet Railway trees on the other hand were estimated to be 350 + years old. Also the much higher quality of between-curve matching at Railway was consistent with a source in the same tree, while the MH boards suggested different sources in the variable growth rates and patterns.

As the tree-ring work continued beyond the 1974-75 material, which used a number of tree groups involving the most similar curves, each curve was matched against each tree group to see which it most resembled. Ideally, but totally impractioable, each curve should be compared with every other, but even then with this amount of material it would be difficult to define criteria with which to distinguish timbers from the same tree.

So the tree groupings are now largely irrelevant, but their value lay in being able to define how many curves showed similar growth rates and patterns, and the table below indicates the distributions. Most of the curves fall into the A/E pattern, which is similar to B but the latter maintains much faster growth in the last few decades where A/E decline into very narrow but variable G type patterns. C,D and F have been integrated into A/E in the mean curve, as they do not differ signifi-

Tree:	Years spanned:	No. of timbers:	Ave. ring width:	Mean sensitivity:
A/E	34-144	56 107	1.54	0.195
B	61-148	14	1.78	0.192
C	53-113	3	1.19	0.181
D	35-128	4	1.48	0.160
F	56-100	3	1.33	0.209
G	102-146	7	1.41	0.397
Unknown		3		

cantly. G in particular is very distinctive, with its very high mean sensitivity - bands of 2 or 3 very narrow rings being separated by 2 or 3 wide ones, a pattern reminiscent of the latter half of Tree 2 from the Tinney's Ground tracks (Morgan, 1978, Table 2b). It leads one to speculate whether such an effect on tree growth could be as contemporary as suggested by the C14 dates, but no certain ring-width ~~pattern~~ matching can be found between the two groups of material. It is possible that such a growth type could be related to some anthropogenic effect in the area which was obviously being intensively exploited in the last few centuries of the 2nd millennium. Lambert & Orcel (1977) interpret bursts of rapid growth as the effect of forest clearance on the prehistoric Swiss lake shores, and perhaps the same could be postulated here. Alternatively, periodic flooding or something similar could have drastic effects on growth rate - we understand the causes and effects too little to be certain.

Following the previous tree groups, the majority of the curves resembled the A/E and B pattern of average sensitivity for oak and average ring widths. Several other groups were also apparent among the material - one group of 8 curves (not all matched or contemporary) followed the G type pattern of extreme sensitivity. Three curves showed unusually fast growth of 3-5mm a year, and 7 showed a very sudden fall to extremely narrow rings, almost a diffuse-porous structure, which could not be measured or even counted accurately. This decline occurred around years 90-115, but none of the timbers were apparently from the same tree, so the effect was not local. It may be related to the same cause as the decline of tree G type, but while these trees recovered and fell several times, the group mentioned here could not recover their normal growth rates.

The evidence suggests that the majority of the timber came from a fairly immature woodland on well-drained slopes enabling a growth rate of 1-2mm per year to be maintained. In addition there is a certain amount of timber from trees probably growing in the same area, since the ring-width patterns match, but under less congenial conditions, perhaps on lower slopes which were waterlogged periodically or under stress from competition.

t values between tree groups:

		overlap:	t:
E with	A	102	3.89
	B	85	4.92
	C	61	4.41
	D	97	5.55
	F	45	2.65
	G	45	1.48

Conversion methods

One question continually asked throughout this work was why some boards were split radially and some tangentially, a much more difficult process with only bronze tools. The MH material was split into 5 groups based on the orientation of the rings in cross-section, and the groups were then examined closely to see if they could be related in any way to the functions they served in the track or to features of the tree from which they originated.

In woodworking terms, the radially split board would be the easiest to produce and the most satisfactory in performance, but its width is limited to the radius of the tree, or less if the sapwood and pith are removed. The problem here seems to be the necessity to use quite small trees, probably with an average diameter of about 300mm, occasionally reaching 500mm, and one solution to this was to split and adze out tangential boards (II in Fig. 3) or an intermediate type which was quite common (III) defined by Coles, Heal and Orme (1978 Fig. 15 (2)) as a 'halved log split radially to the centre and then again on the chord.' The natural radial splitting in oak would lead to a tangential board splitting along its length into two or more boards, as possibly noted on the track surface where two boards lay parallel (Coles & Orme, 1978, p.30).

Three points have been considered here:

1) Average ring-width

(Table 4) This was calculated for each of the measured timbers to see if trees of different growth rate and size were converted into different types of board. The results suggest that stakes, tangential boards and split halves came from much slower growh trees than radial or intermediate boards. The last in particular were much wider-ringed and had the largest radius. Possibly the largest fast-grown oaks were selected to convert in this way into the widest boards, but the usual proximity to the pith and the wider innermost rings may have affected the average ring-width values.

The almost identical ring-widths of the tangential boards and the stakes is of interest, since such boards would be ideal for splitting vertically into stakes along the rays and may have led to the experience in use of this method (supported by groupings of stakes by length of c. 400/600 or 1300mm as if from one board).

2) Curve distribution compared to function

(Fig. 5) A second possibility was a connection between the curve distributions of timbers serving similar functions. Separate block diagrams were prepared for the tangential and intermediate boards and the pegs where known. The curves for the pegs tend to lie quite early in the time scale suggesting the use of inner parts of the trees for this purpose, as well as quite a regular fall-off. The curves from the boards tend to finish at a similar time, many between years 100 and 120. The intermediate boards start much earlier than the tangential, i.e. were cut from much nearer the pith.

3) Conversion for specific function

It was hoped that a neat pattern might emerge, such as all the transverses being tangential, but in fact the opposite seemed true - either type was used for either function (Table 5). Transverses were particularly random, but the majority of the longitudinals were radially split as if the builders recognised the problem of lengthwise splitting. However the figures involved are low as much of the material could not be classified.

Extent of woodland exploitation

The figures given in Coles & Orme (1976, p.311; 1978 p.39) for the numbers of trees needed to build the trackway may be rather on the low side, in view of the evidence from further sampling. Diameters seem to reach 500mm only exceptionally and were probably nearer 300mm on average; tree ages were probably well below 100 years, with only a few exceeding 100 - only 6 timbers have more than 100 rings. The location of sapwood makes tree age easier to determine. In view of the more wasteful conversion methods such as tangential splitting, more trees would be required.

(Note trees are not mature nor are most planks thin, so fewer per tree).

Proposals

In view of the damaged condition of the track and the difficulty of defining the original function of many of the timbers disturbed by peat-cutting, it is essential that sections of all located wood should be cut particularly those which are known to have served as transverses, longitudinals or stakes. It would then be possible to extend the evidence of Fig. 5 and Table 5 . The overal ring-width pattern is now well known and is unlikely to be added to by further material. It would also be valuable to have wood from sections of track between the excavations of 1974-5 and in MHF in 1977, since local differences are likely to occur, as between Sweet Railway and Drove.

MEARE HEATH TRACK - tree-ring samples, 1974-1977

TABLE 1

Year	Sample no.	No. of rings	No. of sapwood rings	Years spanned of 150 yr curve	Conversion R=radial T=tangential S=stake T/R=intermediate
74	1.17	65		67-131	T/R
	1.22	39		87-125	R
	1.23	81		50-130	T
	1.24	69		66-134	T/R
	1.26	64		53-109	R
74/5	1.45	63		14-76	R
	1.47	80		35-114	R
	1.56	44		6~~6~~5-109 ?	T
	1.96	39		-	S
	1.98	38		45-82	S
	1.126	47		67-113	S
	1.140	108		8-115	T/R
	1.147	28		?51-78	T
	1.148	97		18-114	R
	1.150	56		?48-103	T
	1.151	40		73-112	T
	1.152	74		44-117	T
	1.154	47		6~~6~~5-112	T
	1.164	31		43-73	S
	1.165	37		71-107	S
	1.174	64+		33-96+	R
	1.175	30		7-38	R rings 3-5mm
	1.178 +A	63		49-111	R
	1.184	75		38-112	R
	1.187	29		44-72	S
75	2.2	57		4~~6~~7-102 ?	S ?
	2.3	43		-	R ?
	2.7	46+		?58-103+	R ?
	2.8	36		51-86	S
	2.16	77		50-126	R
	2.22	31		-	R
	2.23	46		36-81	R
	2.24	30		-	R

		2.28	79		29-107	R
		2.29	46		49-94	S
		2.30	51		35-85	R
		2.32	51		53-103	split half
		2.35	30		42-71	S
		2.36	55+		-	R
		2.37	95		25-119	T/R
		2.38	45		?54-98	R
		2.42	22		39-60	T
		2.43	36		28-63	S
		2.52	69		54-122	R
		2.60	35		-	S
		2.61	26		40-65	S
		2.66	54		60-113	S
		2,78	26		?95-120	S
		2.81	63		59-121	R
		2.87	44		37-80	R/S?
		2.99	24		49-72	S
		2.102	45		88-132	R
		2.108	61		39-99	R
		3.1	36		90-135	S
		3.2	38		58-95	S
		4.3	81		33-113	T/R
		4.5	113		18-130	R
		4.6	90		36-125	R
	76	7.1	68+		33-100+	split half
		7.2	57		?23-79	R
		7.3	50		?35-84	R
		22	44+c.10		58-101+	R
		03.2	44		41-85	R
		05.8	58		67-124	R
		05.9	32		75-106	T
MHF	77	4	53		14-66	R
		5	62		?75-136	R/S?
		9	49		60-108	R
		11	79		31-109	R
		13	38		64-101	S
		15	64+c.30		25-89+	R
		17	64	20	86-149	T
		1.23	30		36-65	R
		1.50	58		60-117	split half
		1.70	c.50+43		+64-106	S
		1.88	81		28-108	T/R

1.90	59		45-103	T	
1.96	35		-	R	
1.102	30		-	S	
1.119	35		77-111	R	
1.139	111+c.8	19	?38-148+	R	
1.152	34		2-35	R	
1.159	40		-	S	
2.32	48		43-90	R	
2.33	126	33	25-150	R	to bark edge
2.34	34		-	T/R	
2.50	89		24-112	R	
2.56	28		39-66	R	
2.74	88	24	60-147	R	
2.78	93		16-108	T/R	
(4-bog oak	210			T)	
D1	58		47-104	T/R	near pith
D10C	77		21-94	R	
D13	91		35-125	T/R	near pith
D15	43		83-125	S	
D21	74		10-83	T/R.	pith
TA1	66		51-116	T/R	
TA5	30		61-90	T	
TA6	36		98-133	S	
TA10A	59		69-127	S	
B	66		57-122	R	
C	39		55-93	R	
D	45		22-66	R	
E	111		34-144	R	
F	61	22	84-144	R	
G	59		21-79	T/R	
H	46		88-133	S	
A	37		91-127	R	rings 3-5mm
B	71		29-99	R	
C	65		86-149	R	
D	49		22-70	R	

MEARE HEATH 74-7

Summary of timber ages:

Years	No. of samples
0-40	56
40-60	38
60-100	37 8
100+	6
unknown	7
	144 5

Table 2

Timber ages v. conversion method:

Years	Stakes	Intermediate boards	Tangential boards	Radial boards	Split halves	
0-40	38	2	6	10	-	56
40-60	11	3	5	17	2	38
60-100	1?	8?	3	24	1	37 5
100+	-	1	-	5	-	6
unknown	-	1	2	4	-	7
	50	15	16	60	3	144 5

Table 3

MEARE HEATH 74-77

Average ring width & size:

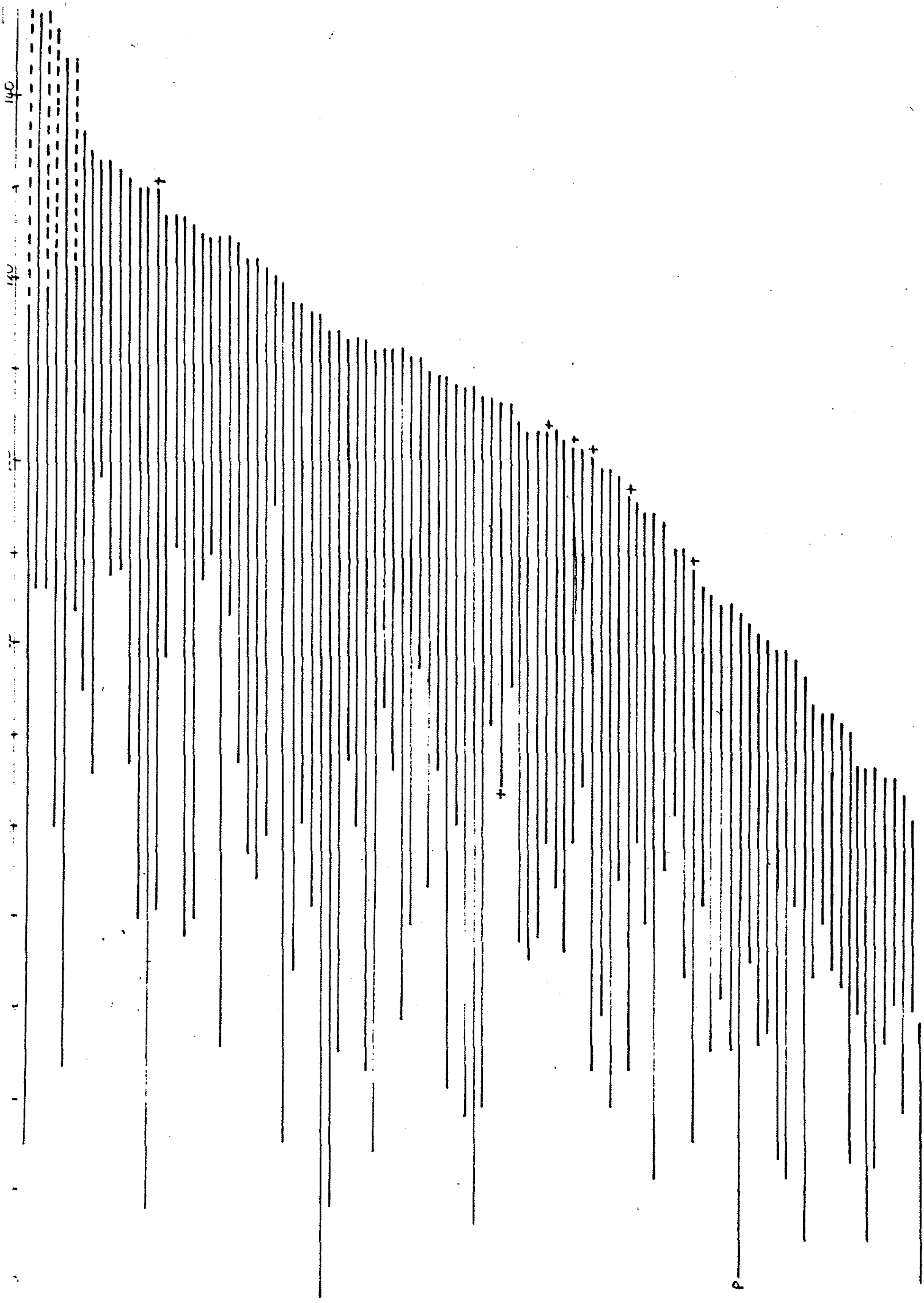
Type	Ave, ring-width mm	Ave. board width mm	No. of samples involved
Stakes	1.41		
Radial boards	1.79	122	60
Tangential "	1.45	148	16
Intermediate "	2.00	174	14
Split halves	1.22		
Ave	1.654		

Table 4

Conversion v. use:

	Radial boards	Tang. boards	Intermediate boards	Split halves	Stakes/ slats
Transverses	13	9	6 7	2	1
Longitudinals	9	2	4	-	1
Pegs	5	1	-	-	25
Unknown	33	4	5	1	23

Table 5



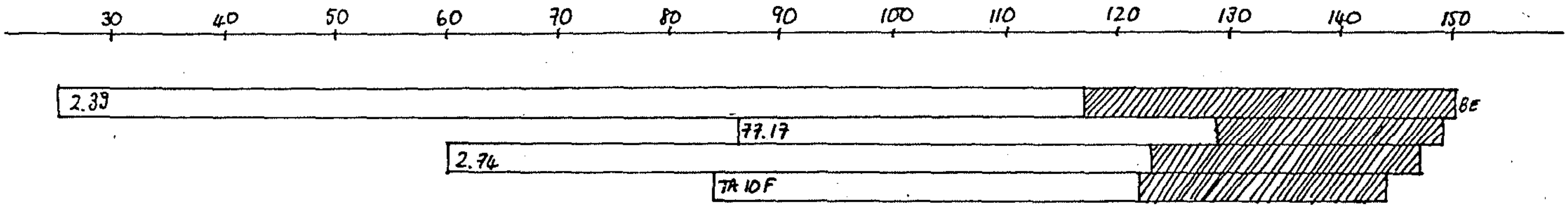


Fig.

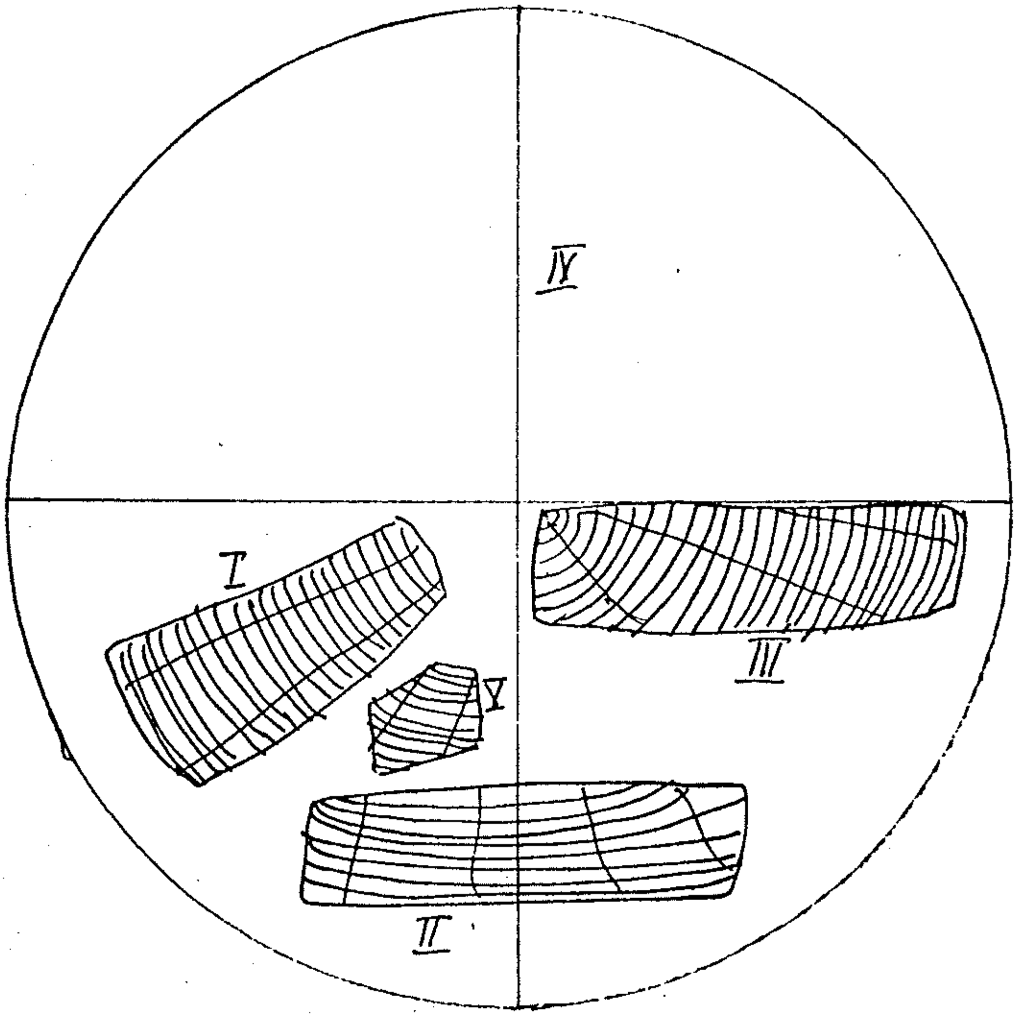
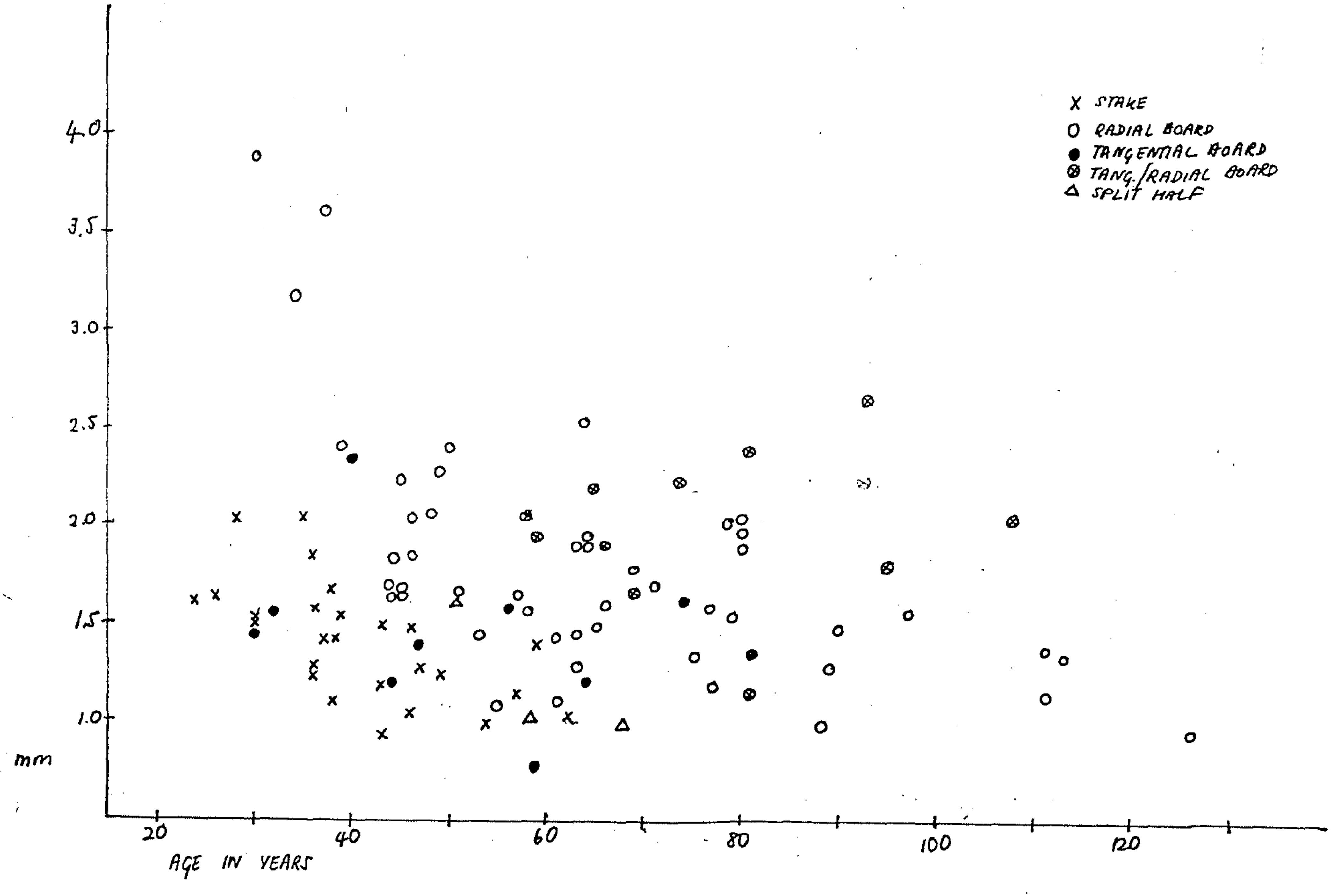


FIG. 3


X STAKE
O RADIAL BOARD
● TANGENTIAL BOARD
⊗ TANG./RADIAL BOARD
△ SPLIT HALF
4.0
3.5
3.0
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mm
20
40
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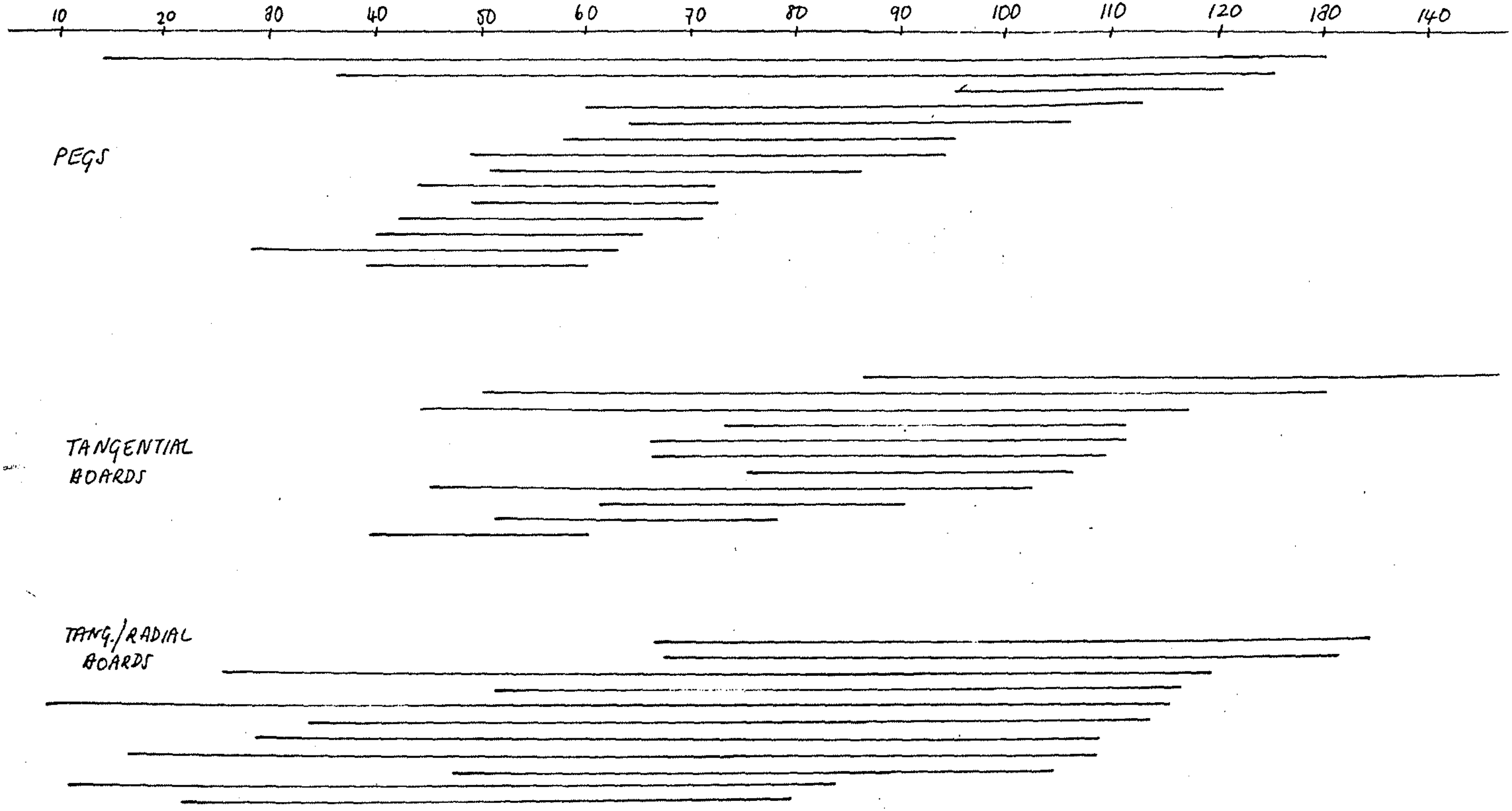
100
120
AGE IN YEARS

FIG. 4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PEGS
TANGENTIAL BOARDS
TANG./RADIAL BOARDS

FIG 5

Fig. 5