hole 42mm wide, 10mm deep. SF418, Context 400, Topsoil

84. Pivot stone. Buff sandstone. Rough lump, broken off on one side, originally sub-triangular. Hole in top face worn deep and very smooth with steep sides and rounded bottom. 160 × 120mm, 96mm thick, hole 46mm wide, 30mm deep. SF422, Context 400, Topsoil

85. Pivot stone. Slate. Sub-square slab with worn edges. Shallow round depressions in centre of both faces. 174 × 145mm, 33mm thick, holes 30mm wide, 7mm deep and *c* 25mm wide, 4mm deep. SF793, Context 4003, Phase 3

86. Pivot stone. Grey schist. Ovoid rounded slab, shallow depression in approx centre of flattest face. 197 × 170mm, 45mm thick, hole 45mm wide, 12mm deep. SF502, Context 4001, Phase 3

87. Pivot stone. Grey schist. Irregular unworked slab, small shallow depression towards centre of one face. 260 × 160mm, 43mm thick, hole *c* 25mm wide, 9mm deep. SF605, Context 4001, Phase 3

88. Pivot stone. Shale or schist. Large sub-rectangular roughly squared block with round depression. 350 × 260mm, hole 50mm wide. Context 4497, Phase 1

Window glass

There was very little evidence of window glass from the site. A few crystallised fragments were found in a grave (G44) to the south of the chancel. Soil conditions, however, were clearly not conducive to glass preservation and it is therefore impossible to say to what extent the church may have been glazed.

Roof slates

Slate is readily available on Inchmarnock. The site was littered with pieces of slate, some entirely natural, some incised (Chapter 6.3, above), some fashioned into roof slates. It seems likely that the roof of the medieval church was slated. There are no examples of tiles. The use of organic roofing materials such as shingles or some kind of thatch is entirely possible, particularly in its early years, but it seems likely that towards the end of its life at least, the church was slated.

The only complete slate (Context 455, Phase 3) measured 270 × 135mm, with a variable thickness up to 22mm. It had a nail still in place, with a domed square or lozenge shaped head inside a 15mm wide nail hole. There are some slates which appear to be wider than this. There are only two pieces of holed slate from Phase 1, both are small and abraded and may have been used as weights. Most of the slates are from Phase 2 and especially Phase 3. There are very few large pieces, suggesting that most of the usable slate was stripped from the roof and reused elsewhere on the island.

6.10 THE OIL SHALE ARTEFACTS AND RELATED MATERIAL

FRASER HUNTER (WITH A CONTRIBUTION BY J M JONES)

Introduction

The Inchmarnock church excavations produced a small but informative range of debris from the manufacture of items of black jewellery, primarily bangles of oil shale and related material. The 19 items cover most stages of the production process, although no finished ornaments are present. Unusually, two different production techniques were used, suggesting either different phases of activity or craft-workers trained in different traditions.

The individual items are listed below in the catalogue. The craft process is then discussed and the material considered in its wider context. The following abbreviations are used: *L*ength, *W*idth, *T*hickness, *D*iameter, *int*ernal, *ext*ernal, *max*imum, *min*imum. Where no abbreviations are given, measurements are in the order L × W × T. With bangles, W is the radial width of the original circular form and T the thickness of this circle. All dimensions are in millimetres.

Catalogue

Prepared roughouts (Figure 6.46)

89. Rounded block, abandoned due to excessive flaking during edge shaping. Edges generally bifacial, either flaked or knife-trimmed (?after flaking). One natural face, the other with some flaking. The natural face has remains of an incised line marking the outer edge, two grooves from an incipient perforation, and an unexplained short radial groove from a notch on the edge. It is notable (and unusual) that considerable effort was expended on shaping the edges before perforation was begun. 90 × 76 × 10mm; max ext D 90 SF462. Context 4001, Phase 3.

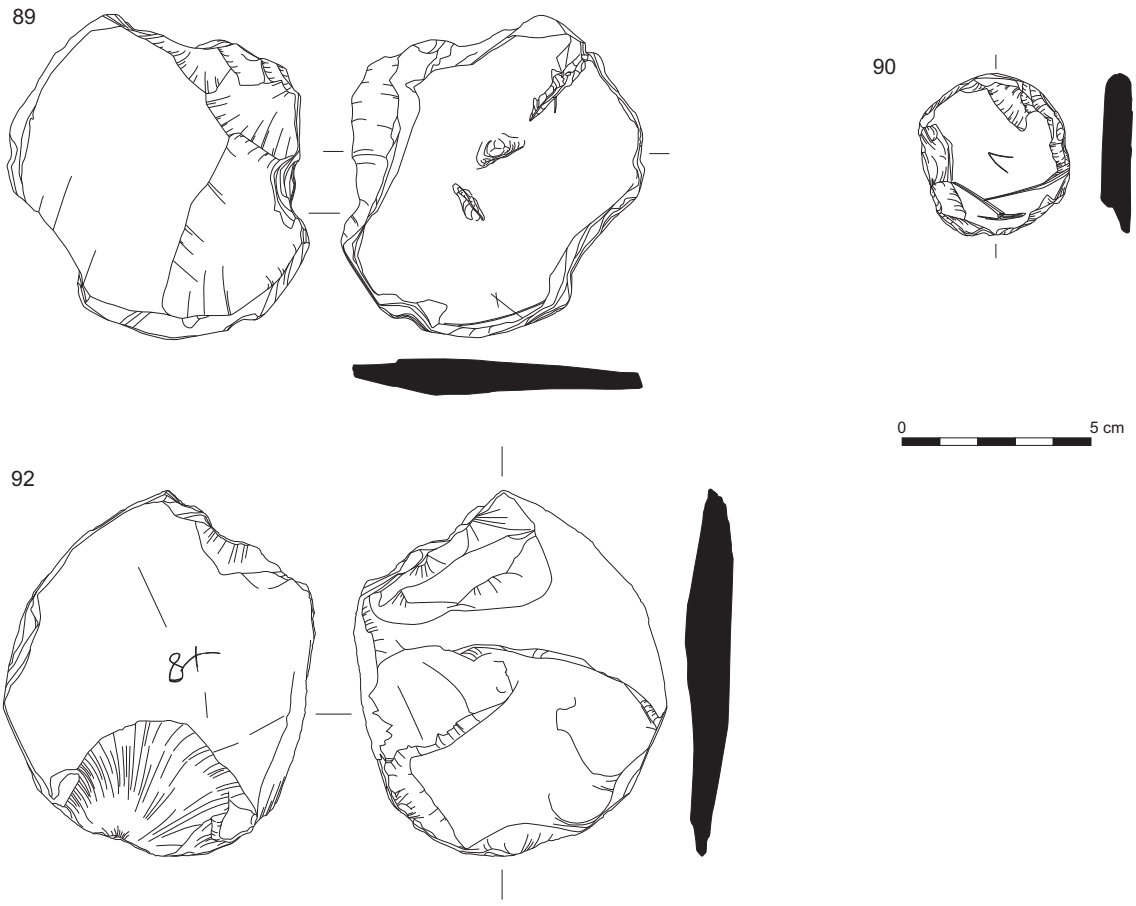

Figure 6.46
Cannel coal jewellery: prepared roughouts (nos 89, 90, 92)

90. Unfinished disc, probably a waste core removed from a bangle which was then itself used as a smaller roughout. One (natural) face has a central marking-out dot; the other is gouged and flaked flat, with a central mark and a couple of grooves crudely locating the perforation. The edge shows varied treatment; in places it has been snapped, in others knife-trimmed, while on one face a circular groove was cut to smooth the edge. This postdates removal of the core, and confirms it was being prepared for further use. D 39–44, T 7.5mm. SF484. Context 4001, Phase 3.

91. Rounded block, broken at one edge. Natural surfaces and one naturally square edge, the others shaped by gouging. Its size suggests it was for a small item such as a ring-pendant. 76.5 × 61 × 11.5mm, max ext D 60mm. SF542 (not illustrated). Context 4001, Phase 3.

92. Rounded block, the edges natural in places, elsewhere both unifacially and bifacially flaked, gouged and perhaps knife-cut. Faces partly flaked, one with a near-central incised figure-of-eight marking the centre of the intended perforation. Perhaps abandoned because flaking left it over-thin in places. D 97 × min 81.5, T 13.5. SF592. Context 4001, Phase 3.

93. Prepared roughout, broken prior to perforation. Part-rounded block with two naturally-square parallel edges, the others bifacially flaked to shape. One face has been partly flaked, the other apparently split. Two lines on this face (a fine straight one and a deeper curved one)

may mark the very beginning of perforation attempts, prior to the piece breaking. 117 × 66 × 18mm. SF615 (not illustrated). Context 4001, Phase 3.

94. Chunk, perhaps from a broken squared block. One face natural, one flaked; one, perhaps two prepared edges, others apparently broken. Probably a broken corner, although it could be a very small roughout. 37 × 29 × 9mm. SF673 (not illustrated). Context 4001, Phase 3.

95. Fragment of broken prepared block. Thick, with natural edges; a band of markedly inorganic stone within it probably caused it to fracture. Surfaces partly trimmed with long-bladed knife (cut-marks *c* 70mm L). 100 × 53 × 34mm. SF745 (not illustrated). Context 4510, Phase 2.

Perforated roughouts, finishing in progress (Figure 6.47)

96. Intact perforated roughout with perforation in process of expansion; probably abandoned because the material was not working well. Edges unifacially flaked then knife- and gouge-trimmed; all surfaces extensively flaked and gouged. Biconical perforation, formed by near-vertical pecking and ?gouging, with deep radial knife-cut grooves to expand it. There is a distinctive 'signature' pattern on the gouge marks, a phenomenon noted in toolmarks on wood (eg Sands 1997); it was not noted on other pieces. D 97 × 88mm, T 17.5mm; perforation 17 × 12.5mm. SF456. Context 4000, Phase 5.

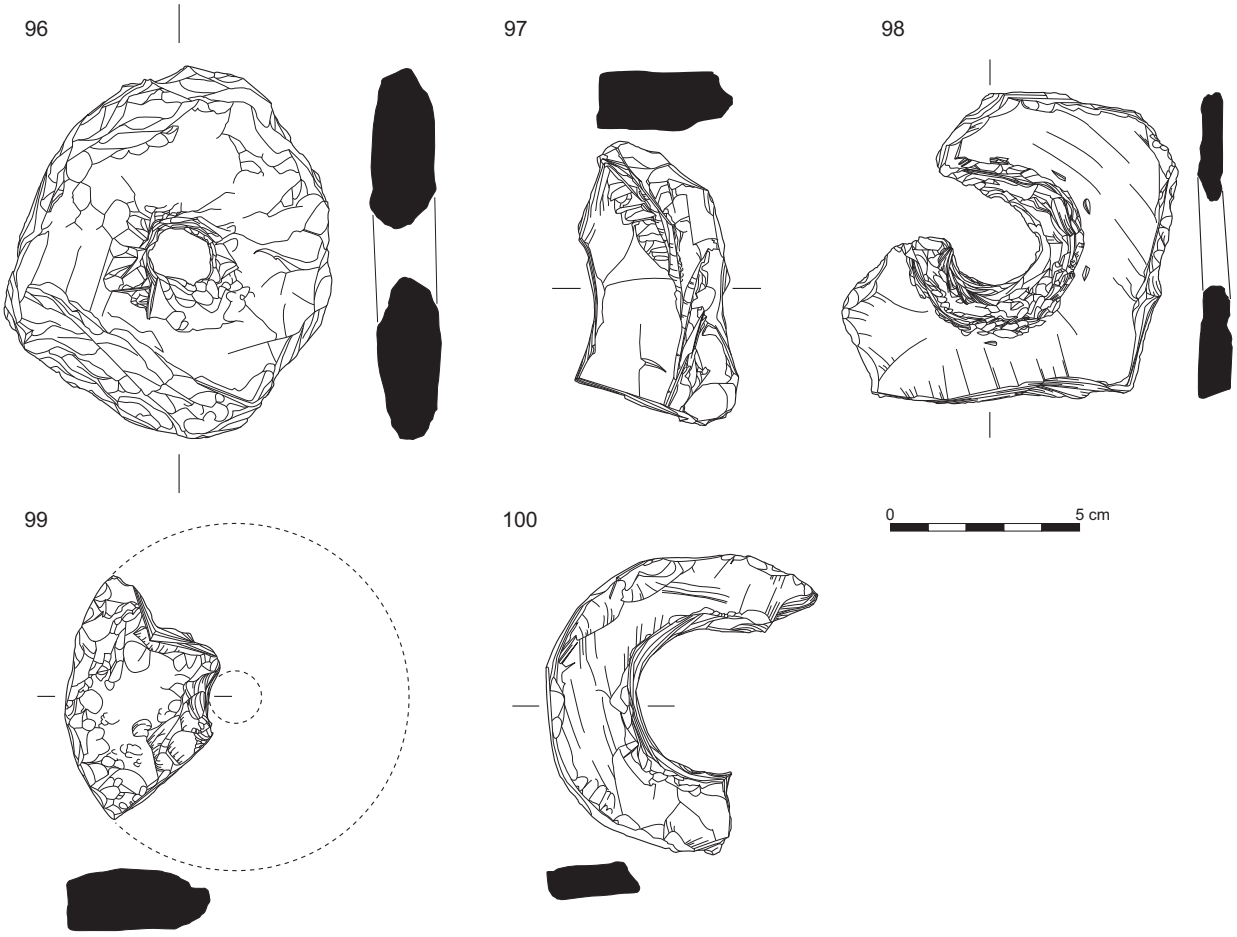

Figure 6.47
Cannel coal jewellery: perforated roughouts, finishing in progress (nos 96–100)

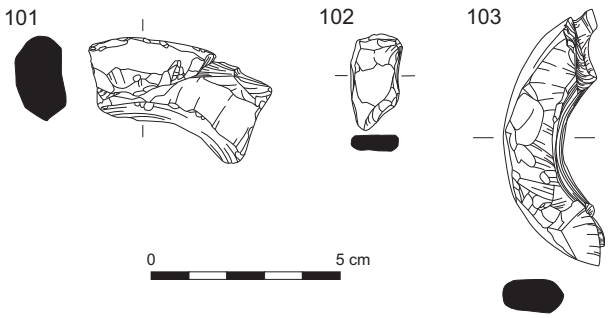

Figure 6.48
Cannel coal jewellery: near-complete items (nos 101–3)

97. Faces flaked, outer edge bifacially flaked and in process of being shaped by chopping from either side with a heavy knife, creating deep cut facets of L 20–30mm. The inner edge is a very smooth flake, unusual as a working trace and more likely from accidental flaking than deliberate shaping. 93 × 47 × 18.5mm, intended W *c* 27mm. SF458. Context 400, Phase 6.

98. Squared roughout with disc removed from centre. The two intact edges were shaped by cutting straight grooves on either side and snapping. One surface natural, other split and flaked. The perforation was created by removal of a central disc *c* 30mm D by bifacial chiselling or gouging around the margins (using a tool *c* 4mm W). An outer gouged line in areas marks initial unsuccessful attempts to remove the disc. One surface bears random knife cuts. It is unusual to leave the block so square at such a late stage, suggesting this perforation technique was recognised as hazardous. 115 × 115 × 11mm. SF621. Context 4009, Phase 1/2.

99. Broken perforated roughout with limited finishing. Flat faces, one gouged to shape, the other with some abrasion; the edge also shows abrasion to round off the gouged facets from shaping. Biconical perforation with marks from a fine gouge (2.5–3mm wide). 65 × 39.5 × T 17mm; ext D *c* 95mm. SF633. Context 4009, Phase 1/2.

100. Roughout with expanded perforation. Unusually thin, its non-biconical perforation suggesting this was a thicker roughout which was split horizontally to make a thin bangle. Edge carinated in places, with extensive gouging and areas of abrasion; the perforation was expanded by cutting and abrasion. One face split, the other natural with some flaking. D ext 93, int 45, T 9. SF645. Context 4001, Phase 3.

Near-complete items (Figure 6.48)

101. Two joining fragments of an unfinished bangle. Faces trimmed and flaked, with some natural surface remaining; outer edge with extensive knife-trimming facets; angular perforation with pronounced knife facets. Ext D 95–100, int D 50–55mm; *c* 20% survives. 49 × 21 × 12.5mm. SF541, Context 4001, Phase 3 and SF715, Context 4059, Phase 1.

102. Flat, thin bangle roughout with natural surface; biconical perforation with knife-cut facets, outer edge facetted. 25.5 × 13 × 5mm. SF590. Context 4001, Phase 3.

103. Unfinished bangle, near its final shape although still uneven. Flat D-section, the surfaces and inner face with fine knife-trimmed facets (typically 1.5mm W), and some abrasion on the exterior. The latter appears to predate the trimming, implying it was from earlier stages in the shaping. Ext D 70–75, 42% surviving. L 67.5, W 15–17.5, H 9–12mm. SF661. Context 4001, Phase 3.

Working debris (Figure 6.49)

104. Edge-trimming flake, removing a knife- or gouge-trimmed corner; ?natural faces. 24 × 14 × 10.5 mm. SF558. Context 4001, Phase 3.

105. Either a large thinning flake or an accidentally spalled surface from a prepared roughout. Sub-oval disc, with one natural face apart from

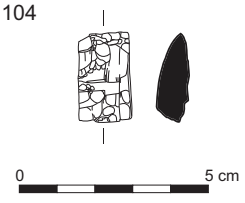

Figure 6.49
Cannel coal jewellery: working debris (no 104)

Table 6.6 Phasing of the Inchmarnock oil shale

Phase	*Context*	*No of finds*
1	4059	1
1/2	4009	2
2	4510	2
3	4001	13
5	4000	1
recent	400	1

limited edge-flaking, the other flaked. Naturally rounded, with some cutting and flaking of the edges in places. 94.5 × 79 × T 7.5mm. SF561 (not illustrated). Context 4001, Phase 3.

106. Edge-trimming flake, removing the corner of a squared block. Two edges flaked, then snapped. One, perhaps both sides flaked. 44 × 24 × 7mm. SF742 (not illustrated). Context 4510, Phase 2.

Other

107. Unidentified fragment, either a thin block or a flake. All edges broken; flake scars on faces. 70 × 60 × 7mm. SF.638 (not illustrated). Context 4001, Phase 3.

Discussion

The working of black organic-rich stones into jewellery was a long-lived tradition in Scotland, but bangle production was largely a phenomenon of the later prehistoric and early historic periods. Their popularity continued in Norse areas (eg Grieg 1940, 24, 70, 87; Hamilton 1956, 114, 121), but there is no evidence of production in the medieval period. Only one of the Inchmarnock finds (part of no 101) comes from a stratified early historic context (4059), although fragments of the same bangle were also found in 4001 (Table 6.6). Two fragments were recovered from a Phase 1/2 horizon; the remainder are residual in later contexts, but there is no doubt they are connected to the pre-medieval use of the site. However, they cannot be more closely dated typologically. The degree of post-depositional disturbance is seen by the existence of joining fragments spread between Phase 1 and Phase 3 contexts. Two stray finds of manufacturing debris are also known from the island (Marshall 1980, 16), but the recorded provenance is too unclear to know if they are connected to the current finds.

The craft process

What is preserved are traces of the process of jewellery manufacture. No finished products were found, but the debris indicates the main product was bangles, some of which (eg nos 100 and 102) were quite fine. The size of roughouts 90 and 91 shows that smaller items, probably rings or ring-pendants, were also produced.

Two different production methods for bangles are represented. The normal sequence of manufacture was as follows. Blocks of raw material were gathered and roughly worked to a square or sub-circular shape by trimming the edges and thinning one or both faces. This allowed the craftworker to assess the working properties of the block. Natural edges were utilised where possible, but various shaping techniques were used: snapping, unifacial and bifacial flaking, knife-trimming and gouging. A number of pieces bear incised guidelines, with central points to guide the initial perforation (nos 89, 90 and 92) or circles to mark the intended edges (no 89). A small central hole was made by bifacial pecking and gouging, and then expanded by knife and gouge. Normally the shaping of the outer edge was delayed until the initial perforation was completed, as this was one of the riskiest parts of the operation, although the edge of block 89 was rounded and well-finished before perforation had even begun. Final shaping involved fine knife-trimming of the roughout to shape, and abrading and polishing it to its final form and finish. No 103 is important as it shows abrasion preceding knife-trimming, suggesting cycles of increasingly fine abrasion and trimming to get the piece to its desired form. This general sequence is well-attested elsewhere (Callander 1916, 235; Hunter 1998; Hunter forthcoming).

A second technique is also represented at the site, where a solid disc was removed from the centre of the roughout to make the perforation. This is represented by no 98 (where some trial and error can be noted) and by disc 90, a waste disc which was being reused to make a smaller item. There is a stray find, poorly located, of another disc from the island (Marshall 1980, 16, fig 2, 2). This technique is attested elsewhere, although less widely than the perforation method (Callander 1916, 236–7). With the exception of Carn Liath in Sutherland there is a marked concentration in west and south-west Scotland, suggesting it was a regional tradition. Similar finds are known from early historic sites in northern

Table 6.7 Raw material identification

Group	*Finds*	*Identity*	*Petrological sample and results*
A	95, 97, 100, 101, 103, 104 and 106	Canneloid shale	100: canneloid shale, very fine-grained, rich in small plant fragments
B	89–94 and 98	Oil shale	91: shale, rich in algae – Torbanite or Boghead coal 98: amorphinite-rich shale, rich in algal fragments
C	102, 105 and 107	Oil shale	107: shale, rich in amorphinite and algae
D	99	Lignite	Coal containing algal fragments
E	96	Oil shale	Shale, amorphinite-rich with inertinite fragments and algae

Ireland (eg Armagh: Crothers 1999, 63, fig 13), raising the possibility that the tradition may have been shared between these areas, but further research is required on the Irish material to clarify this.

Inchmarnock is so far unique in having these two different processes represented on the one site, although both were known in the area. The relationship between them is unclear: this may represent different phases of working (which is impossible to prove on the available evidence), or craftworkers trained in different traditions. It does not seem to be a response to different raw materials. There is no sign of the unusual technique represented at nearby St Blane's, Bute, where a partial core was removed and the remaining thin layer of material then perforated and cut away (Callander 1916, 236).

The small amount of working debris (the flakes and chunks carved off the main block in the process of shaping it) is surprising. This may be an issue of recovery: such material is often not recognised by excavators. However, this lack was noted at the assessment stage and sample residues were checked for debris, to no avail. It is likely that, since most of the finds are from secondary contexts, the smaller debris had been broken up and dispersed, and the centre of production lay outwith the excavation area.

The raw material (with J M Jones)

To identify the raw materials used, the pieces were inspected visually for key characteristics (such as conchoidal fracture and evidence of laminar structure) and analysed by surface X-ray fluorescence (XRF; for methodology, see Davis 1993; Hunter *et al* 1993). This technique provides broad groupings of the material (Table 6.7). Five groups were defined in the Inchmarnock assemblage. Representative samples were then studied by J M Jones for petrological characterisation (Allason-Jones & Jones 2001).

Amorphinite is amorphous organic material, rich in hydrogen and the source of oil. The algae are all *Botryococcus*, which is a freshwater algae. This strongly suggests that these are carboniferous 'oil shales' from the Midland Valley. When they are very rich in algae they are termed Torbanites or Bog Heads after Torban Hill and Bog Head near Bathgate. All the samples, except possibly the Group A canneloid shales, probably come from the Midland Valley sources.

Visually there are two clear outliers, confirmed by XRF: no 99 (lignite) and no 96 (an oil shale with poor working properties). Fragments 101 and 104 are a distinctive highly organic material; they were not studied petrologically, and may be cannel coal or a high-quality compact lignite, as the visible pore structure may suggest. Otherwise clear groups were not distinguished in the analytical data, suggesting use of a related group of sources with similar inorganic inclusions. Many of the pieces had noticeable levels of barium, which is unusual but has been noted previously in Clyde coast finds (Hunter 1998, 48).

The Midland Valley Carboniferous deposits occur extensively, but the source of the raw materials is likely to have been the eastern shore of the Clyde. The raw material occurs abundantly in Ayrshire and neighbouring areas (Gibson 1922); a thin seam of Coal Measure deposits is known across Bute, north Arran and south Kintyre (MacDonald 1982, 184; Gibson 1922, 30; Gunn *et al* 1903, 37, 48–9, 54, 146; Mann 1915), but it is unclear if this is usable. The Bute raw material

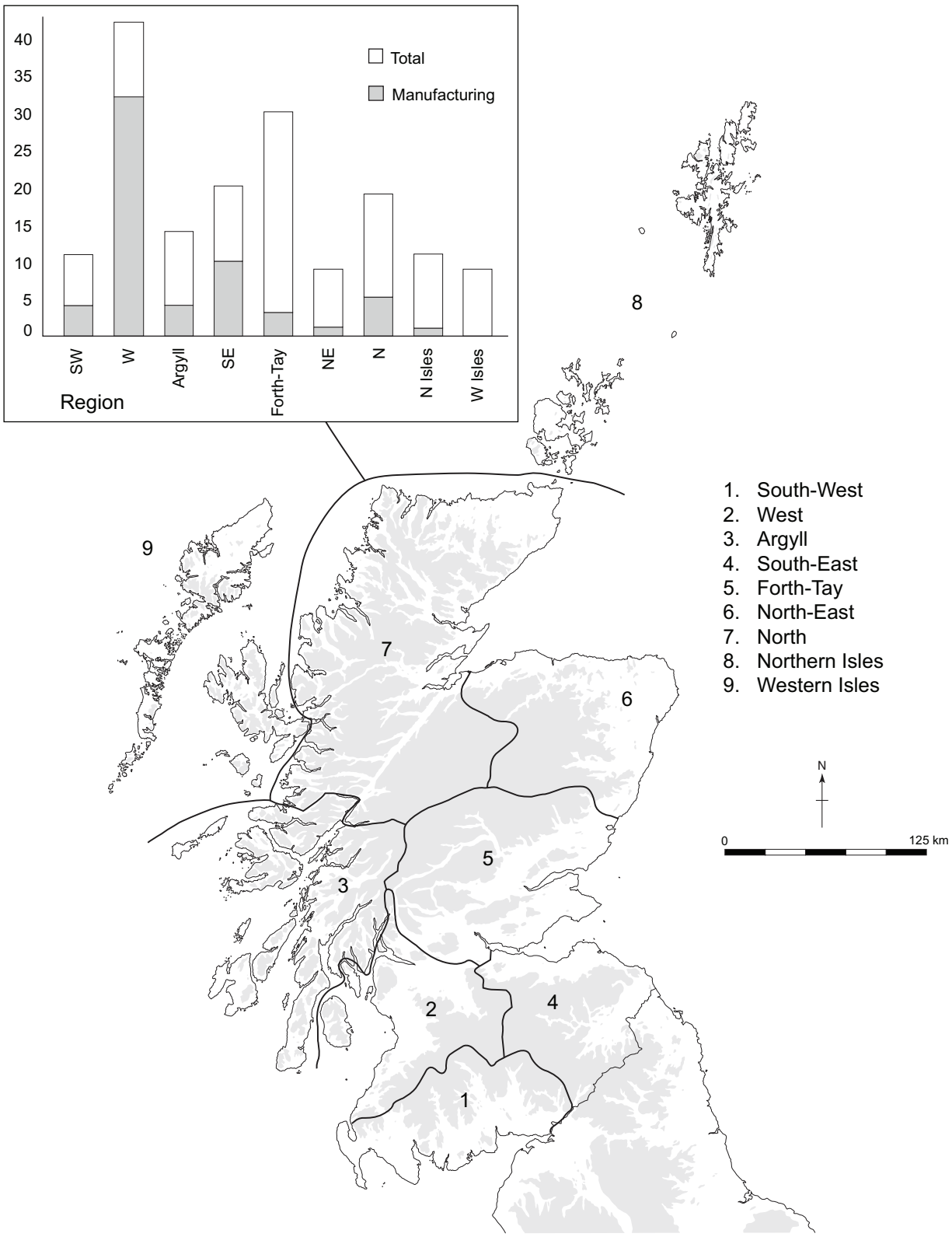

Figure 6.50
Regional variety in the occurrence of cannel coal and related materials on settlement sites in Scotland, *c* 1000 BC–AD 1000. The proportion of sites with evidence for manufacturing is indicated.

Table 6.8 Scottish sites with evidence for jewellery of oil shale and related material, most likely of early historic date. (The Cumbrae find is included as sculpture indicates the presence of an early church (Waddell 1932, 411–12; Curle 1962, 223–5). The Lasswade fragment is unworn and thus need not be residual, as the excavator implies; it may be a token thrown into the burial.)

Site	*Island/ county*	*Site type*	*Production evidence*	*Finished products*	*Reference/notes*
RELIGIOUS SITES					
Inchmarnock	Bute	Church	X		This volume
St Blane's	Bute	Church	X	X	Anderson 1900
St Ninian's Chapel	Bute	Church		X	Aitken 1955, 70
Great Cumbrae Churchyard	Bute	Church?	X		*PSAS* 27 (1892–3), 244; NMS FN 80
Holy Island	Arran	Church?	X		Balfour 1909, 151 (possible early chapel under medieval tower)
Govan Old	Renfrew	Church	X		Unpublished
Barhobble	Wigtown	Church	X	X	Hunter 1995
Whithorn	Wigtown	Church	X	X	Hunter & Nicholson 1997
St Andrew's	Fife	Church		X	Hay Fleming 1909, 412 (from a burial)
Isle of May	Fife	Church		X	Peter Yeoman, pers comm
Tarbat	E Ross	Church		X	Unpublished
OTHER SITE TYPES					
Little Dunagoil	Bute	Settlement	X	X	Marshall 1964, 18, 20, 22, 39–45
Auldhill	Ayr	Fort	X	X	Hunter 1998
Buiston	Ayr	Crannog	X	X	Crone 2000, 142, 148
Lochspouts	Ayr	Crannog	X	X	Munro 1882, 13; 1884, 15–16
Dunadd	Argyll	Fort	X	X	Lane & Campbell 2000, 192–5
Kildalloig	Argyll	Dun		X	RCAHMS 1971, 87–8
Kildonan	Argyll	Dun		X	Fairhurst 1939, 215
Ugadale Point	Argyll	Fort		X	Fairhurst 1956, 19
Parkburn, Lasswade	Midlothian	Cemetery		X	Henshall 1956, 264–5
Jonathan's Cave	Fife	Cave		X	MacKie 1986

Table 6.9 Composition of the Inchmarnock finds compared to other early historic assemblages with ten or more finds of oil shale and related materials. (The Auldhill assemblage is a mixture of Iron Age and early historic date; Little Dunagoil is excluded because the material has not yet been studied by the writer.)

Type	*Inchmarnock*	*St Blane's*	*Govan*	*Auldhill*	*Buiston*	*Dunadd*	*Whithorn*
Gathered blocks	–	2	–	–	–	1	–
Prepared roughouts	7	6	7	2	2	3	–
Part-perforated roughouts	–	2	–	3	–	1	–
Perforated roughouts	8	10	3	2	3	5	8
Finished items	–	3	–	5	5	18	12
Working debris	3	10	11	9	–	–	1
Unidentified	1	2	–	–	–	–	–
Total (objects + debris/unidentified)	15 + 4	23 + 12	10 + 11	12 + 9	10 + 0	28 + 0	20 + 1

samples seen by the writer are unworkable, and it is unclear if the Arran deposits (which are immediately adjacent to Inchmarnock) included suitable material. Similar transport of raw materials is attested at Dunadd (Lane & Campbell 2000, 192–5).

Comparisons (Figure 6.50)

The presence of manufacturing debris at Inchmarnock is not surprising. Both this area and this type of site regularly produce such evidence. However, the comparanda have not been synthesised, and it is worth considering in more detail how Inchmarnock fits into its regional and cultural context.

There is evidence for the production of oil shale or cannel coal bangles in the Firth of Clyde area on the vast majority of excavated sites in the later prehistoric and early historic periods. Figure 6.50 provides a regional summary of the evidence for the manufacture and use of oil shale and related items in Scotland in the period *c* 1000 BC–AD 1000. It is clear that there was considerable regional variety both in availability of such jewellery and in its production. Unsurprisingly it was most common in areas near major coal seams such as Ayrshire, Fife and the Lothians. However, there are also hints of differences in production systems: in western Scotland most sites have working debris while in the Forth–Tay area only a minority do, suggesting more centralised control over production. Manufacturing evidence is all but unknown in the north-east and the Atlantic island archipelagos, and finds generally are rarer there.

This general picture undoubtedly conceals chronological and sub-regional variety. For the early historic period, Table 6.8 lists all the Scottish evidence known to the writer; Table 6.9, meanwhile, looks at the composition of those early historic assemblages with ten or more finds and the relative proportions of finished objects to working debris.

It can be seen that manufacture was common at many religious sites in western Scotland, one of a range of craft processes carried out under the wing of the church. Yet church sites were only one centre among many: a range of other site types was producing similar jewellery. Unlike the production of non-ferrous metalwork, where centralised control has been suggested (Campbell 1996, 84–6), the manufacture of black jewellery was widely dispersed. However, there are indications of regional variety: in Argyll, so far only Dunadd has produced manufacturing evidence, and thus may have been a central site for this as with other craft processes.

Table 6.9 compares the major early historic assemblages known from the area. Differing excavation scales and styles will cause some variation, but the broad patterns are likely to be robust; with Dunadd, for instance, the more recent excavations have a similar picture to the early ones. There appear to be

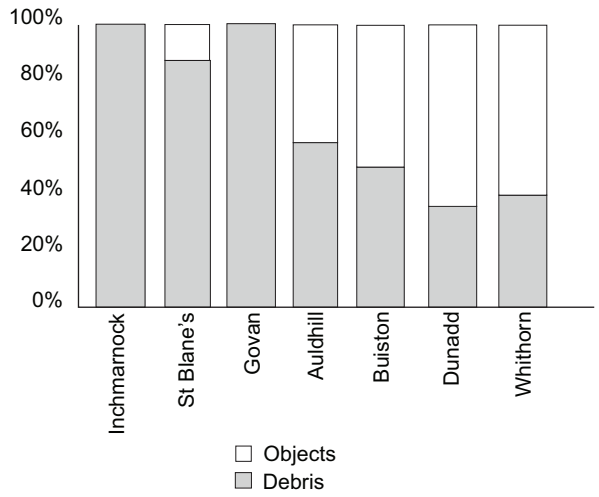

Figure 6.51
Proportions of finished objects and manufacturing debris in early historic assemblages with ten or more finds (working debris excluded).

two different patterns, summarised in Figure 6.51: sites where debris far outweighs products; and those where products equal or exceed the debris. The three 'producer' sites in the former category are all churches around the Clyde estuary. It seems the jewellery saw only limited use at these religious sites, suggesting that, despite manufacturing evidence being commonplace in the area, there was some localised exchange system for the products.

The Inchmarnock assemblage is a valuable addition to our knowledge of oil shale and cannel coal working in the early historic period. It is the first site to have produced evidence of both major production methods, which raises questions of the relation between them that require further work. The debris provides a vivid insight into this craft process, and also feeds into wider questions on the nature of craft production and exchange in the region and beyond.

6.11 FERROUS METALWORKING DEBRIS

ANDREW HEALD AND DAWN McLAREN

Introduction

A total of 32.3kg of material was visually examined, which allows it to be broadly categorised using the criteria of morphology, density, colour and vesicularity. In general, assemblages of slag can be divided into two broad categories. The first group includes the diagnostic material which can be attributed to metalworking. In the case of ironworking a range of slag morphologies are produced. Only a few, for example tapped slag and hammerscale, are truly diagnostic (of smelting and smithing respectively). The second category includes the non-diagnostic slags, which could have been generated by a number of different processes but show no diagnostic characteristic that can identify the process. Within this group there is often a significant amount of material which is unclassifiable, making the allocation of individual pieces (particularly small samples) to specific types and processes difficult (Crew & Rehren 2002, 84). That said, in many cases these undiagnostic residues, such as hearth or furnace lining, may be ascribed to a particular process through archaeological association.

The slag has been described using common terminology (eg McDonnell 1994; Spearman 1997; Starley 2000). A full catalogue of the material is given in the archive report. Further scientific analyses would be necessary to classify the material more conclusively. This was only undertaken on a few samples by Lore Troalen and Jim Tate in NMS Conservation and Analytical Research Department [noted in the catalogue].

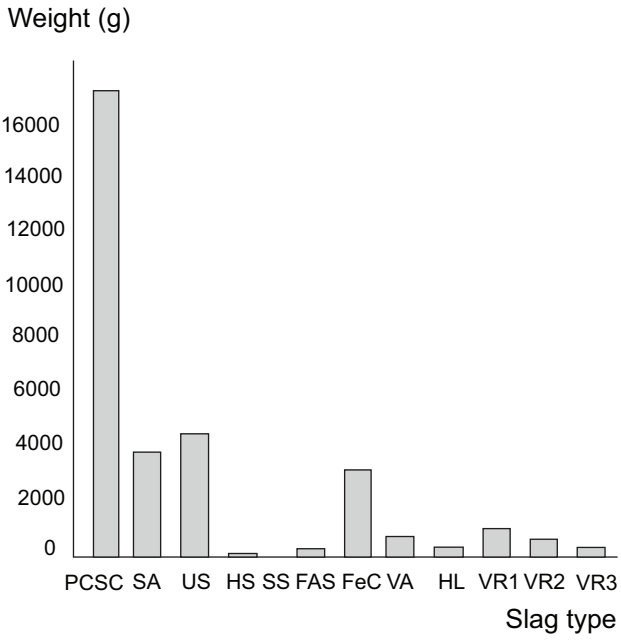

Figure 6.52
Total quantities of ferrous slag and other residues (weight g)