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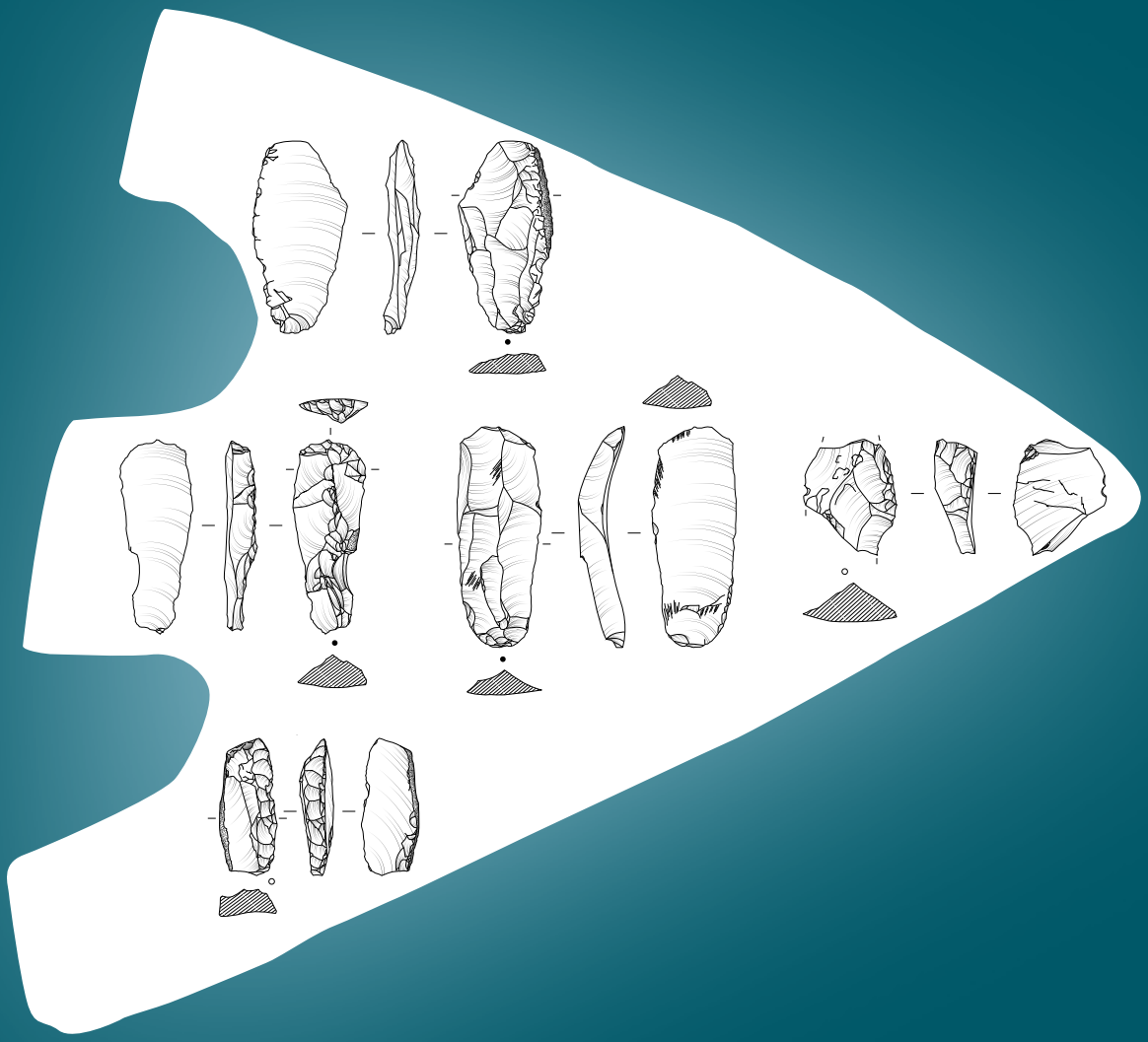

ARO48: A likely late Upper Palaeolithic assemblage from Lunanhead in Angus: re-examination and discussion

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Published by GUARD Archaeology Ltd, www.archaeologyreportsonline.com

Editor Beverley Ballin Smith

Design and desktop publishing Gillian Sneddon

Produced by GUARD Archaeology Ltd 2021.

ISBN: 978-1-9163261-9-4

ISSN: 2052-4064

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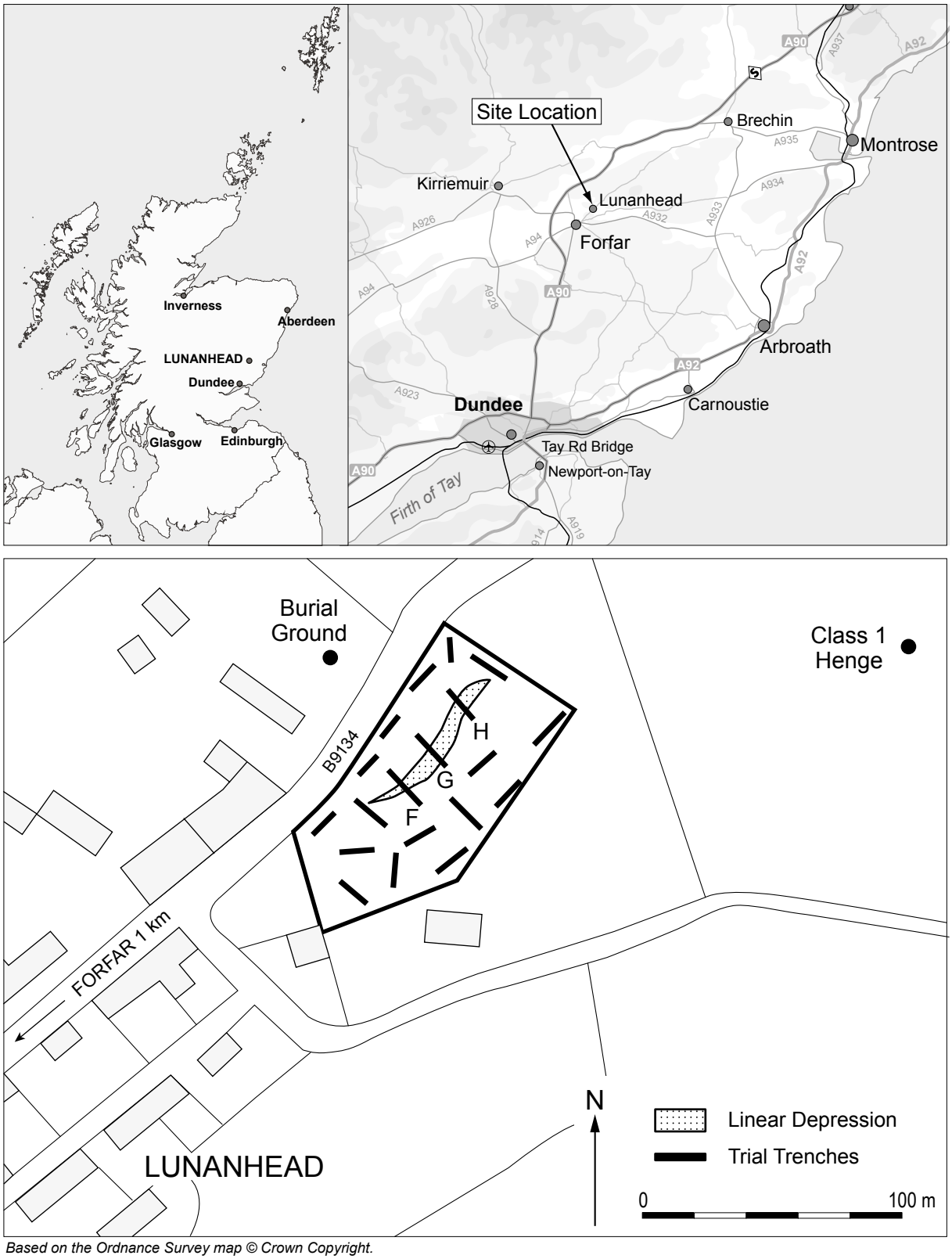

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Figure 1: Location map. Drawn by Gillian Sneddon, GUARD Archaeology Ltd.

'When you have eliminated the impossible, whatever remains, however improbable, must be the truth'.

Arthur Conan Doyle, The Sign of Four (1890)

Abstract

In 1996, a paper on the flint assemblage from Lunanhead, Angus, eastern Scotland (Wickham-Jones and Mackenzie 1996) suggested a Neolithic date for this small but unusual assemblage. This date was supported by a number of authorities on Scottish flint assemblages, and at the time the date seemed to be the 'best fit', as some Neolithic assemblages with large flint blades were known, whereas no Late Upper Palaeolithic (LUP) assemblages had yet been discovered and characterised. Since then, several LUP assemblages have been found, excavated and investigated, and it is thought that an LUP date for this assemblage is now more likely than a Neolithic one. The present paper is based on re-examination of the finds from Lunanhead, and the LUP attribution is supported by the presence of a number of diagnostic elements, such as raw material preferences and several burins, one of which is a burin on a truncation. However, the most important diagnostic element is the operational schema responsible for the production of the blades and the blade tools, and the fact that the blades and blade blanks were detached from large opposed-platform cores, where in Scotland all known post-Palaeolithic industries focused on the production of broad blades and microblades from single-platform cores, with opposed-platform cores generally representing the worked-down/re-orientated remains of single-platform cores.

Introduction

Two or three decades ago, archaeologists were still in doubt as to whether Scotland had been properly settled in Late Glacial times as no firm material culture evidence had been recovered. Three tanged flint points from western and northern Scotland had been discussed by R.G. Livens in a paper from 1956 (the Balevullin, Brodgar and Millfield points), but he stated that *'... there is no question of any [of the three points] being of Palaeolithic date*'. As all three pieces then 'disappeared', two of them only being re-found in museum stores recently, an opportunity was lost, and focused research into a possible Scottish Late Upper Palaeolithic had to wait another half a century, until new evidence allowed the outlines of a Scottish Late Upper Palaeolithic (LUP) period to be defined[1]. This new evidence includes Livens' rediscovered points, diagnostic pieces found by the re-examination of old museum collections, as well as newly excavated sites.

Chronological Framework

In Britain, the terminology used to describe the various LUP material cultures has been slightly confusing, and it is suggested to follow Paul Pettitt's (2008) 'Europeanist' approach: If the industries we are dealing with form part of techno-complexes covering large parts of north-western Europe, using the standard north-west European terminology makes more sense and this will make it easier to compare the British and Scottish material with contemporary related finds on the Continent. In Pettitt's terminology, the LUP (12,700-9,800 cal BC) covers three main stages, namely the Hamburgian (north)/Creswellian (south) (LUP I), the *Federmesser-Gruppen* (LUP II), and the Ahrensburgian (LUP III) (Table 1).

Lithic industry	Dates cal BC
Early Mesolithic	9,800 -
Ahrensburgian (LUP III)	10,800 - 9,800
Federmesser-Gruppen (LUP II)	12,000 - 10,800
Hamburgian (LUP I)	12,700 - 12,000

Table 1: The Scottish Late Upper Palaeolithic period and Late Upper Palaeolithic lithic industries identified in Scotland. The dates are largely according to Sonia Grimm at Scloss Gottorf, Schleswig-Holstein (pers. comm.). The dates for the Hamburgian include Classic Hamburgian as well as Havelte industries.

In addition, finds have been made in northern Scotland which suggest contact with Scandinavia, such as the single-edged point from Brodgar on mainland Orkney (Ballin and Bjerck 2016) and points from Millfield on Stronsay, also on Orkney (e.g. Wickham-Jones 2012, Fig. 1). These pieces are diagnostic of the Fosna-Hensbacka Complex, which straddle the Palaeolithic-Mesolithic transition, and they probably developed from

1 In this paper, the following abbreviations are used: LUP = Late Upper Palaeolithic; EM = early Mesolithic; LM = late Mesolithic; EN = early Neolithic; MN = middle Neolithic; and LN = late Neolithic.

Ahrensburgian points. As contacts between northern Scotland and Scandinavia depend on the existence of a route across the northern part of Doggerland, they are probably more likely to be contemporary with the later part of the Ahrensburgian (the early part of the Fosna-Hensbacka Complex) than with later stages of the Fosna-Hensbacka Complex (Kindgren 2002; Bjerck 2008). Although these pieces would fit best into a Fosna-Hensbacka scenario, it cannot be ruled out that they are in fact proper Ahrensburgian points, as small numbers of similar pieces have been found in Ahrensburgian contexts in Denmark, for example, (see for example Buck Pedersen 2009, Figure 22).

'State of the art' 2018

By 2019, four LUP industries have been preliminarily identified in Scotland, either through finds of settlements or through the recovery of stray finds or admixtures to assemblages from palimpsest sites.

Scottish settlements attributed to the LUP include Hamburgian Howburn in South Lanarkshire (Ballin *et al.* 2018), the *Federmesser-Gruppen* site Kilmelfort Cave near Oban in the Highlands (Saville and Ballin 2009), probably Ahrensburgian Rubha Port an t-Seilich on Islay in the Inner Hebrides (Mithen *et al.* 2015; Berg-Hansen *et al.* 2019), and Milltimber Scatter 4 in Aberdeenshire (Ballin 2019b) which is only attributable to the LUP in general.

Probable LUP objects have been recovered from several sites across Scotland: Ahrensburgian-type points have been retrieved from Shieldaig in Loch Torridon (Ballin and Saville 2003) and Balevullin on Tiree, Inner Hebrides (Livens 1956; Ballin and Saville 2003), and probable Fosna-Hensbacka points from Brodgar (Ballin and Bjerck 2016) and Millfield (Livens 1956) on Orkney. Likely LUP blades, cores and tools, not arrowheads or points, have been found throughout Aberdeenshire, such as at Nethermills Farm (Ballin and Wickham-Jones 2017), Blackdog (Ballin *et al.* 2017), Wester Clerkhill (Cameron and Ballin 2018), and several sites fieldwalked by the late Dr Grieve (Ballin forthcoming b).

In addition, a collection from Lunanhead in Angus was presented in 1996 (Wickham-Jones and Mackenzie 1996) as a probable Neolithic assemblage, as it included impressively large blades of what appeared to be exotic flint. At the time, this was a sensible assessment, as it is generally accepted that by the early/middle Neolithic transition large amounts of flint began to be imported into southern and central Scotland (Ballin 2011b) from north-east England ('the Greater Yorkshire area'), almost completely replacing the local chert with grey and black flint from large nodules, and with eastern Scotland also receiving some of this flint (e.g. Midmill in Aberdeenshire and Guardbridge in Fife; Ballin 2010; 2016a). However, the inclusion in the Lunanhead assemblage of several burins (a tool type which in Scotland has only been safely associated with sites attributed to the Palaeolithic and Mesolithic periods; cf. Ballin *et al.* 2018) suggests a considerably earlier date, and reconsideration of the age of this material is essential.

Aims and Objectives

The main aim of this paper is therefore to re-examine the Lunanhead assemblage and assess its likely date. The burins in particular indicate a LUP date, and the question is how assemblages like this may be distinguished from MN/LN assemblages based on similar raw material, that probably had been procured from sources on Doggerland rather than from the Greater Yorkshire area; Ballin 2011b; 2016b), and from broad blade assemblages from the EM which may also contain burins.

It is the author's working hypothesis that the transition between the Palaeolithic and Mesolithic periods saw the gradual replacement of one set of operational schemas by another set of schemas, where the production of broad blades prior to this transition was based mainly on the reduction of large opposed-platform cores (cf. Ballin *et al.* 2018; Ballin 2019a), and with Mesolithic and EN broad blades being struck from relatively small single-platform cores (cf. Ballin and Wickham-Jones 2017) with opposed-platform cores usually representing a late stage in the reduction sequence. During the LM, the reduction process focused on the manufacture of diminutive microblades, and at the EN/MN transition, the sophisticated Levallois-like technique was introduced (Ballin 2011a; Suddaby and Ballin 2010).

It is suggested that Scottish LUP assemblages without strictly diagnostic pieces like tanged and backed points, and occasionally individual finds, may be identifiable as pre-Mesolithic pieces by detailed analysis of their technological attributes. The defining attributes are those identifying the applied operational schema as one focused on blade production from large opposed-platform cores as later opposed-platform cores tend to be small, representing re-orientated single-platform cores. The analysis of the Lunanhead assemblage also includes comparison with certain LUP assemblages, like the one from Howburn (datable by its unique diagnostic Havelte points to the Late Hamburgian; Ballin *et al.* 2018), and probable LUP assemblages which include large blades from opposed-platform cores of exotic flint (such as the one from Milltimber, Aberdeenshire; Ballin 2019b). The finds are also compared with available Scottish blade-assemblages from the Mesolithic and EN periods.

The Location and Excavation

In 1993, Scottish Urban Archaeological Trust Ltd. (SUAT) carried out an investigation of a field near the village of Lunanhead, c. 3 km north-east of Forfar in Angus, eastern Scotland (NGR: NO477523; Figure 1). The work was prompted by a housing development and undertaken on behalf of Historic Scotland. A Neolithic henge (NRHE NO45SE38) was situated c. 150 m east of the field, and a Bronze Age burial site (NRHE NO45SE12) was located north of the field, on the opposite side of the B9134 road. The investigation showed that the burial ground did not extend into the development site.

Approximately one hectare of land was affected by the development, and this area was situated on the plateau of a hill, which towards the south sloped down towards marshland, the remains of Restenneth Loch. The loch was drained in modern times, and it, along with other lochs along Lunan Water, probably forms the surviving parts of a more substantial prehistoric waterway. The agricultural topsoil had a depth of c. 0.40 m, which rested directly on undisturbed fluvio-glacial sand and gravels, suggesting that any archaeological remains would have been disturbed by agricultural activity.

In total, 19 trenches were dug across the field, but most of those produced no finds. Three Trenches (F, G and H) were positioned across a 60 m long and 10 m wide depression, a possible palaeochannel, as it was hoped that archaeological features might have survived here. A reddish-brown sandy silt loam filled parts of the depression's base. This context was 0.30 m thick and may have been post-glacially water-sorted. However, this feature had clearly been disturbed by bioturbation and truncated by ploughing.

The lower fill of the feature was hand-excavated and sieved through a 5 mm mesh. No finds were recovered from Trenches F and G, but 28 lithic pieces were retrieved from a small area measuring 1.5 m2 in Trench H, and one piece (CAT 29) was found in the topsoil towards the south-western corner of the site. The 28 pieces from Trench H were mixed randomly into the lower fill, and it is thought that their individual positions had been affected by bioturbation.

This section represents a summary of the introductory section of Wickham-Jones and Mackenzie (1996), and Catherine Smith, formerly of SUAT, provided additional information on the site and its excavation.

The Assemblage

In total, 29 lithic artefacts were recovered from Lunanhead. They are listed in Table 2. The collection includes 76% debitage (flakes, blades and crested pieces), whereas 24% is tools (scrapers, burins, strike-a-lights and edge-retouched pieces). No cores were recovered.

Type	Number
Flakes	5
Blades	13
Crested blades	4
Blade-scrapers	1
Side-scrapers	1
Burins	2
Burins/burin-spalls	1
Strike-a-lights	1
Pieces w edge-retouch	1
Total	29

Table 2: General artefact list.

Raw materials – types, sources and condition

All 29 artefacts from Lunanhead are of first-class pure and homogeneous flint with excellent flaking properties. A total of 27 pieces are of mottled light-grey flint, whereas two are described as mottled light-brown flint (a slightly darker form of the mottled light-grey flint). The former corresponds to the flint recovered from the Hamburgian site of Howburn in South Lanarkshire (in this context referred to as Doggerland flint; Ballin *et al.* 2018), and from MN/LN sites near the Overhowden Henge in the Scottish Borders (in this context referred to as Yorkshire flint; Ballin 2011b). Doggerland flint and Yorkshire flint are basically the same type of flint, namely Upper Cretaceous flint with excellent flaking properties, and the different names simply refer to the likely location of the sources – it is most likely that the flint from Howburn was procured from sources on Doggerland, as the LUP hunters who settled this site would have come up the River Tweed following reindeer inland from the then dry Doggerland basin (Ballin 2016b), whereas it is most likely that the Neolithic settlers from the area around the Overhowden Henge in the Borders would have obtained their flint through trade with people in the Greater Yorkshire area where this form of flint was plentiful (Durden 1995).

Generally, lithic assemblages from eastern Scotland include notable numbers of artefacts based on honey-brown, red, orange and yellow flint, which is almost considered a hallmark of this region (in this paper referred to as red-brown flint; Stevenson 1948, 181). The recently excavated assemblage from Carnoustie in Angus (Ballin forthcoming a) includes a notable proportion of red-brown flint, which was associated with three EN timber-halls, as well as Yorkshire flint, which was associated with a number of MN/LN pits. The assemblage from the mainly Mesolithic site at Nethermills Farm on the Dee, Aberdeenshire (Ballin 2017), contains notable proportions of red-brown flint, as well as some probably local grey flint. The assemblage from the recently excavated early prehistoric scatters at Milltimber, immediately north of the Dee, Aberdeenshire (Ballin 2019b), includes some flint of the red-brown form, but it is dominated by local grey flint. In addition, Milltimber Scatter 4, which was attributed to the LUP by its operational schema, includes large proportions of what is thought to be Doggerland flint, procured in the form of very large nodules.[2]

As indicated by Figure 2, which compares the size of blades from Lunanhead with LUP blades from Howburn (Ballin *et al.* 2018) and probably LUP blades from Milltimber Scatter 4 (Ballin 2019b), the blades from Lunanhead (Width = c. 16-30 mm) form a size category between Howburn (Width = c. 8-20 mm) and Milltimber Scatter 4 (Width = c. 18-32 mm), overlapping partially with both. The Hamburgian blades from Howburn are the narrowest, although in a local Scottish context they are still quite broad blades and those from Milltimber, which are not assigned to any specific part of the LUP are the broadest.

It was subsequently attempted to compare the blades from these LUP and likely LUP sites with the blades from known Mesolithic and Neolithic sites, relying on published material, and Figure 3 shows the dimensions of the blades from LM Standingstones from Aberdeenshire (Ballin 2019c), EN Garthdee Road from Aberdeen (Ballin 2014), and MN/LN Midmill, also from Aberdeenshire (Ballin 2010), as well as the average width of EM microliths from eastern Scotland. Most of the blades from Standingstones have widths of c. 5-6 mm, those from Garthdee Road c. 9-14 mm, and the blades from Midmill overlap with those from Garthdee Road. Inspection by the author of the entire lithic collection at the Marischal Museum in Aberdeen showed that Neolithic tools based on blade blanks larger than those represented by the assemblages in Figure 3 exist, but they tend to be exceptionally well-executed prestige pieces which may have been manufactured for special purposes, such as the inclusion in burial and ritual contexts. Also, these large blade blanks are considerably more regular and thinner than those recovered from for example Lunanhead and Milltimber Scatter 4.

Scottish Early Mesolithic sites and assemblages are exceptionally rare, and as put in Ballin and Ellis (2019) only the small assemblage from Donich Park in Argyll is likely to be entirely unmixed, but unfortunately the lithics from this

2 In Ballin (2019a) it was estimated that the Mesolithic local grey flint was procured from 40-70 mm long pebbles from local beach walls, whereas the Palaeolithic grey flint was procured from nodules up to 150 mm long from sources on Doggerland.

retooling station include few blades. The larger assemblages from Morton Site A and An Corran may include some later material and their blade assemblages were therefore not suitable for inclusion in Figure 3. However, the size of EM obliquely blunted points and isosceles triangles from sites in eastern Scotland indicate the general size of the region's EM blades as – in contrast to for example LM scalene triangles which after modification tend to be approximately half as wide as their parent blades – the EM microliths tend to have widths close to those of the original blades. Scottish EM blades are mostly small broad blades (i.e. broader than 8 mm), and those from eastern Scotland have estimated widths between, or just above, 8-10 mm, based on 31 EM microliths from Nethermills Farm and 16 from Grieve's Collection. Both assemblages are chronologically mixed (Ballin 2017; forthcoming b).

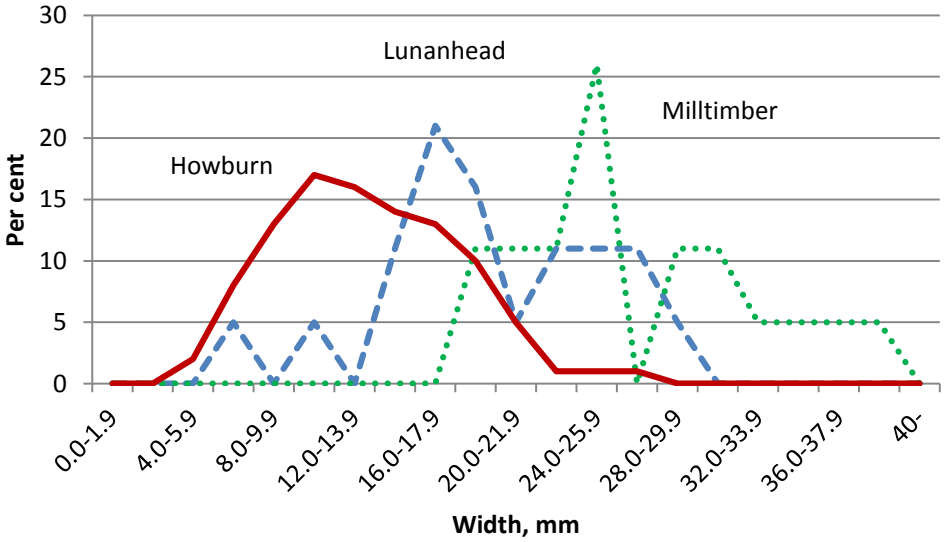

Figure 2: The dimensions (width) of the blades from the mainly Hamburgian site of Howburn, South Lanarkshire, and the two assumed LUP sites from eastern Scotland, Lunanhead in Angus and Milltimber Scatter 4 in Aberdeenshire.

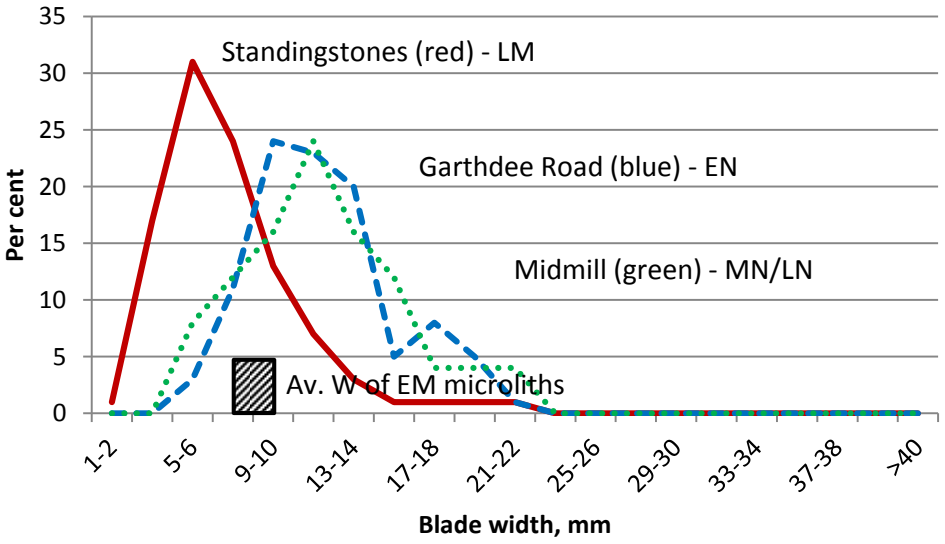

Figure 3: The dimensions (width) of post Palaeolithic blades from sites in eastern Scotland: LM Standingstones, Aberdeenshire; EN Garthdee Road, Aberdeen; and MN/LN Midmill, Aberdeenshire. In addition, the width of EM microliths from Aberdeenshire sites are shown (black).

The fact that the LUP assemblages from Lunanhead and Milltimber Scatter 4 in eastern Scotland do not include any blades based on red-brown flint, and that they are considerably larger than the region's Mesolithic and Neolithic assemblages, suggests that lithic procurement strategies may have changed over time. As mentioned above, it is thought that the flint used at the former two sites was procured from sources on Doggerland, where large nodules may have been available from primary and/or secondary outcrops, whereas the region's later assemblages may be dominated by flint procured mainly from beach walls along the North Sea coast in the form of smaller nodules. Information in Wickham-Jones and Collins (1978, 9-12) suggests that some flint may be present in the till/boulder clay along the entire Scottish east-coast, deposited there by glaciers moving inland. This movement is – although not yet fully understood – supported by the presence in the till of eastern Scotland from Orkney to Yorkshire, of erratic cobbles and pebbles of rhomb porphyry from the Oslo area (Harker 1897; Merritt *et al.* 2003; Leather 2006). Most likely, the small flint pebbles found along the east-coast of post-glacial Scotland eroded out of the till.

Two flakes and two blades have soft-ish cortex, supporting the suggestion that some of the exploited flint was procured from primary sources on Doggerland. Only two of the artefacts are thermally affected (burnt or frost-shattered). CAT 18, the side-scraper, and CAT 7, one of the burins, display several cracks, but it is not possible to determine with certainty whether the pieces were exposed to fire or frost.

Debitage

As shown in Table 2, the assemblage includes 22 pieces of debitage: five flakes, 13 blades and four crested blades.

Only eight of the 13 blades are intact (Figure 4), and they have average dimensions of L:44.3; W: 18.9; Th[3]: 5.4 mm (LW[4] ratio 2.3:1.0). Although two relatively small blades have LW ratios between 4:1 and 3:1, most blades have LW ratios between 2:1 and 3:1. As shown in Figure 4, Most blades have widths between 14 mm and 30 mm. The difference between the delineation of the curve in Figure 5 and that of Figure 2 is due to the fact that the curve of the former diagram is based on increments of 1 mm and that of the latter on increments of 2 mm. This makes the latter curve fluctuate slightly less. A selection of blades is shown in Figures 8 and 9 (CATs 3, 4, 16, 20 and 24).

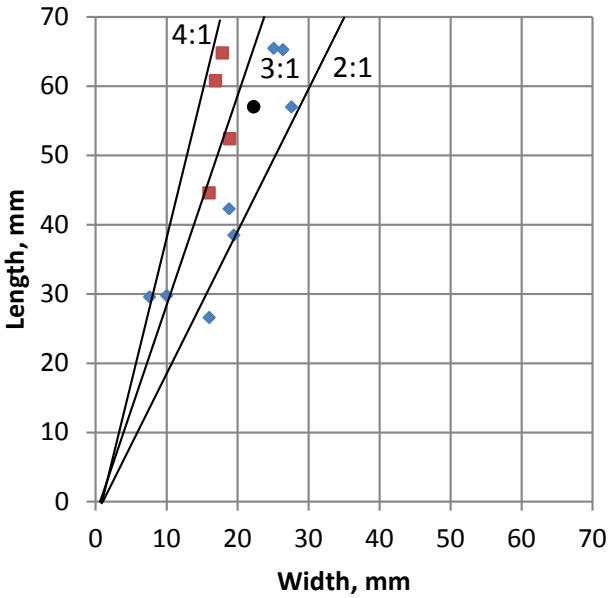

Figure 4: The dimensions (length/width) of all intact blades (blue), crested pieces (red), and blade-scrapers (black).

All flakes were detached by direct hard percussion and display pronounced bulbs of percussion; no bipolar flakes were recovered. An attribute analysis was carried out of 16 intact blades and proximal blade fragments, and the results may be summarised as follows:

- The sample includes 16 specimens, three of which are crested blades and one is a blade-scraper
- Nine pieces are tertiary and seven are secondary blades
- The ventral flaking-angle is generally obtuse (>90 degrees)
- Most platform remnants are plain, but five are either faceted or finely faceted
- Three blades have no dorsal preparation of their platform-edges (all faceted pieces), one displays trimming/abrasion, whereas the remainder are either trimmed or crudely trimmed

3 L = length, W = width, Th = thickness
4 LW = length/width

- Following the definitions of Madsen (1992) and Sørensen (2006), one platform remnant is broad and thin, whereas the remainder are either punctiform, small and thin, or small and thick
- Compared to the impressive size of the blades (Figures 2 and 4), the platform remnants are quite small (Figure 6), with average dimensions of 6.8 by 2.3 mm, and an average width:depth ratio of 3:1
- One blade suffered platform collapse, two display pronounced bulbs, whereas the remainder either display discrete bulbs, discrete lips or they have no bulbs or lips
- Two terminations are hinged - one has an overpassed termination, whereas the remainder have feathered terminations.

Most likely, the blades from Lunanhead were produced by the application of direct soft technique with the percussor being either a soft stone hammer or an antler hammer, (see Sørensen's Schema 3; Sørensen 2006, 63), but the small platform remnants indicate that in some cases indirect (punch) technique may have been applied (see Hartz 1987, Abb. 9, Ahrensburger Kultur).

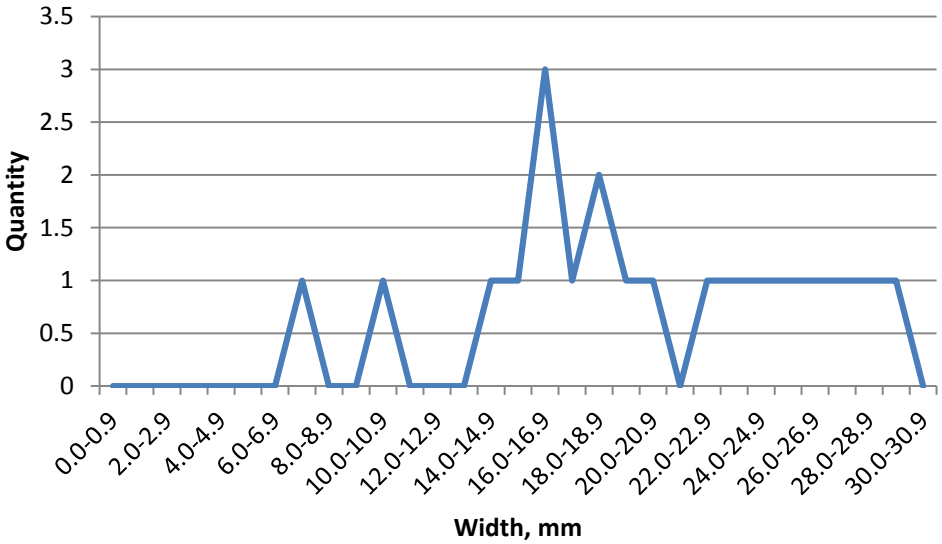

Figure 5: Widths of all unmodified and modified blades.

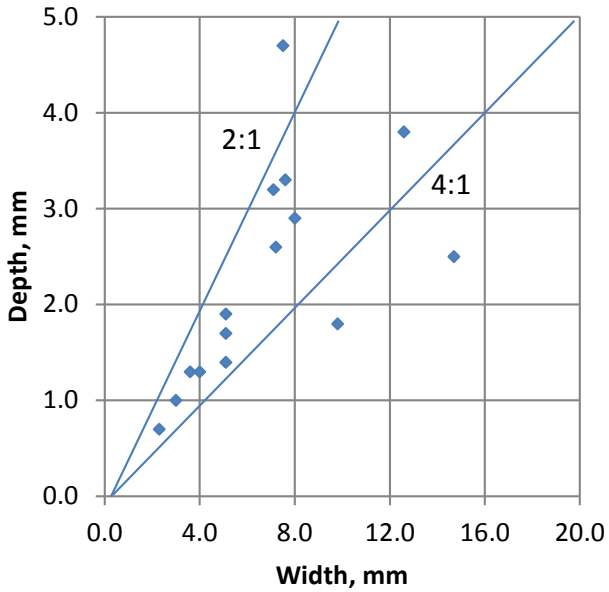

Figure 6: The dimensions (width/depth) of all blade platform remnants.

Eleven of the blades and blade tools (CATs 3, 4, 5, 11, 12, 14, 16, 18, 20, 23 and 24, Figures 7 and 8) have opposed dorsal scars, indicating that they were struck from large opposed-platform cores. Two of these blades (CAT 5 and 24; Figures 8 and 9) have surviving trimmed platform-edges at their distal ends. These elements are discussed further in the technology section.

As shown in Figure 4, the four crested blades (CATs 5, 11 both Figure 8, 14 not illustrated, and 28 Figure 8), are slightly larger and slightly more slender than the uncrested blades. The average dimensions of the crested pieces are L: 55.7; W: 17.4; Th: 6.7 mm (LW ratio 3.2:1.0). The larger size of the crested blades is due to these pieces representing an earlier stage of the reduction process than the uncrested blades (see Technological Summary, below). Both scrapers (CAT 18, Figure 8 and CAT 27, Figure 9) are based on crested blades.

Tools

The seven tools include two scrapers, three burins, one strike-a-light, and one piece with edge-retouch.

Scrapers: CAT 27 is a large blade-scraper (L: 57.0; W: 20.5; Th: 8.3 mm), based on a crested blade (Figure 9) and approximately 53 mm of dorsal crest survives. It has a convex, steep scraper-edge at its distal end, and the scraper-edge angle varies between 55-70 degrees. In addition, it has fine hafting retouch at the proximal end, right-hand side.

CAT 18 is a side-scraper, and the surviving medial fragment measures L: 31.8; W: 29.8; W: 10.8 mm (Figure 9). The blank may have been either a large flake or an impressively large blade, and it has a short stretch (2-3 mm) of surviving dorsal crest. Along its right lateral side it has a slightly convex, steep scraper-edge (55-65 degrees).

Burins: The assemblage includes three robust burins. CAT 6 (not illustrated) is a double-burin on the medial section of a large blade (L: 42.1; W: 23.5; Th: 9.7 mm), and it has a burin-edge at either end. At the distal end, a burin-edge was formed by detaching a burin-spall from the right corner of a distal break, and at the proximal end, a burin-edge was formed by two transverse blows to the right lateral side, where a break facet had developed when this side broke off. Both burin-edges show distinct macroscopic wear from the use as 'gravers', easily distinguishable in 8x or 10x magnification. The distal working-edge has wear at its ventral corner, and the proximal one at its ventral and dorsal corners.

CAT 7 is a burin of similar size (L: 48.7; W: 24.7; Th: 12.9 mm) and type (Figure 9). This piece is also based on the medial section of a large blade, and it also has a burin-edge at either end. At the distal end, a burin-edge was formed by detaching two ventral burin-spalls from the right corner, and their removal makes this piece easily identifiable as a burin. The proximal end was removed by a blow to the dorsal face, and a burin-edge was formed by removing a flake along the tool's left lateral side. Both burin-edges display macroscopic use-wear, and fine chips along the right lateral side of the piece show that it was also used in other ways. Future microscopic use-wear analysis may be able to determine whether it was used as a knife, scraper or spoke-shave.

CAT 12 is definitely the most interesting and informative of the three burins (Figure 8). It measures L: 40.7; W: 14.9; Th: 4.9 mm, and it is technically a burin-spall, but due to its size and robustness it was used as a burin. Figure 7 shows how this implement was formed: A large blade with an oblique truncation (retouched from both faces, that is, *sur enclume*) was struck at its distal left corner to detach a burin-spall along its left lateral side, but the burin-spall overshot and detached the entire distal right corner of the original blade. The piece has very fine macroscopic use-wear at its distal left corner barely visible at 10x magnification. It also has use-wear at its unmodified proximal right corner, showing that CAT 12, like the other two burins from Lunanhead, was used as a double-burin. The fact that this is a burin on a truncation defines it as almost certainly an LUP burin (see Dating, below).

Figure 7: The formation of burin/burin-spall CAT 12.

Strike-a-lights: One piece (CAT 29) was identified as a strike-a-light (Figure 9). It is based on the medial-distal segment of a large blade, and it measures L: 38.8; W: 17.1; Th: 9.2 mm. Its right lateral side was blunted by well-executed coarse retouch, whereas its left lateral side was naturally blunted by cortex. Its distal end was rounded by smooth abrasion, probably from its use as a strike-a-light, where fire was made by striking a piece of pyrite (Stapert and Johansen 1999). As noted by Wickham-Jones and Mackenzie (1996, 13), the right lateral modification of the piece gives it a superficial similarity with an early Bronze Age 'slug knife' (Finlayson 1997). Both these pieces were mostly based on flakes as no 'proper' blades were produced after the

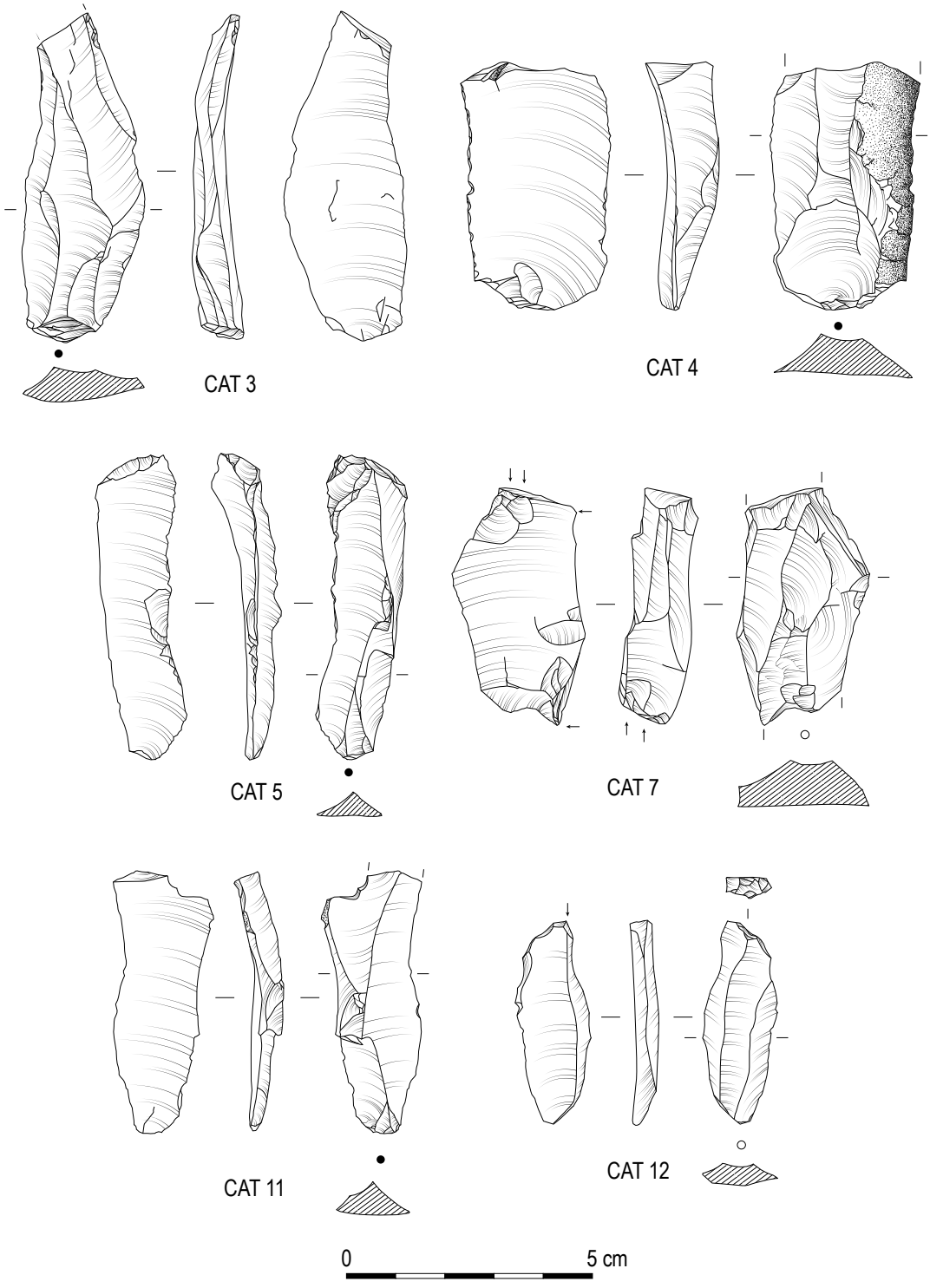

Figure 8: Selected pieces: Blades (CAT 3 and 4), crests (SF 5 and 11) and burins (7 and 12). Drawings by Leeanne Whitelaw.

Neolithic/Bronze Age transition, whereas CAT 29 is based on a large blade. The raw material is similar to that of the collection's other 28 pieces, that is mottled light-grey flint. Where the other pieces from Lunanhead were recovered from Trench H, this piece was discovered in the topsoil in another part of the field. If this piece truly is of a Palaeolithic date, this suggests that LUP objects may have been included in topsoil and subsoil contexts throughout the field.

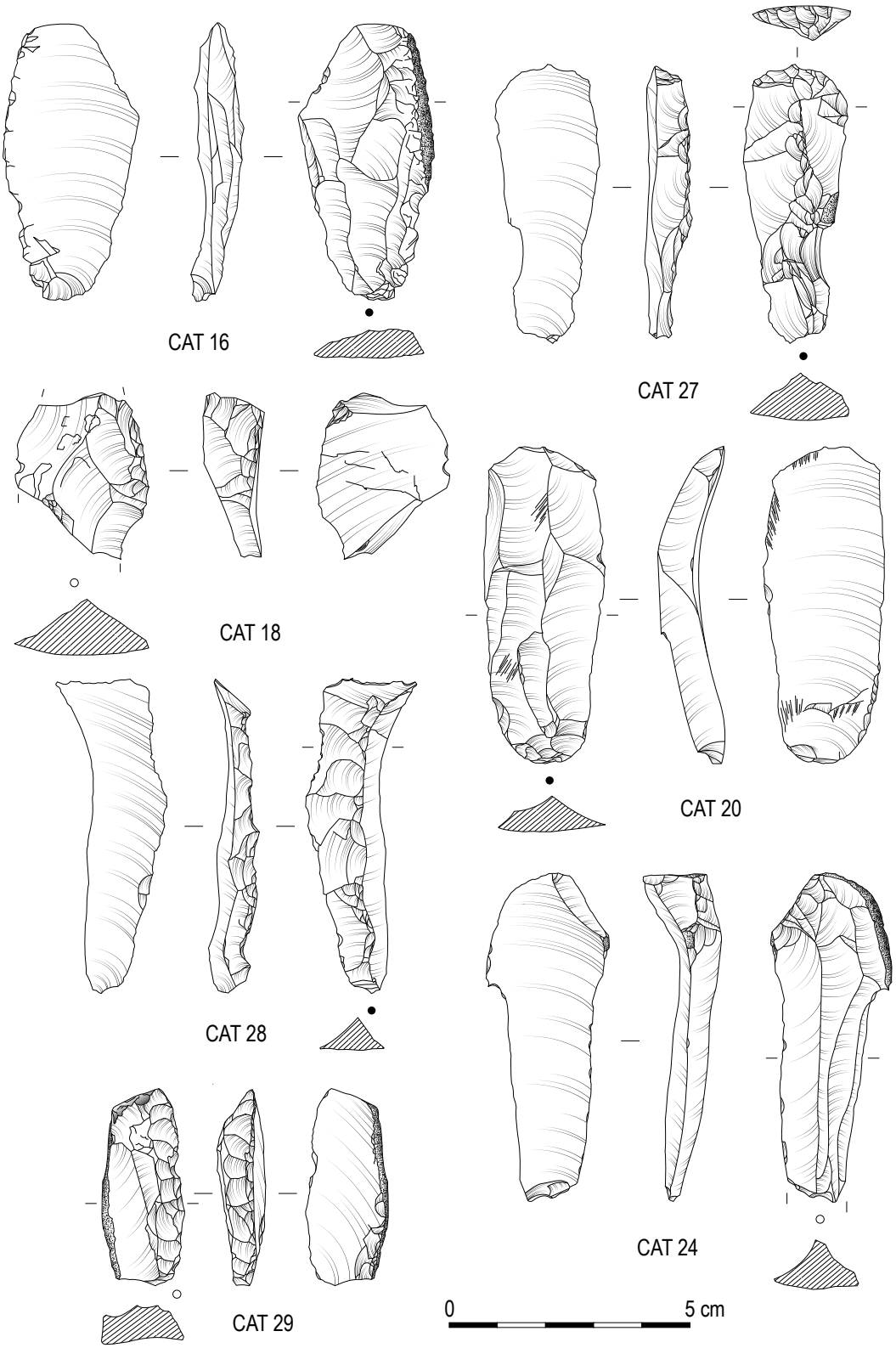

Figure 9: Selected pieces: Blades (CAT 16, 20 and 24), crest (SF 28), blade-scraper (CAT 27), side-scraper (CAT 18) and strike-a-light (CAT 29). Drawings by Leeanne Whitelaw.

Pieces with edge-retouch: CAT 1 is a large hard percussion flake with a short stretch of hafting retouch along its left lateral side, proximal end. It measures L: 48.8; W: 26.3; Th: 6.8 mm. It has fine macroscopic use-wear (flat spin-offs) along both lateral sides from its use as a knife.

Pieces with use-wear: Several of the formal tools - one scraper, all burins, and one piece with edge-retouch - show distinct macroscopically visible use-wear that is, use-wear visible by the use of a magnifying glass but *not* needing a microscope to be seen, and which was in most cases associated with their modified working-edges. In addition, five blades and two crested pieces have finely chipped lateral edges from use as informal knives.

Technological Summary

This technological summary is based on information presented in the raw material, debitage, and tool sections above. The preferred raw material at Lunanhead is mottled light-grey flint with excellent flaking-properties and without impurities. The largest blades and crested pieces have lengths of almost 70 mm, suggesting that prior to the preparation of the cores, the procured raw nodules would have been more than 100 mm long. Although no platform rejuvenation flakes were recovered from the Lunanhead site, it is expected that platform rejuvenation would have taken place, as at Milltimber Scatter 4 (Ballin 2019b), adding another few centimetres to the length of the original nodules, and the length of the nodules would probably have exceeded 120 mm.

The recovery of 13 broad blades, four crested blades, and tools based on similar blades and crested pieces suggests that the industry responsible for this assemblage focused on the production of broad blades. As shown in Figures 4 and 5, the manufactured blades have average dimensions of L: 44.3; W: 18.9; Th: 5.4 mm, but with some blades being up to almost 70 mm long. The crested blades, which would have been struck off the cores prior to the initiation of actual blade production, are even longer. As shown in Figures 2 and 3, the blades are considerably larger than those produced by later east of Scotland blade industries. The blades and the crested blades are generally fairly slender, with LW ratios of up to 4:1. The flakes probably largely represent decortication of the core rough-outs (including one primary flake), as well as final blank production when cores had lost their original regular shape.

The directionality of the blades' dorsal scars suggest that most, if not all, of the blades were detached from large opposed-platform cores, and several blades have surviving trimmed platforms at their distal ends, like the blades from Milltimber Scatter 4 (Ballin 2019b). Unfortunately, no cores were recovered during the investigation of the site. The flakes were generally manufactured by the application of direct hard percussion, whereas most blades appear to have been produced by the application of direct soft technique with the percussor being either a soft stone hammer or an antler hammer (see Sørensen's Schema 3, Sørensen 2006, 63). Five blades have either faceted or finely faceted platform remnants, but most of the blades are only trimmed or crudely trimmed. No *en* éperon blades were recovered (Barton 1990), that is, finely faceted blades with a small spur at the centre of their platform remnant, dorsal edge. Such pieces were common at Howburn (*Ballin et al. 2018*), and they are diagnostic of Hamburgian industries, as well as their Creswellian and Late Magdalenian contemporaries (Barton 1990; Jacobi 2004; Weber 2012).

In general terms, the applied operational schema corresponds to those defined for the assemblages of Howburn and Milltimber Scatter 4, with preparation of large opposed-platform cores by the application of serial cresting and platform rejuvenation and where most blades were detached by direct soft percussion, but there are also differences. At Howburn, for example, *en* éperon technique was used, but this approach was not applied at Lunanhead and Milltimber Scatter 4. At Howburn and Lunanhead some core platforms were prepared by fine faceting, whereas this practice was not followed at Milltimber Scatter 4.

Dating

The flint assemblage from Lunanhead appears to be a coherent chronological unit, and its typo-technological composition suggests that

it may have been deposited within a relatively short span of time. The assemblage includes a number of diagnostic elements, such as the raw material exploited at the site, the typology of the tools, and technological attributes as well as the applied operational schema.

Raw material

As shown above in the raw material and technology sections, the colour (mottled light-grey), quality (purity and flaking properties), and size (nodules probably exceeding 120 mm) of the lithic artefacts from Lunanhead define the procured raw material as exotic flint, that is, flint procured outside present-day Aberdeenshire. It was suggested that the assemblage from Milltimber Scatter 4 (Ballin 2019b) was procured from sources on Doggerland, as it was dated by its operational schema to the LUP, and as routes followed by LUP reindeer hunters up and down the rivers of Aberdeenshire, in this case the River Dee, are likely to have included parts of Doggerland (Ballin 2016b). Similar exotic flint was exploited during the middle and late Neolithic periods but probably procured from Yorkshire (cf. Ballin 2011b; Suddaby and Ballin 2010). The flint used by post-LUP industries in eastern Scotland may have been procured in the form of smaller pebbles from the shores of the North Sea where they probably eroded out of the till (see above).

Typology

Several of the tool types recovered at Lunanhead – one blade-scraper, three burins, and one strike-a-light – supports the suggested LUP date of this assemblage. Although in eastern Scotland blade-scrapers do occur during other prehistoric periods, such as the Neolithic – and in particular the later Neolithic (Suddaby and Ballin 2010) – they are quite rare on early Mesolithic sites, which are also associated with broad blade production. The early Mesolithic assemblage from Star Carr in Yorkshire includes blade-scrapers (Clark 1954: Fig. 40; Conneller *et al.* 2018: 523), and it has therefore been considered that blade-scrapers might also have formed part of early Mesolithic assemblages in Scotland. However, scrutiny of Scottish early Mesolithic assemblages – such as those from Morton in Fife and An Corran on Skye (Coles 1971; Saville *et al.* 2012) suggests that Scottish scrapers from this period are mostly short and squat flake-based end-scrapers, although small numbers of blade-scrapers are occasionally found. The blanks of the blade-scrapers from Scottish later Neolithic sites, e.g. those from sites near the Overhowden henge in the Scottish Borders (Ballin 2011b), tend to be based on more robust percussion techniques. However, the one from Lunanhead is likely to have been produced by direct soft percussion, the preferred percussion technique during the LUP (e.g. Hartz 1987, Abb. 9; Madsen 1992, 108; Barton 1992, 100; Lewis and Rackham 2011, 96; Weber 2012, 133).

The three burins are robust pieces, and the fact that CAT 12 is based on a truncated blade indicates a date in the LUP. In Scotland, burins have not yet been recovered from safe post-Mesolithic contexts, where Butler (2005, 131) reports that they are occasionally discovered on early Neolithic English sites. They seem to be generally datable to the LUP-Mesolithic framework, with burins on truncations apparently being absent in Mesolithic contexts, whereas they are common in LUP contexts. At Howburn, a Hamburgian site (Ballin *et al.* 2018), 16 of 40 burin-edges were on truncations (or 40%), and at Kilmelfort Cave near Oban, a *Federmesser-Gruppen* site (Saville and Ballin 2009), two of four burins were on truncations.

Although burins do occur on Scottish Mesolithic sites, they are much rarer in these contexts than in pre-Mesolithic contexts. They tend to be absent on Mesolithic sites, and if they are present, then it is usually only as ones, twos or threes, depending on the numerical size of the assemblage. At Howburn, 40 burins were recovered! In his paper on Scottish gravers, Lacaille wrote (1938, 180-181) '*… it is in the different divisions of the Upper Palaeolithic that they abound to such extent as virtually to constitute the type tools of these stone industries*'; and '*…compared with their Palaeolithic forerunners, the relatively uncommon gravers of later stone industries are generally inferior and rudimentary*'.

Although it is uncertain how numerically large the Lunanhead assemblage would originally have been as the present assemblage is obviously a truncated sample, three clearly identifiable burins in an assemblage of 29 pieces (10% of the total), and three burins of seven formal tools (43% of the implements) clearly defines the

burins of the collection as 'numerous' in relative terms. This suggests a date for the Lunanhead assemblage of the LUP period. By comparison, the Kilmelfort Cave burins represent 3.5% of the site's tools, where the Howburn burins make up almost 6% of the site's tools.

Flint strike-a-lights were probably manufactured throughout early prehistory and used for fire-making with a piece of pyrite (Stapert and Johansen 1999). However, they are quite common in British LUP contexts. One combined scraper/strike-a-light was recovered at Howburn (Ballin *et al.* 2018; Plate 16, 2433), and the assemblage from Gough's Cave, Somerset, includes pieces with simple edge-retouch and rounding (Jacobi 2004: Figure 29), as well as composite tools with rounded ends (ibid, Figure 15). Similar pieces were also recovered from the slightly later site of Hengistbury Head (Barton 1992, Figures 4.27-28).

Technology

Several technological attributes suggest a pre-Mesolithic date for the Lunanhead assemblage, such as the very large size of the blades (Figures 2 and 3), the general application of direct soft percussion, and the use of fine faceting as a means of preparing the cores' platforms. As demonstrated by Figures 2 and 3, the assemblage from Lunanhead forms part of a group of assemblages from central and eastern Scotland, which are characterised by blades considerably larger than the blades characterising later sites in the region. Some of these blades are so large, particularly those from Milltimber, that they could be called *Riesenklingen* (or 'giant blades').

Riesenklingen were discussed by Schwabedissen (1954, 36) based on the site of Rissen Fundplatz 14/14a near Hamburg. Although this site also yielded finds dating to other periods, the *Riesenklingen* were mainly associated with Ahrensburgian elements at the location. In Britain, this industry has been referred to as the Long Blade Industry (Barton 1998) or, based on the presence of a specific type of wear on some of these blades, the Bruised Blade Industry. However, the author finds it unfortunate to define an industry based on a particular type of (robust) wear, as it is highly likely that the bruised blades represent only one aspect of an industry rather than the industry as a whole.

Some colleagues have suggested that the Lunanhead blades may, for example with reference to material from Star Carr in north-east England (Clark 1954; Conneller *et al.* 2018), be attributable to the EM, but this view is based on the assumption that Scottish EM material is similar to English EM material. However, lithic industries from the Scottish EM may have developed along a different trajectory, as indicated by the absence in the north of several English industries e.g., Horsham and Honey Hill industries (Clark and Rankine 1939; Saville 1981; Waddington *et al*. 2017) and their typical microlith forms, and Scottish EM blades are likely to be considerably smaller than those characterising English EM assemblages from the chalk of eastern and southern England.

Mesolithic cores from Scottish sites tend to have plain platforms, whereas fine faceting is diagnostic of British Hamburgian/Creswellian e.g. Howburn and Gough's Cave (Ballin et al. 2018; Jacobi 2004), and Ahrensburgian assemblages e.g. Three Way Wharf Scatter A (Lewis and Rackham 2011, 46). Only a small number of British assemblages from *Federmesser-Gruppen* sites have been published, but analysis of the blades from Nea Farm in Hampshire suggests that although faceting of platforms was not common, it did occur on c. 13% of all blade butts (Barton *et al.* 2009, 10). However, at Rookery Farm in Cambridgeshire as many as 33% of the site's blades had faceted butts (Conneller *et al.* 2009: 175).

The most important technological indicator is arguably the full operational schema of a site, and the fact that at Lunanhead the settlers focused on the production of very large blades from well-prepared opposed-platform cores by the application of direct soft percussion and fine faceting of platforms. These suggest a date in the LUP period. In Scotland, the Palaeolithic/Mesolithic transition represents a (probably gradual) transition from one main approach to another, where prior to this point in time most blades were struck from opposed-platform cores, and after this from smaller (mostly conical) single-platform cores (Ballin 2019a). The Lunanhead operational schema appears to be roughly similar to the one defined for the LUP assemblage from Milltimber Scatter 4 (Ballin 2019a). However, the Milltimber operational schema did not include

fine faceting of the cores' platforms, suggesting that the two assemblages may represent different parts of the LUP period. As no Lunanhead blades and no blades from Milltimber Scatter 4 were produced by the application of *en* éperon technique, those two assemblages probably post-date the Hamburgian period – or they may be from a part of the Hamburgian pre- or post-dating Howburn - it must be borne in mind that we still only have one certain Hamburgian site in Scotland.

Discussion

As mentioned in the introduction, the Lunanhead collection was initially defined as a probably Neolithic assemblage, as this was what the existing evidence of the mid 1990s suggested. At that time, no Scottish LUP assemblages were known, and the only stray Scottish LUP arrowheads in existence had been suggested by Livens (1956) to *not* be Palaeolithic, and following their presentation in PSAS in 1956 all three points had subsequently been temporarily lost (apart from the Tiree point they have all been re-found), and it was therefore not possible for anybody to examine them. Based on comparison with Continental assemblages, they must now be considered probable LUP points, either of Ahrensburgian or Fosna-Hensbacka affiliation (Ballin and Bjerck 2016).

However, re-examination of the Lunanhead assemblage, exposure of the collection to typo-technological attribute analysis, and comparison of the Lunanhead artefacts with recently discovered Scottish LUP, and likely LUP, assemblages and stray finds suggest that the Lunanhead assemblage most likely dates to the LUP, although an unspecified part of this period. The presence of robust burins suggests that the assemblage should be attributed to the LUP-Mesolithic framework, whereas the recovery of one burin on a truncated blade blank, as well as the site's relatively large number of burins, indicates a pre-Mesolithic date. This likely date is supported by the fact that several blades have finely faceted platform remnants.

One of the key chronological indicators, however, is the fact that the collection's large blades were detached from impressively-sized opposed-platform cores, where Mesolithic and rarely Neolithic blades were mostly struck from considerably smaller single-platform cores, and some middle and late Neolithic blades from Levallois-like cores. It is suggested in eastern Scotland to distinguish between first- and second-generation opposed-platform cores, where first-generation opposed-platform cores may be diagnostic of the LUP period (Figure 10). First-generation opposed-platform cores are defined as large opposed-platform cores prepared in connection with the first stage of a reduction sequence, whereas second-generation opposed-platform cores are considerably smaller pieces produced by recycling damaged or exhausted single-platform cores, usually when these cores had lost their original apex by breaking or by blades overpassing.

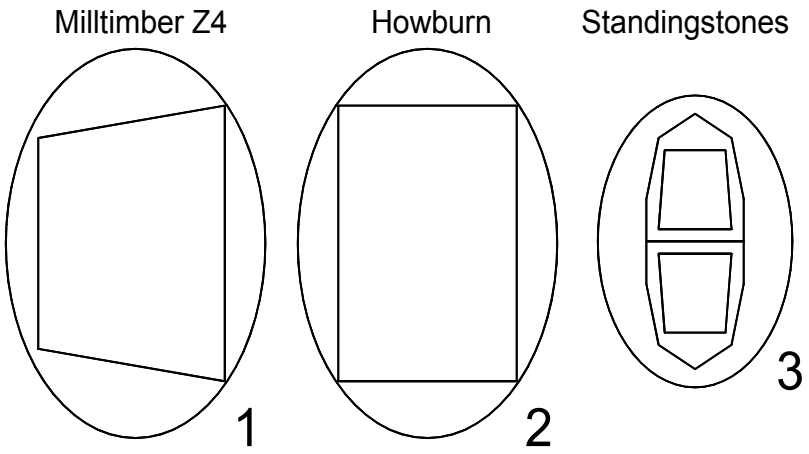

Figure 10: First-generation opposed-platform cores from Milltimber Scatter 4 and Howburn, and second-generation opposed-platform cores from Standingstones.

At Milltimber Scatter 4 (Ballin 2019a), one relatively small (L: 48; W: 28; Th: 27 mm) first-generation opposed platform core was recovered. However, the size of the site's opposed-platform blades – a cluster of intact broad blades have lengths between 50-80 mm, and the width of some blade fragments of 30-40 mm suggests blade lengths of 120-150 mm – indicates that much bigger opposed-platform cores were originally present at the location. It is thought that this LUP location was thoroughly 'mined' by later late Mesolithic settlers, who scavenged all larger flint objects on the spot or removed them from the site.

This core has two sloping opposed platforms, one long flaking-front, and a cortical 'back-side' (Figure 10.1). The shape of the core corresponds to typical Hamburgian cores, as defined by Madsen and Weber (Madsen 1992, Fig. 81.B; Weber 2012, Fig. 32), although the absence of fine faceting and *en* éperon spurs suggests that the Milltimber scatter may post-date the Hamburgian. The raw material of this core is mottled light-grey flint and thought to have been procured from sources on Doggerland.

Figure 10.2 shows the outline of a typical Hamburgian opposed-platform core from Howburn in South Lanarkshire (Ballin *et al.* 2018). Although the Howburn cores may initially have been prepared and shaped like the Continental ones, with one main flaking front and one clearly definable 'back-side', most of the ones from Howburn had been reduced along the entire circumference, giving them an approximately cylindrical shape (Figure 11). The Howburn cores are generally fairly small, most probably due to the exotic nature of the raw material (Doggerland flint) and attempts to completely exhaust this precious resource. The cylindrical core in Figure 11 (CAT 2803) measures 40 by 39 by 25 mm, although considerably larger opposed platform cores were also recovered from this site (e.g., CAT 3789: L: 52; W: 24; Th: 19 mm) and the longest blades from Howburn have lengths of c. 80 mm.

The third illustration in Figure 10 shows how Mesolithic people in eastern Scotland may have reduced their flint nodules. First they procured much smaller pebbles than those procured by the region's LUP settlers. They then prepared fairly small conical single-platform cores and the refitting of two conical microblade cores at Standingstones (from an upland location south of the Don, Ballin 2019c) platform-to-platform, indicates that occasionally this process was initiated by splitting the small pebbles. Each split resulted in two small single-platform core rough-outs with ready-made plain striking-platforms. Finally, some damaged or exhausted single-platform cores would be transformed into opposed-platform microblade cores. In eastern Scotland, many Mesolithic assemblages include no opposed-platform cores, but a number of small opposed-platform cores were recovered at Nethermills Farm on the Dee (Ballin 2017). These microblade cores have average dimensions of L: 34; W: 27; Th: 17 mm, and like most of the site's conical microblade cores they have cortical 'back-sides'.

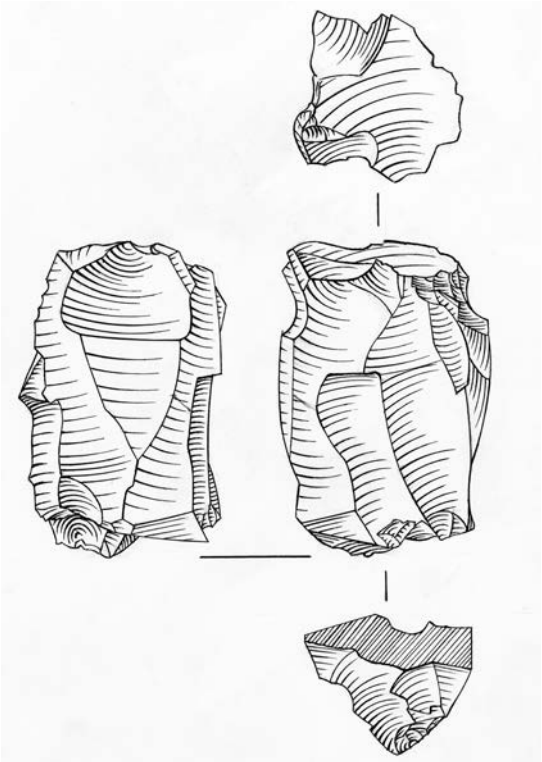

Figure 11: A small cylindrical core from Howburn, South Lanarkshire (CAT 2803); L = 40 mm. Draw by Hazel Martingell.

Most likely, large first-generation opposed platform cores found in eastern Scotland are attributable to the LUP period, and most large blades struck from such cores (for example large blades with surviving secondary trimmed platforms at their distal ends) are also likely to date to this period. The key thought behind the definition of these cores as diagnostic LUP

pieces is that they are highly sophisticated forms, and that the shaping of such cores required the knapper to adhere to a well-defined sophisticated operational schema, based on a specific mental template and the availability of first-class flint in the form of large nodules. The need for flint in the form of large nodules means that this sophisticated operational schema would have included a well-defined procurement strategy which, at least in the early stages of the period, meant procurement of (some) flint from sources on Doggerland. That is, at least some of the flint may have been procured along the routes followed by these highly mobile groups when they followed the reindeer on their trek from Doggerland and onto what is now mainland eastern Scotland. The highly mobile life-style of the first Scottish settlers suggests that the flint may have been obtained as part of embedded procurement (Morrow and Jefferies 1989).

Acknowledgements

I am grateful to the Society of Antiquaries of Scotland for supporting the production of this paper. I am also grateful to Catherine Smith, Alder Archaeology (formerly of SUAT), and Caroline Wickham-Jones, University of Aberdeen, for taking the time to discuss the site and its excavation with me, and to Neil Curtis for allowing me to inspect the stores of the Marischal Museum in Aberdeen. Leeanne Whitelaw drew the artefacts, and Gillian Sneddon produced the location map.

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