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Upper Palaeolithic evidence from Kilmelfort Cave, Argyll: a re-evaluation of the lithic assemblage

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ABSTRACT

*An assemblage of flint and quartz artefacts recovered during the destruction of Kilmelfort Cave, Argyll, in 1956, was initially attributed to the Mesolithic period. In this paper the assemblage is re-analysed and the conclusion that it represents the residue of human occupation at the site during the Late Glacial Interstadial is reached. Typological considerations indicate the assemblage is of Curve-Backed Point Group (*Federmessergruppen*) affiliation and likely to date to the 12th millennium ^{14}C yr* BP*. Significantly, the evidence from Kilmelfort provides the first substantive indication of the presence of Late Upper Palaeolithic hunters in Scotland.*

INTRODUCTION

In 1956, the North of Scotland Hydro-Electric Board carried out construction work on the south-east face of An Sidhean (also known as An Sithean, Hill of the Fairies), at Melfort, Kilmelford, near Oban in Argyll (NGR NM 8405 1475: illus 1). The blasting operations exposed a small opening in the hillside at approximately 105m OD, formed in the local limestone outcrop (Robertson et al 1949, 50). This opening has come to be known as Kilmelfort Cave (Coles 1959; 1983), taking its name from the adjacent Pass of Kilmelfort. The entrance to the cave and some 6m of its depth were destroyed, leaving only 3–4m of the original far back-end of the cave, where the height narrowed to around 1m (Coles 1983, 11). A salvage operation was mounted at the time by John Coles with students from the Archaeology Department of Edinburgh University. Some lithic artefacts were recovered from the rear of the cave, but most of the finds were from the disturbed, post-blasting deposits in front of the cave and scattered beyond (Coles 1983, plate 1, and pers comm).[1] No artefacts were retained with reference to an on-site provenance (grid system, context etc), although it was noted that some of them derived from a 'well-defined grey occupation deposit' only 100mm thick, revealed in surviving stratification at the rear-side of the cave (Coles 1983, 11–13 and fig 1). However, the degree of artefact recovery, given the on-site conditions, was excellent, with numerous fragments smaller than 5mm collected. Today the cave remains much as described by John Coles, with the rear portion surviving in an overgrown state (illus 2).[2]

The site and its lithic assemblage were published by Coles (1983). Given the limited knowledge about lithic typology and chronology in Scotland at the time, the excavator was understandably very cautious in his interpretation of the atypical finds (Coles 1959). He suggested that the remains were of Mesolithic character and most likely to date within the range 6000–4000 BC (Coles 1983, 11), but he also hinted, based on

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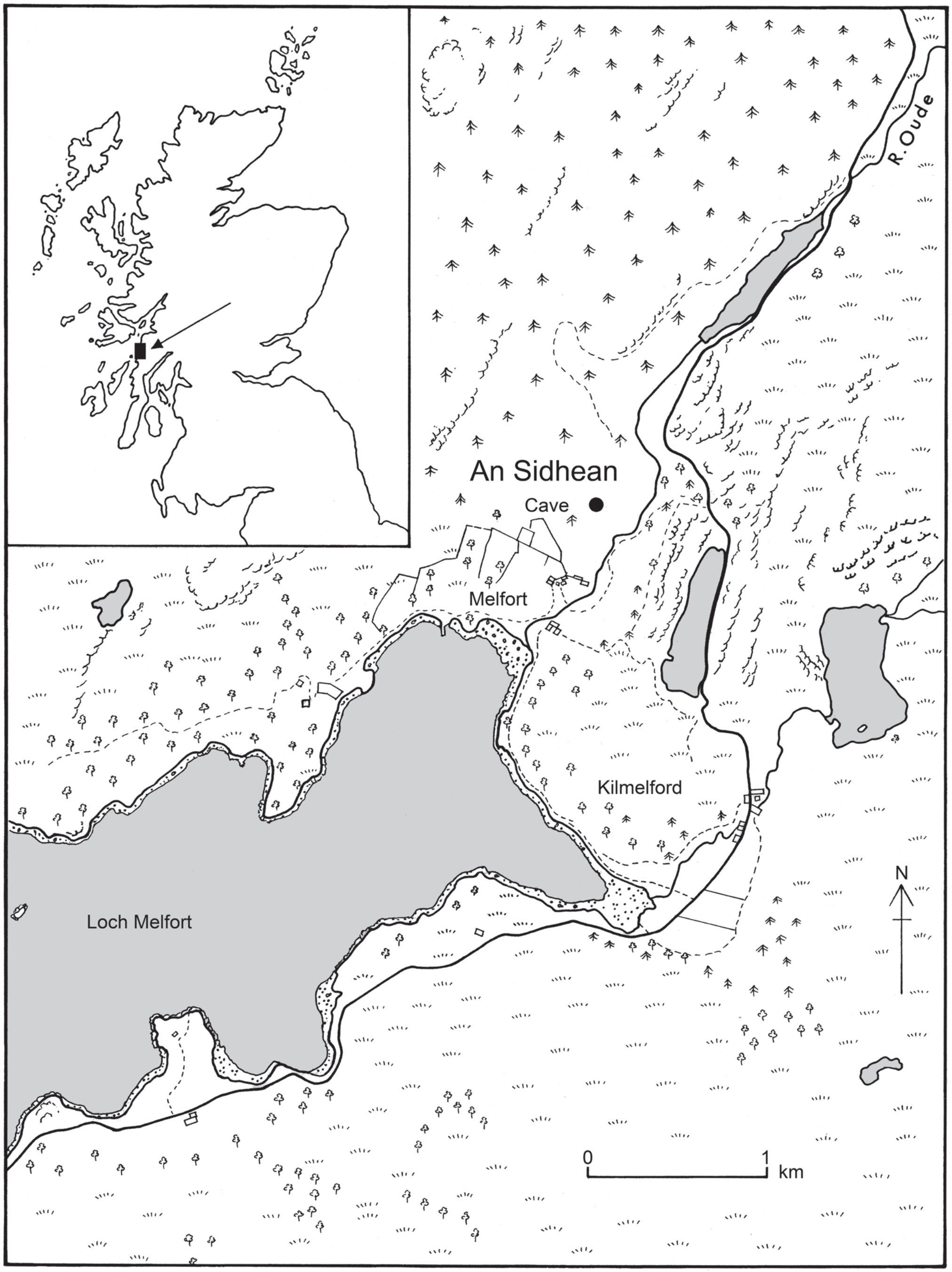


Illus 1 Kilmelfort Cave location map (Marion O'Neil)

Illus 2 Kilmelfort Cave in August 2009 (Alan Saville)

what had by then been published about Mesolithic sites on Jura, that 'the Kilmelfort assemblage may belong to an earlier phase of the settlement of Scotland rather than a later one' (Coles 1983, 18). Intriguingly (although not referenced by Coles) there had been an earlier, perceptive suggestion by the late Richard Atkinson that the affinities of the Kilmelfort assemblage were with 'the later stages of the Creswellian' (Atkinson 1962, 5) – that is to say of Upper Palaeolithic rather than Mesolithic date.

The Kilmelfort artefacts from John Coles's fieldwork are in the collection of the Archaeology Department at National Museums Scotland (Reg no X.HMA.1–743),[3] and have been the subject of re-examination over recent years by the authors. While initially both hesitant to pronounce on the affinities of the Kilmelfort assemblage (Ballin 2001a; Saville 2003, 343–4), confidence has been growing in drawing parallels with Upper Palaeolithic, rather than Mesolithic, lithic material elsewhere

Table 1
General artefact list

Debitage	*Flint*	*Quartz*	*Totals*
Chips	118	54	172
Flakes	118	210	328
Indeterminate pieces		40	40
Blades	18	5	23
Microblades	25	9	34
Crested flakes/blades	5	5	10
Total debitage	*284*	*323*	*607*
Cores			
Discoidal cores		1	1
Irregular platform cores	2		2
Bipolar anvil cores	13	6	19
Total cores	*15*	*7*	*22*
Tools			
Microliths	2		2
Backed points	3		3
Backed blades/bladelets	14		14
Edge-backed fragments	22		22
Scrapers	25	3	28
Piercer	1		1
Burins	4		4
Burin spalls	7		7
Truncated piece	1		1
Splintered piece	1		1
Edge-trimmed pieces	4		4
Miscellaneous retouched pieces	24	2	26
Hammerstones		1	1
Total tools	*108*	*6*	*114*
Overall Totals	**407**	**336**	**743**

in Britain and beyond (Saville 2004, 210), something which we now both fully accept (Ballin 2008, 7–8). Nevertheless, aspects of the Kilmelfort assemblage, which so far has no parallels within Scotland, remain problematic. Given the significance and the potentially controversial nature of this attribution to the Upper Palaeolithic, hitherto virtually *terra incognita* for Scotland, it was considered essential to present a detailed reassessment of this important assemblage to allow others to appreciate the scope of the evidence and the reasons for our interpretation.

The purpose of this report, therefore, is to characterise the lithic assemblage, with special reference to raw materials, typological composition and technology. The date of the flint and quartz sub-assemblages will be discussed, and an attempt will be made at defining whether the Kilmelfort Cave assemblage is mixed. A distribution analysis might have shed light on site activities and intra-site chronology, but due to the find circumstances this is not possible.

The background to the present paper lies in the research undertaken by one of the authors (TBB) on the use of quartz in prehistoric Scotland (Ballin 2001a; 2008; Saville & Ballin 2000) and by the other (AS) on the evidence for early settlement in Scotland (Saville 2003, 343–4; 2004, 210). The current re-evaluation is founded upon a detailed archive catalogue of all the lithic artefacts from Kilmelfort – the artefacts in this paper are referenced by their number in this catalogue. Unillustrated pieces are distinguished by being set in square brackets (eg [64]).

THE ASSEMBLAGE

The extant 743 lithic artefacts from Kilmelfort (which represent an unquantifiable sample of the artefact assemblage originally present at the site) comprise 407 items of flint and 336 of quartz (Table 1).

As demonstrated in Table 2, the general composition of the flint and quartz sub-assemblages differ considerably. The main cause for these differences is fluctuations of the tool ratio, triggering variations in debitage and core ratios. The flint assemblage has an unusually high tool ratio (26.5%), whereas the quartz assemblage (as is the case with most quartz assemblages) has a low tool ratio (1.8%). The high tool ratio of the flint assemblage is discussed below.

Table 2
Percentage distribution of flint and quartz assemblages by main artefact categories

	Flint	*Quartz*
Debitage	69.8	96.1
Cores	3.7	2.1
Tools	26.5	1.8
Total	*100.0*	*100.0*

The definitions of the main lithic categories are as follows:

Chips: All unmodified flakes and indeterminate pieces the greatest dimension (GD) of which is ≤ 10mm.

Flakes: All lithic artefacts with one identifiable ventral (positive/convex) surface, GD > 10mm and L < 2B (L = length; B = breadth).

Indeterminate pieces: Worked lithic artefacts which cannot be unequivocally identified as either flakes or cores. Generally the problem of identification is due to irregular breaks, frost-shattering or fire-crazing. *Chunks* are larger indeterminate pieces, and in, for example, the case of quartz, the problem of identification usually originates from a piece flaking along natural planes of weakness rather than flaking in the usual conchoidal way.

Blades and bladelets: Flakes where L ≥ 2B. In the case of blades B > 8mm, and in the case of bladelets B ≤ 8mm. In southern England, bladelets have been defined as blades which are narrower than 12mm, or 9mm in the case of retouched pieces (Barton 1992, 264). In southern Scandinavia bladelets are defined as pieces narrower than 10mm; in Norway as pieces narrower than 8mm. This difference is due to different raw material situations, and the blades of Norway are generally much smaller than in southern Scandinavia. As the blades in Scotland are of a similar size to the Norwegian blades, we recommend adopting the 8mm criterion for the definition of blade and microblade blanks (cf Wickham-Jones 1990, 73).

Cores: Artefacts with only dorsal (negative/concave) surfaces – if three or more flakes have been detached, the piece is a core; if fewer than three flakes have been detached, the piece is a split or tested pebble.

Tools: Artefacts with secondary retouch (modification).

The descriptive terminology (type of retouch, orientation of retouch, morphology of retouch etc) follows Ballin (2001b). When referring to flake/blade artefacts, proximal always relates to the end from which the artefact has been struck, and distal to the end farthest from the striking platform/bulb of percussion.

FLINT

RAW MATERIAL

The finds from Kilmelfort Cave represent a spectrum of flint types, from very fine and vitreous to coarse and dull (like un-glazed porcelain). The flint is generally good, with few impurities and excellent flaking properties. Approximately one-fifth of all artefacts retain some heavily abraded cortex, demonstrating that the flint probably was collected at a beach source. Not all of the pieces are necessarily of Cretaceous chalk flint; some pieces are more likely to be chalcedonic silica of volcanic origin (eg illus 5: 147 & illus 8: 80). One piece (illus 10: 101) is of an unidentified silicious material and although it is obviously a knapping discard product, no other pieces of this material were present in the collection. No flint artefact from the site exceeds 58mm in length, and the average size of the collected pebbles used as cores is estimated to have been approximately 60mm.

With few exceptions, the Kilmelfort flint is completely corticated (sensu Shepherd 1972, 115). The resulting surface discolouration varies from uniform white or creamy to a more irregular covering of bluish-white and greyish-white tones. The cortication reflects the effects of the local alkaline, calcareous ground conditions in the vicinity of this limestone cave.

Although it is always possible that a given flint assemblage may constitute a mixture of material from different phases of activity or even different periods, the cortication in this case does not give any indication of contextual or chronological mixture. This is the case both in the absence of contrasting cortication between individual artefacts or artefact types, and in the absence of any two-phase cortication on individual worked pieces. Some 20 pieces are clearly burnt, suggesting that the occupation activity at this location may have included one or more hearths.

DEBITAGE

The 284 pieces of flint debitage recovered comprise 118 chips, 118 flakes, 18 blades, 25 microblades and five crested pieces. The relatively high number of chips, the unmodified flakes and the crested pieces (together with the cores) indicate that some primary production took place at the site. The flint flakes are generally quite small and irregular, and the flake group contains material manufactured in platform technique as well as bipolar anvil technique. The flint blades and microblades are relatively robust, albeit apparently produced in many cases by the application of soft percussion. The striking platforms of all the blades and many of the microblades are plain, indicating derivation from platform cores, not anvil-struck ones. At least one of the intact unretouched blades ([182]; Coles 1983, fig 2, 22) can be seen from its dorsal flake scars to derive from an opposed platform core. Nine microblades are narrow bipolar spalls, some of which could derive from burin manufacture (see description of burin spalls below). Five crested pieces (three blades and two flakes) were found on the site, four of which are unilateral (illus 10: 99 and [100, 102, 181]) and one is bilateral (illus 10: 101).[4]

CORES

Fifteen flint cores were recovered, two of which are irregular platform cores, and 13 are bipolar anvil cores. The dimensions (L × B × Th) of cores are measured in the following ways: in the case of platform cores, the length is measured from platform to apex; the breadth is measured perpendicular to the length with the flaking-front orientated towards the analyst; and the thickness is measured from flaking-front to the often unworked/cortex-covered 'rear' of the core. In the case of bipolar cores, the length is measured from terminal to terminal; the breadth is measured perpendicular to the length with one of the two flaking-fronts orientated towards the analyst; and the thickness is measured from flaking-front to flaking-front. The measurements of multi-platform/multi-terminal cores are presented in sequence of size with the greatest dimension first.

One irregular core (illus 3: 54) is a small flake core (25 × 24 × 21mm) which has been knapped from four different directions. The other irregular core (illus 3: 55) is of approximately the same size (24 × 23 × 22mm), but with a more complex biography: it probably started as a single-platform microblade core, and when it became too small to knap in this fashion, it was reduced in a more ad hoc way and achieved its irregular shape. Bipolar percussion was possibly attempted as well. One end is heavily crushed from use as a hammerstone, but it is not certain whether it is a hammerstone recycled as a core, or whether it is a core recycled as a small hammerstone (if so, probably for trimming or similar more delicate work).

The 13 bipolar anvil cores form a relatively homogeneous group of very small artefacts (average dimensions 23 × 13 × 6mm); their lengths vary between 14mm and 28mm. However, detailed examination of this artefact group reveals that several different artefact biographies are represented:

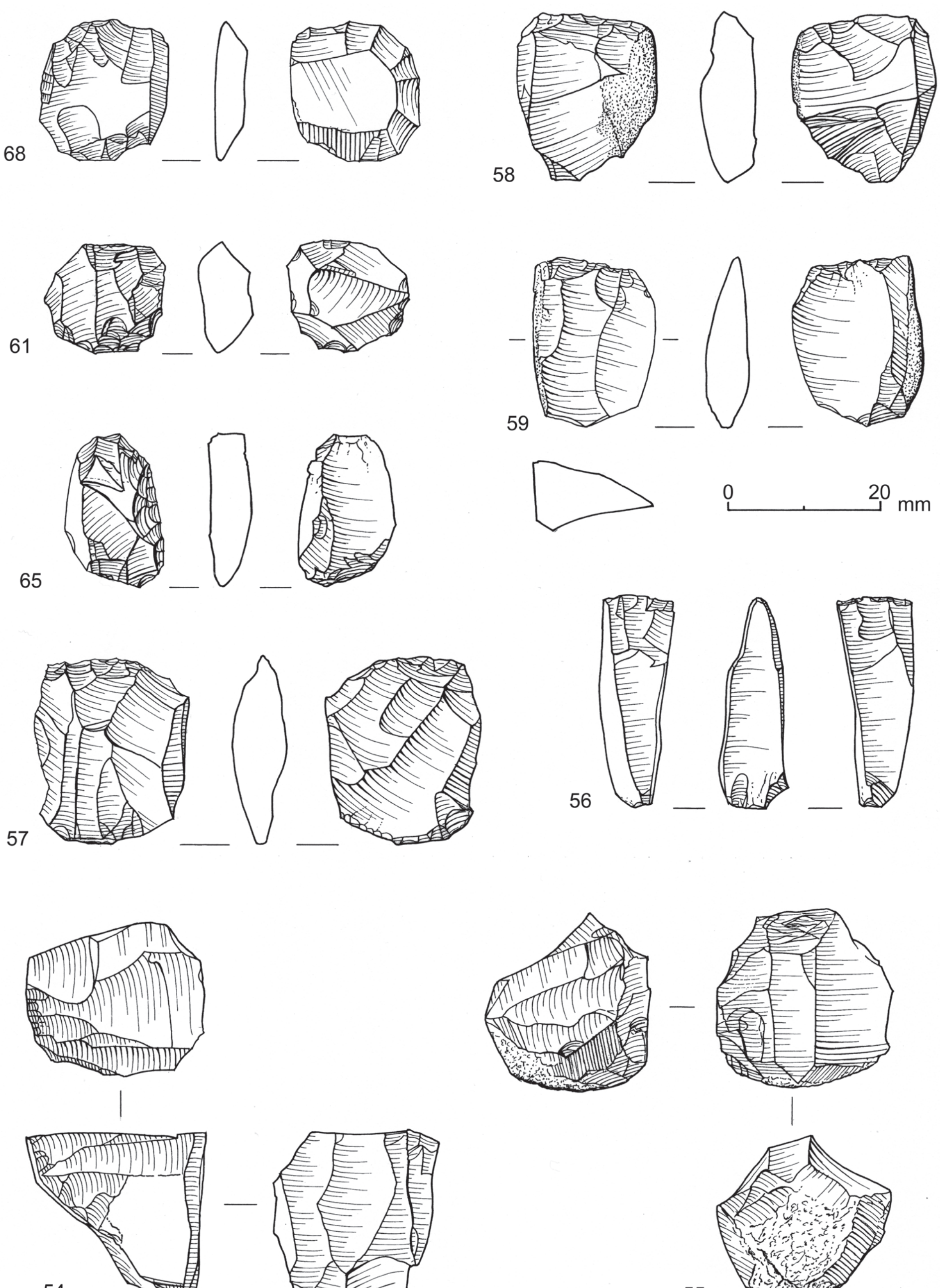
(a) seven pieces are classic bipolar cores (Ballin 1999a) with two terminals or crushed ridges (illus 3: 56, 57, 58, 59 and [60, 63, 64]);
(b) two are reorientated bipolar cores with four terminals (illus 3: 61 and [62]);
(c) one is a recycled platform core with remaining platform trimming along one lateral side (illus 3: 65);
(d) one is a recycled fragment of a tool on a platform flake [67];[5]
(e) two are recycled short end-scrapers with remaining areas of scraper edge retouch (illus 3: 68 and [69]).

It is important to emphasise just how small these residual bipolar cores are, with an average weight of only 2.4g (range from 1.4g to 3.2g), in comparison to the two irregular cores which weigh 11.5g and 11.9g respectively. It seems clear from the flakes and blades that most of the larger blanks derive from the knapping of platform cores, indeed from cores of a much larger size than any present in the collection.

NOTES ON THE FLINT TECHNOLOGY

There is clearly a mix of flake and blade technology in this assemblage.[6] To characterise the blades, a detailed attribute analysis was carried out, including all unmodified blades/bladelets and modified blades that had not been significantly reduced by secondary retouch. Only pieces with intact proximal ends were included – 36 pieces in total.

The average blade length of all intact flint blades is a mere 27.7mm, indicating that only the



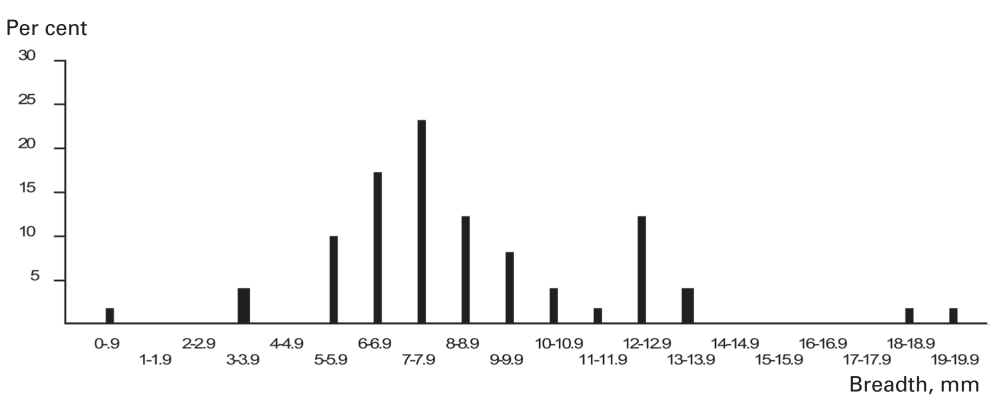
Illus 3 Flint cores (Marion O'Neil)

shorter and more robust blades have survived in an intact state (see discussion in Ballin 2004a). This is supported by the fact that the longest intact blade measures 57.9mm (illus 11: 128). The average breadth is 8.8mm (illus 4), and the average thickness is 3.1mm. The average breadth and depth of the platform remnants are 2.3mm and 0.9mm respectively, suggesting that platform isolation (Crabtree 1972) was standard practice at Kilmelfort. The average flaking angle (73.3°) is acute (measuring the angle between the platform and the dorsal face), and the 'ridge index' (ie the average number of dorsal arrises or ridges) is 1.38.[7] Cortex is present on 13.8% of the blades.

Most flint blades were detached by the application of soft percussion: 58% of all blades have a ventral lip; only 14% have a pronounced ventral bulb; whereas 11% have neither; 14% have been detached in bipolar technique; and 3% of all bulbar areas display platform collapse (Bordes & Crabtree 1969). The platform edges have been carefully prepared, with 48% of all edges having been trimmed and 45% abraded; only 7% have no preparation of the platform edge. The platforms are generally plain (93%), supplemented by some (7%) coarsely faceted platforms (probably formed by the detachment of partial core tablets).

Although no single or opposed platform blade cores are present, the dorsal flake scars and the curvature of the blades suggest manufacture in the main on single-platform cores (production on opposed-platform cores tends to counteract curvature and usually results in straighter blades). An exception is a blade mentioned above with bidirectional dorsal scars ([182]; Coles 1983, fig 2, 22). Similarly, in terms of flake production, the flake scrapers indicate production from relatively short and squat single-platform flake cores, but no cores of this type were found and, as has been shown, almost all of the cores recovered are of very small bipolar anvil type. The most probable explanation for this discrepancy is that, following their initial exploitation by platform technique, cores were subsequently reduced to exhaustion by bipolar anvil working. This approach is common in connection with the reduction of relatively scarce raw materials (Ballin 1999a).

Based on the attribute analysis of the flint blades, it was possible to establish a distinct technological profile at Kilmelfort. Broader and narrower blade/bladelet types are both characterised by acute flaking angles (platform/flaking-front), plain (un-faceted) platforms and trimmed/abraded platform edges. In southern Norway, for example, abrasion of the platform edge is a highly diagnostic feature associated only with the Middle Mesolithic (Ballin 2004a), but as technological profiling has not yet become standard practice in Scottish Stone Age



Illus 4 Blade breadths

research, the diagnosticity of this attribute is as yet uncertain.

TOOLS

The assemblage contains 108 flint tools or related forms, comprising: 41 backed pieces; 25 scrapers; one piercer; four burins (and seven burin spalls); one truncated piece; one splintered piece; four edge-trimmed pieces; and 24 miscellaneous retouched pieces. The tool ratio is 26.5%, a high ratio which may be biased by the find circumstances and recovery methods. It is possible that the assemblage represents a specific activity area of the site, and that other activity areas (eg the main knapping areas most likely to have been away from the cave entrance) were lost prior to any archaeological investigation.

Abruptly modified (ie backed) tools form the single largest category of retouched pieces at Kilmelfort, and before they are described it is essential to consider some questions of microlith and related artefact typology. Not all publications of Scottish microlith collections have followed the same type schemes, and the microlith typologies in Scottish archaeological literature are, to some degree, incompatible (eg Mercer 1968; Wickham-Jones 1990; Finlayson et al 1996; 2001). Some of the main confusions concerning microliths have arisen from the inclusion of broken fragments in analyses and the existence of the type concept of 'rods'.[8] Microlithic rods have not been clearly defined in the archaeological literature, other than as having one or two straight retouched lateral sides. This lack of definition has led to overlap with the definition of backed bladelets, and it is not certain to what extent they cover Clark's microlith types B and C (Clark 1934, 56). Finlayson et al (1996; 2001) have chosen to combine the categories of rods and backed bladelets under the label 'backed bladelets', and they have, in practice, discarded the type concept of rods. While agreeing insofar as not using the term 'rods' in this report, we regard it as essential to the typological terminology for the Scottish Upper Palaeolithic and Mesolithic to separate the category of backed blade/bladelet from that of microlith, and equally important that fragmentary pieces are excluded from categorisation into specific microlithic or other sub-types when they are insufficiently diagnostic (Saville 2002, 260).

As a foundation of general microlith typology, it is proposed to follow Clark's (1934, 55) definition:

> The term microlith is applied only to flakes [*sensu lato* – normally bladelets] from which the bulb of percussion has been removed, and which show the typical steep secondary work ... The term 'blunting' is applied to steep, often vertical, secondary working, in distinction to the flatter edge 'trimming'.

This definition allows the microlith to maintain its diagnostic value as a pre-Neolithic artefact (cf Ballin 1996a); the definition also separates microliths 'proper' from backed blades/bladelets. The latter, *sensu stricto*, always have an intact bulbar end with visible striking platform, though edge blunting or other ancillary retouch may modify the platform and bulb of percussion while still allowing it to be seen that the bulbar end has not initially been removed. In Scandinavian typology, a microlith is usually defined as a bladelet which has had its proximal end removed by the application of microburin technique.[9] Although this technique is also commonly used for microlith production in British later Mesolithic industries, it is not an absolute *sine qua non* since it is well known that Mesolithic people occasionally manufactured microliths in what might be considered ad hoc or unconventional ways (eg with the tip at the most suitable end, and formed in the most appropriate technique) when adapting to a specific raw material, and the definition of the microlith should reflect this fact. Also, as all lithic analysts dealing with Mesolithic assemblages discover, it is frequently impossible to determine the direction from which the blank has been struck on any given microlith, and consequently the 'correct' orientation (Clark 1934, 55) of that microlith (ie which ends are the presumed 'tip' and 'base'). There will always be occasional atypical forms that resist further classification. The function of microliths is not part of their typological definition, but it is conventionally assumed that they were in the main manufactured to form part of composite tools, either as points or as edges/barbs (the many composite tools found in Scandinavia and the general Baltic area support this point; eg Lidén 1942). We therefore suggest the following definition of the type:

> Microliths are small lithic artefacts which *generally* conform to a restricted number of forms or sub-types, shaped by blunting (steep/abrupt) retouch, and they are *in most cases* made on blanks which were in origin bladelets. One end (usually the tip) of a microlith is formed by removal of one end of the original blank (usually the proximal, bulbar end), and this process was *commonly* carried out by microburin technique.

In the case of the Kilmelfort assemblage, there are in fact only two complete microliths and no fragments intact enough for certain classification as microliths. The complete examples are both lanceolate types (defined here as a microlith with one side completely blunted or with one side blunted combined with opposed distal or proximal retouch). The classifiable backed pieces are otherwise all backed blades/bladelets, or fragments thereof that retain the proximal end (striking platform/bulb of percussion) of the blank, or they are backed points on which retouch has removed or obscured the original proximal terminal. Fragmentary backed pieces that do not retain the original proximal end cannot strictly be classified as either backed blades/bladelets or as microliths, and so are classed as edge-backed fragments. When they are complete or near complete (Table 3), backed points can be separated out from the other categories on the basis of larger size (L > 30mm), greater thickness (Th > 4mm) and distinctive pointed (usually bipointed) and curve-backed form,[10] though in terms of technology they overlap

Table 3
Dimensions of the complete, near complete, and larger fragmentary backed pieces

Catalogue number	*Length in mm*	*Breadth in mm*	*Thickness in mm*	*Weight in grams*	*Type*
138	23	8	3	0.5	backed blade / bladelet
140	25	7	2	0.4	backed blade / bladelet
141	26	8	2	0.4	backed blade / bladelet
142	24	7	3	0.4	backed blade / bladelet
143	27	8	3	0.4	backed blade / bladelet
144	39	9	3	0.8	backed blade / bladelet
145	22	9	3	0.6	backed blade / bladelet
146	41	10	5	1.7	backed point
147	41	12	7	2.3	backed point
148	36	13	6	2.2	backed point
149	26	7	3	0.4	microlith
152	25	7	3	0.4	edge-backed fragment
153	26	8	3	0.4	edge-backed fragment
154	21	8	3	0.5	edge-backed fragment
155	38	9	4	1.2	edge-backed fragment
156	33	10	4	1.1	edge-backed fragment
158	21	7	2	0.3	backed blade / bladelet
159	17	7	2	0.2	microlith

with microliths, since they have usually lost the platforms and bulbs of percussion of the original blanks. With the single possible exception of one piece mentioned below (180) it is most likely that none of the non-bulbar backed pieces has been manufactured in microburin technique.

Lanceolate microliths

Both microliths have abrupt retouch on their right lateral edge (illus 6: 149, 159). On one (149) the basal left edge has abrupt retouch and there is slight damage at the tip. The other example (159) has been retouched through the original proximal area of the blank, thus truncating the bulb of percussion rather than removing it entirely – demonstrating that this microlith was not manufactured by microburin technique.

Backed points

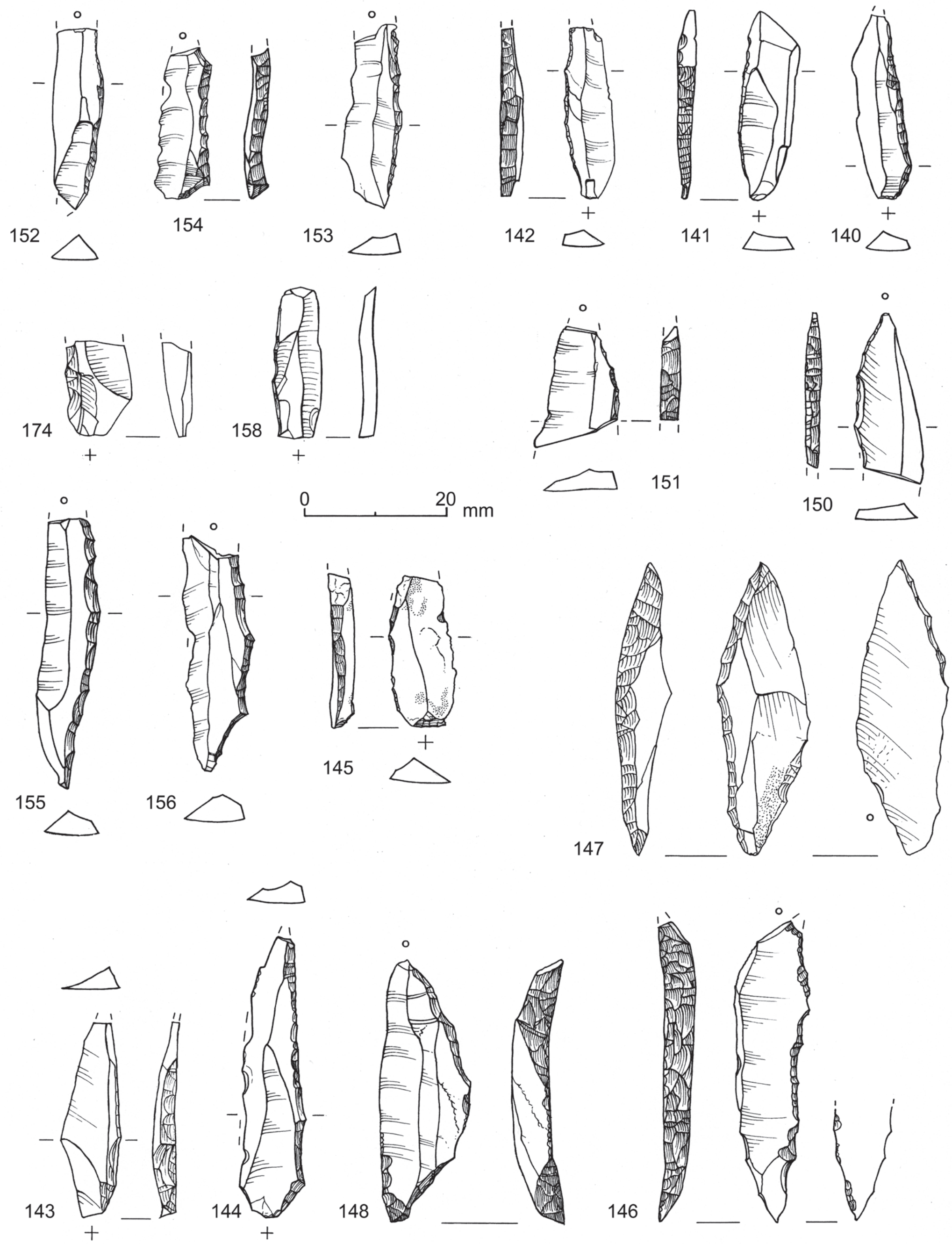
The three backed points comprise two curve-backed forms and one that is somewhat atypical. The latter (illus 5: 148) has abrupt retouch on the right side; at the proximal end the oblique retouch is convex, and at the distal end the retouch is concave. In between is an essentially unretouched section of the original edge of the blank, lightly trimmed or use-abraded. It has some abrupt and semi-abrupt retouch on its basal (ie in this case distal) left edge, probably defining the hafting end of the piece, which could perhaps be seen functionally as a shoulder, but this piece is rather curved in longitudinal profile and quite thick (6mm) for a projectile point. The curve-backed pieces are both larger (illus 5: 146, 147). The wider and thicker of the two (147) has an almost isosceles shape, but the angle of the two retouched arms is rather obtuse (*c* 155°) and essentially creates a curve. Whereas all the other backed pieces at Kilmelfort are on either blades or bladelets, this piece is on a broad flake, and the bulbar area has been removed by slight retouch. It is further unusual in retaining a patch of cortex or unsilicified matrix near the base, and near the tip has some *enclume* retouch (ie 'on anvil', struck from the dorsal ridge as well as from the ventral surface). The other (146) has abrupt retouch on its curved left side, whereas its right side has a finer, unevenly denticulated retouch. On the lower left edge the retouch is *enclume* and there is some flat ventral retouch across the base. The retouched left edge is overhung completely, so the backing retouch is invisible when the tool is viewed in dorsal plan-view.

Backed blades or bladelets

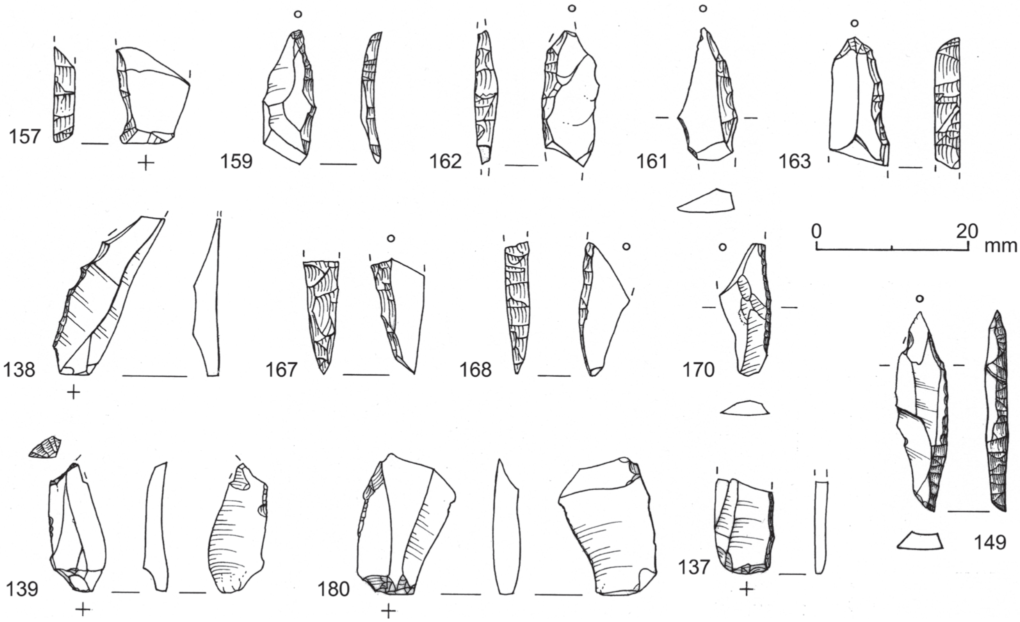
Of the 14 backed blades and bladelets only two are entirely intact (illus 5: 141, 158) and these are both rather small and delicate examples. Five further near-complete examples (illus 5: 140, 142, 143, 144; illus 6: 138) have average dimensions of $26.5 \times 7.8 \times 2.8$mm. At least two of these (142, 144) could be classed as straight-backed bladelets. Among the other more fragmentary examples, two stand out as being distinctive in size and form and can be regarded as almost certainly fragmentary backed points (illus 5: 155, 156). One (155) is a curve-backed specimen, with a slight concavity to the blunted edge near the base; the other (156) is markedly angular at two, possibly three, points along the retouched edge. The remaining five examples are all proximal segments (illus 5: 145, 174; illus 6: 137, 157, 180), of which only one (145) is of sufficient size for its original form to be envisaged. One example (180), which has only a very short section of retouch below a snap break that resembles a microburin facet, is more likely to be the proximal end of a backed piece than an irregularly formed microburin. Eight of these backed pieces have their abrupt retouch on the left edge, six on the right. All of the platforms are simple plain or linear types except for one partially faceted example (158).

Edge-backed fragments

Most of the 22 artefacts in this category are very small medial fragments which are impossible to classify any further, other than that they form part of backed tools, but 11 are of a sufficient size to merit illustration (illus 5: 150, 151, 152, 153, 154; illus 6: 161, 162, 163, 167,



Illus 5 Flint backed pieces (Marion O'Neil)



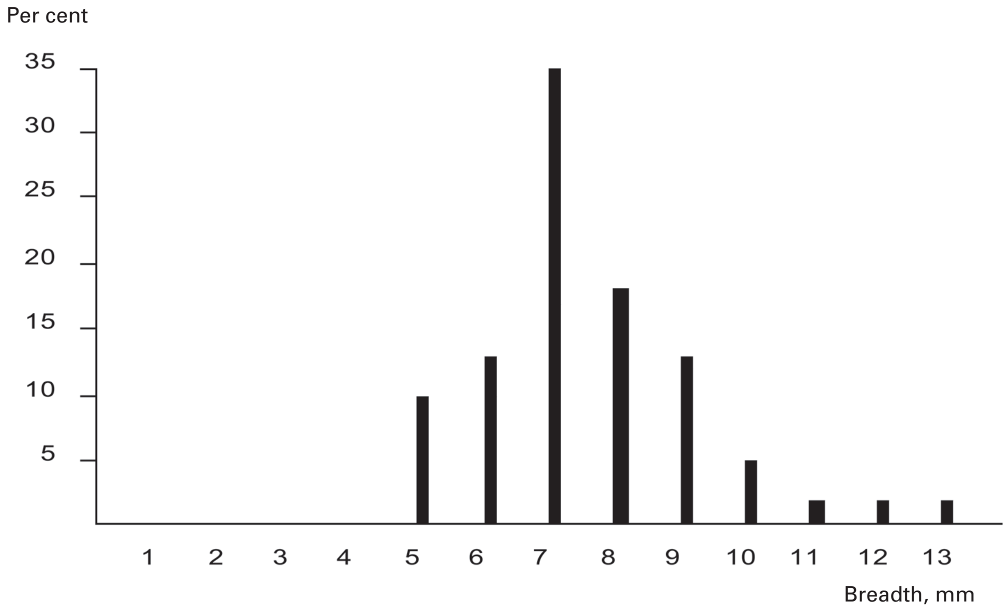
Illus 6 Flint backed pieces and truncated bladelet 139 (Marion O'Neil)

168, 170). Subjectively, at least one of these is likely to be part of a microlith (170); three may be parts of backed points (151, 163, 167); and two of the unillustrated fragments are probably from microliths [165, 166]. Otherwise they are resistant to further subdivision. It can be noted that one of these pieces (154) stands out as the only backed piece that is an uncorticated medium grey colour.

As most of the backed pieces are more or less fragmented, the length dimension does not yield much information on, for example, the technological (and possible chronological) coherence of this tool group. In contrast, the breadth dimension is almost always intact, and illus 7 presents a regular bell-shaped curve based on this dimension. This perhaps supports the homogenous impression (and possible contemporaneity) of the Kilmelfort backed pieces. It can be noted that some workers have seen a significant distinction between slender backed pieces (5–12mm broad, 1–6mm thick) and larger, heavier examples (12–29mm broad, 3–9mm thick); the former being projectile components and the latter knives or unused discards (De Bie & Caspar 2000, 123–35).

Scrapers

Of the 25 scrapers, six can be classed as discoidal (illus 8: 75, 84, 85, 86, 87, 88); 15 are short end or end-and-side scrapers (illus 8: 72, 73, 74, 76, 79, 107, 131) or fragments thereof (illus 8: 71, 77, 78, 80, 82, 134 and [81, 83]); and four are unclassifiable (illus 8: 89 and [106, 135]), including one which might be a combined scraper/piercer on which the point has broken (illus 11: 70). The discoidal scrapers and the short end-scrapers form a continuum (illus 9; average scraper dimension: 15 × 16 × 6mm), only separated by the degree of edge-retouch: discoidal scrapers are retouched on all or nearly all the circumference, giving them a circular outline, whereas the short end-scrapers are retouched at the distal end only, or at the distal



Illus 7 Backed pieces breadths

end and one or both lateral sides, giving them a roughly oval outline, though some are more angular (illus 8: 80, 107).

The complete scrapers vary in length between 20mm and 11mm ('thumbnail' or 'button-sized' scrapers), with only a few of the incomplete examples suggesting larger sized blanks (illus 8: 80), and thickness varies between 3 and 10mm. The scraper edge retouch is in all cases convex, and usually semi-abrupt, but becomes acute on some of the smaller, thinner scrapers (illus 8: 82). The scraper edges usually consist of series of 'normal' (relatively broad and overlapping) removal scars, whereas many of the smaller scrapers have a series of 'long', narrow, parallel removal scars indicating pressure flaking. Two of the scrapers are formed on crested flakes (illus 8: 80, 107), and one is on a plunging flake [135].

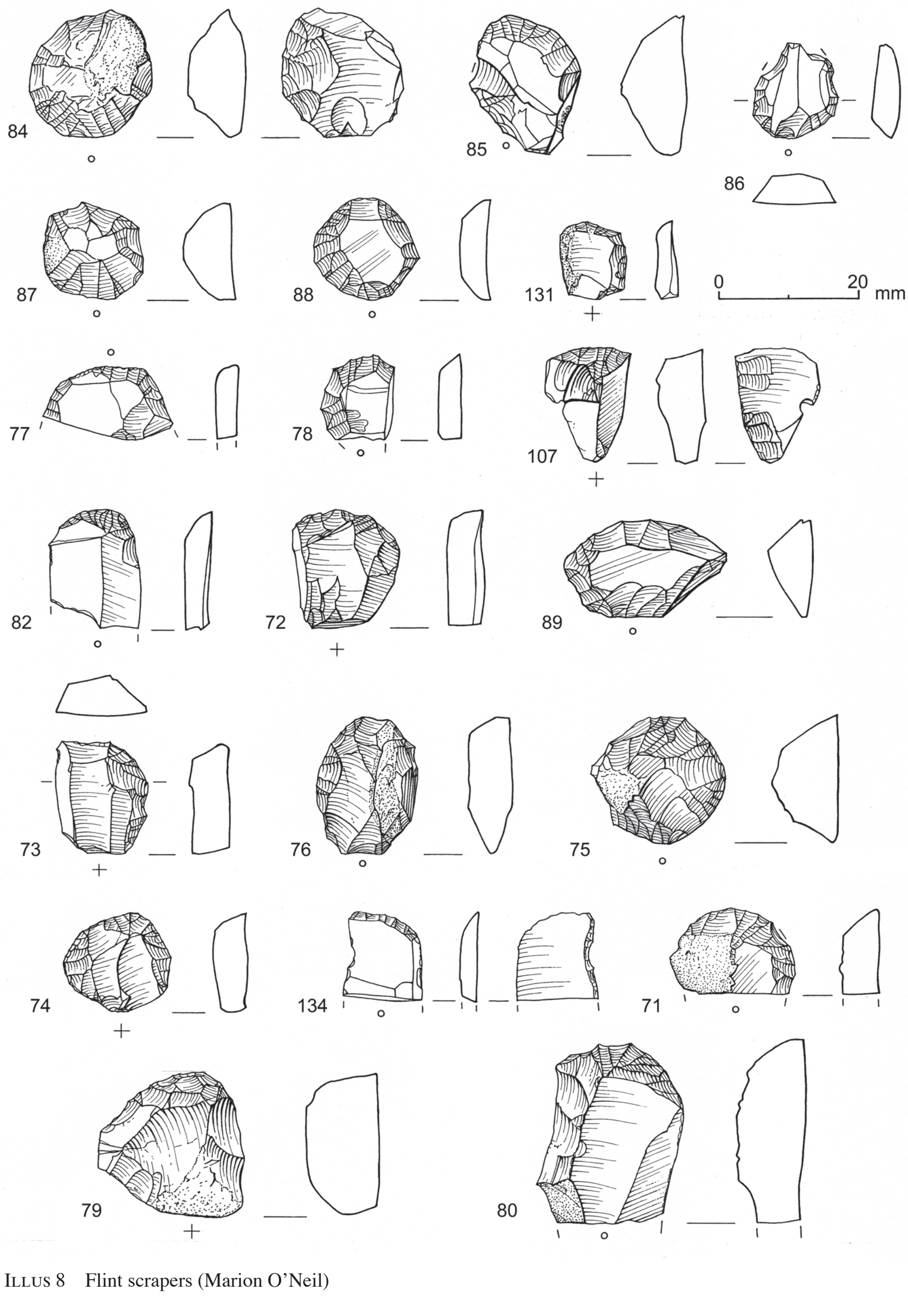
All scrapers show distinct use wear. The small size of the scrapers is an obvious point of note, and there is little to suggest that this results from resharpening rather than representing the intentional selection of small blanks (or the limited availability of larger ones).

Piercer

The only apparent piercer (illus 10: 98; 19 × 5 × 3mm) is a bipolar 'spall' with retouch on the distal 10mm of one side, with additional retouch of the distal part of the dorsal arris. It is not certain the striking platform exists as shown in the illustration, or whether this is a break facet. The identification as a piercer is tentative, and it is possible this piece is in fact the broken-off part of a backed bladelet or some other retouched tool form.

Burins

The four burins (average dimension: 20 × 14 × 7mm) from the site can be subdivided into two groups – an angle burin (illus 10: 90) and three dihedral burins (illus 10: 103, 104, 105) – all on flakes or flake fragments. The edge of the angle burin was formed by blows to the corner of a break. The first burin blow plunged

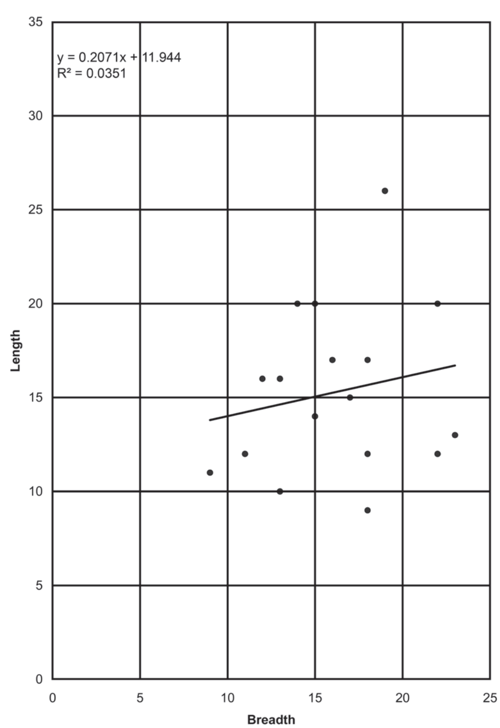


Illus 8 Flint scrapers (Marion O'Neil)

and removed the end opposite the burin edge. The three dihedral burins have their burin edges positioned roughly on the central axis of the pieces, either at the distal end (103 and 105) or the proximal end (104). One is a recycled short end-scraper (103), and its burin edge was formed by two burin blows to an oblique distal break; the scraper edge has been removed, and only some remaining retouch of the lateral sides indicate the original function of the piece; two (104 and 105) have had their burin edges created by one or more burin blows to oblique truncations. Again, the diminutive size of these pieces should be noted.

Burin spalls

There are quite a few spalls in the assemblage, seven of which have been classified as burin spalls (average dimensions 22 × 4 × 3mm), with the remainder having been classified as microblades. In this paper a 'spall' is defined as a long and slender removal with a breadth:thickness ratio approaching 1.0 and edge angles generally exceeding 45°. To qualify as a burin spall, a piece should preferably have been struck from the distal end of the parent blank. Additional qualifying attributes are: a) lateral removals from previous burin blows (illus 10: 95, 97 and [96]); and b) lateral retouch (illus 10: 91, 94, 95 and [92, 93]). Lateral retouch is a clear indication that a particular spall is not a bipolar microblade but a spall struck off a recycled tool. Microblades detached from the lateral sides of bipolar cores tend to have distinctly prismatic cross-sections, and, without additional attributes, may be almost impossible to distinguish from burin spalls.



Illus 9 Length:breadth of all intact flint scrapers

Truncated piece

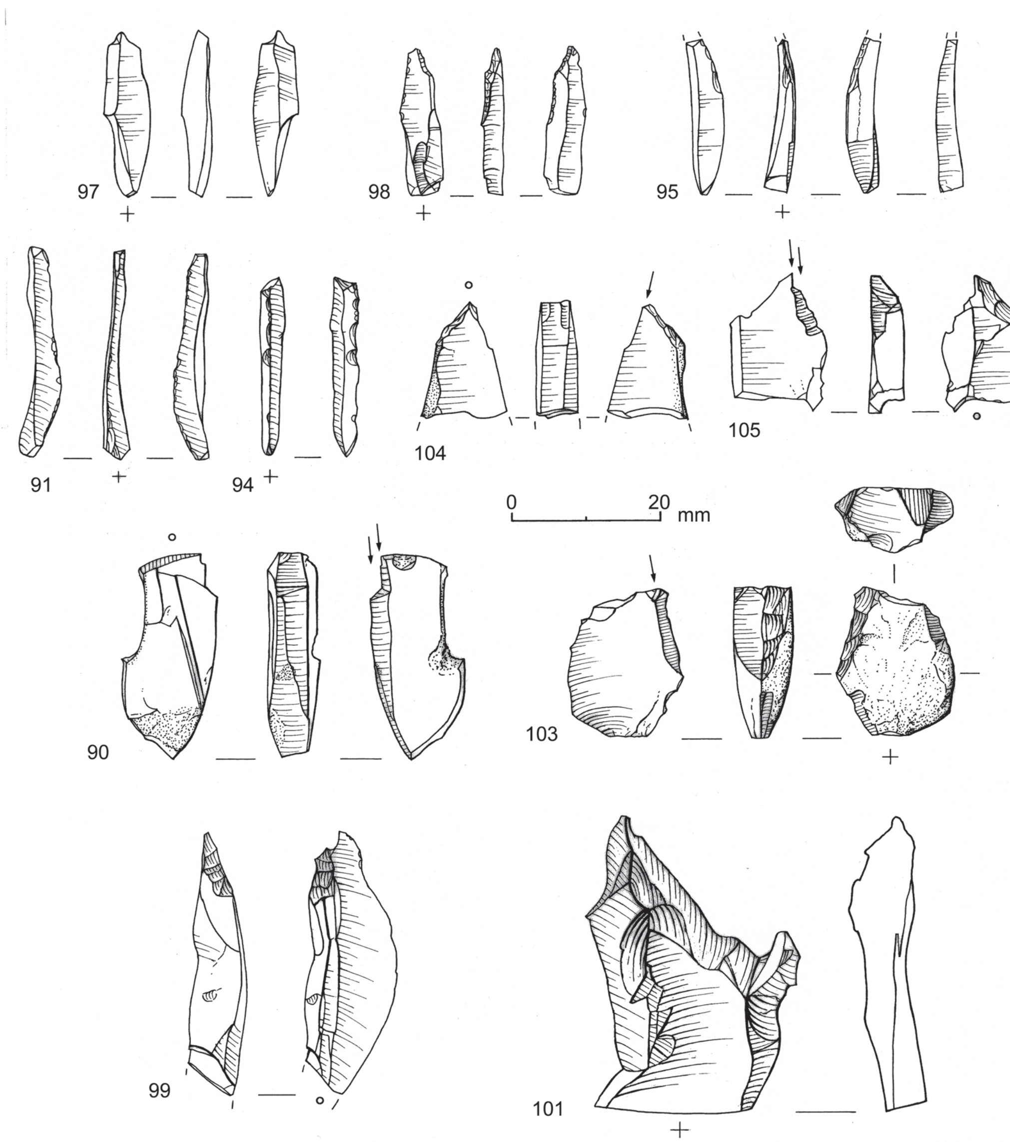
The single piece in this category is a bladelet with an oblique distal truncation (illus 6: 139). Since the distal tip of this implement is removed by an impact or quasi-impact fracture, this could be a damaged piercer or even a projectile component.

Splintered piece

One secondary flake with a plain striking platform has scalar removals on the ventral surface at both terminals, the more extensive removals being at the distal end (illus 11: 66). There is also retouch or damage on both lateral edges. The terminal removals are similar to those on bipolar anvil cores, but this flake (27 × 18 × 5mm) has clearly not functioned as a core.

Edge-trimmed pieces

Three blades (illus 11: 128, 129 and [117]) and a bladelet [136] fall into this category, having minor retouch or use damage on one or both lateral edges. One of the blades (128) is the largest artefact in the collection at 58mm long; another (129) has inverse thinning of the bulbar area – probably to facilitate hafting – and has snapped medially so could have had further, perhaps alternatively diagnostic, modification of



Illus 10 Flint piercer (98), burins (90, 103,104, 105), burin spalls (91, 94, 95, 97) and crested flakes (99, 101) (Marion O'Neil)

the distal part; the third [117] is a burnt medial segment.

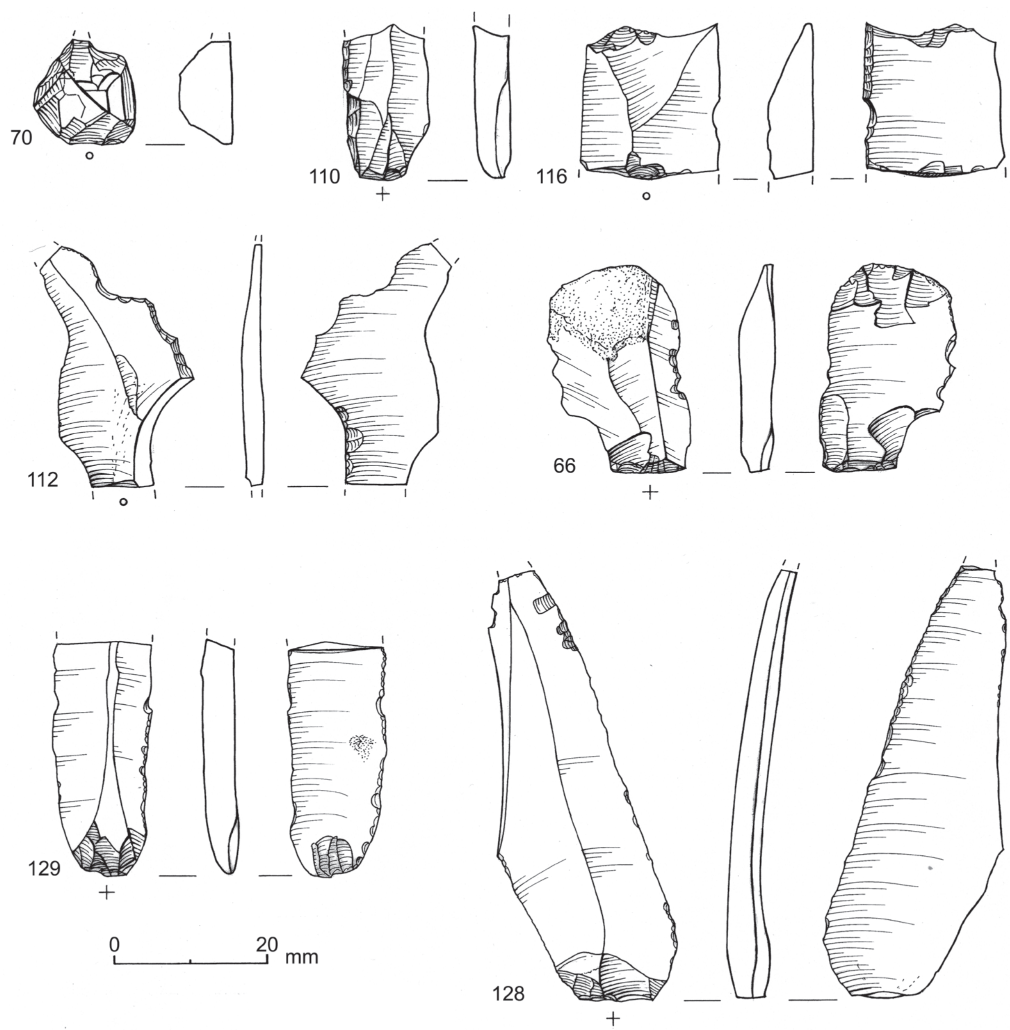
Miscellaneous retouched pieces

The 24 pieces in this heterogeneous category are mostly small, completely undiagnostic fragments of implements. The three illustrated pieces are the largest and comprise: a proximal blade segment with semi-abrupt retouch on the left edge (illus 11: 110); an irregular blade with abrupt retouch along an uneven upper edge and some inverse scalar removals (illus 11: 112); and a medial blade segment with inverse abrupt retouch on one edge and modification after the distal break (illus 11: 116). Other fragments might be from backed pieces (eg [132]), scrapers (eg [178]), burin spalls [130, 171], and edge-trimmed pieces (eg [114, 120, 121]), but in the main they resist further speculation [108, 109, 111, 113, 115, 118, 119, 122, 123, 124, 125, 127, 133] and some could simply reflect accidental modification, for example by trampling (eg [126]).

QUARTZ

RAW MATERIAL AND TECHNOLOGY

The quartz assemblage was manufactured in white, homogeneous milky quartz without impurities of, for example, mica. The quartz is very pure, and a few pieces are almost translucent, thereby approaching rock crystal in appearance. Compared to other quartzes used



Illus 11 Flint scraper (70), splintered piece (66), edge-trimmed flakes (128, 129) and miscellaneous retouched pieces (110, 112, 116) (Marion O'Neil)

in prehistoric tool manufacture, the Kilmelfort quartz has good flaking properties. It seems to have a less pronounced tendency to flake along the internal planes of weakness so typical to most quartzes; this is illustrated by the fact that most of the indeterminate pieces (including chunks) have been deemed indeterminate due to burnt ('peeled-off') surfaces (76%) rather than surfaces characterised by weakness planes (in comparison, *c* 35% of all quartz flakes and blades are burnt).

However, the Kilmelfort quartz is not without inherent weaknesses. Instead of the usual smooth weakness planes, this quartz is characterised by intersecting planes of very small crystals. Approximately 5% of all flakes show surfaces covered by 'micro-crystals' (greatest dimension *c* 1mm). In a few cases, those crystals have grown to become 'macro-crystals' with diameters of *c* 20mm.[11]

Usually, a quartz assemblage would be distinctly dominated by one type of quartz – either vein quartz or pebble quartz. An attribute analysis of the Kilmelfort quartz (see below) shows that *c* 25% of all pieces has one or more yellow, orange or red-brown surfaces (probably the coating of internal cracks, owing to the percolation of water through the rock matrix), identifying the pieces as vein quartz, whereas only *c* 6% has an abraded surface, thus identifying those pieces as pebble quartz. It is assumed that both sources of quartz were local.

In an attempt to answer a number of specific questions, a limited attribute analysis was carried out on 100 quartz flakes, all indeterminate pieces in quartz (40 pieces), and all quartz blades (14 pieces). The questions were: what proportions of the quartz assemblage come from vein and pebble sources; what proportions of the quartz flake and blade assemblages were detached in either platform or bipolar anvil technique; what proportion of the quartz assemblage is burnt; and what proportion of the quartz assemblage is affected by crystals or planes of 'micro-crystals'? Classification of blanks as platform flakes or bipolar flakes relied on a number of attributes associated with the bulbar or terminal ends of the blanks, and classification of the quartz pieces as derived from a vein or pebble source relied on different cortex characteristics (rough yellow/orange/red-brown surfaces vs smooth abraded surfaces).

As Table 4 clearly demonstrates, most of the quartz was collected, or quarried, from veins, supplemented by collection of quartz pebbles. Generally, vein quartz is reduced by applying platform technique and pebble quartz in bipolar anvil technique. The most important reasons for this are assumed to be differences in size and shape; vein quartz is usually available as larger angular blocks or plates, whereas pebble quartz

Table 4
Attribute analysis of quartz flakes, indeterminate pieces and blades. The number in brackets refers to flakes with trimming of the platform-edge; * only flakes and blades

	Flakes	*Indet. Pieces*	*Blades*	*All debitage*
With vein quartz surfaces	30%	19%	7%	25%
With pebble quartz surfaces	5%	11%	0%	6%
Definitely knapped in platform technique	18% (5%)	N.A.	0%	16%*
Definitely knapped in bipolar technique	26%	N.A.	100%	35%*
Burnt	34%	76%	36%	44%
With planes of 'micro-crystals'	0%	24%	0%	16%
With facets from 'macro-crystals'	2%	0%	0%	1%

is available as relatively small round or oval nodules. Reducing a smallish pebble applying platform technique would be uneconomical as too much of the material would be lost in preparing the core, and initial cortex removal would be difficult due to the curved surface of the nodule (for a general discussion of bipolar technology see Ballin 1999b).

This fact is reflected in Table 4 with 16% of the quartz blanks being identifiable as platform flakes and 35% being identifiable as bipolar flakes and blades. The reason for the dominance of bipolar technique, in spite of vein quartz being more abundant than pebble quartz, is probably the fact that platform cores, when deemed too small to be knapped further in platform technique, were exhausted totally by continuing the reduction process in bipolar technique (eg see the description of the operational schema at Bayanne, Yell, Shetland; Ballin forthcoming).

Although no 'proper' quartz platform cores were recovered at Kilmelfort, it is possible to discover details of a reduction process involving such cores. First of all, five crested flakes demonstrate that quartz platform cores were carefully prepared before initiation of the primary production. One crested flake is bilateral and has the typical zigzag-shaped dorsal ridge, whereas the other four are unilateral. The dominance of unilateral crested flakes may be explained by the specific properties of the raw material: on three of the four crested flakes, one of the two dorsal facets is either a plane of weakness or an 'attachment plane' (where the quartz was attached to the rock matrix). Both types of planes are exceedingly level, and to achieve a regular crest it was only necessary to adjust the dorsal ridge by detaching small flakes to one side. The same tendency is seen in the dominance of unilateral crested blades in Norwegian Early Neolithic rhyolite assemblages, with the Norwegian rhyolite being characterised by the same planes of weakness as most quartzes (Ballin 1999b).

No quartz platform rejuvenation flakes were found, and it is possible that this kind of core rejuvenation was not part of the operational schema at Kilmelfort. The regular trimming of the platform edge observed on several quartz flakes testifies to the careful adjustment of platform edges between the individual flake series. A number of pronounced bulbs-of-percussion indicates that direct hard-hammer technique was applied.

DEBITAGE

A total of 323 pieces of quartz debitage was recovered. This included 54 chips, 210 flakes, 40 indeterminate pieces (including chunks), five blades, nine microblades, and five crested flakes. Usually a relatively high chip ratio (in this case 16%) is an indication that some degree of primary production took place on site. That is probably the case here, although some of the chips may result from damage due to excavation/post-excavation handling and storage.

Approximately 35% of all quartz flakes and blades show signs of burning, with 76% of all indeterminate pieces in quartz having been burnt. Usually, the main reason for defining a piece of quartz as 'indeterminate' is the presence of anonymous (non-dorsal/non-ventral) faces left by the flaking along natural planes of weakness; at Kilmelfort, the main reason for those pieces being deemed indeterminate is the peeling-off of surfaces due to burning.

The attribute analysis of the assemblage (Table 4) revealed that 18% of all quartz flakes are platform flakes with 5% having trimmed platform edges; 26% of the quartz flakes are bipolar. The quartz blades and microblades are all rather simple 'metric' blades, that is, defined as blades due to their length:breadth ratio only ($L \geq 2B$) – it is probably more correct to describe the quartz blades here as 'blade-like flakes'.[12] Their lateral sides and dorsal arrises are rarely straight or parallel, and the cross-sections are generally triangular or prismatic rather than the 'flat-ish' cross-sections of true blades.

The quartz assemblage includes five crested flakes or fragments of crested flakes. Four of those are unilateral (illus 12: 8 and [6, 7, 10]), that is, with a dorsal ridge adjusted by small flake detachments to one side, and one is bilateral (small flake detachments to both sides), resulting in a typical zigzag-shaped dorsal ridge [9].

CORES

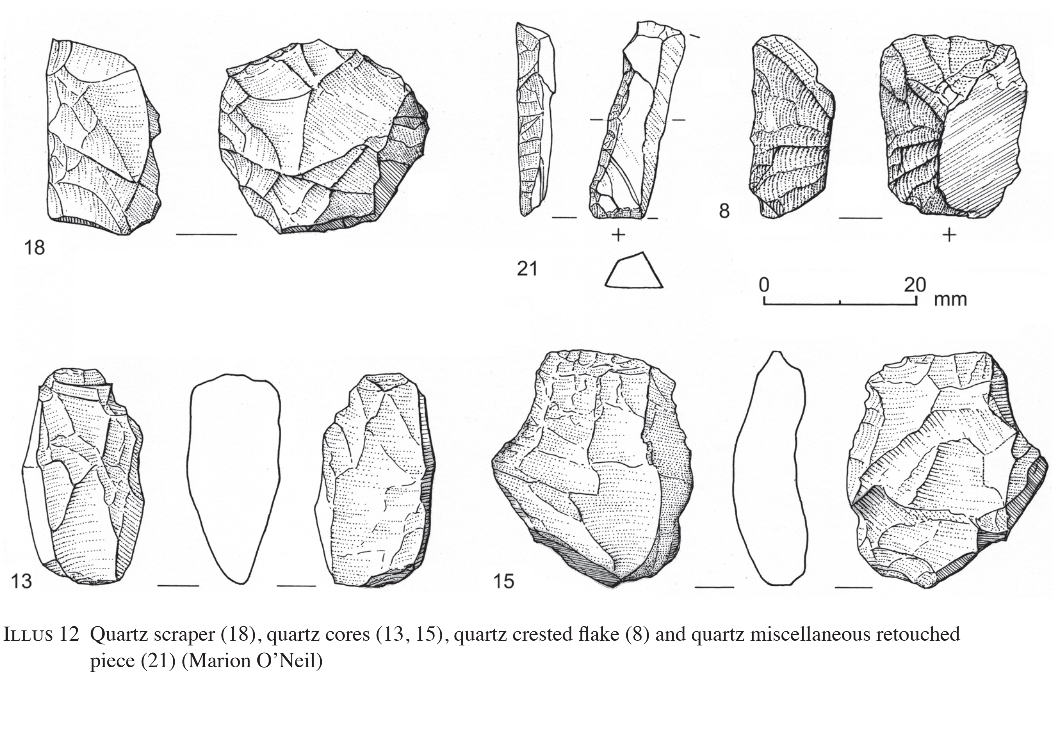
Seven quartz cores are present: one discoidal core and six bipolar anvil cores. The discoidal core [11] is large (66 × 58 × 31mm) and based on a pebble. Three to four flakes have been detached from either face of the core along one third to half of the circumference. The knapping quality of this core was affected by a plane of small crystals intersecting the nodule. The six bipolar anvil cores (average dimension: 28 × 21 × 11mm) form a relatively homogeneous artefact group as they are all at the same final stage of reduction, that is, heavily reduced (illus 12: 13, 15 and [12, 14, 16, 17]). Their greatest dimensions (terminal–terminal) vary between 24 and 42mm. One bipolar core is broken, and in this case only one crushed terminal survives [17]; in Coles (1983, fig 3.22) it was classified as a side-scraper. Though in quartz assemblages the anvil technique is more often associated with the reduction of pebbles (Ballin 2008), one bipolar core is clearly in vein quartz [14].

TOOLS

There are only six quartz tools, corresponding to a tool ratio of only 1.8%. Three are scrapers; one is a notched piece; one a retouched piece; and one a hammerstone.

Scrapers

The scraper group is quite heterogeneous. One scraper (illus 12: 18) is an intact short end-and-side scraper with a steep convex scraper edge covering approximately two-thirds of the circumference (25 × 27 × 15mm). Another scraper [19] is heavily fragmented (23 × 19 × 8mm), and only 6mm of the original edge remains; it is not possible to define the

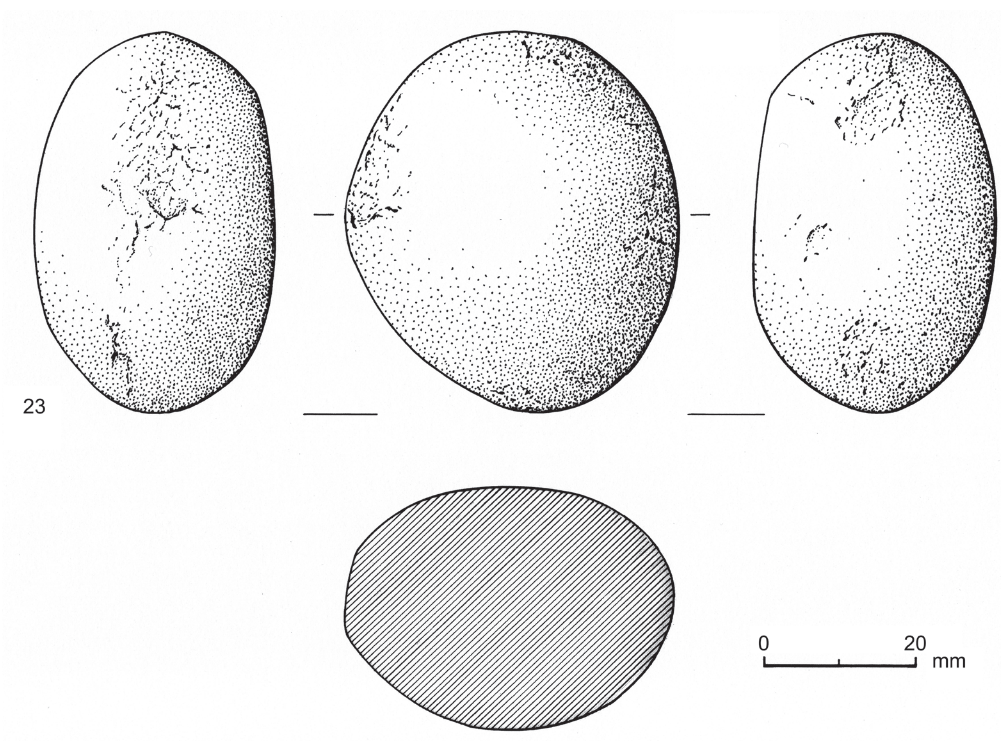


Illus 12 Quartz scraper (18), quartz cores (13, 15), quartz crested flake (8) and quartz miscellaneous retouched piece (21) (Marion O'Neil)

scraper type. The third [20] is the broken-off convex edge (8 × 17 × 7mm) of a regular short end scraper. All three scraper edges have varying degrees of overhang, demonstrating that they are used pieces, or fragments of used pieces.

Notched and retouched pieces

One fragment of a bipolar flake (29 × 15 × 19mm [22]) has two notches next to each other on one lateral side. The notches are not retouched but individual detachments; the chords measure 4–5mm. It is unknown whether the notches represent a deliberate attempt to form a tool (eg hafting notches), whether they represent use-wear, or alternatively are fortuitous. One retouched piece (illus 12: 21) deserves special attention as its previous classification as a backed blade (Coles 1983, 13, fig 2.19) was the single main diagnostic element linking the Kilmelfort quartz and flint assemblages. Close scrutiny of the piece and comparison with Coles's illustration of it reveal some misconceptions: the blank is not a blade, as the left side of the piece as illustrated by Coles (ie the right side in illus 12: 21) represents a break – in the centre of the left dorsal facet is a clear concavity with radiating fissures indicating that the blank was struck at this point, thereby detaching half (or more) of the piece; and the retouch of the upper end of the piece as illustrated by Coles (ie the lower end in illus 12: 21) is not an intentional secondary retouch, but the splintered remains of a bipolar flake's terminal. In other words, the piece is a fragmented bipolar flake with some regular, semi-abrupt retouch on the left lateral side (25 × 8 × 5mm).



Illus 13 Quartz hammerstone (Marion O'Neil)

Hammerstone

One small hammerstone (illus 13: 23) was recovered (50 × 43 × 32mm). It is oval and relatively flat with slight crushing abrasion at both terminals, and is most likely to be a flint knapping tool, though relatively lightly used.

COMPARISON OF THE FLINT AND QUARTZ ASSEMBLAGES

According to this re-evaluation of the lithic assemblage of 743 artefacts, 55% are flint and 45% quartz. Mainly due to different tool ratios (flint *c* 25%/quartz *c* 2%), the general composition of the two sub-assemblages differ considerably (Table 5).

DEBITAGE

As demonstrated in Table 5, the composition of the debitage differs as well. The differences are caused by a multitude of factors, such as raw material properties, recovery policy, prehistoric behaviour and technology. Due to the known properties of flint and quartz, it was to be expected that the quartz assemblage would have a slightly higher chip ratio, and the fact that the quartz chip ratio is considerably lower than that of the flint assemblage may be explained by either variable excavation recovery or prehistoric behaviour (the two assemblages possibly representing different activity areas).

Table 5
Percentage distribution of flint and quartz assemblages by debitage types

	Flint	*Quartz*
Chips	41.5	16
Flakes	41.5	65
Indeterminate pieces	–	12
Blades and microblades	15	5
Crested pieces	2	2
Total	*100*	*100*

Only the quartz assemblage contains indeterminate pieces, which is a result of different raw material (flaking) properties, but the debitage from both assemblages contains 2% crested pieces, indicating that platform technique was an integral part of both.

CORES

The flint and quartz cores are of similar types with both assemblages being dominated by bipolar material (88% and 86%). The flint bipolar cores are supplemented by irregular (multi-platform) cores, whereas the quartz bipolar cores are supplemented by one discoidal core.

TOOLS

With tool ratios of *c* 25% (flint) and *c* 2% (quartz), the two assemblages obviously differ considerably. In the flint tool group there are significantly higher proportions of backed tools (41 pieces) and scrapers (25 pieces), as well as burins and other modified pieces. In comparison, there are only six quartz tools, three of which are short end-scrapers.[13]

The attribute analyses of the flint and quartz assemblages suggest that both represent a technology based on platform technique, with bipolar technique having been applied to completely reduce exhausted platform cores. Some smaller nodules were probably reduced applying bipolar technique only, and Table 5 (the high proportion of bipolar flakes) suggests that quartz in particular may have been knapped in this way. Even though both assemblages were knapped predominantly in platform technique there are significant differences as well. In particular, the flint assemblage is characterised by soft percussion and the quartz assemblage by hard-hammer technique, and where the platform edges of the flint blades were prepared by trimming (48%) or abrasion (45%), approximately 28% of the platform edges of the quartz platform flakes were prepared by trimming.

DISCUSSION

Having described the lithic assemblage – which, as was intimated in the introduction, requires to be assessed almost entirely on its own merits without benefit of any horizontal or vertical stratigraphy, any clear contextual grouping, or any alternative chronological or cultural indicators – several key problems and questions arise over its interpretation. These can be summarised as relating to homogeneity and chronology.

Homogeneity is an issue on at least two counts: first, is the flint collection entirely of the same period; and second, is the quartz collection of the same period as the flints?

Looking first at the flint artefacts, in terms of their physical condition and appearance, there are no strong grounds for suggesting they should belong to more than one period separated by any major length of time. It is not possible to be dogmatic about this, because there are no empirical data by which to assess whether a fresh flint artefact discarded at Kilmelfort, say 10 000 years ago, would be visibly differently corticated to one discarded 5000 years later. However, experience gained from studying multi-period lithic assemblages from a variety of contexts in which cortication occurs favours the likelihood of a difference being visible if deposition was widely separated in time. Nor is there any marked discrepancy or separation within the assemblage in terms of the flint raw material exploited. There is a technological divide apparent between platform core flaking and bipolar anvil core production, and between hard- and soft-hammer reduction, but it has been proposed above that this could be explained as representing a continuum conditioned by the exigencies of the raw material available. Whether or not there are typological discordances within the flint collection will be considered below, but on all other grounds the authors have a preference for considering the flint artefacts from Kilmelfort as belonging to a single period. This is not to say that all the flint artefacts result from a single phase of occupation or activity at the site, merely that they do not appear to be multi-period.

As for the quartz artefacts, although the study of quartz technology employed in prehistoric Scotland has developed considerably in recent years (Ballin 2004; 2005; 2008), it is still not possible to make any hard-and-fast, direct typological correlations between quartz and flint assemblages when assessing contemporaneity. This is because of the fundamental divergences in technology and products resulting from the different physical properties of the two materials, which are only reconciled fully when skilled quartz knappers elect to copy flint forms, as in the case of the Bronze Age barbed-and-tanged arrowheads found on the Isle of Lewis (eg Ballin 2008, illus 27). Those same properties mean that the external appearance of quartz is not susceptible to alteration through being in a calcareous depositional environment in the same way as flint. Thus, there seem to be no intrinsic grounds for assessing whether the flint and quartz artefacts at Kilmelfort are, or are not, of the same period. The only possible hint of divergent depositional biographies lies in the evidence for burning. A higher proportion of the quartz artefacts has been exposed to burning than the flints. Assessment of burning on quartz is more subjective than in the case of flint but, even if this contrast is correctly identified and quantified, there could be numerous explanations for why such a contrast could occur within a single period during different episodes or modes of activity.

Therefore, while definitive evidence for establishing the homogeneity of the whole Kilmelfort lithic assemblage is lacking, it is equally impossible, on the basis of the traits considered above, to deny potential homogeneity. This places the burden squarely on the typological and techno-typological characteristics of the assemblage for assessing its chronological position(s), coherence and/or mixture.

The chief typological indicators in the assemblage must be regarded as the flint tools, and among them the backed pieces are diagnostically paramount. 'Backing' (edge blunting/abrupt modification) is an attribute of Upper Palaeolithic and Mesolithic lithic industries in Western Europe. It applies in particular when blade/bladelet blanks are being fashioned into microliths, points and other backed-blade forms, and is not found as a regular production mode in Neolithic or Bronze Age assemblages. It is therefore a strong, indeed conclusive, sign that the backed element of the Kilmelfort collection is of Upper Palaeolithic or Mesolithic attribution. In seeking parallels for these particular backed pieces, the authors are aware of no closely comparable artefacts from any Mesolithic assemblage in Scotland, despite the reasonably large number of such assemblages available for study. When seeking parallels farther afield, it immediately becomes apparent that these lie not with Mesolithic assemblages, but in the Later Upper Palaeolithic industries of north-west Europe. There are numerous other clues in the assemblage to support this, such as the presence of burins (and burin spalls), the absence of microburins, and the minimal presence of microliths; all of which would be very unusual in a Scottish context were the assemblage of Mesolithic age. Also, with regard to Continental connections, it must be borne in mind that Kilmelfort Cave is on the same latitude as parts of Jutland, where all the main industries of the north-west European Upper Palaeolithic – Hamburgian, *Federmessergruppen*, Brommian and Ahrensburgian – are represented.

The archaeological record for the Later Upper Palaeolithic period in southern Britain is currently divided between material of Magdalenian, *Federmessergruppen*, and Ahrensburgian affinities, using the broad western European techno-complex nomenclature (Pettitt 2008, 33–50), with the potential for further subdivision in some cases (Pettitt 2008, 23–4).[14] It is not appropriate to explore the chronological position of these Upper Palaeolithic groupings in any detail here. It will suffice to note that Magdalenian and *Federmessergruppen* occurrences relate primarily to the first (Bølling) and second (Older Dryas/Allerød) phases of the Late Glacial Interstadial (Windermere) respectively, and the Ahrensburgian to the later part of the Younger Dryas Stadial (Loch Lomond) immediately before or during the transition to the Holocene/Flandrian.

The Kilmelfort assemblage shows no strong resemblance to any material that might be considered Ahrensburgian (cf Ballin & Saville 2003), but does have definite similarities with assemblages and isolated finds deemed to fall within the later part of the Windermere Interstadial (ie the Allerød), prior to the early Younger Dryas, at which point it is thought that severe environmental conditions of the initial Loch Lomond Stadial may have made Britain once again temporarily uninhabitable. While the Kilmelfort artefacts lack any of the distinctive traits of Magdalenian/Hamburgian/Creswellian type (such as sharply angle-backed points, tanged and shouldered points, end-of-blade scrapers, *Zinken*-type piercers and *en éperon* preparation of striking platforms), there are clear comparabilities with artefacts of *Federmessergruppen* and related technologies (Schwabedissen 1954).

There are no *Federmesser* (penknife points) *sensu stricto* (ie with the distinctive basal retouch; see for example Barton 2005, fig 132) in the Kilmelfort assemblage, but its backed points and blades do fall well within the range of forms which are characteristic of the closely related Curve-Backed Point (CBP) groups that were present over a large swathe of north-western Europe and the North European Plain during the latter part of the Late Glacial Interstadial in the 12th millennium ^{14}C yr BP (eg Baales & Street 1996; Bolus 1992; Coudret & Fagnart 1997; De Bie & Caspar 2000; Holm 1991; 1996; Schild 1984; Schwabedissen 1954; Street & Baales 1997; Street et al 2006; Terberger 2006).[15]

In Britain there are few if any assemblages which can be regarded as unmixed CBP examples, but typologically diagnostic backed pieces, including true *Federmesser* in some cases, are known from: Nanna's Cave; Potters Cave and Priory Farm Cave, Dyfed (Barton & Price 1999; David 1991; 2007); King Arthur's Cave, Hereford and Worcester (Barton 1995; 1997); Symond's Yat East Rockshelter, Gloucestershire (Barton 1994); Three Holes Cave, Broken Cavern and Pixie's Hole, Devon (Barton & Roberts 1996); Mother Grundy's Parlour, Derbyshire (Armstrong 1925; Jacobi 2004, 72); Gough's Cave, Somerset (Jacobi 2004); and Seamer, Yorkshire (Conneller 2007). The dominance of cave sites – as at Kilmelfort – as find-spots for curve-backed pieces is notable, but with so few find-spots overall in the UK the precise significance of this is elusive.[16]

Trying to draw any exact comparisons between individual abruptly modified tools at Kilmelfort and those from sites elsewhere in Britain and Europe is probably a futile exercise, especially when there is no particular diagnostic 'type fossil' in this assemblage. Taken as a whole, however, quite close analogies can be drawn with other assemblages, such as that from the *Federmessergruppen* site of Niederbieber at Neuweid, Germany (Bolus 1992). Suffice to say that the range of backed pieces at Kilmelfort fits very well in general terms with those found in CBP group and related assemblages from France to Denmark and Poland to Britain.[17] This matching is especially strong since it is characteristic of the CBP industries that they evidence an adaptable technology. Where preceding Magdalenian/Hamburgian groups tend to exhibit careful selection of high quality raw material and a more standardised blade production technique involving elaborate preparation to produce distinctive, recurrent specialised tool forms, CBP/*Federmesser* groups frequently exploited relatively poor quality and smaller-sized lithic resources and demonstrate ad hoc flexibility in production, resulting in less formulaic tools (eg De Bie & Caspar 2000, 112–15, 211–12). These characteristics relate perfectly to Kilmelfort and could explain many aspects, such as the serendipity at work in the use of irregular blanks, the small size of the scrapers, and possibly even the utilisation of quartz.[18]

Interpretations of the contrast between the earlier and later technologies of the Late Glacial Interstadial (ie between those of the Bølling and Allerød chronozones) are often explained on environmental grounds. The later, more vegetated landscape may have made lithic resources harder to locate and changes in the type and availability of fauna caused 'subsistence stress' which impacted on all aspects of life, including technology (eg Floss 2002; for a contrary view see Rozoy 1998). In the case of the specifics of the Kilmelfort assemblage, it is hard to avoid the conclusion that access to lithic raw material was at an absolute premium and dictated the extreme exhaustion of the cores.

Are there any indications of typological non-homogeneity among the flint artefacts? While the abruptly modified pieces could not, as a group, be accommodated within any assemblages of more recent date than the Upper Palaeolithic, both authors had initial qualms about the attribution of the scrapers. On the basis of previous knowledge about Scottish lithic artefact typology, the scrapers seemed to fit well with Later Mesolithic finds, or even in some respects with those from Early Bronze Age contexts – the latter also possibly providing a chronological peg on which to hang the Kilmelfort quartz items (Saville & Ballin 2000, 47). In this we were probably swayed by preconceptions about Upper Palaeolithic scrapers as predominantly end-of blades types. In fact, most Upper Palaeolithic assemblages include some short end scrapers, and this is particularly true of CBP/*Federmesser* group assemblages, among which short scrapers can predominate (eg Bolus 1992, 58), irrespective of the raw material exploited – a facet which is often seen as an indicator of the process of 'Azilianization' (De Bie & Caspar 2000, 184–6; Grimm 2004; Jacobi 2004, 72; Pion 1997; Street & Baales 1997, 378). Otherwise, there are no artefacts present among the Kilmelfort flint finds that obviously hinder classification as a coherent Late Glacial assemblage.

In the absence of any radiometric dating for the Kilmelfort assemblage, or in fact for any pre-Holocene archaeology in Scotland, we have chosen not to refer to any precise chronology in this paper. The chronological position of the CBP/*Federmesser* groups in mainland Europe has been much debated and only relatively recently has opinion, with the availability of more reliable radiometric dates, coalesced on the 1000 ^{14}C years from 11,800 to 10,800 BP (Street et al 2006), with a concentration towards the latter part of the Allerød chronozone, *c* 11,500–11,100 ^{14}C yr BP, subsequent to all reliable classic Hamburgian (and Havelte Group) radiocarbon dates (Grimm & Weber 2008). The best age indications for CBP/*Federmessergruppen* assemblages in Britain come from Gough's Cave, Somerset, and Pixie's Hole, Devon (Jacobi 2004; Pettitt 2008, 45). These broadly concur with the mainland European dating, although newly available and forthcoming sets of radiometric dates obtained by the Ancient Human Occupation of Britain project based at the Natural History Museum, London, are in the process of further refining the chronological position of all the British Late Glacial industries (Roger Jacobi, pers comm). It is now possible to calibrate these Late Glacial radiocarbon age determinations to calendar years, and to nuance the probable date ranges obtained using Bayesian modelling of sets of dates from individual sites. The challenge will be to correlate these results satisfactorily with ice-core years and marine oxygen isotope stages (Lowe et al 2008) and to factor-in the other indicators of climatic conditions (such as pollen, coleoptera, chironomid, marine shell, tephra and nitrogen isotope data) to arrive at a more coherent picture of the changing Late Glacial environmental backdrop to human presence in various parts of north-west Europe (cf Barton et al 2003; Edwards 2004; Eriksen 2002; Stevens et al 2008; Street et al 2006).

For the time being, most of the existing relevant archaeological literature for this period expresses chronology in uncalibrated radiocarbon years BP (ie before AD 1950) set against the former conventional subdivisions of the late Quaternary (see below).

The details of Late Glacial climatic change are now known to be extremely complex but,

Age ^{14}C years BP	*Scottish stages/biozones*	*NW European chronozones*	*Epochs*
To 13,000	Dimlington Stadial	Middle Weichselian	
13,000–12,000	Windermere	Bølling	
12,000–11,000	Interstadial	Older Dryas/Allerød	Pleistocene
11,000–10,000	Loch Lomond Stadial	Younger Dryas	
from 10,000	Flandrian	Preboreal	Holocene

to generalise, the Windermere Interstadial (the broad phase to which we relate the Kilmelfort assemblage) marks a change from the glacial conditions of the Dimlington Stadial, throughout which the presumption is made that Britain and most of north-western Europe was unoccupied by humans during the coldest phases (although for a contrary view see Blockley et al 2006). Temperatures rose rapidly between *c* 13,000 and 12,500 ^{14}C yr BP, with present-day summer temperatures probably exceeded, and it is likely that the first phase of human resettlement of Late Glacial Britain began around this time (Barton et al 2003; Conneller & Ellis 2007; Jacobi 2004). Permafrost was absent from Britain during the Windermere Interstadial, but returned *c* 11,000 ^{14}C yr BP with the near-arctic conditions that occurred during the earlier part of the Loch Lomond Stadial, when it is envisaged that the environment in Scotland would have again been unfavourable for continuous human occupation. In the later, Allerød phase, of the Windermere, pollen data show an expansion of birch-dominated woodland, succeeding the juniper scrub of the Bølling, with a return to grassland as cooling began around 11,300 ^{14}C yr BP (Tipping 1991). It is important to remember that throughout this period Britain was not an island, but a peninsula connected with the Continent by what was then largely land (Doggerland) – now the bed of the southern North Sea – across which both humans and the mammals on which they predated would have roamed (Coles 1998; Gaffney et al 2009).

The larger mammalian fauna envisaged for Scotland during the 2000 ^{14}C yrs of the Late Glacial (Windermere) Interstadial would fluctuate both through time and between the different regions, but at various stages it potentially included mammoth, aurochs, horse, brown bear, reindeer, red deer, saiga antelope, and probably elk. This is the Gough's Cave mammal assemblage-zone as defined by Currant and Jacobi (2001). Clearly it is not possible to be specific about which of these animals were in the vicinity of Kilmelfort at the time of human presence, but it is likely that one of the above species formed the major prey focus for the human group who produced the flint tools, among which the abruptly retouched pieces are best interpreted as projectile armatures (with some possibly having functioned as knives). If we are correct in assuming a correlation between the Kilmelfort assemblage and the Allerød chronozone, and therefore between a partially closed, rather than tundra-like, environment, then red deer (perhaps along with elk) might well have been the hunters' target, which would of course be consistent with the only potential faunal identification from the site (see endnote 3; Coles 1983, 13). If the Kilmelfort inhabitation relates to a very late stage within the Allerød – as is entirely possible (cf Baales et al 2001; Grimm 2004) – then predation upon reindeer or wild horse could be envisaged if it is assumed these animals returned to Scotland with the onset of colder, more open conditions. It has to be admitted, however, that the changing patterns of mammal presence in Scotland during the climatic twists and turns of the 12th millennium ^{14}C yr BP remain purely speculative.

CONCLUSION

Having reanalysed the Kilmelfort lithic assemblage we conclude that culturally it belongs to the Curve-Backed Point tradition of the Late Upper Palaeolithic in north-western Europe, and chronologically most probably to the second half of the 12th millennium BP in radiocarbon years. As such, it represents the first fully published lithic assemblage relating to Upper Palaeolithic human activity in Scotland, finally bringing Scotland into the mainstream recolonisation of north-west Europe at the end of the Pleistocene, from which it has anomalously stood apart for far too long.[19]

The known severity of glacial and periglacial conditions associated with the Last Glacial Maximum and the Loch Lomond Stadial in

Scotland has, perhaps unduly, coloured and deterred expectations of human presence during the Late Glacial period. In fact, logically, it was always more likely than not that people, as with the game on which they depended, would have inhabited Scotland in the favourable circumstances which pertained before and after the Loch Lomond Stadial (cf Price 1982, 67, 70). There must be other assemblages comparable to that from Kilmelfort awaiting discovery. Hopefully they will be found in contexts with some organic preservation and provide material for radiocarbon dating.

For the moment, if we are correct in our diagnosis, it might be argued that the Kilmelfort flint artefacts represent one of the best examples of a CBP group assemblage from the Late Glacial British peninsula, because they appear to be uncontaminated by any earlier or later admixture.

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NOTES

1 John Coles (*in lit*, 6 August 2009) has explained that the initial discovery resulted from flints recovered by workmen after blasting operations began. These flints were passed to the late Roy Ritchie, an Inspector of Ancient Monuments at the Ministry of Works, who informed the late Professor Stuart Piggott and subsequently showed the flints to Piggott and Coles, after which Piggott encouraged Coles to visit the site. It would appear that these original finds, described by Coles as 'moderately large, perhaps diagnostic' are not among those now in the NMS. Their present whereabouts are unknown.

2 A site inspection by the authors in 2009 confirmed the absence of any remaining in situ deposits within what survives of the cave. Also, the zone immediately outside what is left of the cave appears to have little or no potential for further archaeological investigation. Nevertheless, other south-facing spots along the sides of An Sidhean and adjacent hills could very well contain similar traces of early prehistoric activity that are masked by scree, as was the case with Kilmelfort Cave before the blasting operations.

3 The finds donated to the former National Museum of Antiquities of Scotland (now National Museums Scotland) by Professor John Coles in 1982 do not include the 'few fragments of bone' mentioned in the excavation report (Coles 1983, 13). These were sent for identification to A S Clarke at the then Royal Scottish Museum in Edinburgh. Clarke's comments after examining the bones were contained in a letter sent to Coles on 11 September 1959 (copy on file at NMS), which reads as follows:

> I have now had a look at the fragments from Kilmelfort cave. This has taken longer than I anticipated but then I didn't realise how fragmentary they really are.
>
> I can see no hope of being able to piece the bits together so I can only judge by one or two relatively intact pieces. From these I am as sure as one can be, under the circumstances, that the teeth were those of a Red Deer.
>
> There are one or two lumps of cancelleous bone from the articular ends of limb bones. These are quite unidentifiable but they could certainly also be deer.

We are grateful to Dr Jerry Herman, Senior Curator (Mammals) at NMS Natural Sciences, for his attempts to locate these fragments, but to date they have not come to light. Apart from the lithic artefacts, the only other extant finds from Kilmelfort are two very small (17.5mm and 12.5mm in maximum dimension) fragments of red ochre and some tiny fragments of charcoal (Coles 1983, 13). The lack of precise contextual information concerning the latter, coupled with the reported turbation of the cave deposits (Coles 1983, 13), have thus far dictated reluctance to attempt accelerator dating.

4 A unilateral crested flake has had the crest formed by removing small flakes to one side of the crest, whereas a bilateral crested flake has had the crest formed by removing small flakes to either side of the crest (Ballin 1996a, 10).

5 Cf bipolar cores of type 4 (Ballin 1999a, 18, fig 7).

6 The lamellar index (Bordes & Gaussen 1970) of the Kilmelfort flint assemblage is 26%. An index of 20% or more indicates specialised blade production.

7 In Ballin (2004) it is suggested that the arris/ridge index be used as a measure of blade regularity:

1.00–1.45 Irregular blades
1.46–1.55 Regular blades
1.56–1.65 Very regular blades
1.66 > Elegant blades

Based on this classification, the blades from Kilmelfort are clearly 'irregular'.

8 Similar confusion surrounds the use of the term 'needle point' for microliths.

9 '*Pièce qui sont façonnèes principalement par la technique des microburins, que leur forme soit géometrique ou non. Celles-ci ne doivent pas montre de bulbe, étant donné que c'est souvent la partie proximale qui est enlevée par la technique en question*' (Brinch Petersen 1966, 93).

10 There are no typical tanged or shouldered points in the Kilmelfort assemblage.

11 On Norwegian sites (eg Storsand 53; Kongsdelene 71–2; Ballin 1998, 40, 85) large crystals have been found in quartz caches, and they were probably collected deliberately as raw material; if large enough, such crystals would form naturally prepared cores as their hexagonal shape includes six natural crests or guiding ridges. Separate collection of quartz crystals, however, does not seem to have taken place at Kilmelfort, where most crystals were too small.

12 According to Ballin (1996a, 9) blades and blade-like flakes share the same metric requirements (L ≥ 2B). Blades are defined as having approximately parallel straight lateral sides and one or more dorsal arrises running approximately parallel to the lateral sides. Blade-like flakes do not meet these demands of regularity. Inizan et al (1992, 76) reject this distinction, claiming it to be difficult to make in practice, but it is a fact that most products of specialised blade production are blades *sensu stricto*.

13 If burins can be difficult to identify in flint, they are almost impossible to identify in quartz, and the graving/shaving function of burins may, to some extent, have been carried out by unmodified quartz chunks and fragments with suitable corners and edges.

14 In the spirit of 'lumping rather than splitting', current consensus seems to have moved towards the use of the generic western European designations of Magdalenian, *Federmessergruppen*, and Ahrensburgian when referring to the British Upper Palaeolithic material in preference, respectively, to the subdivisions of Late Upper Palaeolithic, Final Upper Palaeolithic, and Terminal Upper Palaeolithic, which were in favour until recently (eg Barton 2005). In this sense, Magdalenian would equate in very broad technological and chronological terms with other existing designations such as Creswellian, Cheddarian, Hamburgian, Havelte, and perhaps Hengistbury Head type assemblages; *Federmessergruppen* would equate with Curve-Backed Point groups and Azilian; and Ahrensburgian would equate with Long Blade industries. It remains to be seen whether the chronological sequence of the groupings implied by these designations can be constrained more exactly, and whether Scottish Late Glacial assemblages will prove to relate more directly to those found farther north in Europe than the material from southern Britain (cf Ballin et al forthcoming).

15 In the English-language literature, there are frequent inconsistencies in the precise wording for curve-backed points, which are alternatively called curved-backed or curved-back points, or more infrequently arch-backed and convex-backed. Although convex-backed might actually be the most appropriate term, it has not been widely adopted and in this report we have used curve-backed by analogy with the standard use of angle-backed when referring to Creswell and Cheddar points, though admit that this is still grammatically inconsistent with the use of straight-backed point. In French a curve-backed point is *pointe à dos courbe*, and in German

Spitze mit gebogenem Rücken or *Spitze mit geschwungenem Rücken*.

16 The most parsimonious explanation would be that caves and rock shelters not only afford better circumstances for the preservation of Late Glacial residues, but that they are more archaeologically visible and liable to investigation, and hence have become disproportionately represented in contrast to the less easily detected 'open-air' sites. Other arguments have been advanced to suggest that the topographical zones in which caves occur may have been preferentially inhabited because they correlate with particular faunal niches and consequent hunting strategies (Barton et al 2003, 637; Jacobi 2004, 79).

17 The affinities of the Kilmelfort assemblage within Britain do appear to lie with the generalised Curve-Backed Point group industries rather than those of the more specific – and perhaps early *Federmessergruppen* horizon – assemblages of the Hengistbury Head type. Although including curve-backed points, the latter are characterised by straight-backed blades and bladelets, while also including tanged and shouldered points (Barton 1992; Barton et al 2009; Conneller 2007b).

18 Although some of the backed pieces (eg illus 4, 148) might not be out of place on Continental Hamburgian sites, suggesting the possibility of Hamburgian/*Federmessergruppen* transitional status for the Kilmelfort finds, it can be noted that the technological and typological range of the lithic assemblage at Kilmelfort is in complete contrast to that at the very recently recognised late Hamburgian site at Howburn (see the following note).

19 There is accumulating evidence for an even earlier human presence within the Late Glacial Interstadial in Scotland. The isolated find of an angle-backed point from Fairnington, Berwickshire, initially published as an intriguingly 'early'-looking piece (Saville 2004, fig 10.23) has been accepted as being of Creswellian affinity (Jacobi 2007, 105; Pettitt 2008, 43; Pettitt & Jacobi 2009, 32), and there is now the recent discovery of an open-air site of clear-cut late Hamburgian affinity at Howburn Farm, near Biggar in South Lanarkshire, with tanged points, end-of-blade scrapers, *en éperon* platform preparation, and other diagnostic features (originally announced as early Holocene in age: Saville et al 2007; see Pitts 2009; Ballin et al forthcoming).

APPENDIX

Concordance between artefacts illustrated in Coles (1983) and those illustrated or catalogued here (all are of flint unless otherwise indicated).

Coles (1983)	*This report*
Fig 2, 1	155, illus 5
Fig 2, 2	146, illus 5
Fig 2, 3	156, illus 5
Fig 2, 4	144, illus 5
Fig 2, 5	142, illus 5
Fig 2, 6	147, illus 5
Fig 2, 7	140, illus 5
Fig 2, 8	152, illus 5
Fig 2, 9	150, illus 5
Fig 2, 10	141, illus 5
Fig 2, 11	148, illus 5
Fig 2, 12	149, illus 6
Fig 2, 13	153, illus 5
Fig 2, 14	143, illus 5
Fig 2, 15	145, illus 5
Fig 2, 16	151, illus 5
Fig 2, 17	154, illus 5
Fig 2, 18a	91, illus 10
Fig 2, 18b	53, not illustrated
Fig 2, 18c	53, not illustrated
Fig 2, 19 quartz	21, illus 12
Fig 2, 20	181, not illustrated
Fig 2, 21	129, illus 11
Fig 2, 22	182, not illustrated
Fig 2, 23	128, illus 11
Fig 2, 24	90, illus 10

Coles (1983)	*This report*
Fig 2, 25	55, illus 3
Fig 2, 26	? not recognised
Fig 3, 1	75, illus 8
Fig 3, 2	84, illus 8
Fig 3, 3	87, illus 8
Fig 3, 4	88, illus 8
Fig 3, 5	74, illus 8
Fig 3, 6	71, illus 8
Fig 3, 7	76, illus 8
Fig 3, 8	86, illus 8
Fig 3, 9	80, illus 8
Fig 3, 10	72, illus 8
Fig 3, 11	73, illus 8
Fig 3, 12	78, illus 8
Fig 3, 13	81, not illustrated
Fig 3, 14	62, not illustrated
Fig 3, 15 quartz	18, illus 12
Fig 3, 16	89, illus 8
Fig 3, 17	63, not illustrated
Fig 3, 18	79, illus 8
Fig 3, 19	85, illus 8
Fig 3, 20	69, not illustrated
Fig 3, 21	82, illus 8
Fig 3, 22 quartz	17, not illustrated
Fig 3, 23	68, illus 3
Fig 3, 24	77, illus 8
Fig 3, 25	83, not illustrated
Fig 3, 26	56, illus 3
Fig 3, 27	57, illus 3
Fig 3, 28	52, not illustrated

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