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CHURCH OF ST HELEN AND ST GILES, THE BROADWAY, RAINHAM, LONDON BOROUGH OF HAVERING
TREE-RING ANALYSIS OF TIMBERS FROM THE SOUTH CHANCEL DOOR

SCIENTIFIC DATING REPORT

Martin Bridge and Dan Miles

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SUMMARY

The recently uncovered door in a twelfth-century doorway comprises three layers of oak boards with late twelfth-century ironwork. The rear-most layer of thick boards is much later than the other two. The next layer was not suitable for dendrochronological analysis because of the fragility of the boards and the level of visible intervention that would have been necessary to extract the tree-ring data. The four front boards were cored with a micro-borer and were found to be imported timber. The resulting site chronology spans the years AD 1225–1379, but no sapwood is evident. The most likely felling date is in the late-fourteenth or early-fifteenth century.

CONTRIBUTORS

Dr M C Bridge and Dr D H Miles

ACKNOWLEDGEMENTS

The sampling and analysis of these boards was funded by English Heritage (EH), and requested by the EH Historic Buildings Adviser, Simon Hickman. Brenda and Elphin Watkin were most helpful in supplying a copy of their recording report and introducing us to the door. Jane Geddes (Aberdeen University) was helpful in her descriptions of the importance of the ironwork. Danny Agaer facilitated access to the door and the generous hospitality of the church members is gratefully acknowledged. The work was commissioned by Isabelle Parsons (EH). Cathy Tyers (Sheffield University) and John Meadows (EH) are thanked for their comments on an earlier draft of this report.

ARCHIVE LOCATION

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DATE OF INVESTIGATION

2009

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INTRODUCTION

This Grade-I listed church, situated in the centre of the town (Fig 1), is a remarkably complete and unaltered Norman church, thought to date to *c.* AD 1170. When the RCHME visited in the early part of the last century (RCHME 1923), they noted a twelfth-century doorway in the north aisle of the church and one in the south wall of the chancel (Fig 2), which they described thus:

> 'between the two western windows is a late 12th-century doorway with a semi-circular arch of two orders enriched with chevron ornament and with a label carved with nail-head ornament; the jambs have each an attached shaft with the capital carved with water-leaf and grotesque face; the lower parts of the jambs have been restored.'

No comment is made on the door itself, which a photograph in the same volume shows already had an outer covering of boards. The door was not mentioned in either Pevsner's 1954 edition of *Buildings of England: Essex*, or Cecil Hewett's (1982) *Church Carpentry*, suggesting that it has remained covered up for at least the last 85 years. Geddes (1999) notes that the ironwork of the north aisle door is of *c.* AD 1160–70 date, but does not mention the door in the south chancel as it was still boarded, and was not visible to her.

When the doorway was recently opened up, the door and its ironwork created great excitement, as it was felt it could be the original door. However, the profile of the V-edged tapered boards was not usually found in Norman doors, and these suggested a later, possibly fourteenth-century date. Recording was undertaken by Brenda Watkin, who kindly supplied a copy of her unpublished report (Watkin 2008), and Jane Geddes (pers comm) commented on the ironwork:

> 'This [discovery] is particularly good because it's an untouched example of the early Essex type. It has the tendril on top of the C, which makes it look almost like an animal head, similar to Heybridge, Stifford, Willingale Spain, and Eastwood. It also has the cluster of curls at the tip of the bars, like Eastwood (N), and Stifford. My guess is that the door is contemporary with the doorway, somewhere mid-12C'.

The ends of the hinges, where they fit onto the pintles, is very unusual in that they are horizontally aligned rather than forged around the pintle. The door has clearly been altered in the past, probably losing its lowest section at some stage. In its present form it is approximately 710mm (28") wide by 2060mm (81") high. The outer (front) three boards are between 180 and 210mm wide, and about 30mm thick at one end, gently tapering to around 15mm, before tapering more sharply in the last approx 25mm to a near-point. The thicker ends contain similarly shaped grooves to receive the pointed end of the neighbouring board. The innermost board, closest to the hinge, hardly tapers at all (Fig 3). Seven rectangular ledges remain in place, and although difficult to see, these appear to be original. The rear of the door has much thinner boards, which also taper and fit into

grooves on the adjacent board, and these have again been covered in much thicker boards (Fig 4). The outer boards have been heavily weathered, and the position of now moved or missing ironwork can be seen as ridges of less weathered material (Fig 5).

Dating of the boards was requested by Simon Hickman (English Heritage Historic Buildings and Area Adviser) to establish whether this door is contemporary with the initial construction of the church around AD 1170.

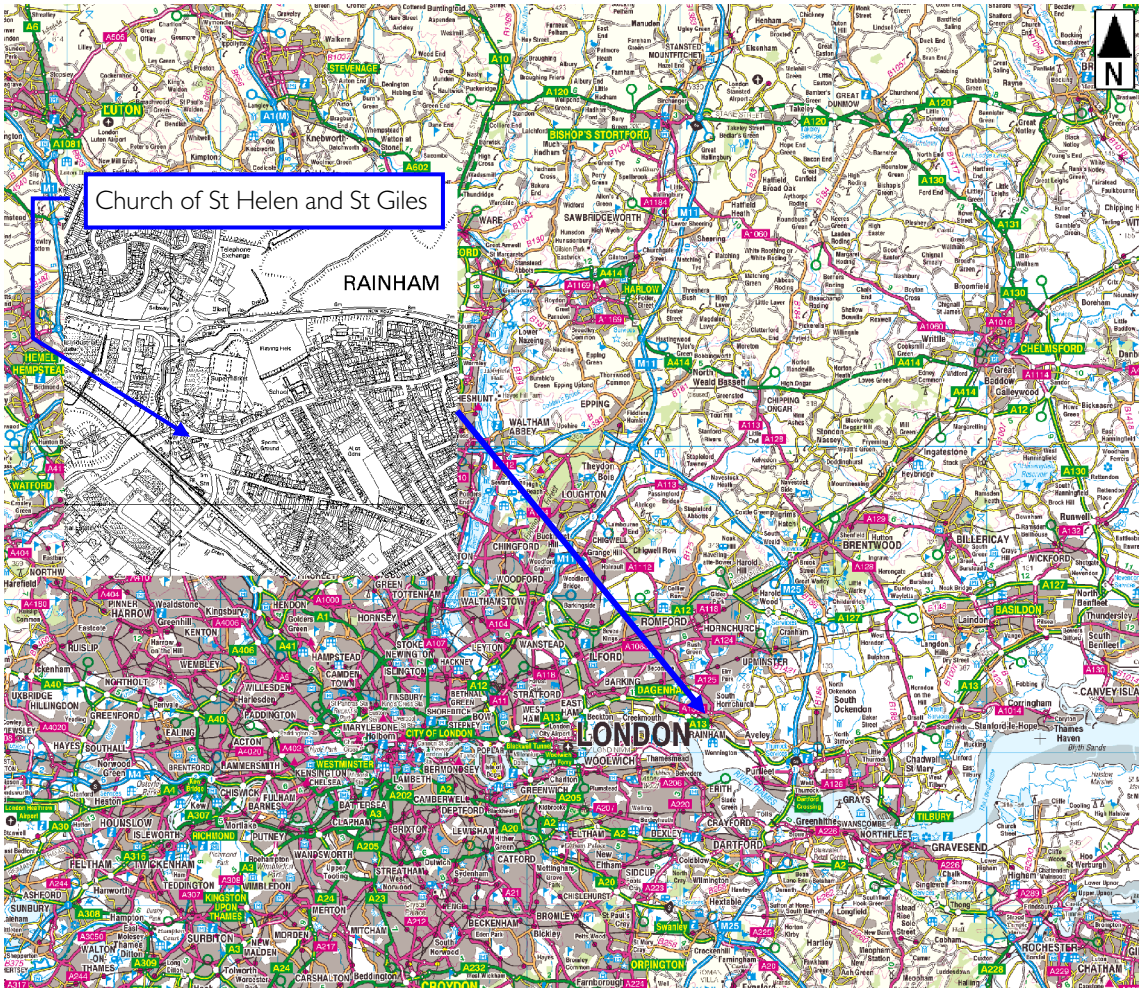

Figure 1. Map to show the location of the church

Figure 2. Photograph of the twelfth-century doorway and the front of the recently uncovered door

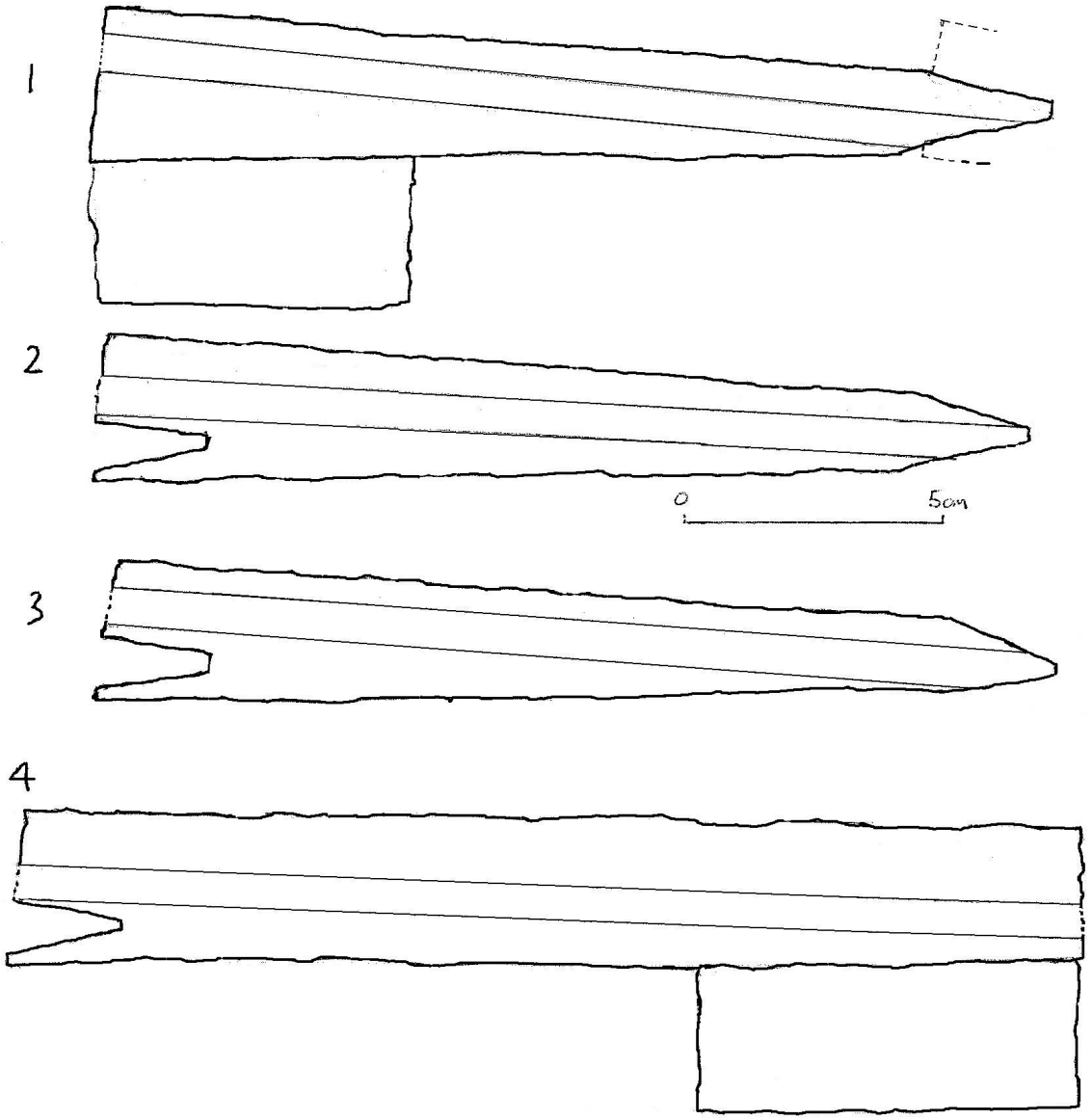

Figure 3. Field sketch of the boards showing their dimensions, shape, and the approximate position of the core extracted from each board

Figure 4. View of the door showing the front boards, the ironwork, the original pintle, the very thin rear boards, and the thicker rear cladding and present pintle

Figure 5. View looking down the outer face of the door from an elevated position, showing the degree of weathering and a raised section where ironwork once sat, protecting the wood surface

METHODOLOGY

The door was originally assessed *in situ* in January 2009, when it was felt that it might be possible to date the thin rear boards as well as the front weathered boards that carry the early ironwork. A micro-borer was used to extract samples from the front boards. This system was initially developed for work on the medieval doors at the Tower of London, commissioned by the Historic Royal Palaces Agency. This minimal intervention approach was accomplished by using a small 8mm external diameter hollow drill bit, which extracts a 5mm diameter core. The drill bit is cooled and cleared of dust with the aid of compressed air, which is channelled through the inside of the cutting tube and clears the waste from around the outside of the bit. The drill bit is accurately aligned by the use of a series of guides fitted to a jig, which is clamped to the face of the board. The hole is afterwards plugged with an oak pellet and stained.

The cores thus extracted were mounted on grooved timber mounts and prepared by being sanded on a linisher using 60 to 400 grit abrasive paper, and cleaned with compressed air to allow the ring boundaries to be clearly distinguished. The samples had their tree-ring sequences measured to an accuracy of 0.01mm, using a specially

constructed system utilising a binocular microscope with the sample mounted on a travelling stage with a linear transducer linked to a PC, which recorded the ring widths into a dataset. The software used in measuring and subsequent analysis was written by Ian Tyers (2004). Cross-matching was accomplished by a combination of visual matching and a process of qualified statistical comparison by computer. The ring-width series were compared for statistical cross-matching, using a variant of the Belfast CROS program (Baillie and Pilcher 1973). Ring sequences were plotted to allow visual comparisons to be made between sequences on a light table. This method provides a measure of quality control in identifying any potential errors in the measurements when the samples cross-match.

In comparing one sample or site master against other samples or chronologies, *t*-values over 3.5 are considered significant, although in reality it is common to find demonstrably spurious *t*-values of 4 and 5 because more than one matching position is indicated. For this reason, dendrochronologists prefer to see some *t*-value ranges of 5, 6, and higher, and for these to be well replicated from different, independent chronologies with both local and regional chronologies well represented, except where imported timbers are identified. Where two individual samples match together with a *t*-value of 10 or above, and visually exhibit exceptionally similar ring patterns, they may have originated from the same parent tree. Same-tree matches can also be identified through the external characteristics of the timber itself, such as knots and shake patterns. For shorter ring sequences from the same tree, lower *t*-values do not preclude same-tree derivation.

Ascribing felling dates and date ranges

Once a tree-ring sequence has been firmly dated in time, a felling date, or date range, is ascribed where possible. With samples which have sapwood complete to the underside of, or including bark, this process is relatively straightforward. Depending on the completeness of the final ring, ie if it has only the spring vessels or early wood formed, or the latewood or summer growth, a precise felling date and season can be given. If the sapwood is partially missing, or if only a heartwood/sapwood transition boundary survives, then an estimated felling date range can be given for each sample. The number of sapwood rings can be estimated by using an empirically derived sapwood estimate with a given confidence limit. If no sapwood or heartwood/sapwood boundary survives, as is the case here, then the minimum number of sapwood rings from the appropriate sapwood estimate is added to the last measured ring to give a *terminus post quem* (*tpq*) or felled-after date.

A review of the geographical distribution of dated sapwood data from historic timbers has shown that a sapwood estimate relevant to the region of origin should be used in interpretation. It must be emphasised that dendrochronology can only date when a tree has been felled, not when the timber was used to construct the structure or object under study. Generally, objects such as doors utilised boards which had been seasoned, but this was usually through air-seasoning, which usually equated to one inch per year in thickness (Miles 2006).

RESULTS

The surfaces of the inner rear boards were generally too abraded or damaged to allow the rings to be accurately measured, and it was decided that cleaning the surfaces would cause unacceptable visual intervention to the timberwork on these thin fragile boards, which are too thin to use the micro-borer on. These boards were not therefore investigated further.

Details of the samples taken from the four outer boards are given in Table 1. Where a core broke during extraction, the inner part of the sequence was labelled 'i', and the outer part 'ii'. In the case of board 1, the outermost board away from the hinge, cross-matching demonstrated that no rings had been lost when the core broke, so the two sequences, rhm01i and rhm01ii, were combined into a single sequence, rhm01, for further analysis. Cross-matching between the samples, shown in Table 2, was strong in some cases, weaker in others, particularly the short sequences from rhm04, the innermost board closest to the hinge. Subsequent cross-matching revealed that one ring had been lost when this core broke, and when a 'dummy' ring value was added to represent the year AD 1315 as part of the quality control process, the combined series rhm04 was found to match the other sequences well, eg rhm01 *v* rhm04, $t = 4.7$, and rhm02 *v* rhm04, $t = 9.2$.

The sequences were combined into a single 155-year site sequence, RAINHMDR. This was dated to the period AD 1225–1379, a selection of the strongest matches being shown in Table 3. The relative positions of overlap of the dated samples are shown in Figure 6, where the minimum likely number of sapwood rings has been added to show the earliest likely date after which the parent tree for each board was felled. The tree-ring width data for the series are given in the Appendix.

Table 1. Details of the samples taken for dendrochronology

Sample	Description	Rings	Sapwood	Date of measured sequence (AD)	Interpreted felling date (AD)
rhm01i	inner rings of outer board	56	-	1272–1327	-
rhm01ii	outer rings of outer board	50	-	1328–77	-
rhm01	rhm01i + rhm01ii	106	-	1272–1377	after 1385
rhm02	second board	111	-	1269–1379	after 1387
rhm03	third board	141	-	1225–1365	after 1373
rhm04i	inner rings of fourth board	50	-	1265–1314	-
rhm04ii	outer rings of fourth board	62	-	1316–77	after 1385

Table 2. Cross-matching between the sample sequences; t-values over 3.5 are considered significant

	t-value			
Sample	rhm02	rhm03	rhm04i	rhm04ii
rhm01	6.1	2.3	2.6	3.1
rhm02		4.1	4.8	7.7
rhm03			2.6	3.1

Table 3. Dating evidence for the site master RAINHMDR, AD 1225–1379

Reference chronology	*t*-value
BALTIC0, early Baltic Master Chronology (Tyers pers comm)	7.2
ABB_DOOR, reused door, Southwark, London (Tyers 1994)	6.8
HMC_T165 , Hull Magistrates Court (Tyers 1998)	6.6
CLS2000, Chapel Lane Staith, Hull (Tyers 2000)	6.3
MAGDALN2, Magdalen College Oxford (Miles and Worthington 2000)	6.2
GRIMSBY1, New Baxtergate, Grimsby (Groves 1992)	6.2
MBC_BALT, Millennium Bridge, London (Tyers 1999)	6.1
WMNSTR13, Large Treaty Chest, Westminster Abbey (Miles and Bridge 2008)	5.8
BALTIC2, Baltic Master Chronology (Hillam and Tyers 1995)	5.2
NWCOLLG2, New College Oxford, Bell tower door (Miles and Worthington 2006)	4.9
STHELEN2, East St Helen's Street, Abingdon (Miles and Haddon-Reece 1995)	4.6
LTWLDGFD, Chest, Little Waldingfield, Essex (Bridge and Miles 2008)	4.4

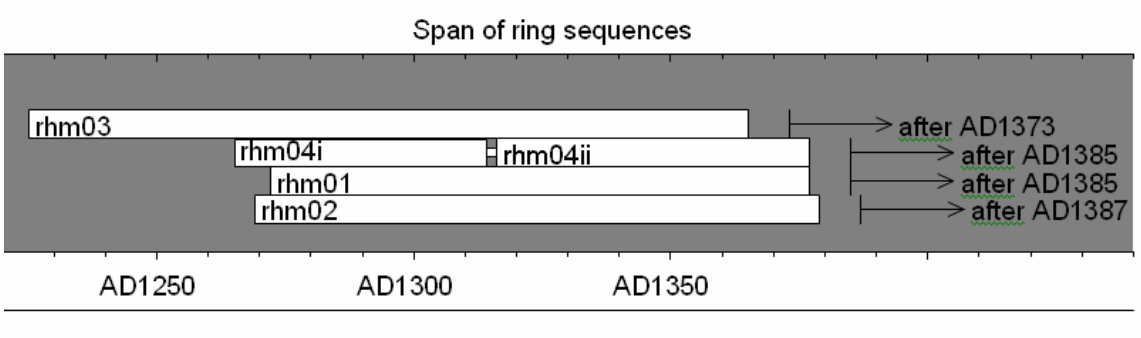

Figure 6. Bar diagram showing the absolute dating positions of the sequences from the four boards of the door and their interpreted likely felling dates

DISCUSSION

Although it is impossible to give a precise felling date for the trees from which the boards were converted, the time required for seasoning the boards would have been no more than a year or two, which means that seasoning is not a significant factor in the interpretation of the construction date. What the dendrochronology has proven without question is that the door does not date *before* AD 1379, the date of the outermost measured ring of rhm02, and that the oak used almost certainly grew in the region around the Baltic Sea. The relatively poor matching between the boards suggests that they were probably derived from different trees, although boards rhm02 and rhm04 may have come from a single tree.

It is interesting that the final measured heartwood rings on each board all fall within a fourteen-year period, suggesting that they may all be close to the heartwood-sapwood boundary. If so, assuming minimal trimming and given the likely sapwood numbers of trees from the Baltic area, 8–24 (Tyers 1998), a felling date range in the latter decades of the fourteenth or very early fifteenth century would be suggested. This is not unreasonable,

given previous studies on Baltic boards that have shown minimal loss of heartwood rings (Miles and Bridge 2005). The thin unsampled boards are stylistically sixteenth-century in origin, though these were not investigated here. It is clear therefore that the ironwork has been reused, probably from the original door from this doorway.

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APPENDIX

Ring width values (0.01mm) for the sequences measured

rhm01

144	134	195	207	125	91	82	140	171	193
162	129	141	169	168	200	167	186	152	114
88	97	110	104	113	113	113	121	102	106
122	99	81	58	69	67	88	89	98	117
195	337	248	196	208	113	140	170	146	99
141	146	114	131	115	252	277	302	252	223
250	190	213	224	229	220	215	184	182	116
156	202	207	212	181	157	158	144	147	156
142	161	124	142	192	193	171	199	216	168
280	201	194	187	209	209	224	223	223	199
145	127	138	203	175	188				

rhm02

243	251	205	189	167	199	198	149	145	150
180	157	162	168	108	130	143	110	74	77
106	131	164	81	95	173	138	208	190	156
156	110	84	130	94	85	83	132	166	152
151	113	138	198	227	172	139	170	127	150
159	150	144	162	160	106	116	94	125	159
152	157	116	106	79	191	149	153	141	175
184	144	138	125	137	109	135	104	91	105
99	97	138	149	142	84	110	127	127	121
175	173	79	124	145	136	117	141	167	154
125	134	123	110	103	117	175	141	137	118
105									

rhm03

183	102	111	167	189	218	169	240	214	211
122	102	163	206	169	132	113	122	174	205
197	191	203	114	136	142	183	225	219	168
253	168	210	145	114	122	171	180	131	125
114	133	106	108	112	147	157	144	110	120
137	84	114	126	97	100	128	129	113	98
114	95	101	111	112	111	107	78	64	92
97	112	111	110	93	67	93	74	80	106
81	79	104	104	131	84	64	109	155	141
146	140	135	97	78	79	94	107	103	77
92	101	121	97	88	84	104	98	87	113
105	107	92	95	125	114	117	120	121	96
111	105	101	126	108	121	128	111	123	131
129	145	158	119	141	147	95	109	134	128
139									

rhm04i

168	136	188	198	201	217	182	214	181	185
182	146	103	183	193	163	150	159	112	117
120	105	100	129	143	120	189	115	122	218
196	214	183	138	201	147	163	179	133	170
112	177	149	231	234	187	209	231	271	237

rhm04ii

303	198	273	276	266	221	212	207	139	201
184	230	234	200	188	150	150	124	253	214
285	214	222	150	148	116	174	178	148	173
121	119	137	99	105	152	167	168	139	155
133	155	158	204	208	110	170	163	194	140
154	212	206	163	179	167	169	146	189	167
171	234								