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TREE-RING ANALYSIS OF TIMBERS
FROM THE ISACC LORD COMPLEX,
IPSWICH, SUFFOLK

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Summary

This complex of buildings includes a merchant's house on the road frontage with several phases of warehousing behind, running down to the River Orwell. Range 1 (80 Fore Street) is stylistically dated to the late-fifteenth or early-sixteenth centuries. A single timber from this range yielded an earlier than expected felling-date period of AD 1418 - 1449. If this single timber is representative of the date for the whole range, the dendrochronological evidence suggests that this is the earliest extant building on the site. This range was cut through to make a carriageway, probably at the same time as range 2 was constructed. Range 2 (80A Fore Street) of the merchant's house was constructed from timbers felled in the spring of AD 1636, confirming the date carved into a gable bressumer. The merchant's house truncates a two-storey building to the rear (range 3), which could not be dated dendrochronologically, but must predate range 2, and probably post-dates range 4. A 'crossway' warehouse (range 4), previously thought to be the earliest extant building on the site, yielded several dated samples, but only one with sapwood. The tree supplying this timber was felled in AD 1587, the other four dated timbers possibly representing a group felled a few decades earlier.

A 216-year site chronology spanning the period AD 1420 - 1635 was produced for an area for which little reference data exists. Later ranges are constructed from coniferous timbers and provide an exciting potential resource for further dendrochronological studies of non-oak species.

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Introduction

The Isaac Lord complex (NGR TM 168 441) consists of a merchant's house (80 and 80a Fore Street) with a number of warehouses to the rear, running directly to the dock front (Fig 1). Merchandise would have been loaded and unloaded directly to shipping, stored and distributed wholesale from the site, or sold retail from the shop at the front (north) of the site. The individual ranges (Fig 2) have undergone many adaptations over the years as the major trading commodities, such as wool, coal, and malted grain, have changed in importance. One range of warehouses (range 7) on the west of the site has now been converted to retail and business units, whilst part of the old malting buildings (ranges 9, 10, and 11) has been converted into a public house.

The front of the property is dominated by 80 (range 1) and 80A (range 2) Fore Street, an imposing merchant's house with a carriageway into the rest of the property (Fig 3). These two ranges have different roof structures. Bond (1999) suggests that range 1 is a typical Suffolk-style jettied house, similar in style to several properties in near by Lavenham, which date from the late-fifteenth to early-sixteenth centuries. It has been cut through by the inserted carriageway at a later date, probably at the same time as the construction of range 2 (Fig 4). The gable bressumer of 80A (range 2) bears the date '1636'. Range 3 (Fig 2) appears to have been truncated by the construction of range 2, and therefore presumably predates it.

Range 4, the 'crossway' is thought to be the earliest of the warehouse buildings (Bond 1999). It has several interesting features, including a clasped-purlin roof in which the purlin sections are splay halved together with no butts or pegging. This building probably predates range 3.

More than eleven phases of building have been recognised, and dendrochronological investigation was commissioned by English Heritage to help clarify the chronological development of the site during the fifteenth to nineteenth centuries.

Methodology

The site was visited in December 1998, when the timbers were assessed for their potential use in dendrochronological study. Many of the timbers in the warehouse ranges were covered in limewash at the time of this investigation (December 1998), making species identification and suitability for dendrochronological study difficult by examination of the external surfaces alone. The initial phase of work therefore consisted of a close look at the various ranges in order to determine the variety of wood used in its construction, and its potential for dendrochronological study.

The majority of samples were taken of those oak (*Quercus* spp.) timbers judged suitable, ie having sufficient rings and preferably some sapwood (see below). It is rare for sequences of less than 45 - 50 rings to be crossmatched with sufficient confidence to be dated. Some cores were taken from limewashed timbers simply to determine whether the wood was oak or not.

Core samples were obtained using a 15mm auger attached to an electric drill. The cores were glued to wooden laths, labelled, and stored for subsequent analysis. The cores were prepared for measuring by sanding using an electric belt-sander with progressively finer grit papers down to 400 grit. Any further preparation necessary, eg where bands of narrow rings occurred, was

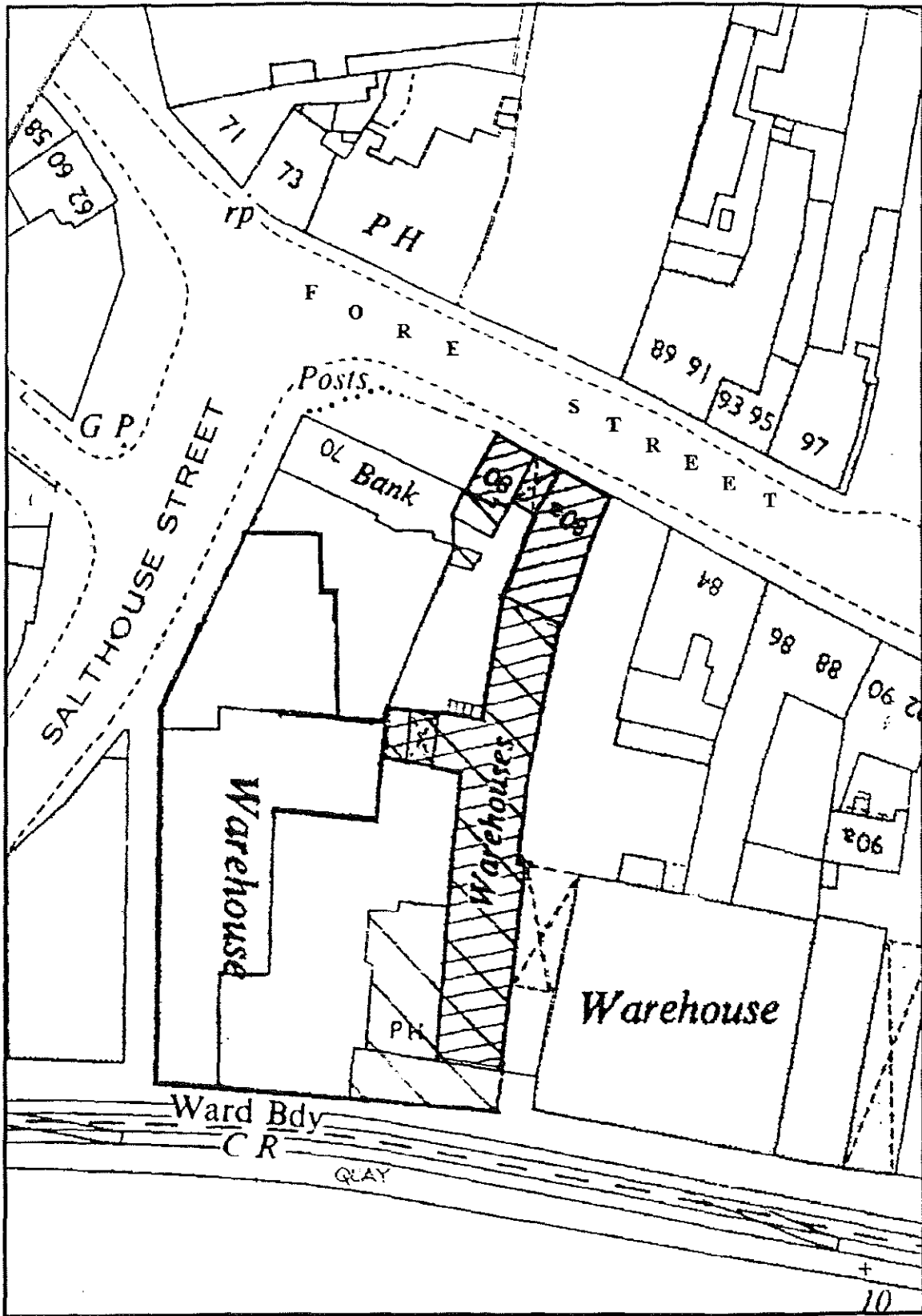


Figure 1: Location of the Isaac Lord complex within Ipswich, Suffolk

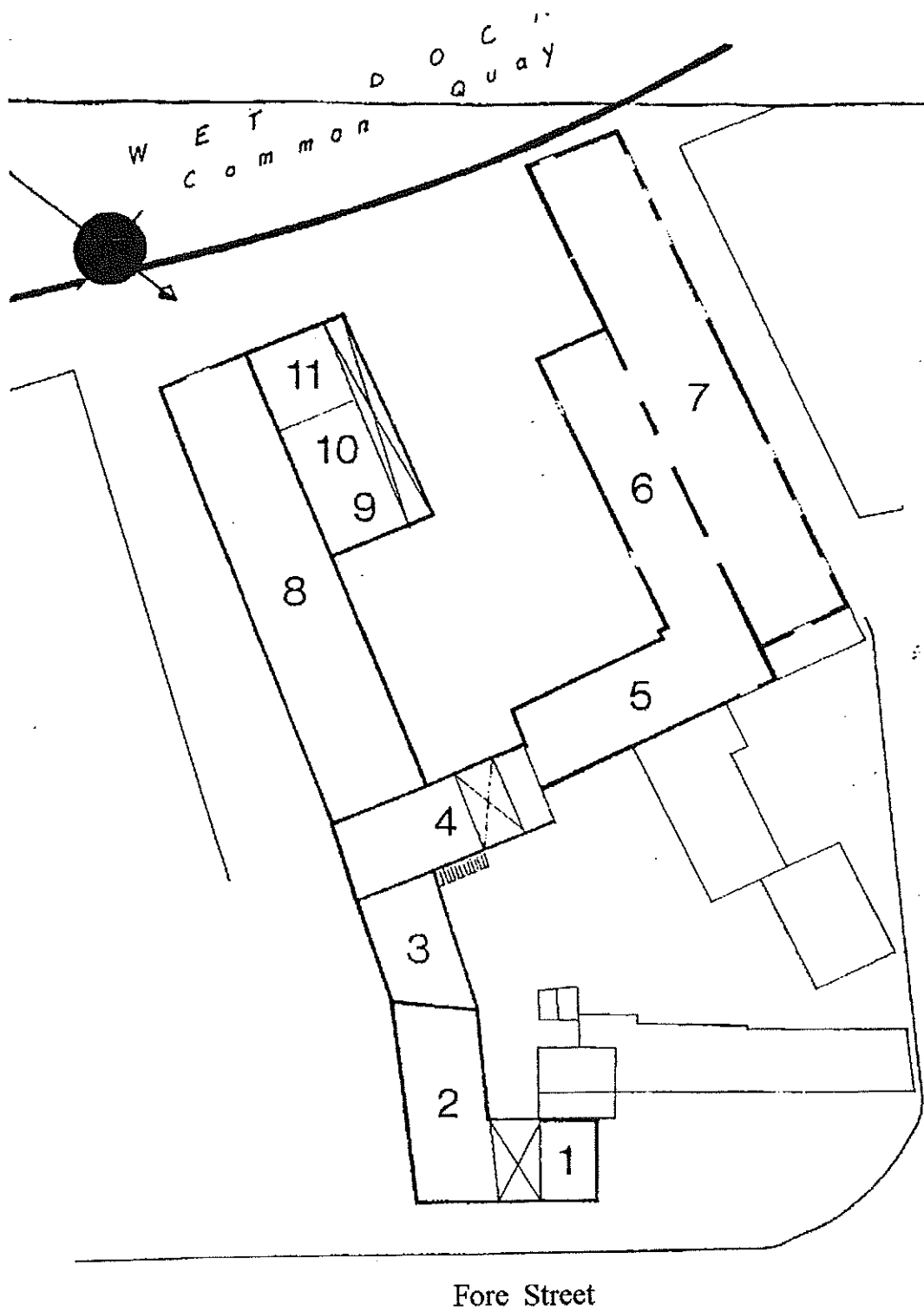


Figure 2: Numbering of the ranges within the Isaac Lord complex

done manually. The samples had their tree-ring sequences measured to an accuracy of 0.01 mm using a specially constructed system utilizing a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to an Atari desktop computer. The software used in measuring and subsequent analysis was written by Ian Tyers (pers comm 1992).

Ring sequences were plotted on translucent semi-log graph paper to allow visual comparisons to be made between sequences on a light table. This activity also acts as a measure of quality control in identifying any errors in the measurements when the samples crossmatch. Statistical comparisons were made using Student's *t*-test (Baillie and Pilcher 1973; Munro 1984). The *t*-values quoted below were derived from the original CROS program (Baillie and Pilcher 1973). Those *t*-values in excess of 3.5 are taken to be indicative of acceptable matching positions provided that they are supported by satisfactory visual matches, and give consistent matching positions.

When crossmatching between samples is found, their ring-width sequences are meaned to form an internal site mean sequence which is then compared with a number of reference chronologies (multi-site chronologies from a region) and dated individual site masters in an attempt to date it. Individual long series which are not included in the site mean(s) are also compared with the database to see if they can be dated.

The dates thus obtained represent the time of formation of the rings available on each sample. Interpretation of these dates then has to be undertaken to relate these findings to the construction date of the phase under investigation. An important aspect of this interpretation is the recognition of any heartwood-sapwood boundaries and the estimate of the number of any sapwood rings missing (English Heritage 1998). In this instance, the sapwood estimates are based on those proposed for this area by Miles (1997), in which 95% of samples are likely to have from 9 to 41 sapwood rings. Where bark is present on the sample the exact date of felling of the tree used may be determined.

The dates derived for the felling of the trees used in construction do not necessarily relate directly to the date of construction of the building. However, evidence suggests that, except in the re-use of timbers, construction in most historical periods took place within a very few years after felling (Salzman 1952; Hollstein 1965).

Results

Upon close examination of the timbers, those in ranges 5, 6, 7, 9, 10, and 11 were immediately excluded from further study at this stage, either because the timbers were not oak (ranges 5, 6, and 7) or because they evidently had too few rings (some in ranges 9, 10, and 11) or because coring would cause unacceptable aesthetic damage (others in ranges 9, 10 and 11).

Three cores from the heavily limewashed timbers in range 8 (the old malting floor), including a post, a tie beam, and a floor beam, were found to be of coniferous wood. No further sampling was therefore carried out in this range.

The oak timbers in range 3 were rejected both on the grounds that they had too few rings to be of interest, and that several appeared to be re-used timbers. The crown post appeared to be of elm (*Ulmus* spp.). The structure appears to pre-date range 1 which truncates it.

This left range 4 (the 'crossway'), and ranges 1 and 2 (the merchant's house) judged as somewhat borderline because of the overall lack of visible rings, but considered suitable for sampling in order to try and establish some dating framework for the site, and reference material for this area of the country.

Summaries of the sample details are given in Tables 1 and 2.

Table 1: Timbers sampled from the first floor, Range 4 (the crossway), Isaac Lord complex, Ipswich, Suffolk

Sample No	Origin of core	Total No of years	Average growth rate (mm yr ⁻¹)	Sapwood details	Date of sequence AD	Felling date of timber AD
ILI01	South post, truss 3	74	1.97	-	1433 - 1506	after 1515
ILI02	South post, truss 2	31	not measured	-	unknown	unknown
ILI03	Tie beam, truss 2	27	not measured	-	unknown	unknown
ILI04	North post, truss 2	75	2.32	-	1420 - 1494	after 1503
ILI05	North post, truss 1	32	not measured	-	unknown	unknown
ILI06	West wall plate	50	2.05	12	unknown	unknown
ILI07	South post, truss 1	25	not measured	-	unknown	unknown
ILI08	Joist, bay 3	73	1.62	-	1438 - 1510	after 1519
ILI09	Joist, bay 3	40	2.28	-	unknown	unknown
ILI10	Joist, bay 3	50	2.24	-	1473 - 1522	after 1531
ILI11	Tie beam, truss 4	75	2.15	17 + bark	1513 - 1587	spring 1587

Table 2: Timbers sampled from 80 and 80A Fore Street, Ipswich, Suffolk

Sample No	Origin of core	Total No of years	Average growth rate (mm yr ⁻¹)	Sapwood details	Date of sequence AD	Felling date of timber AD
ILI12	Floor beam, rear wing, 80A	59	1.43	18 + bark	1577 - 1635	spring 1636
ILI13	Post, south east corner of infill	52	1.93	14	1578 - 1629	1629 - 1656
ILI14	North wall plate, 80A	68	2.13	16	1562 - 1629	1629 - 1654
ILI15	North east corner post, 80A	c 55*	unmeasured	-	unknown	unknown
ILI16	North wall plate to west of window, 80A	64	1.99	17 + bark	1572 - 1635	spring 1636
ILI17	North west corner post, 80A	c 80*	unmeasured	-	unknown	unknown
ILI18	West post, crossframe, rear wing, 80A	c 70*	unmeasured	-	unknown	unknown
ILI19	South west post, rear wing, 80A	c 55*	unmeasured	-	unknown	unknown
ILI20	Ceiling beam, rear range, 80A	66	1.65	h/s + 11 sap rings broken off + bark	1559 - 1624	spring 1636
ILI21	Post, south east corner to front range, 80A	72	1.47	-	unknown	unknown
ILI22	Post, south west corner of 80	61	2.01	10	1358 - 1418	1418 - 1449
ILI23	North wall plate, west end, 80	44	unmeasured	1	unknown	unknown
ILI24	North wall plate, east side, 80	59	2.29	13	unknown	unknown
ILI25	South wall plate, 80	48*	unmeasured	7	unknown	unknown
ILI26	Rafter near rear dormer, 80	19	unmeasured	3	unknown	unknown
ILI27	South centre post, 80	45	unmeasured	21	unknown	unknown

* = core with sections of narrow rings where individual rings could not be distinguished

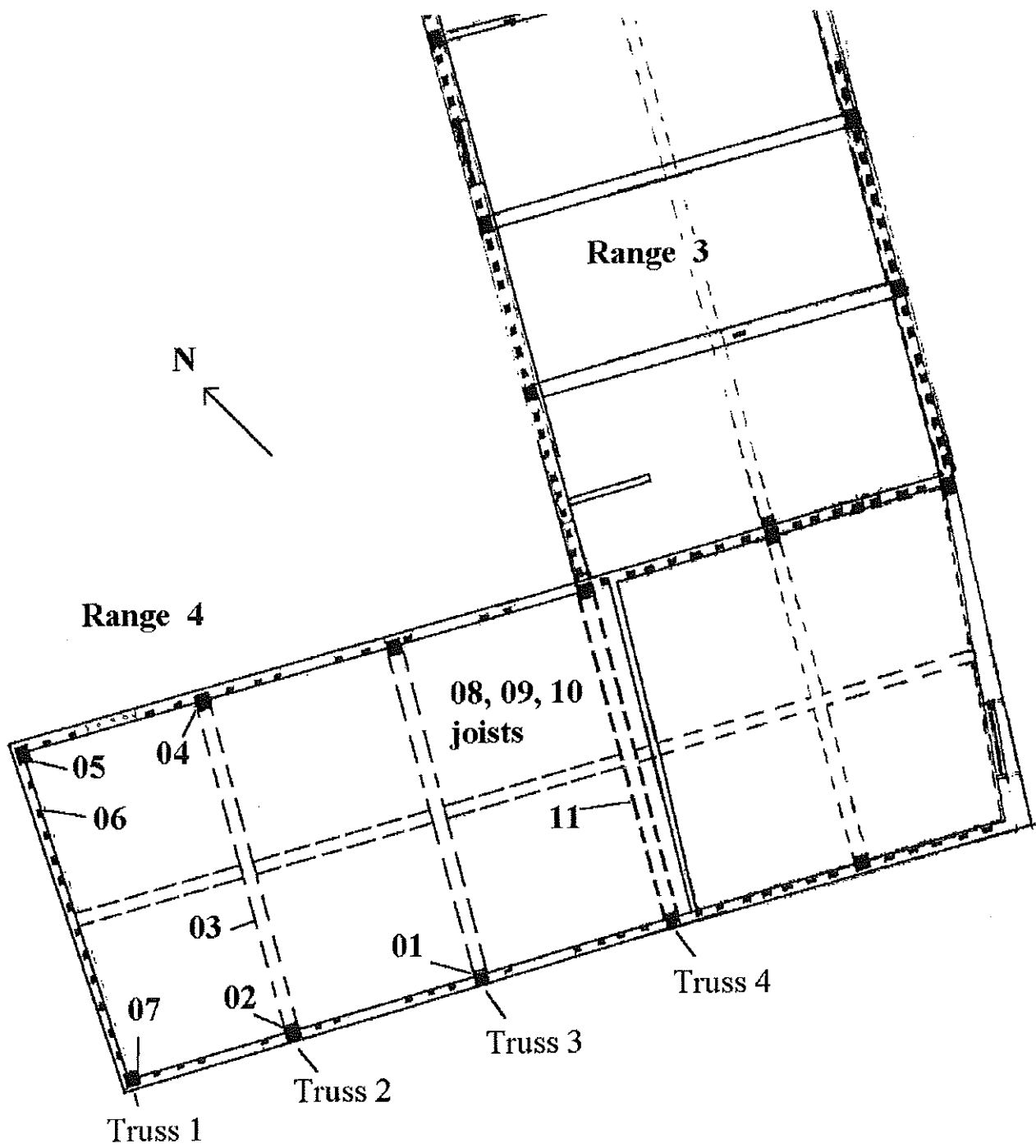


Figure 3: Locations of the samples taken from the 'Crossway', Range 4, Isaac Lord complex, Ipswich



Figure 4: Front (upper) and side (lower) elevations of Nos 80 and 80A Fore Street, Ipswich

Table 3: Crossmatching between the dated timbers in the site chronology CROSSWAY, not including ILI11 which was dated separately. - indicates a t-value below 3.5

Sample No	t values		
	ILI04	ILI08	ILI10
ILI01	4.3	4.2	4.4
ILI04		-	-
ILI08			5.3

Table 4: Dating evidence for sample ILI11 from the Crossway, Isaac Lord complex

Dated reference or site master chronology	ILI11 1513 - 1587	
	t-value	Overlap (yrs)
London1175 (Tyers pers comm)	4.3	75
East Midlands (Laxton and Litton 1988)	4.3	75
Oxon93 (Miles pers comm)	4.1	75
Newdigate2 (Bridge 1998a)	4.1	75
Windsor Castle kitchen (Hillam and Groves1996)	4.1	61

Table 5: Dating evidence for the site chronologies 01/04/08/10 and CROSSWAY, Isaac Lord complex

Dated reference or site master chronology	01/04/08/10 AD 1420 - 1522		CROSSWAY AD 1420 - 1587	
	t-value	Overlap (yrs)	t-value	Overlap (yrs)
Chicksands Priory, Bedfordshire (Howard, <i>et al</i> 1998)	6.9	103	7.0	122
Nostell Priory I, Yorkshire (Tyers 1998)	6.2	103	5.7	117
Gosfield, Essex (Bridge 1998b)	5.7	73	5.6	88
Thames, London (Hillam 1997)	5.3	103	5.4	165
Hill Hall I, Essex (Bridge forthcoming)	5.1	98	5.2	140
Marriots Warehouse, Norfolk (Tyers 1999)	4.8	103	5.0	164
Windsor Castle kitchen, Buckinghamshire (Hillam and Groves 1996)	4.2	103	5.2	154

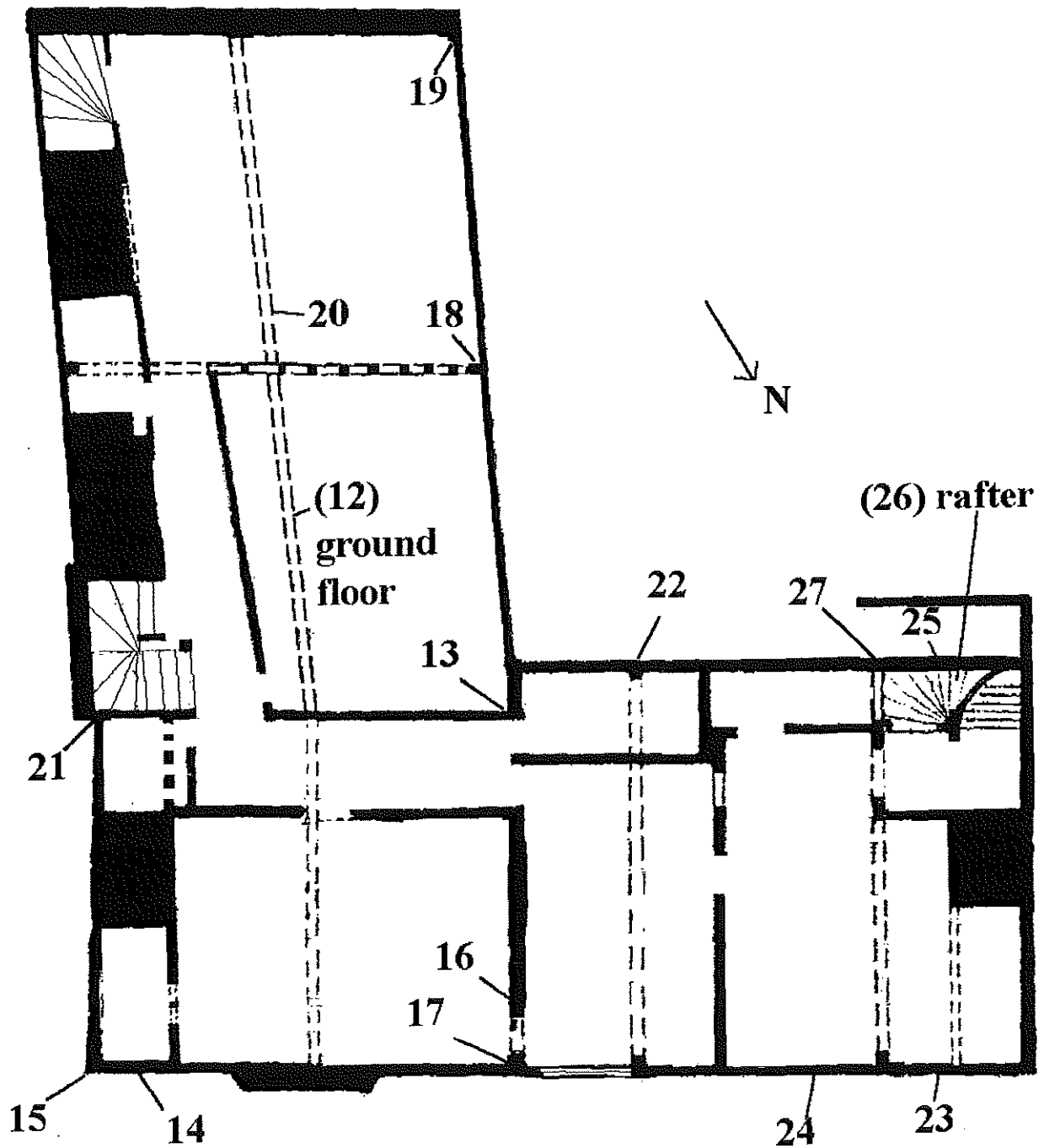


Figure 5: First-floor plan of ranges 1 and 2 (80 and 80A Fore Street) showing the locations of samples taken for dendrochronology

Table 6: Dating evidence for sample ILI22

Dated reference or site master chronology	ISI22 AD 1358 - 1418	
	<i>t</i> -value	Overlap (yrs)
Thaxted2, Essex (Tyers 1990)	7.4	61
Cranfield bellframe, Bedfordshire (Bridge 1998c)	6.9	61
Chicksands Priory, Bedfordshire (Howard, <i>et al</i> 1998)	6.1	61
Hill Hall1, Essex (Bridge forthcoming)	5.6	61
Mary Rose 'original' (Bridge and Dobbs 1996)	5.2	61

Table 7: Crossmatching between the dated components of the site chronology 80A. - indicates *t*-values below 3.5

Sample No	<i>t</i> values			
	ILI13	ILI14	ILI16	ILI20
ILI12	6.5	4.3	5.1	-
ILI13		4.0	4.6	3.6
ILI14			-	-
ILI16				4.0

Table 8: Dating evidence for the site chronology 80A Isaac Lord complex, Fore Street, Ipswich, Suffolk

Dated reference or site master chronology	80A AD 1559 - 1635	
	<i>t</i> -value	Overlap (yrs)
Oxon93 (Miles unpubl)	5.3	77
Oriel College, Oxford (Miles pers comm)*	5.2	77
East Midlands (Laxton and Litton 1988)	4.3	77
Anglia98 (Bridge unpubl)	3.9	77

* This chronology is a component of Oxon93

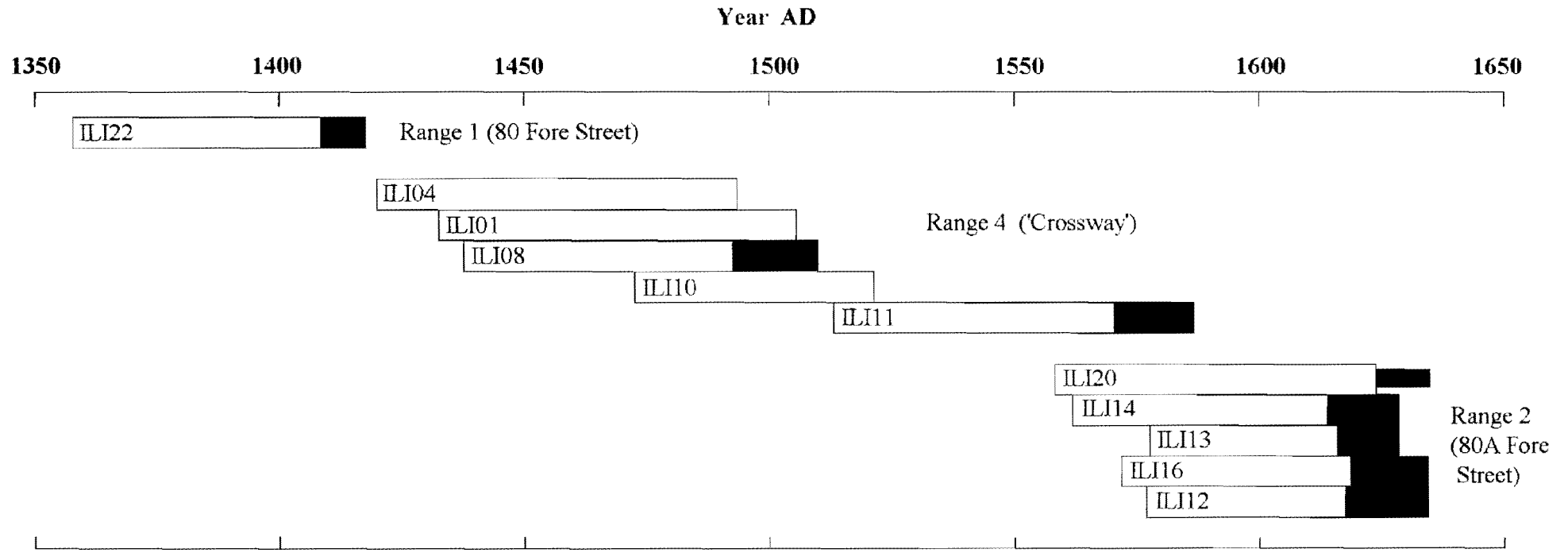


Figure 6: Bar diagram showing the relative positions of overlap of the dated sequences from the Isaac Lord complex. Shaded areas represent sapwood rings, the narrow bar represents unmeasured sapwood rings

Table 9: Dating evidence for the site chronology ISAACLD

Dated reference or site master chronology	ISAACLD AD 1420 - 1635	
	<i>t</i> -value	Overlap (yrs)
London1175 (Tyers pers comm)	7.8	216
Oxon93 (Miles pers comm)	6.9	216
East Midlands (Laxton and Litton 1988)	6.6	216
Hants97 (Miles pers comm)	5.8	216
Anglia98 (Bridge unpubl)	5.4	216

RANGE 4

Eleven samples were taken from a variety of structural elements (Table 1; Fig 3). Four of the ring-width series were found to crossmatch each other (Fig 6; Table 3) and were combined into a chronology which was dated (Table 4). One further timber barely overlaps the others, but did date independently (Table 5) against several chronologies at a later date than the other four. All five series were combined to produce a site chronology 'CROSSWAY' the dating evidence for which is given in Table 5. The relative positions of overlap of the samples are illustrated in Figure 6. The chronology itself is presented in Table 10.

RANGES 1 and 2 (80 and 80A Fore Street)

Although these two properties appear superficially to be contemporaneous, detailed examination (Bond 1999) has shown that range 1 is of earlier construction. Only one timber from range 1 dated (Table 6) this giving a felling date range of AD 1418-1449. This date agrees well with stylistic evidence (Bond 1999) but needs to be used with caution since one cannot have great confidence in dating a phase on a single sample. Details of the samples are given in Table 2, their locations being shown in Figure 5. Crossmatching was found between five timbers (Table 7), which were combined to form a second site chronology '80A'. This chronology (Table 10) was subsequently dated (Table 8). The relative positions of overlap of the samples is illustrated in Figure 6.

An overall site chronology 'ISAACLD' combining all ten dated timbers was formed (Table 10) and dated against a range of available data (Table 9).

Interpretation and Discussion

Interpretation of the date of construction of range 4 (the 'crossway') remains problematic. The grouping of four timbers without sapwood (Fig 6) suggests a possible felling date in the mid-sixteenth century. However, one sample with complete sapwood was felled in AD 1587. It would be dangerous to date the whole range on the evidence of this one timber, although the other dated samples could be contemporaneous. It requires careful re-examination of the structure of range 4 to make sure that the single timber for which there is a felling date is indeed part of the primary building phase. Sample ILI08 was noted at the time of sampling as probably being drilled through the heartwood-sapwood transition, although the limewash made this difficult to determine. It could be that the four timbers without sapwood represent a group of timbers felled a few decades before AD 1587.

Range 3 has been truncated by the construction of range 2, and therefore, although unsuitable for dendrochronological analysis, it can confidently be ascribed to the period before the construction of this range (ie before AD 1636). The architect for current work at the site suggests that range 3 is likely to post date the building of the crossway, although there remains some elements of doubt about this (Bond 1999). The nature of the timbers, and their apparent re-use, means that dendrochronology will not be able to provide additional precise independent dating evidence for this phase of construction.

Only one of the timbers sampled (ILI22) from 80 Fore Street (range 1) dated (Table 6). Although this range is thought to have been built before 80A (Bond 1999) and the rear wall plate to 80 Fore Street was found to contain a splayed edge-halved bridled scarf joint with sallied abutments, which would agree well with construction in the period suggested by this single timber (AD 1418 - 1449). There are obvious dangers in dating a whole phase on the basis of a single timber. This evidence suggests that careful examination of the range is required to

make sure that the post has not been inserted. If this date is accepted for the whole range, which is stylistically acceptable, it would make this building the earliest extant building of the complex, and not the 'crossway' (range 4) as was previously thought.

Range 2 (80A Fore Street) is represented by 5 contemporaneous timbers which come from a group felled in spring AD 1636. This confirms the dated carved on the front gable bressumer.

It was known that some of the ranges in this complex were relatively recent. For example, part of the complex was extended nearer to the river frontage in 1840 (Bond 1999). Many of the younger ranges were found to have been constructed from softwoods. Range 8 for example contains a large number of conifer timbers with many rings and a date known to within decades. A research project assessing the potential use of imported coniferous timbers is currently being undertaken for English Heritage (Groves 1997). This conclusions of that project may determine whether the coniferous timbers at the Isaac Lord complex may be incorporated into a dendrochronological study at a later date.

The combined site chronology 'ISAACLD' matches well with other chronologies (Table 9) and will be of great use in dating other sites in the Suffolk area, although it should be noted that it is poorly replicated in some parts of the overall period covered.

Acknowledgements

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Table 10 continued:

Year	ring widths (0.01mm)	no of trees
ISAACLD		
AD1420	381	1
	332 223 274 104 63 29 113 292 241 192	1 1 1 1 1 1 1 1 1 1
	151 256 229 271 308 251 295 223 222 241	1 1 2 2 2 2 2 3 3 3
	198 261 276 184 212 232 257 237 382 278	3 3 3 3 3 3 3 3 3 3
AD1451	278 239 230 279 239 294 277 209 206 222	3 3 3 3 3 3 3 3 3 3
	235 180 182 199 255 237 207 211 229 262	3 3 3 3 3 3 3 3 3 3
	203 205 191 145 195 136 130 163 226 187	3 3 4 4 4 4 4 4 4 4
	258 229 182 174 146 185 246 182 225 168	4 4 4 4 4 4 4 4 4 4
	134 122 124 142 154 233 183 155 129 128	4 4 4 4 3 3 3 3 3 3
AD1501	137 166 136 168 126 154 99 129 153 140	3 3 3 3 3 3 2 2 2 2
	204 231 284 243 234 250 194 303 346 242	1 1 2 2 2 2 2 2 2 2
	259 326 267 295 378 378 401 403 345 296	2 2 1 1 1 1 1 1 1 1
	333 196 291 246 274 342 306 265 237 288	1 1 1 1 1 1 1 2 2 2
	231 213 154 100 96 138 102 146 191 216	2 2 2 2 2 2 2 2 2 2
AD1551	144 112 136 192 248 168 150 154 184 170	2 2 2 2 2 2 2 2 3 3
	146 212 177 180 165 140 171 155 187 217	3 4 4 4 4 4 4 4 4 4
	146 155 119 117 150 158 182 186 188 284	4 5 5 4 4 4 5 6 6 6
	189 179 192 220 227 219 199 219 225 201	6 6 6 6 6 6 6 5 5 5
	269 230 254 222 168 190 178 192 163 190	5 5 5 5 5 5 5 5 5 5
AD1601	148 187 182 190 141 211 179 180 163 175	5 5 5 5 5 5 5 5 5 5
	161 201 194 146 115 114 163 221 194 208	5 5 5 5 5 5 5 5 5 5
	185 170 141 119 173 147 218 180 189 131	5 5 5 5 4 4 4 4 4 2
	112 176 165 135 152	2 2 2 2 2