Historic England

Research Report Series 29/2025

Panel Paintings from the English Heritage Collections: The Suffolk Collection, EH88019201 ‘Mary Beaton’, Attributed to Anthonis Mor

Tree-ring Analysis of an Oak Panel Painting

Ian Tyers

Scientific Dating

Panel Paintings from the English Heritage Collections: The Suffolk Collection, EH88019201 ‘Mary Beaton’, Attributed to Anthonis Mor

Tree-ring Analysis of an Oak Panel Painting

Ian Tyers

National Grid Reference: TQ 27085 87418 (Kenwood House)

Print: ISSN 2398-3841
Online: ISSN 2059-4453

Summary

A programme of tree-ring assessment, measurement and analysis was commissioned on a panel painting from the English Heritage Collections whilst the panel was undergoing conservation treatment at Rangers House Conservation Studios in 2024. Direct tree-ring measurement was undertaken on the three boards of this oak panel painting. The portrait sitter is conventionally identified as Mary Beaton, a companion of Mary, Queen of Scots. The tree-ring analysis dated all three of these boards and identified them as being derived from timbers imported from the eastern Baltic. These timbers provide a likely usage date for the panel that may assist with corroborating the sitter's identification and the artist attribution.

Contributors

Ian Tyers

Acknowledgements

I would like to thank Rachel Turnbull for enabling access to this panel, as well as for her assistance and the provision of information. Shahina Farid, Historic England Scientific Dating Team, is also thanked for commissioning and facilitating this programme of dendrochronology analysis.

Front cover image

Both sides of EH88019201 - Mary Beaton panel painting. [© English Heritage]

Archive location

The Historic England Archive, The Engine House, Fire Fly Avenue, Swindon SN2 2EH

Historic Environment Record

Greater London Historic Environment Record, 4th Floor Cannon Bridge House, 25 Dowgate Hill, London EC4R 2YA

Date of investigation

2024

Contact details

Historic England Customer Service: customers@historicengland.org.uk

Ian Tyers, Dendrochronological Consultancy Ltd., Lowfield House, Smeath Lane, Clarborough, Nottinghamshire DN22 9JN ian@dendro.co.uk

Contents

Illustrations

Tables

Introduction

This document is a technical archive report on the tree-ring analysis of oak boards from a panel painting, which is normally housed at Kenwood House in London (List Entry No. 1379242: https://historicengland.org.uk/listing/the-list/list-entry/1379242). It was undergoing conservation at the English Heritage Conservation Studios at Rangers House, Greenwich, at the time of the analysis. It is beyond the dendrochronological brief to describe these objects in detail here although elements of this report may be combined with detailed descriptions, photographs and other technical reports at some point in the future.

Methodology

The panel was constructed from vertically-aligned oak boards. These boards taper slightly from one end to the other, were bevelled around their reverse edges and had original surfaces on their reverse faces. The boards were radial, or near radial sections of straight-grained slow growing oak (*Quercus* spp.). The panel was given an analysis number, and each board was labelled from A onwards from its left as viewed from the front.

Tree-ring dating employs the patterns of tree-growth to determine the calendar dates for the period during which the sampled trees were alive. The amount of wood laid down in any one year by most trees is determined by the climate and other environmental factors. Trees over relatively wide geographical areas can exhibit similar patterns of growth, and this enables dendrochronologists to assign dates to some samples by matching the growth pattern with other ring-sequences that have already been linked together to form reference chronologies.

Timbers intended for dendrochronological analysis need to be free of aberrant anatomical features such as those caused by physical damage to the tree, which may prevent or significantly reduce the chances of successful dating.

Standard dendrochronological analysis methods (English Heritage 1998) were applied to each suitable board in each panel. Complete or partial sequences of the annual growth rings were measured to an accuracy of 0.01mm using a microcomputer based travelling stage. The sequences of ring widths were then plotted onto semi-log graph paper to enable visual comparisons to be made between sequences. In addition, cross-correlation algorithms (e.g. Baillie and Pilcher 1973) were employed to search for positions where the ring sequences were highly correlated. Highly correlated positions were checked using the graphs and, if any of these were satisfactory, new composite series were constructed from the synchronised sequences. Any *t*-values reported below were derived from the original CROS algorithm (Baillie and Pilcher 1973). A *t*-value of 3.5 or over is usually indicative of a good match, although this is with the proviso that high *t*-values at the same relative, or absolute position need to have been obtained from a range of independent sequences, and that these positions were supported by satisfactory visual matching.

Not every tree can be correlated by the statistical tools or the visual examination of the graphs. There are thought to be a number of reasons for this: genetic variations; site-specific issues (for example a tree growing in a stream bed will be less responsive to rainfall); or some traumatic experience in the tree’s lifetime, such as injury by pollarding, defoliation events by caterpillars, or similar. These could each produce a sequence

dominated by a non-climatic signal. Experimental work with modern trees shows that 5–20% of all oak trees, even when enough rings are obtained, cannot be reliably cross-matched.

Converting the date obtained for a tree-ring sequence into a useful date requires a record of the nature of the outermost rings of the sample. If bark or bark-edge survives, a felling date precise to the year or season can be obtained. If no sapwood survives, the date obtained from the sample gives a *terminus post quem* for its use. If some sapwood survives, an estimate for the number of missing rings can be applied to the end-date of the heartwood. This estimate is quite broad and varies by region. This report uses a minimum of 6 rings, and a maximum of 36 rings, 95% confidence limits, as a sapwood estimate for the eastern Baltic boards based on comparative data from other groups of eastern Baltic data (Sohar et al. 2012; Eckstein et al. 1986).

The analysis may highlight potential same-tree identifications if two or more tree-ring sequences are obtained that are exceptionally highly correlated. Such pairs, or sometimes more, are then used as a same-tree group and each can be given the interpreted date of the most complete of the samples. They are most useful where several timbers date but only one has any sapwood, or where same-tree identifications yield linkages within or between objects.

Eastern Baltic boards of *c.* 270–310mm width are likely to have been minimally trimmed as this appears to have been the typical maximum usable width of the traded boards. The tree-ring results obtained from boards of these sizes, thus appear to be broadly indicating the usage period for these panels, even when they retain no sapwood. In these cases, an estimated usage date based on a range of 6–40 trimmed rings is used following Baillie (1984).

Results

This panel painting comprised three oak boards, all of which were suitable for measurement. All were dated and all were eastern Baltic in origin.

The measurement data for the measured boards are listed in Appendix 1.

EH88019201 Mary Beaton, Anthonis Mor

Mary Beaton (*c*. 1543–1597), was a Scottish courtier to Mary, Queen of Scots. This panel was *c*. 1109mm high and *c*. 823mm wide. It comprised three vertical oak boards (Fig 1; Table 1). The boards were labelled A to C from the left. All three boards were suitable for measurement. Complete sequences were obtained from one end of boards A and C, and both ends of board B. The board B series were synchronised and combined into a single sequence. The series from boards A and C matched each other (*t*-value 21.21; Fig 2). These sequences are very similar and were derived from the same tree. The board B ring-width series does not match these and is, therefore, unlikely to be from the same tree. The sequences from boards A and C were combined and this, and the board B series were compared with reference data of historic date from throughout England and northern Europe. A number of statistically significant matches were obtained between these board sequences and reference series, along with other contemporaneous objects. These indicate the three sequences date (Fig 3; Tables 2 and 3).

None of the boards retained sapwood and thus, the interpretations given to these boards are *terminus post quem* dates based on a minimum estimate of six sapwood rings. The interpreted dates represent the earliest possible felling dates for board A after *c*. AD 1551, board B after *c*. AD 1563, and board C after *c*. AD 1529. Assuming minimal trimming of heartwood for these wide boards suggests a usage date after *c.* AD 1563 and before c. AD 1593.

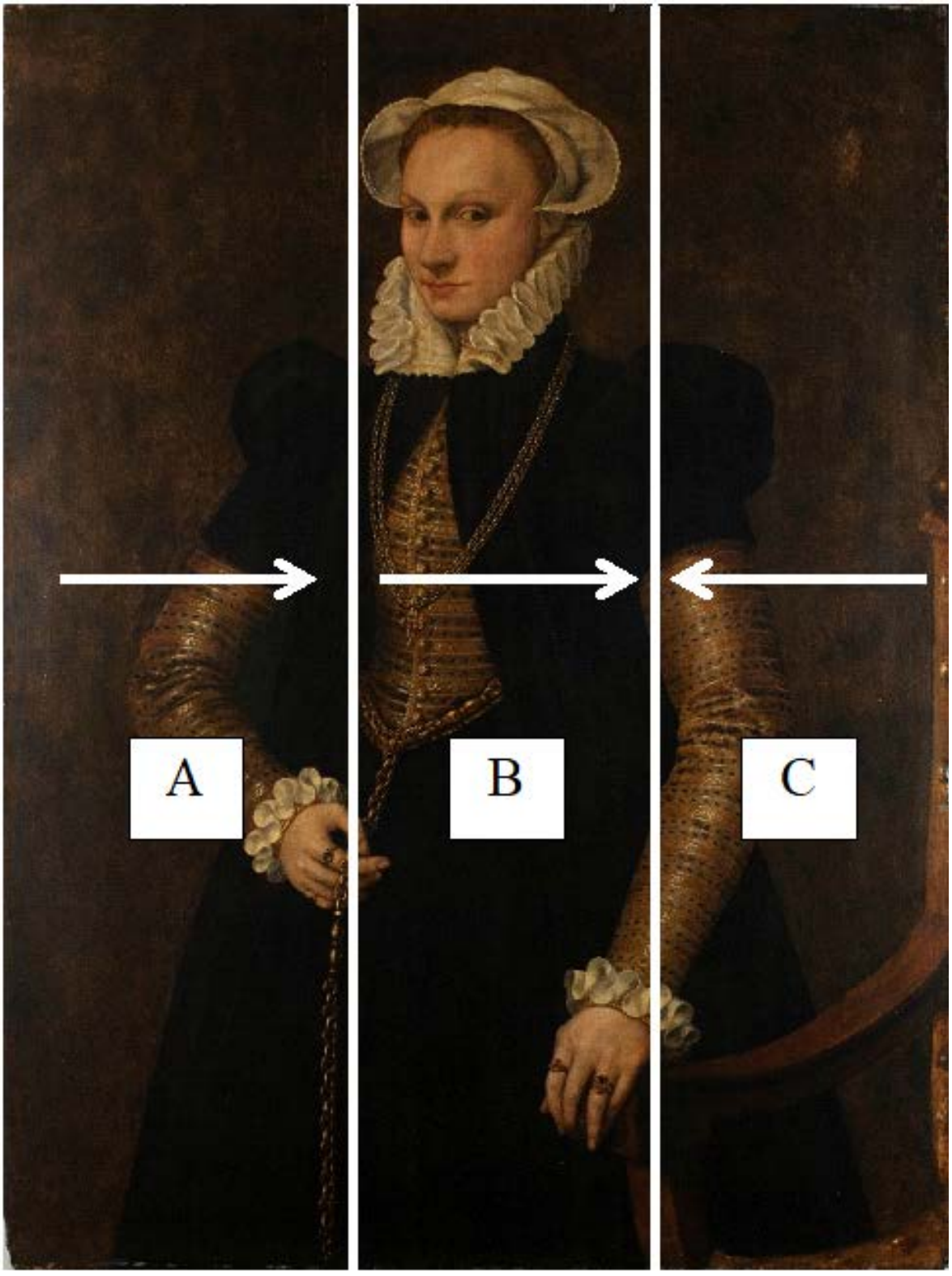

Figure 1: The construction of the Mary Beaton panel painting (the locations of the board joints are approximate). [© English Heritage]

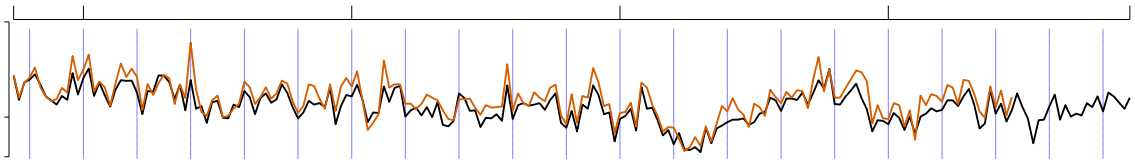

Figure 2: The tree-ring sequences from board A (black) and board C (red) from the Mary Beaton panel painting. These sequences are very similar *t*-value 21.21 and were derived from the same tree.

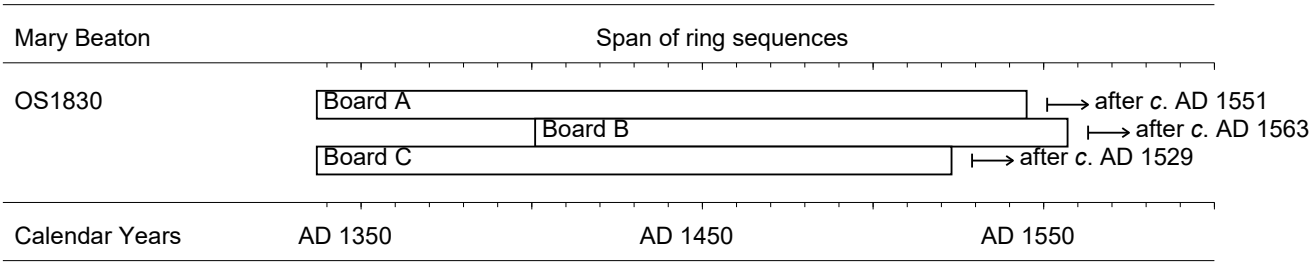

Figure 3: Bar diagram showing the absolute dating positions of the dated tree-ring sequences for boards from the Mary Beaton panel painting. The interpreted felling dates are also shown for these dated boards.
KEY: White bars are eastern Baltic oak heartwood

Table 1: Details of the three oak boards from the Mary Beaton panel painting.

OS1830 Board	Width (mm)	Rings	Average Growth Rate / year (mm)	Date of measured sequence	Interpreted result
Board A	283–268	209	1.24	AD 1337–1545	after *c*. AD 1551
Board B	274–280	157	1.92	AD 1401–1557	after *c*. AD 1563
Board C	266–270	187	1.42	AD 1337–1523	after *c*. AD 1529

KEY: sequences obtained from the lower edges of the boards A and C, and the upper and lower edges of board B

Table 2: Example *t*-values between the composite sequence from boards A and C from the Mary Beaton panel painting and eastern Baltic oak reference data.

Reference chronology	Boards A+C AD 1337–1545
Baltic Area 2 (Poland?) reference (Daly and Tyers 2022)	8.92
Elizabeth I ‘Clopton Portrait’ (Tyers 2022a)	9.73
Philip Sydney, National Portrait Gallery (Tyers 2009a)	8.95
Elizabeth I aged 26 (Tyers 1996)	8.60
Elizabeth I (Tyers 2011)	8.48
Tax Collectors, after Reymerswaele (Tyers 2018)	8.31
London, Sutton House panelling (Tyers 1991)	8.28
Jacques Wittewronghele, Visscher (Tyers 2013) and Mary Mildmay, Emmanuel (Tyers 2019) the same tree is in both panels	8.16
Elizabeth I ‘Phoenix Portrait’, Hilliard, Tate/National Portrait Gallery & Elizabeth I ‘Pelican Portrait’ Hilliard, Walker (Tyers 2010) the same tree is in both panels	7.90
Henry Fitzalan 12th Earl of Arundel, NPG (Tyers 2008a)	7.63

Table 3: Example *t*-values between the sequence from board B from the Mary Beaton panel painting and eastern Baltic oak reference data.

Reference chronology	Board B AD 1401–1557
Baltic Area 2 (Poland?) reference (Daly and Tyers 2022)	10.33
London, Brooke House panelling (Tyers 2015)	9.13
Elizabeth I ‘Darnley Potrait’, National Portrait Gallery (Tyers 2009a)	8.54
Tax Collectors, after Reymerswaele (Tyers 2018)	8.44
Henry Fitzalan 12th Earl of Arundel, National Portrait Gallery (Tyers 2008a)	8.04
John 1st Baron Lumley, National Portrait Gallery (Tyers 2009b)	7.99
London, Sutton House panelling (Tyers 1991)	7.70
Mary FitzAlan, Duchess of Norfolk (Tyers 2020)	7.70
Lady 1573 aged 24, Gower (Tyers 2022b)	7.65
Elizabeth I ‘Armada Portrait’, Gower, National Portrait Gallery (Tyers 2008b)	7.63

Discussion

The panel utilises three oak boards. These boards are of a single radius ranging from true radials to moderately tangential sections, with no centres or centrelines within the boards. As is usual in portrait format panels (that is taller than it is wide) these boards are arranged with vertical grain. Typically, each of these boards taper both slightly from one end of the panel to the other and also in thickness, with the thicker sections towards the middle of the panel. Contemporaneous panels were mostly constructed using boards of a maximum of 6–11mm thick, sometimes tapering down to only 2–3mm thickness. The panel makers used irregular sectioned and tapering boards to construct flat and right-angled panels. This panel has handsaw toolmarks on its reverse face with simple butt joints.

Most groups of panels from English collections that have been examined hitherto are dominated by eastern Baltic oak boards and very few retain sapwood. This panel, thus, conforms to expectations with this panel using eastern Baltic sources for its boards, even though it was probably an English product. The panel makers usually appear to have deliberately removed the sapwood. This feature has been identified in many other panel paintings from both England and the rest of western Europe, and is known to be a formal statute of the panel makers guild in seventeenth-century Antwerp (Wadum 1998). None of these boards retain sapwood.

The widest board in this panel is 283mm wide, the typical maximum widths seen in Baltic board widths are *c*. 270–310mm. The frequency of these board sizes suggests they represent the usable width of the Baltic boards after trimming of the feathered edges and removal of their sapwood. This possibly indicates choices and convention of panel making at the time, probably the use of the more substantial sections of the boards in order to make satisfactory joints.

Eastern Baltic tree-ring data is not internally uniform, instead boards were mostly derived from three discrete regions, currently known as Areas 1, 2 and 3, and probably located within Lithuania and Poland (Daly and Tyers 2022). These three boards are from Area 2.

There were no potential same-tree matches observed from these series to any other analysed panels.

Any additional technical evidence for either seasoning or reuse of these boards (such as X-ray images showing earlier painting underneath) would make this panel later, possibly much later, than the interpreted date given here. The analysis of panels with good attributions has demonstrated that panels were mostly made from unseasoned oak.

References

Baillie, M. G. L. 1984 ‘Some thoughts on art-historical dendrochronology’, *Journal of Archaeological Science*, 11, 371–93: https://doi.org/10.1016/0305-4403(84)90019-0

Baillie, M. G. L., and Pilcher, J. R. 1973 ‘A simple cross-dating program for tree-ring research’, *Tree Ring Bulletin*, 33, 7–14

Daly, A. and Tyers, I. 2022 ‘The sources of Baltic oak’, *Journal of Archaeological Science*, 139: https://doi.org/10.1016/j.jas.2022.105550

Eckstein, D., Wazny, T., Bauch, J., and Klein, P. 1986 ‘New evidence for the dendrochronological dating of Netherlandish paintings’, *Nature*, 320, 465–6: https://doi.org/10.1038/320465a0

English Heritage 1998 Dendrochronology: Guidelines on producing and interpreting dendrochronological dates, English Heritage: https://historicengland.org.uk/images-books/publications/dendrochronology-guidelines/ (acc. 26 Feb 2025)

Sohar, K., Vitas, A. and Läänelaid, A. 2012 ‘Sapwood estimates of pedunculate oak (*Quercus robur* L.) in eastern Baltic’, *Dendrochronologia*, 30, 49–56: https://doi.org/10.1016/j.dendro.2011.08.001

Tyers, I. 1991 ‘Dendrochronology report on building timbers and wooden panelling from Sutton House, Hackney’, MoL EAS Dendro Rep, 02/91

Tyers, I. 1996 ‘Tree-ring analysis of a Panel Painting: A portrait of Queen Elizabeth in 1559 aged 26’, ARCUS Rep, 284c

Tyers, I. 2008a ‘The tree-ring analysis of panel paintings from the National Portrait Gallery: Group 1.6’, Dendro Co Rep, 157

Tyers, I. 2008b ‘The tree-ring analysis of panel paintings from the National Portrait Gallery: Group 1.5’, Dendro Co Rep, 138

Tyers, I. 2009a ‘The tree-ring analysis of panel paintings from the National Portrait Gallery: Group 3.3’, Dendro Co Rep, 290

Tyers, I. 2009b ‘The tree-ring analysis of panel paintings from the National Portrait Gallery: Group 3.2’, Dendro Co Rep, 281

Tyers, I. 2010 ‘The tree-ring analysis of the National Portrait Gallery 'Phoenix' and the Walker Gallery 'Pelican' portraits of Elizabeth I by Nicholas Hilliard’, Dendro Co Rep, 373

Tyers, I. 2011 ‘The tree-ring analysis of a panel painting: A portrait of Elizabeth I’, Dendro Co Rep, 452

Tyers, I. 2013 ‘The tree-ring analysis of panel paintings for the National Portrait Gallery ‘Elizabeth I & Her People’ exhibition: Jacques Wittewronghele, by Cornelius de Visscher’, Dendro Co Rep, 636

Tyers, I. 2015 ‘Brooke House, Hackney, London: Dendrochronological Analysis of Timbers’, Historic England Research Report Series, 16/2015: https://historicengland.org.uk/research/results/reports/16-2015 (acc. 26 Feb 2025)

Tyers, I. 2018 ‘The tree-ring analysis of a panel painting: The Tax Collectors’, Dendro Co Rep, 1037

Tyers, I. 2019 ‘The tree-ring analysis of 3 panel paintings from Emmanuel College, Cambridge’, Dendro Co Rep, 1094

Tyers, I. 2020 ‘The tree-ring analysis of a panel painting: A portrait of Mary Fitzalan, Duchess of Norfolk’, Dendro Co Rep, 1247

Tyers, I. 2022a ‘The tree-ring analysis of a panel painting: A portrait of Elizabeth I “The Clopton Portrait”’, Dendro Co Rep, 1368

Tyers, I. 2022b ‘The tree-ring analysis of a panel painting: A portrait of a Lady, dated 1573, aged 24, by George Gower’, Dendro Co Rep, 1385

Wadum, J. 1998 ‘Historical overview of panel-making techniques in the northern countries’, in *The structural conservation of panel paintings: proceedings of a symposium at the J. Paul Getty Museum, 24–28 April 1995* (eds K Dardes and A Rothe), 149–77.

Appendix 1: Data of Measured Boards

Measurements in 0.01mm units

os1830al

198	133	177	186	203	171	141	132	123	142
133	207	145	191	223	142	177	143	119	158
184	182	183	150	105	154	152	199	199	178
135	171	112	185	115	120	91	128	131	99
98	123	118	154	139	105	137	148	127	134
172	149	118	98	108	131	123	126	118	162
89	120	144	141	171	134	92	108	107	166
129	162	168	101	112	117	103	118	100	128
88	86	94	148	137	111	112	85	99	98
105	94	169	97	122	126	121	123	126	113
133	148	91	84	111	79	123	115	169	144
105	108	67	97	102	115	80	165	115	117
95	74	81	64	77	59	58	61	56	84
65	83	87	92	96	96	98	88	92	106
109	138	132	111	136	136	133	150	123	149
184	160	222	124	123	140	155	174	137	114
79	95	94	89	107	99	81	101	76	101
106	116	110	113	132	132	120	141	159	123
83	90	158	106	125	93	112	148	118	98
65	95	96	119	145	96	122	101	106	103
126	118	141	110	150	141	127	115	138	

os1830bl

106	140	129	126	193	173	119	136	137	136
158	181	172	143	179	187	325	183	159	248
214	194	177	197	149	154	255	291	194	179
218	139	158	149	197	195	191	166	192	172
178	191	284	218	261	228	195	168	202	210
149	232	236	210	110	156	175	250	213	226
253	213	284	291	279	304	246	251	242	239
176	240	242	155	200	135	145	267	185	256
248	240	351	278	267	268	304	304	289	207
271	294	216	247	193	192	260	249	266	288
246	234	248	190	193	164	208	182	170	235
196	160	135	218	204	210	182	214	245	212
184	237	218	161	185	258	196	181	169	215
164	174	181	196						

os1830bu

180 179 121 129 177 224 170 203 172 188
137 175 162 202 164 250 158 188 218 170
205 166 142 96 145 141 104 165 204 154
112 128 113 150 141 157 140 163 150 267
158 148 182 158 210 185 160 140 127 221
236 163 157 195 125 137 141 181 170 192
134 154 139 199 168 243 214 233 174 185
136 159 174 137 163 180 137 111 148 161
217 180 194 193 184 306 258 255 264 204
190 195 238 197 221 217 148 193 132 130
271 153 197 213 177 248 228 246 229 245
282 235 177 209 258 186 239 169 169 185
197 213 230 223 200 224 179 147 160 166
171 166 207 173 140 122 213 174 203 165
188 224 184 163 187 198 138 173 216 161
194

os1830cl

201 138 176 193 227 164 141 130 135 162
150 275 184 219 281 153 180 163 121 175
243 194 223 194 113 173 144 175 201 190
124 172 137 343 158 109 102 132 143 100
102 115 125 180 164 124 139 164 136 148
183 174 130 107 120 172 167 136 115 172
111 166 191 166 213 133 81 91 105 255
163 172 172 125 125 114 125 145 138 132
112 97 95 134 135 136 117 104 122 117
118 119 240 112 148 126 120 151 138 130
163 171 103 89 146 91 142 138 225 178
120 124 77 107 109 127 86 177 163 123
102 79 85 84 70 57 61 72 62 86
67 90 120 110 137 114 104 85 125 118
102 157 139 126 152 138 156 154 116 187
270 153 220 138 138 161 186 216 210 181
90 122 98 97 126 122 86 112 69 143
122 146 142 129 170 163 124 185 182 147
110 99 166 118 155 103 139

Historic England's Research Reports

We are the public body that helps people care for, enjoy and celebrate England's historic environment.

We carry out and fund applied research to support the protection and management of the historic environment. Our research programme is wide-ranging and both national and local in scope, with projects that highlight new discoveries and provide greater understanding, appreciation and enjoyment of our historic places.

More information on our research strategy and agenda is available at HistoricEngland.org.uk/research/agenda.

The Research Report Series replaces the former Centre for Archaeology Reports Series, the Archaeological Investigation Report Series, the Architectural Investigation Report Series, and the Research Department Report Series.

All reports are available at HistoricEngland.org.uk/research/results/reports. There are over 7,000 reports going back over 50 years. You can find out more about the scope of the Series here: HistoricEngland.org.uk/research/results/about-the-research-reports-database.

Keep in touch with our research through our digital magazine *Historic England Research* HistoricEngland.org.uk/whats-new/research.

ISSN 2398-3841 (Print)
ISSN 2059-4453 (Online)