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**Tree-Ring Analysis of Timbers from Astley Hospital, Church
Road, Astley, Manchester**

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Tree-Ring Analysis of Timbers from Astley Hospital, Church Road, Astley, Manchester

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Summary

Twenty-five samples from the roof and second-floor ceilings of this building were analysed by tree-ring dating. This analysis produced a single chronology consisting of nine samples, its 144 rings spanning the period AD 1507-AD 1650.

Interpretation of the sapwood, and the relative positions of the heartwood/sapwood boundaries on the dated samples, would indicate that the timbers represented were all felled between late AD 1649 and early AD 1650.

Given that a carved stonework plaque commemorating work in AD 1650 is found over the front porch, it is probable that this is the felling date for the majority of the other timbers also. The building thus appears to be of one phase of construction dating from the mid-seventeenth century.

Keywords

Dendrochronology
Standing Building

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Introduction

Astley Hospital, formerly known as Dam House (NY991391; Fig 1) is a grade II* listed brick and timber-framed house of three storeys with a long gallery at attic level. It is believed to date from the late-sixteenth century and, if correct, would thus be a rare survival of its type in north-west England. Other examples of purpose built brick halls with long galleries in Manchester are Hough End Hall, Withington, built around AD 1596 and New Hall Farm, Wythenshawe, built around AD 1590. The long gallery becomes much less common in the late-sixteenth century.

Dam House is unusual for a number of reasons. Firstly it is not lavishly fenestrated, bay windows and large central windows only providing light into the long gallery, rather than a continuous window. Secondly, the gallery is shorter than other examples, being only 64 feet long (most other examples are in the region of 100 feet long). Finally, the long gallery at Dam House is uncommon in that, rather than being a long wide corridor, it has rooms off it.

The house is believed to have undergone alteration and addition in the seventeenth, eighteenth, nineteenth, and twentieth centuries. In the seventeenth century for example a three-storey porch was added to the front. Above the door of the porch a stone cut inscription reads "Erected by Adam Mort and Margaret Mort 1650".

Sampling and analysis by tree-ring dating was commissioned by English Heritage prior to proposed renovation and repairs. The purpose of this was to provide information on the historic development of the house particular as regards the primary construction of the floors of the Hall range, and the roofs of the east and west cross-wings, and the roof of the long gallery. The brief also included a request to sample the timbers of the porch and a fireplace lintel.

The Laboratory would like to take this opportunity to thank Richard Bond for his help in interpreting the various phases of this site and Robina McNeil of Greater Manchester Archaeological Unit for providing drawings upon which the location of samples could be shown. Finally we would like to thank John Norris of Sanderson Watts Associates Ltd for his help and cooperation in sampling.

Sampling

After discussion with Richard Bond and Robina McNeil on the probable phasing of the buildings and the timbers available, and in conjunction with the brief provided by English Heritage, a total of twenty-five core samples was obtained. Each sample was given the code AST-B (for Astley, site "B") and numbered 01 – 25.

Eight samples, AST-B01 – 08, were obtained from beams in the Hall range to the south or front of the building, these being in the ceiling of the second floor. These beams, whilst being substantial timbers some 30 by 30 cms square, had rather wide, and thus relatively few, growth rings. The timbers were also chamfered and trimmed, and in most cases where sapwood might once have existed, it had long since been defrased. The positions of these samples were marked at the time of coring on plans provided, reproduced here as Figure 2.

The remaining seventeen samples were obtained from timbers in the roof spaces. Three samples, AST-B09 – B11, were obtained from the only timbers available in the roof of the east cross-wing. Fourteen samples, AST-B12 – 25 were obtained from the timbers of the roof space of the long gallery.

The roof of the west cross-wing contained no suitable timbers, the presumably original timbers having been replaced in the nineteenth century by an assortment of pine, and in the twentieth by modern softwood rafters. Likewise the porch provided timbers which were unsuitable for analysis by dendrochronology. The lintel of the fireplace was also unsuitable; an exposed end showing that it had only about twenty-five growth-rings.

The timbers selected for sampling were those considered the most suitable for dendrochronological analysis which were also believed by Richard Bond and Robina McNeil to be associated with the primary phase of construction.

Those timbers that were not sampled were generally unsuitable for analysis because they contained too few rings. This was often because the rings were too wide, as was the case, for example, with most of the posts in trusses 1 – 4, or the timbers were too small or cut too thin, as was the case with the majority of elements in the timber-framed walls. In some cases both conditions applied.

Details of the samples are given in Table 1. The roof trusses have been numbered from east to west and the positions of the cores were recorded at the time of sampling on the drawings provided. These are reproduced here as Figs 3a-f.

Analysis

Each sample was prepared by sanding and polishing and the growth-ring widths of all twenty-five were measured; the data of these measurements are given at the end of the report. The growth-ring widths of all the samples were compared with each other by the Litton/Zainodin grouping procedure (see appendix).

At a minimum *t*-value of 4.0 nine samples cross-matched with each other at relative positions as shown in the bar diagram Figure 4. The growth-ring widths of these nine samples were combined at these relative off-set positions to form ASTBSQ01, a site chronology of 144 rings. Site chronology ASTBSQ01 was compared with a series of relevant reference chronologies giving it first ring date of AD 1507 and a last measured ring date of AD 1650. Evidence for this dating is given in the *t*-values of Table 2.

Site chronology ASTBSQ01 was then compared with the remaining sixteen ungrouped samples. There was, however, no further satisfactory cross-matching and all ungrouped samples were compared individually with a full range of relevant reference chronologies. There was, again, no satisfactory cross-matching.

Interpretation

Analysis of samples from Astley Hospital has produced a single site chronology, ASTBSQ01, of nine samples, its 144 rings spanning the period AD 1507 – AD 1650. This site chronology contains samples from both the ceiling of the second floor and the roof of the south range. Three of the nine samples, AST-B05, B13, and B15 have complete sapwood, each having the same last measured complete sapwood ring dates of AD 1649. Under the microscope it is possible to see that a large proportion of the summer cell growth for AD 1649 has taken place on these three samples. It is thus possible that the trees they represent were felled late in that year, or in the very early part of AD 1650, before the spring cell growth for that year began.

This probability is enhanced by the fact that a fourth sample with complete sapwood, AST-B16, has a last measured complete growth-ring dating to AD 1649. However, on this sample it is possible to see that the spring cell growth for the year AD 1650 is just starting.

Conclusion

Following analysis by tree-ring dating it has been possible to obtain dates for some of the timbers in this building. This shows that a number of the beams are from trees felled in late AD 1649 – early AD 1650. These dated timbers all appear to be associated with what was assumed to be the primary construction phase, apparently suggesting that the house dates to the mid-seventeenth century. Documentary evidence points strongly to the presence of an earlier building, dating to the late-sixteenth century, that was subsequently modified, according to the date stone, in AD 1650 by Adam and Margaret Mort. There is no dendrochronological evidence to indicate the presence of timbers felled in the late-sixteenth century so the results either indicate that the present house was constructed shortly after the timbers were felled in AD 1649-50, or that the dated timbers represent a substantial remodeling of an earlier structure.

Sixteen samples remain ungrouped and undated. Of these sixteen only one sample, AST-B20, has more than 60 rings, the remainder having fewer rings and are less suitable for reliable analysis.

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Table 1: Details of samples from Astley Hospital, Church Road, Astley, Manchester

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
Hall range, second floor						
AST-B01	East – west beam to bay window of east room	54	h/s	-----	-----	-----
AST-B02	Central east – west beam of east room	55	h/s	-----	-----	-----
AST-B03	Eastern north – south beam, centre room	54	h/s	-----	-----	-----
AST-B04	Western north – south beam, centre room	71	2	AD 1554	AD 1622	AD 1624
AST-B05	East – west beam to bay window of west room	66	20C	AD 1584	AD 1629	AD 1649
AST-B06	Central north – south beam to west room	54	h/s	-----	-----	-----
AST-B07	North – south beam (west) to west rear room	111	33c	AD 1538	AD 1615	AD 1648
AST-B08	East – west beam (south) to rear west room	58	h/s	-----	-----	-----
Roof of north-east wing						
AST-B09	Ridge-beam	44	7	-----	-----	-----
AST-B10	East purlin	46	h/s	-----	-----	-----
AST-B11	West purlin	42	16C	-----	-----	-----
Roof of south (front) range						
AST-B12	North top rail, truss 1 – east gable	52	h/s	-----	-----	-----
AST-B13	Ridge to south dormer, truss 1 – 2	82	24C	AD 1568	AD 1625	AD 1649
AST-B14	North principal rafter, truss 1	125	h/s	AD 1507	AD 1631	AD 1631
AST-B15	South principal rafter, truss 1	110	16C	AD 1540	AD 1633	AD 1649
AST-B16	Ridge to south dormer, truss 3 – 4	120	31C	AD 1531	AD 1619	AD 1650
AST-B17	Lower south purlin, truss 3 – 4	73	h/s	AD 1548	AD 1620	AD 1620
AST-B18	Lower south purlin, truss 2 – 3	73	h/s	AD 1548	AD 1620	AD 1620
AST-B19	Lower north purlin, truss 1 – 2	33	14C	-----	-----	-----

Table 1: Continued

Sample number	Sample location	Total rings	*Sapwood rings	First measured ring date	Last heartwood ring date	Last measured ring date
Roof of south (front) range						
AST-B20	Valley rafter, front range / north-east wing	65	h/s	-----	-----	-----
AST-B21	South mid-rail, west end bay	44	10	-----	-----	-----
AST-B22	South wall-tie, truss 2	32	h/s	-----	-----	-----
AST-B23	Stud post, south side, truss 3 - 4	38	no h/s	-----	-----	-----
AST-B24	North queen post, truss 1	50	h/s	-----	-----	-----
AST-B25	South lower purlin, truss 1 - 2	52	h/s	-----	-----	-----

*h/s = the heartwood/sapwood boundary is the last ring on the sample

c = complete sapwood on timber, all or part lost in sampling.

C = complete sapwood is retained on sample, last measured ring date is felling date of timber

Table 2: Results of the cross-matching of site chronology ASTBSQ01 with relevant reference chronologies when first ring date is AD 1507 and last ring date is AD 1650

Reference chronology	Span of chronology	t-value	
East Midlands	AD 882 – 1981	3.4	(Laxton and Litton 1988)
England	AD 401 – 1981	5.7	(Baillie and Pilcher 1982a unpubl)
Scotland	AD 946 – 1975	6.3	(Baillie and Pilcher 1982b unpubl)
CHDASQ04	AD 1551 – 1608	6.7	(Howard <i>et al</i> 1996 unpubl)
Colston Bassett, Notts	AD 1465 – 1609	5.1	(Howard <i>et al</i> 1995a)
15 St John's St, Wirksworth, Derbys	AD 1586 – 1676	5.6	(Howard <i>et al</i> 1995b)
Hoyles Farm, Bradfield, Derbys	AD 1469 – 1613	5.4	(Howard <i>et al</i> 1994)
Fair Flats Farm, Bradfield, Derbys	AD 1492 – 1633	4.2	(Howard <i>et al</i> 1994)

Figure 1: Map to show general location of Astley Hospital



Figure 2: Plan of the second floor of Astley Hospital to show position of samples from the ceiling beams

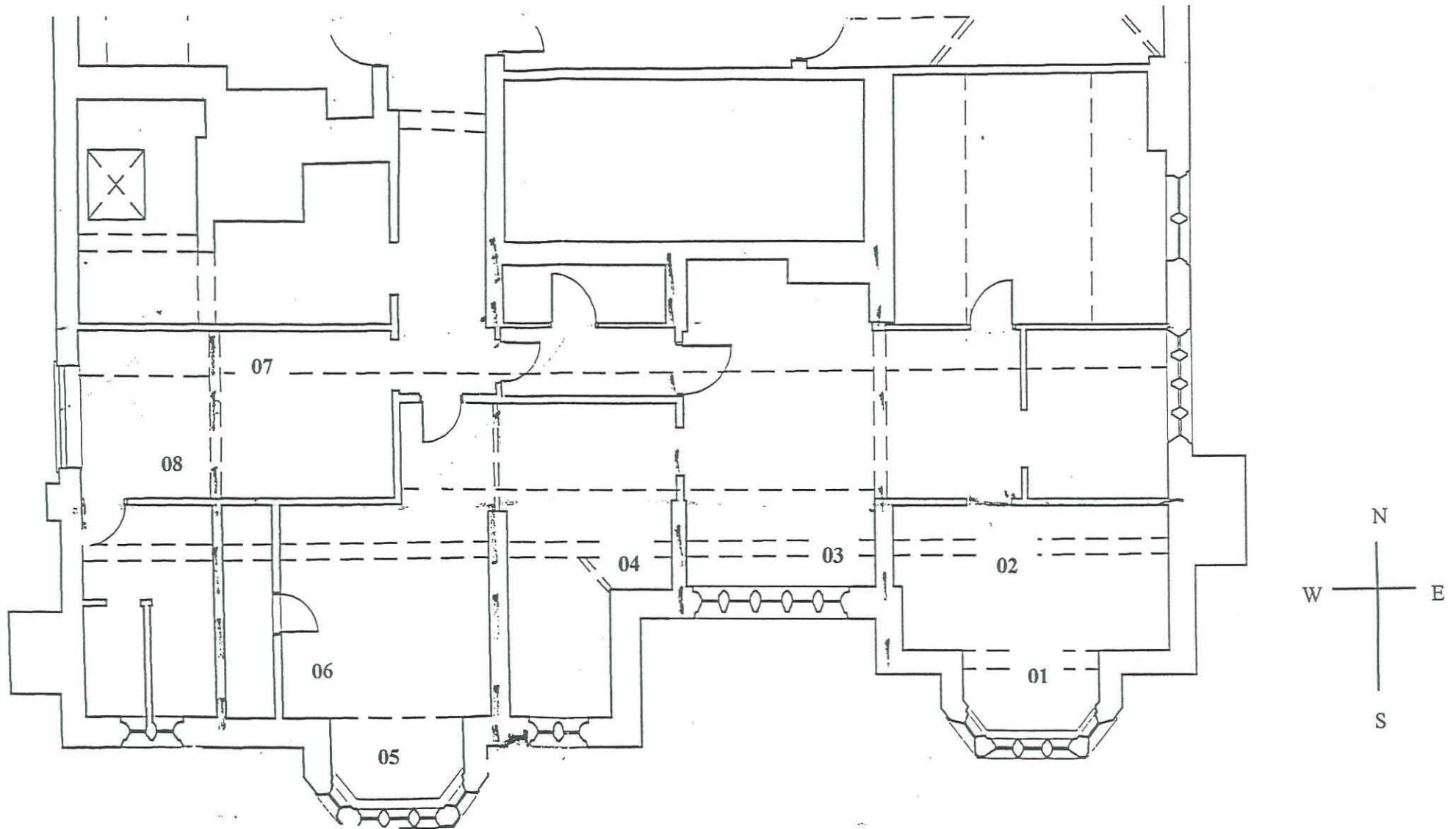


Figure 3a: Elevation of the north wall of the roof space to show position of samples

W ← → E

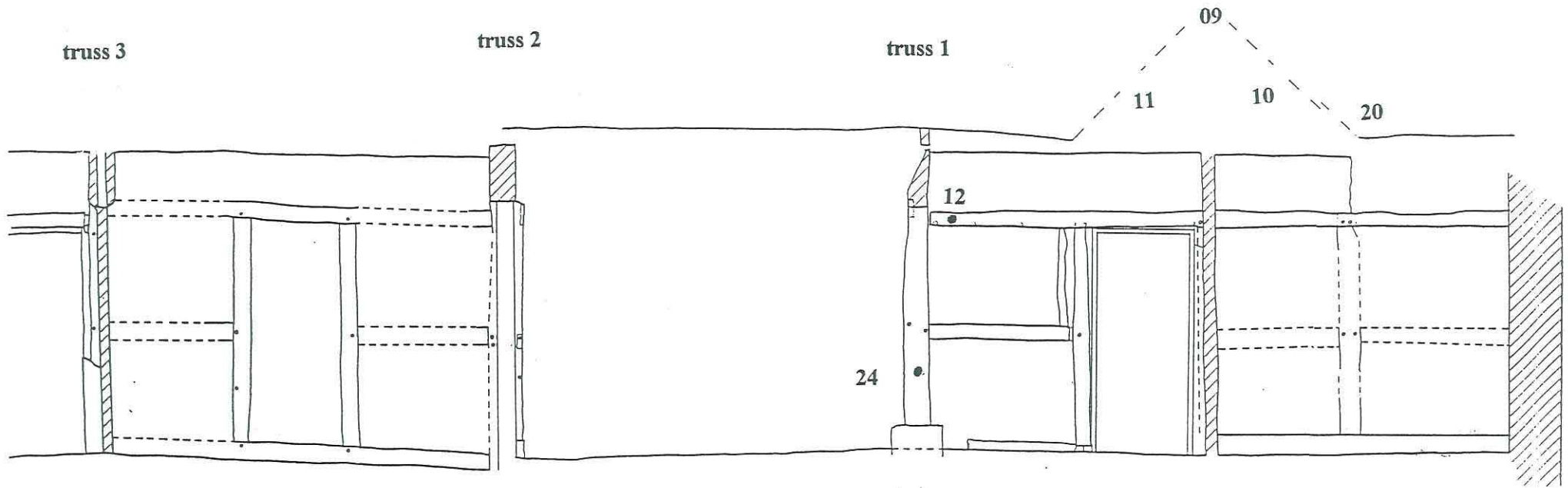


Figure 3b: Elevation of the south wall of the roof space to show position of samples

E ← → W

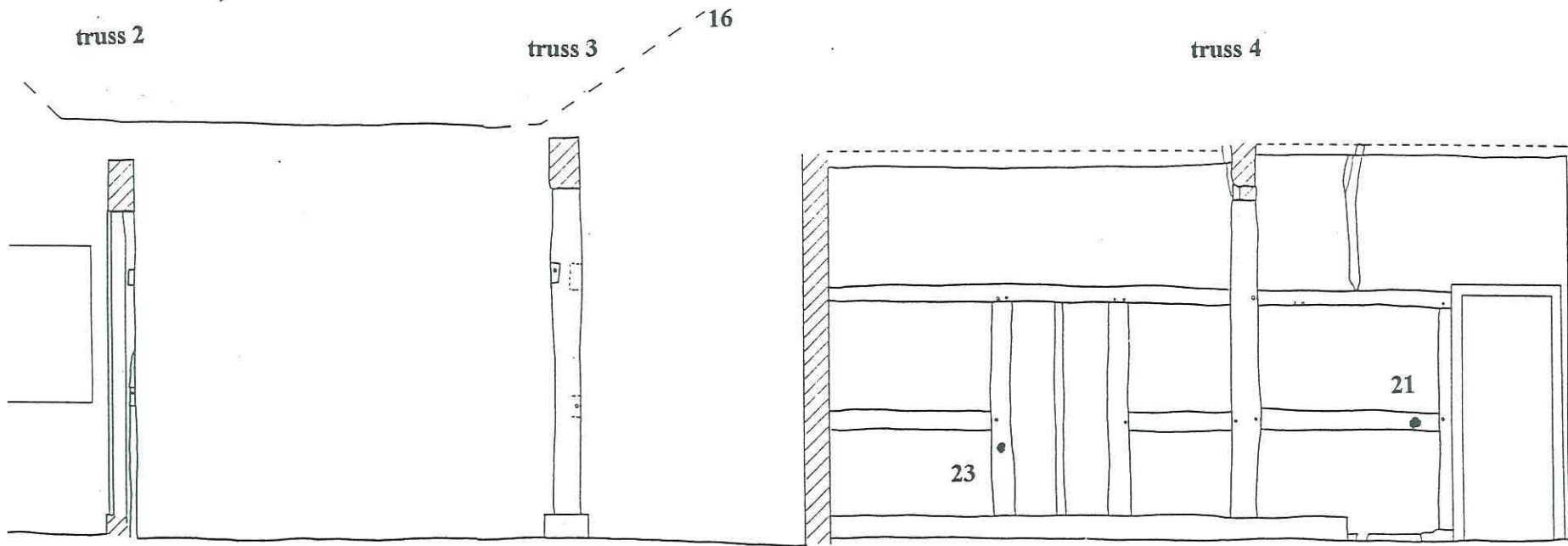


Figure 3c: Truss 1 in the roof space to show position of samples

N ← → S

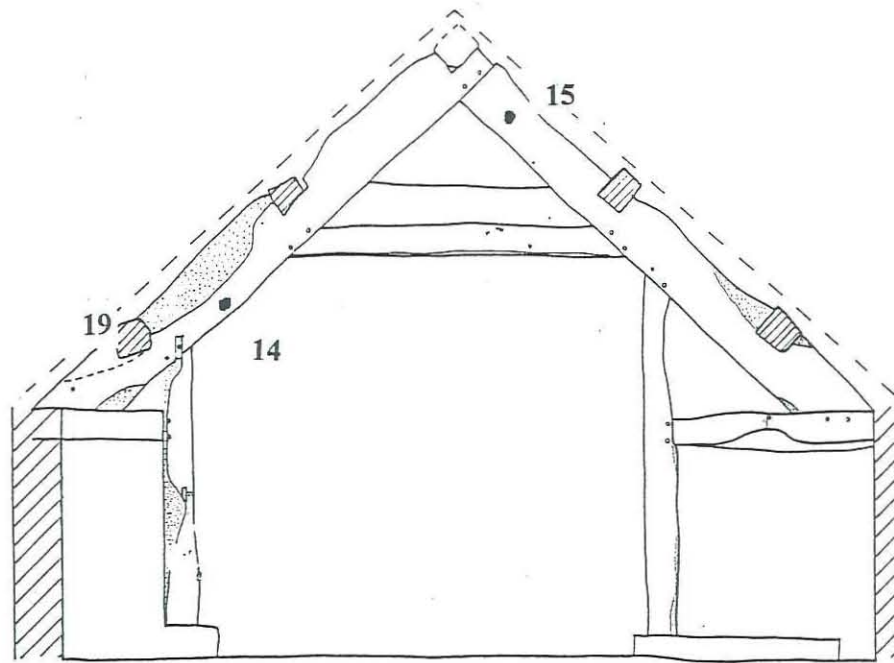


Figure 3d: Truss 2 in the roof space to show position of samples

S ← → N

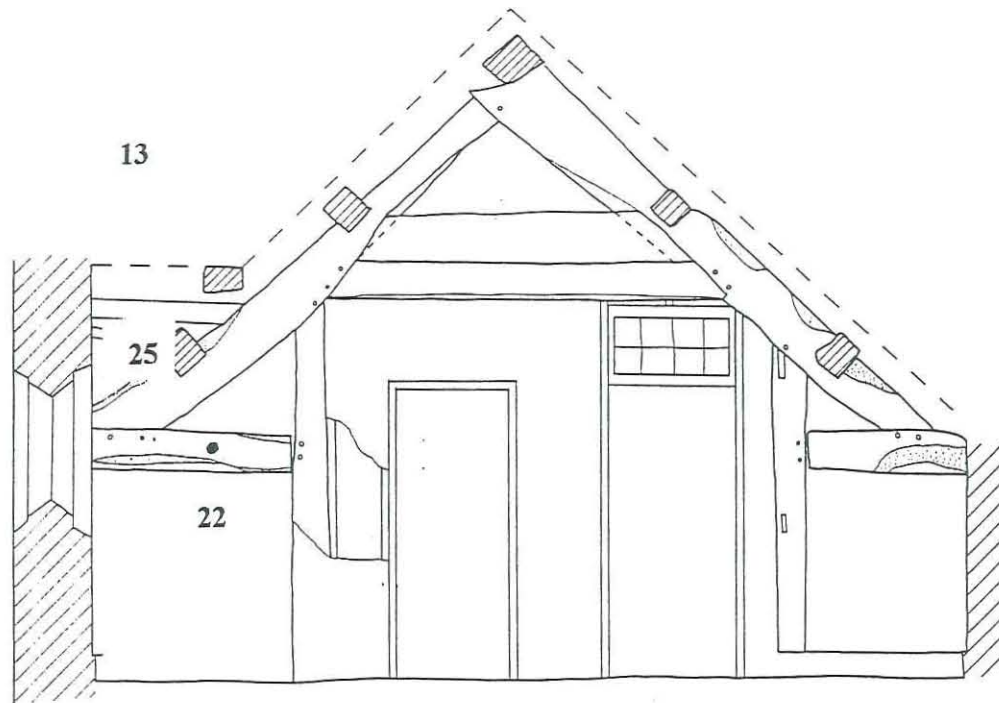


Figure 3e: Truss 3 in the roof space to show position of samples

S ← → N

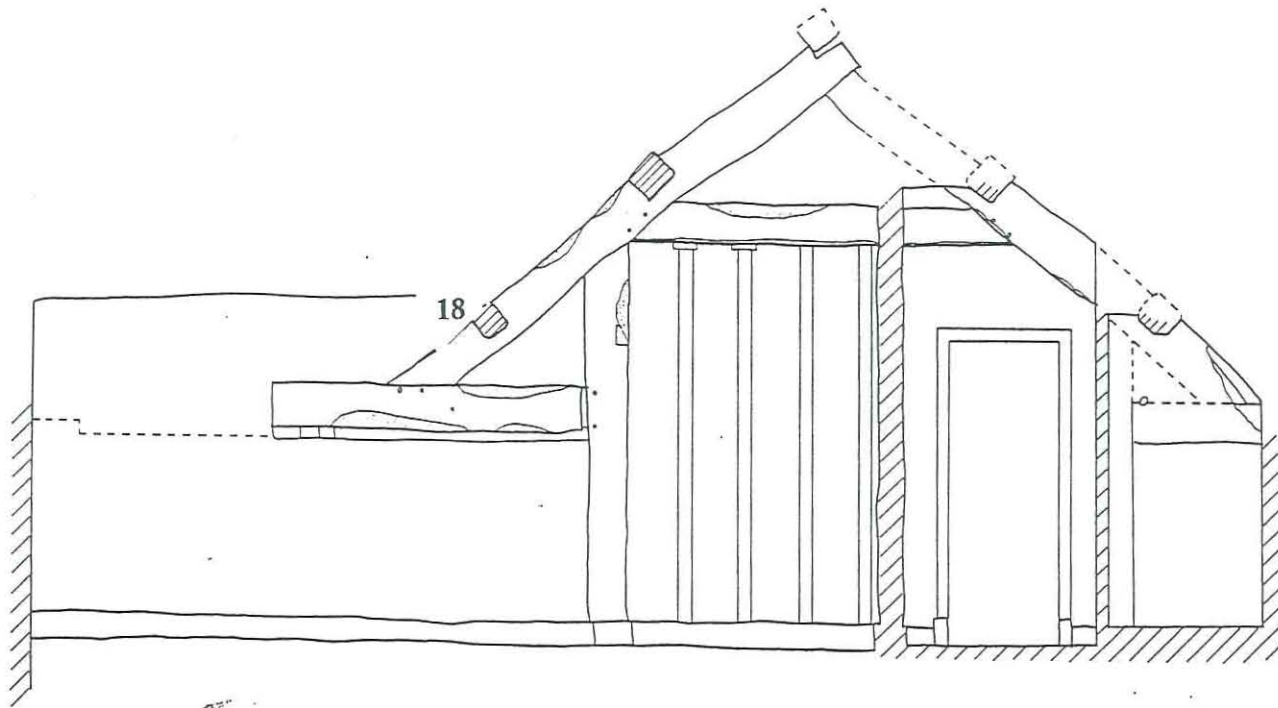


Figure 3f: Truss 4 in the roof space to show position of samples

S ← → N

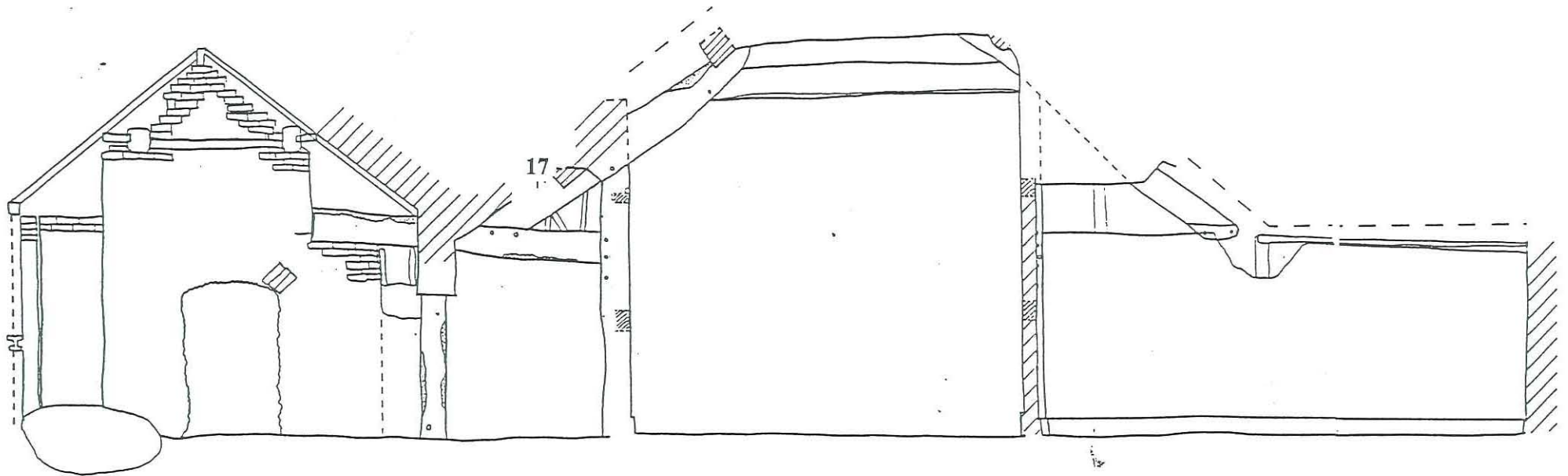
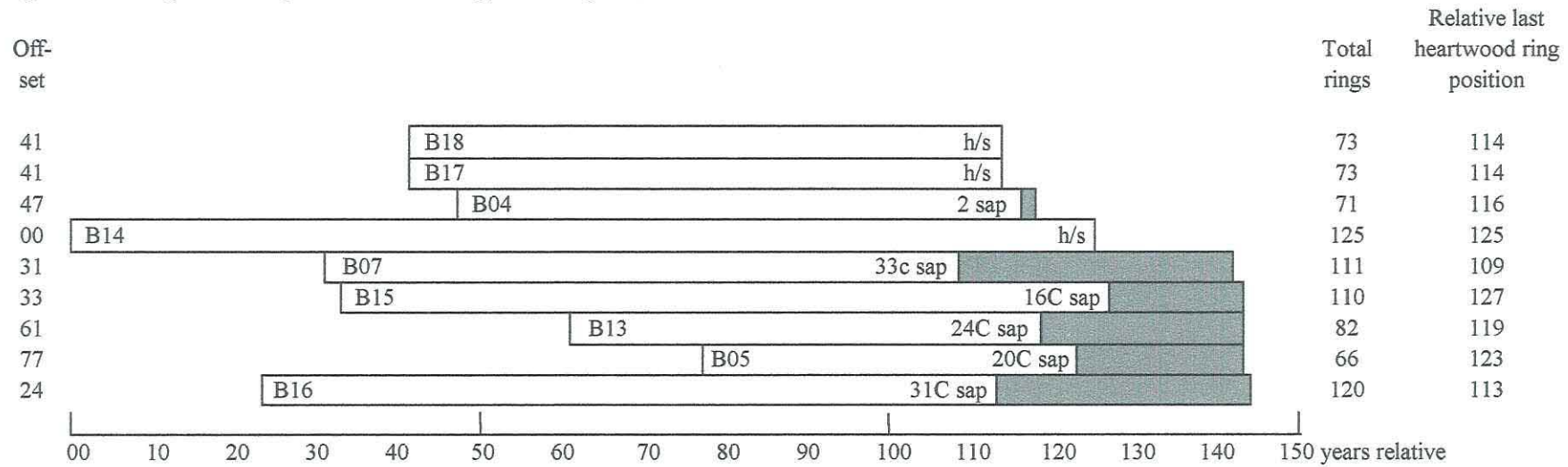


Figure 4: Bar diagram of samples in site chronology ASTBSQ01



White bars = heartwood rings, shaded area = sapwood rings
 h/s = heartwood/sapwood boundary is last ring on sample
 c = complete sapwood on timber, all or part lost in sampling
 C = complete sapwood retained on sample

Data of measured samples – measurements in 0.01 mm units

AST-B01A 54

248 303 482 465 420 387 328 156 280 379 346 362 360 188 161 221 284 227 147 170
338 370 344 180 158 210 269 211 150 172 313 291 252 287 171 166 182 218 192 229
181 153 214 213 281 249 280 264 363 327 253 271 256 237

AST-B01B 54

289 396 369 444 409 388 329 172 252 379 339 393 328 158 161 203 267 235 147 180
349 393 330 181 163 208 283 206 152 205 324 279 252 301 174 168 179 220 185 230
174 137 209 212 269 261 294 268 380 313 248 239 260 216

AST-B02A 55

592 493 495 337 302 378 283 293 415 367 546 508 513 329 295 386 289 288 401 353
593 510 505 331 294 380 282 303 398 341 314 173 269 353 301 302 226 380 317 221
291 255 247 275 302 239 263 332 288 226 282 201 272 272 219

AST-B02B 55

568 504 496 331 297 381 283 298 398 352 546 495 508 339 302 384 281 295 404 347
582 504 494 311 294 360 312 304 390 373 314 186 261 342 295 286 240 368 315 238
286 251 264 270 274 250 267 329 281 215 294 208 255 288 218

AST-B03A 54

636 805 511 346 414 508 676 864 842 603 573 581 436 348 362 476 625 448 452 484
329 245 626 612 348 470 381 384 325 289 352 330 355 492 633 475 348 242 229 325
334 468 393 361 387 499 304 345 382 370 438 413 334 350

AST-B03B 54

585 793 542 395 415 576 637 888 839 548 573 590 447 362 357 497 621 457 458 482
334 280 604 610 345 468 360 380 335 292 352 316 365 484 651 476 339 237 241 325
357 455 394 351 419 449 309 329 401 347 413 457 312 315

AST-B04A 71

201 209 177 195 298 335 342 361 369 267 254 220 172 247 221 220 353 379 303 349
242 211 167 190 238 233 298 284 121 109 97 173 197 204 177 300 157 101 121 181
201 207 206 118 78 71 41 38 29 29 50 62 107 130 82 85 95 87 125 98
80 59 49 79 101 90 162 127 228 162 193

AST-B04B 71

171 211 181 197 244 354 337 372 351 267 249 225 172 255 216 220 350 387 310 347
249 198 157 191 243 238 305 288 113 108 100 167 209 194 174 284 155 110 116 174
206 210 196 117 89 64 44 34 25 34 51 70 103 127 78 80 109 82 124 94
80 56 54 78 89 93 172 122 225 160 201

AST-B05A 66

326 386 441 372 358 405 337 281 344 490 510 489 404 372 325 316 391 368 163 201
297 283 408 431 295 262 273 277 305 368 237 221 215 221 267 225 278 185 149 169
147 108 93 98 97 172 130 161 145 144 162 163 182 197 252 173 230 259 237 245
181 229 254 233 272 251

AST-B05B 66

376 369 441 383 351 410 336 269 361 476 529 495 400 363 325 297 381 372 165 198
303 277 407 439 299 254 282 276 314 382 236 222 220 198 259 233 276 198 177 180
139 108 81 103 102 178 141 154 147 137 165 167 174 201 251 173 235 254 234 234
205 231 259 242 265 242

AST-B06A 54

308 479 498 401 302 474 342 483 492 406 236 190 194 205 230 263 356 351 308 215
149 153 134 99 63 81 168 150 252 330 224 150 148 179 173 164 143 107 100 135
200 142 187 160 157 90 72 84 60 60 64 62 81 95

AST-B12A 52

209 249 193 241 223 189 243 219 139 187 234 276 309 297 225 219 188 134 96 86
109 175 199 233 256 204 173 198 203 292 276 168 148 121 125 186 265 424 387 464
377 269 262 156 187 180 319 352 315 304 379 341

AST-B12B 52

251 243 164 251 222 184 258 212 155 186 226 270 300 294 224 213 194 125 95 72
113 184 220 234 264 201 180 183 204 286 267 190 159 135 124 196 262 451 389 469
352 273 267 160 183 176 310 355 317 311 368 341

AST-B13A 82

133 74 197 151 167 178 324 270 183 217 251 272 142 183 83 170 277 237 249 143
162 215 161 116 97 173 246 316 201 166 121 147 101 106 52 138 470 326 318 187
190 173 220 118 133 161 130 138 110 168 183 157 198 235 220 243 233 157 178 100
132 311 198 111 120 115 86 84 71 138 96 90 156 263 113 176 229 213 154 153
109 124

AST-B13B 82

129 70 190 144 169 178 298 265 175 212 238 254 146 199 71 178 258 206 233 134
169 194 154 118 90 198 279 295 169 157 143 142 105 97 60 144 468 330 313 189
189 170 215 106 136 156 125 139 116 154 182 142 207 228 206 260 231 156 166 92
167 333 185 108 114 106 86 82 88 118 101 87 161 255 136 192 234 198 148 138
123 143

AST-B14A 125

234 245 271 363 331 148 115 132 163 204 270 191 203 224 323 213 223 191 137 122
146 141 76 78 115 123 99 107 193 97 151 282 216 235 211 98 202 203 145 172
239 199 221 225 213 151 230 229 102 122 128 123 98 71 67 91 85 82 54 65
89 101 108 111 87 62 53 53 48 44 40 35 55 32 37 41 60 72 82 81
48 60 71 71 72 56 76 80 82 64 42 56 63 61 39 33 34 95 78 101
72 51 46 41 36 46 40 42 61 80 37 79 75 133 146 162 119 127 86 66
55 55 117 105 111

AST-B14B 125

230 238 267 356 337 140 105 137 160 214 252 198 211 257 320 179 220 220 179 118
158 136 76 88 110 119 99 103 183 98 154 281 203 232 210 92 205 199 144 180
221 201 223 219 233 159 225 230 104 123 129 122 92 80 56 90 92 79 64 58
88 111 110 99 96 64 46 59 50 45 37 35 61 35 35 33 66 74 76 74
56 51 67 61 78 65 77 67 88 54 40 57 65 67 40 35 36 81 84 91
86 70 38 38 28 51 29 36 70 89 54 79 88 141 151 137 141 127 81 62
52 66 104 101 123

AST-B15A 110

445 298 99 149 136 126 133 167 117 203 194 194 148 164 155 125 163 177 102 69
55 54 72 60 93 47 53 68 79 69 111 81 69 62 74 72 59 69 95 74
43 60 51 65 96 129 136 105 88 102 126 163 152 179 192 147 138 77 62 87
119 104 93 112 275 222 180 198 191 138 93 70 67 103 86 130 120 112 165 167
184 229 207 198 197 133 117 91 86 131 151 150 218 182 205 199 188 213 247 164
191 234 207 269 181 234 216 174 211 194

AST-B15B 110

431 313 89 159 135 121 124 181 137 207 188 203 116 166 145 126 148 170 106 76
52 44 77 69 83 41 58 64 83 61 110 91 60 65 70 74 59 70 88 75
51 65 56 65 111 135 133 92 97 113 124 156 180 186 176 158 132 80 59 93
124 113 84 119 256 233 187 194 189 141 104 53 77 104 82 135 119 119 170 162
198 216 218 216 177 139 114 94 85 135 148 150 220 184 217 196 193 203 249 156
199 232 221 256 196 224 210 177 223 215

AST-B16A 120

218 225 299 311 303 262 274 301 275 340 242 118 280 306 254 206 260 306 277 267
277 205 236 133 109 115 65 133 202 206 224 227 201 163 145 118 117 116 53 45
69 56 56 52 56 45 46 64 77 84 67 66 74 106 86 94 69 64 88 63
75 87 91 104 94 86 71 82 61 74 67 59 92 97 79 74 84 75 70 49
83 63 77 76 84 77 60 69 99 139 102 119 98 109 91 87 82 85 103 69
56 76 79 71 62 69 64 76 88 54 52 63 56 63 59 74 82 75 78 93

AST-B16B 120

207 219 298 328 290 281 273 290 274 327 247 119 279 300 251 218 262 310 272 275
257 205 219 121 121 111 66 143 201 202 223 231 205 169 153 112 117 119 58 54
64 58 58 57 54 42 46 63 71 85 66 64 85 94 89 88 67 64 86 63
81 84 94 80 88 77 58 72 65 59 94 59 74 102 76 79 80 65 64 47
76 69 76 73 75 78 62 67 107 128 117 113 106 105 91 95 81 88 71 78
59 79 77 70 61 69 61 75 84 57 55 61 64 56 57 74 75 83 85 79

AST-B17A 73

247 244 198 176 117 220 260 336 184 185 254 297 279 262 201 174 174 159 204 259
225 186 343 275 250 327 295 234 140 155 144 191 244 154 84 113 173 169 183 101
92 73 74 83 110 106 96 143 85 70 36 33 34 39 36 35 67 92 105 120
90 67 50 40 69 72 50 48 33 58 62 55 71

AST-B17B 73

236 275 175 180 137 220 267 384 231 128 265 288 296 274 223 165 182 144 212 229
229 184 345 271 251 323 293 219 147 155 146 192 244 142 92 115 163 177 178 100
87 82 67 76 106 104 104 140 93 65 40 23 42 31 33 40 69 97 97 123
77 64 56 36 67 77 50 41 41 53 58 66 80

AST-B18A 73

218 271 224 237 173 185 107 103 70 64 156 226 142 171 147 122 142 96 74 85
97 94 104 94 103 103 81 116 101 130 126 178 231 138 109 118 223 251 291 204
153 195 132 127 119 150 164 162 150 164 167 135 108 127 99 164 208 191 151 134
146 93 95 94 106 117 85 105 59 61 86 99 135

AST-B18B 73

205 286 224 229 171 193 136 106 68 62 163 218 136 165 150 128 136 95 78 78
98 102 93 98 96 91 97 110 113 122 137 172 224 139 113 112 222 247 299 208
138 202 133 120 123 153 164 153 148 175 167 132 108 121 108 150 211 195 140 145
134 103 90 99 101 116 91 105 63 63 94 85 125

AST-B19A 33

512 479 418 506 531 656 396 157 305 358 420 366 570 392 392 304 314 256 250 109
125 244 141 199 416 177 228 273 444 152 399 200 171

AST-B19B 33

519 509 418 520 513 666 380 167 283 369 409 380 577 400 383 300 326 259 244 112
146 258 139 187 408 194 227 304 407 189 400 190 157

AST-B20A 65

60 42 74 65 52 72 89 81 97 79 122 102 100 92 78 83 93 95 114 137
120 104 78 81 90 76 80 117 82 85 106 76 81 74 83 89 68 74 95 59
58 71 103 159 149 140 119 117 116 77 101 105 92 88 81 89 80 71 95 73
78 151 79 120 102

AST-B20B 65

61 48 67 66 46 76 87 86 97 83 128 97 112 85 85 77 104 91 121 139
133 96 86 80 86 68 91 116 81 83 107 89 75 83 72 93 77 61 96 62
57 74 95 169 144 132 119 119 114 73 102 103 97 102 78 90 77 72 86 75
81 145 79 123 101

AST-B06B 54

320 492 503 460 295 470 317 486 489 376 230 217 201 224 221 294 378 367 306 194
157 149 121 107 72 77 158 159 242 337 219 159 164 186 187 165 148 107 103 132
200 137 185 160 162 91 93 78 61 64 60 63 83 119

AST-B07A 81

330 291 371 243 122 144 121 131 145 175 175 198 160 179 163 170 79 91 78 75
117 157 133 152 131 108 96 79 94 130 98 49 47 81 62 64 55 51 39 45
44 55 50 35 49 51 69 57 65 49 51 64 60 59 80 93 120 125 97 71
97 64 69 77 73 91 79 91 105 120 107 87 71 95 97 95 93 76 91 62
86

AST-B07B 92

81 133 195 157 155 184 150 151 122 105 113 125 55 53 75 64 49 40 59 37
44 54 60 61 53 51 85 92 88 87 76 73 82 93 85 112 150 179 177 133
101 110 108 94 102 84 114 114 86 112 100 88 77 63 107 73 89 78 94 82
59 78 124 144 124 145 120 108 92 54 59 75 66 90 69 84 60 61 57 45
52 77 44 47 96 77 53 88 114 79 60 88

AST-B08A 58

117 92 170 312 175 223 226 246 134 197 301 332 269 537 533 447 342 307 188 153
90 144 264 301 388 552 493 270 314 295 215 130 231 228 199 197 281 186 89 117
107 113 127 105 197 170 217 168 133 170 159 188 134 147 94 175 106 116

AST-B08B 58

101 96 160 314 180 224 237 233 139 202 303 344 285 547 564 436 338 272 140 149
104 137 245 310 427 564 520 283 298 314 235 132 222 229 193 197 287 195 93 99
106 128 125 105 198 157 211 179 147 159 144 174 146 137 101 165 110 143

AST-B09A 44

411 411 352 435 444 264 333 419 421 318 320 363 252 239 252 291 279 342 260 227
257 322 352 315 292 231 237 223 162 143 183 178 228 318 180 174 206 178 132 124
122 123 183 184

AST-B09B 44

398 405 354 427 367 248 342 374 387 290 319 364 247 237 244 304 263 360 255 225
225 305 329 297 313 230 238 212 163 137 186 194 231 315 175 167 201 195 115 118
115 134 155 202

AST-B10A 46

194 272 280 399 327 228 314 492 529 721 708 483 561 620 595 583 605 273 253 429
341 370 120 99 110 188 266 347 286 383 388 409 325 272 213 185 237 342 347 61
53 82 53 57 129 179

AST-B10B 46

194 276 280 392 333 217 322 501 528 721 702 470 564 616 595 584 618 271 244 431
318 374 114 103 113 183 260 345 300 393 384 406 325 288 228 191 238 336 363 60
50 78 50 55 126 175

AST-B11A 42

445 331 359 350 379 388 478 419 260 302 369 323 423 313 385 346 386 283 367 505
410 421 286 303 364 332 258 327 194 292 381 206 263 373 279 236 236 284 253 237
198 223

AST-B11B 42

427 311 353 351 337 380 486 416 251 314 364 323 421 308 357 343 332 290 367 489
410 450 263 301 365 331 268 340 198 285 366 210 253 379 275 246 210 259 287 183
251 234

AST-B21A 44

254 255 246 353 302 223 161 215 144 162 385 251 363 275 333 335 385 331 295 519
389 239 345 288 205 234 333 240 227 315 200 207 420 428 285 492 370 291 307 220
138 92 99 118

AST-B21B 24

455 204 195 453 252 310 264 295 341 394 345 291 508 389 240 337 351 173 231 406
231 192 234 264

AST-B22A 32

206 355 276 338 312 291 216 296 244 251 274 221 137 158 215 295 193 255 276 365
237 234 187 236 254 245 270 182 247 307 285 216

AST-B22B 32

232 327 299 338 292 320 204 227 217 290 276 238 147 161 223 307 198 242 246 361
221 249 193 235 249 259 261 173 258 297 288 218

AST-B23A 31

407 226 235 287 117 188 364 290 215 332 230 301 373 354 371 420 371 254 173 216
315 302 312 204 267 225 261 207 241 209 197

AST-B23B 38

415 682 510 357 334 293 291 249 141 218 499 563 455 530 299 146 163 157 154 207
168 162 172 152 259 252 231 263 355 387 290 277 318 470 268 281 125 237

AST-B24A 50

257 237 255 132 209 215 290 307 445 491 496 556 140 139 168 156 201 201 317 492
403 418 471 421 272 510 474 377 538 323 517 541 485 435 462 502 506 543 484 488
542 374 347 352 521 458 288 380 331 328

AST-B24B 50

255 204 245 141 215 242 245 268 439 500 514 553 145 146 162 162 199 205 318 470
409 414 470 413 255 511 508 367 541 326 521 524 484 438 458 513 497 548 488 470
519 352 360 357 495 416 301 400 333 300

AST-B25A 52

250 349 282 338 335 281 443 455 694 620 297 408 546 455 320 324 227 284 302 447
376 342 355 282 362 323 169 211 231 257 245 367 191 237 326 232 163 105 85 106
103 239 221 303 104 157 137 198 219 260 261 127

AST-B25B 52

243 359 285 353 321 280 437 477 714 626 296 366 490 458 332 317 234 273 291 463
361 341 356 296 362 327 175 195 256 258 240 362 196 238 332 238 137 104 81 111
110 231 218 302 116 161 153 179 236 262 255 144