French Neolithic jadeitite axes from the megalithic tomb of Arzon (Morbihan, Brittany) held in the National Archaeology Museum, St Germain-en-Laye, Paris. These axes were created from raw materials sourced high in the Italian Alps, which once crafted were then traded or exchanged extensively throughout most of Europe from Scandinavia in the north to Spain in the south, and as far east as the Balkans and west to the UK, Ireland and the Isle of Man. These axes and their quarries have been the focus of a ground-breaking new study (see Editorial below).

Photo © Pete Topping

EDITORIAL
Best wishes for the New Year and a warm welcome to issue #9 of The Quarry.

This issue brings a report on the excavation of an important new Late Mesolithic quarry site recently excavated in the Scottish Borders. This discovery provides robust evidence for one of the first Mesolithic extraction sites found to date in the UK, despite such quarries having been located in Ireland and adjacent parts of continental Europe. The site also demonstrates that early communities were actively searching for important raw materials and were prepared to excavate for them and were not simply using surface gathered materials.
One significant publication which readers of *The Quarry* might wish to track down, if not for the fascinating and varied reports on Neolithic axe use and deposition across Europe, then for the novel technical and methodological approaches is:


These two volumes report upon a 15-year research programme which has studied the sources, crafting, distribution and deposition of alpine jadellite, omphacitite and eclogite axes (often collectively called jade in the literature). This project recorded and analysed roughly 1700 axeheads from twelve European countries and described a further 2500 to create a substantial continent-wide data set. The turning point occurred in 2003 when the earliest jade quarries were identified at Mont Viso (near Turin) and Mont Beigua (near Genoa) in the Italian Alps using spectroradiometry, x-ray diffraction and petrographic thin sectioning. This discovery offered the opportunity to study the entire chaîne opératoire of these pan-European artefacts from source to final deposition. The importance of the Neolithic Alpine jade axes lies in the fact that some were clearly invested with a deep cultural significance and had been transported across great distances amongst the early farming communities throughout Western Europe and are often found in special contexts.

These beautifully produced, heavily-illustrated, full colour volumes have 29 chapters (mostly in French with English summaries), rounded off by a detailed inventory which provides information concerning 1619 axes, most illustrated with line drawings and many with colour photographs. The inventory provides an invaluable corpus which brings together geological, typological and contextual information from widely dispersed archives into one convenient data set for research purposes. Consequently, the project team have provided both a great service to European Neolithic archaeology and created an indispensable research tool – while coincidentally setting a benchmark for future pan-European artefact studies.

As this issue is a little ‘Eurocentric’, how about some papers from the US, South America or Australasia? There must be plenty of good work out there just waiting to be reported, either as interims, full reports, news or simply seeking advice or comparanda. *The Quarry* is your voice, do use it!

Notes for contributors
Contributions can be any length but ideally not more than 2,000 words in Word format. Plans and photographs should be supplied as low resolution jpegs; try to keep these to five or fewer to make the Editor’s job as simple as possible and prevent the file size from growing too large (although this guidance is open to negotiation!). Such restrictions will also help authors focus their efforts and use only the truly critical images. If you do use photographs please ensure that you can also supply written permission from the photographer for their use, and if anyone is featured in a photo, as a scale for example, that they also give their written permission for their image to be used in both the e-newsletter and on the SAA website where it will be placed in the archive of Quarry back numbers. These copyright procedures are essential to protect the interests of all concerned and must be in place before web dissemination can take place. So what are you waiting for, get something in to the Editor at: topping.pete@gmail.com.
NEWS & COMING EVENTS
Do check out the preliminary programme for the Annual Meeting in Hawaii, note the timings of PQEMIG events and plan to participate at the members meeting and attend the sponsored symposia.

RESEARCH REPORTS

Burnetland Hill Chert Quarry: A Mesolithic extraction site in The Scottish Borders

Torben Bjarke Ballin¹ and Tam Ward²

INTRODUCTION
Background
Through the Mesolithic and Early Neolithic periods, chert was the dominant lithic raw material in southern Scotland. Chert was occasionally collected from pebble sources (Ballin 1999b) but it was probably more commonly obtained from primary outcrops. At present no full excavations of chert quarries have been carried out in northern Britain, but trial trenching (e.g., Warren 2007) indicates that this raw material was procured mainly from small quarry pits, which occasionally formed notable groups. Several groups of chert quarry pits are known from Scotland, such as Burnetland Hill, Kilrubie Hill, Flint Hill and Wide Hope Shank, all in the Scottish Borders.

Finds from the trial trenching of one such quarry pit (Burnetland Hill) have been analysed to gain information on the actual chert quarrying, and to shed light on the activities taking place at the pit through characterization of the assemblage. The Burnetland Hill excavation took place in 2007 (Ward 2007), and was carried out by the volunteers from the Biggar Archaeology Group (BAG). The work included the excavation of three narrow trenches through the selected quarry pit. During the excavation, approximately 150,000 pieces of chert debris was recovered, including some larger pieces, but mostly consisting of minuscule flakes and chips. Some charcoal was also retained. The excavation is described in a report by the BAG, and it is freely available on the group’s website (Ward 2012).

Preliminary indications are that the Burnetland Hill chert quarry dates to the transition between the Late Mesolithic and Early Neolithic (LM/EN) periods, in which case this would be the earliest indication so far in the British Isles for organized, intentional winning of stone. A LM/EN date is supported by the character of the chert artefacts, as well as by one radiocarbon date (4045-3975 cal BC; SUERC-17876/GU-16473), which provides a terminus ante quem for the finds and the quarry pit. In Scotland, the presence of burins (Figs 17-18) would define the assemblage as more likely Mesolithic than Early Neolithic (Saville 2004).

All preparation flakes, cores and tools are listed and summarily characterized in a catalogue, which will be submitted to the Royal Commission on Ancient and

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² Biggar Archaeology Group
Historical Monuments in Scotland (RCAHMS), Edinburgh. In the present paper, they are referred to by their number in this catalogue (CAT no.). The finds and the site archive are presently being held at Biggar Museum, South Lanarkshire.

Fig. 1. Location map.

THE SITE AND ITS EXCAVATION
The site
As part of the BAG’s investigation of the so-called Biggar Gap (between the upper reaches of the rivers Clyde and Tweed), and their survey of the Tweeddale valley, a small group of eight quarry pits were discovered (Ward 2000). They are dispersed across the steep south-western slope of Burnetland Hill, Broughton parish, Scottish Borders (a short distance east of Biggar; Fig. 1) (Ward 2012). The chert quarry pit discussed in the present paper is situated at NGR NT 09928 37585 at a level of c. 300m above OD. The Burnetland Hill quarry complex is located c. 5km SSW of Flint Hill and its complex of chert quarry pits, with the chert beds of Burnetland Hill probably forming part of the same chert formation described by Warren (2007, Fig. 15.5).

The Burnetland Hill quarry pits, which are all associated with surrounding spoil heaps, were first recorded by BAG in 2004 (Ward 2004). The four most prominent pits form a small cluster, situated close to an as yet unexplored Bronze Age settlement. The quarry depressions are roughly circular to oval in shape, with
diameters of up to 5m and depths of up to 0.3m. The rear scarps formed by the quarry pits are up to 1.5m high.

A combination of animal damage and recent drainage channels provided an impression of the location of a number of buried chert veins, which would otherwise have been invisible. In the area around the quarry pits, much of the exposed grey and bluish chert debris appeared worked.

In 2007, the BAG decided to investigate one of the chert quarry pits (Ward 2007), and the present feature was selected for excavation. The purpose of the investigation was to establish the date of the quarrying, as well as to shed light on the methods used for extraction of the chert. Given the proximity of the Bronze Age settlement platforms below the quarry pits, it was desirable to establish the age of the quarrying activities, as chert is known to have been used throughout prehistory. Lithic extraction sites dating to the Bronze Age have not yet been recorded in southern Scotland.

The excavation
As a quarry pit might potentially yield millions of bits of chert debris, it was decided not to attempt full excavation of the selected pit. Instead, one main Trench (Trench 1) was excavated through the round to slightly oval surface feature, lying approximately NE-SW. The southern end of this trench was initially referred to as Trench 2 (separated from Trench 1 by a baulk). As the excavators interpreted the mass of chert from Trench 2 as being of the same general character as that recovered from Trenches 1 and 3, no chert was retained from this trench. Trench 3, which was orientated approximately NNW-SSE, cut the peripheral deposits of chert upcast (the position of the three trenches is shown in Figs 2-3). The excavation below the turf was carried out by trowel. Consistent sieving of the spoil was not carried out, but samples were taken through the pit and later wet-sieved in the laboratory through a 2mm mesh. Due to the almost overwhelming amount of chert produced by the excavation of the pit, not all finds were retained. However, a sufficient sample of the chert from Trenches 1 and 3 were kept to give a reliable impression of any compositional differences between the finds from the pit itself and its surrounding upcast.

Trench 1 measured 5.4 x 0.5m in length and width, and the trench was 1.95m deep at the northern end, where the back scarp of the pit was evident, whereas the southern end of the trench was 1.25m deep. The turf was approximately 0.2m deep, and upon its removal a concentrated mass of fresh, sharp-edged chert debris was exposed. This fairly compacted deposit extended to the bottom of the trench.

Charcoal fragments were noted throughout the pit but a prominent patch of concentrated charcoal was noted at the southern end of Trench 1, approximately halfway down. The charcoal was identified as oak. A quantity of scattered charcoal fragments was retrieved from the basal layers of the trench, and again oak was the dominant species, although hazel was also identified. A sample of the latter was submitted for AMS dating, which gave a date of 5220±35 BP (SUERC-17876/GU-16473), corresponding to 4045-3975 BC at 68.2% probability or 4080-3960 BC at 85.2% probability.
The base of the pit was a roughly horizontal floor of solid chert, dipping slightly towards the west. At the northern end of Trench 1, bedding (Fig 4) was evident, with the most extensive beds being up to 75mm thick. Fresh sections of the floor indicated that it had been subject to percussion, presumably by using large stone pounders (fifteen hammerstones were retrieved; see below). The rear quarry face was exposed.
after removal of the pit’s infill of chert and soil. Occasional fresh, broken surfaces indicated where extraction of the chert seam had taken place, and here, as on the floor, the surfaces were mostly found to be somewhat weathered bedding planes (Fig 4).

Trench 2 measured 1.05 x 0.5 x 1.05m, whereas Trench 3 measured 0.8 x 0.4 x 0.6m. As indicated by Table 2, the retained chert from Trench 3 for the most part represents upcast from the quarry pit, and the discarded chert from Trench 2 was upcast of a similar nature.

Fig. 3. Excavation of Trench 1 (from the north), with Trench 2 behind the diggers, and Trench 3 to the left.
Fig. 4. Vertical view showing chert bedding at the bottom of Trench 1, northern end (courtesy of Alan Saville, National Museums Scotland).

QUANTIFICATION

Methodology

The quantification of the chert finds was carried out in two main stages, with the first stage being the examination of all finds to identify preparation flakes (crested pieces and core tablets), cores and tools. The second stage was the quantification of the debitage, that is, the blanks and waste left by the site’s quarriers. For obvious reasons, this work had to be carried out in the form of sampling. In addition to the estimation of the numbers of chips, flakes, blades, etc., the counting, weighing and in-depth examination of these samples also allowed a number of weight categories to be defined, resulting in the general composition presented in Table 1. The finds from the Burnetland Hill quarry pit are clearly heavily dominated by minuscule chips. Figs 5-6 give an impression of the recovered chert debris.

Table 1. Definition of size categories.

<table>
<thead>
<tr>
<th>Category no.</th>
<th>Weight categories (gr)</th>
<th>Appr. size categories (mm)</th>
<th>Quantities</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>10</td>
<td>150,466</td>
<td>97.0</td>
</tr>
<tr>
<td>2</td>
<td>10-70</td>
<td>30-60</td>
<td>4,112</td>
<td>2.7</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>30</td>
<td>508</td>
<td>0.3</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>155,086</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Fig. 5 (left). Example of cortical and decorticated chert, as well as hammerstones, from the excavation.

Fig. 6 (right). Examples of different chert size categories (Trench 1, northern end, basal layers).

Characterization of the assemblage
From the excavations at Burnetland Hill, 155,086 chert artefacts were recovered (Table 2). In total, 99.88% of the chert assemblage is debitage, whereas 0.03% is cores, and 0.09% is tools (Table 3). This basic composition clearly sets the present collection apart from assemblages recovered from contemporary domestic sites. In addition to the chert artefacts, 15 large hammerstones were also retrieved; they are dealt with separately.

Table 2. General artefact list, by trench (chert). Fifteen hammerstones in other raw materials were recovered from Trench 1.

<table>
<thead>
<tr>
<th>Debitage</th>
<th>Quantity</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trench 1</td>
<td>Trench 3</td>
</tr>
<tr>
<td>Chips</td>
<td>91,580</td>
<td>46,540</td>
</tr>
<tr>
<td>Flakes</td>
<td>2,714</td>
<td>758</td>
</tr>
<tr>
<td>Blades</td>
<td>114</td>
<td>65</td>
</tr>
<tr>
<td>Microblades</td>
<td>290</td>
<td>185</td>
</tr>
<tr>
<td>Chunks</td>
<td>10,612</td>
<td>2,029</td>
</tr>
<tr>
<td>Crested pieces</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total debitage</td>
<td>105,313</td>
<td>49,580</td>
</tr>
</tbody>
</table>
### Table 3. Distribution of the finds across the main artefact categories, by trench.

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trench 1</td>
<td>Trench 3</td>
</tr>
<tr>
<td>Debitage</td>
<td>105,313</td>
<td>49,580</td>
</tr>
<tr>
<td>Cores</td>
<td>30</td>
<td>22</td>
</tr>
<tr>
<td>Tools</td>
<td>24</td>
<td>117</td>
</tr>
<tr>
<td>TOTAL</td>
<td>105,438</td>
<td>49,647</td>
</tr>
</tbody>
</table>

### Raw materials: types, sources and condition

Apart from the hammerstones, all artefacts from the Burnetland Hill site are of so-called ‘Southern Uplands chert’. Although this type of chert was originally defined by analysis of cherts from the Southern Uplands south of the Southern Uplands Fault Line (Greig 1971, Fig. 2), the term is popularly used to describe not only cherts from this area, but also similar chert forms from other parts of southern Scotland and the Central Belt (cf. Saville 2008, 209). This raw material occurs in many colours, with black, grey, blue, green, and brown being the most common varieties. Though closely related to flint, it is easily distinguished from this raw material by its more
waxy sheen (Pellant 1992, 246). Though banding does occur, most of the Burnetland Hill chert is plain bluish-grey radiolarian chert.

Radiolarian chert was formed in deep tropical oceans when tiny silica-rich shells of plankton called *Radiolaria* settled on the sea floor. The country rock within which the Southern Uplands chert is bedded, greywacke, was formed when medium-grained, inorganic particles settled in a more turbulent marine environment with fast-moving currents (ibid., 229). The local chert is riddled with fissures and fault-planes, which affect the flaking properties of this resource negatively.

A large, but unquantified, proportion of the present assemblage is cortical, and the fresh (powdery) cortex of these pieces clearly defines this raw material as having been procured from a primary source. At Burnetland Hill, assessment of cortication was complicated by the fact that many surfaces associated with the fault-planes are coated, and these surfaces may (incorrectly) be perceived as cortical. Cortical material was particularly common near the base of the quarry pit. No chert artefacts were identified as fire-crazed.

**The hammerstones**

Approximately 15 hammerstones (Fig. 5) are either greywacke (4 pieces) or sandstone (10 pieces), with one possibly being tuff. They are all based on boulders or cobbles, and it would have been possible to collect erratic boulders/cobbles in these raw materials from the immediate surroundings of the site (Greig 1971). It is possible to subdivide the hammerstones into two groups on the basis of size, with one group embracing pieces with a greatest dimension (GD) of between 130-160mm and weights of c. 1000-4000 grams, whereas the other group embraces pieces with a GD of between 75-95mm and weights of c. 250-400 grams. Generally, the hammerstones are round to oval, although some are more irregularly shaped. Several have one worn pointed end, whereas others have two ends with use-wear. A small number of these implements also have wear on their lateral sides or on their faces. In most cases, the wear is in the form of crush-marks, indicating hammering, although a few also show abrasion from rough rubbing.

Most likely, the two hammerstone categories were intended for different tasks, with the larger, heavier pieces being used for battering the greywacke bedrock to detach chert plates or nodules, whereas the smaller hammerstones may have been used for further reduction of the raw chert into rough pre-cores.

**Chert debitage**

From the Burnetland Hill quarry pit, 154,893 pieces of debitage were recovered. In total, 89.2% is chips, with 2.2% being flakes, 0.4% blades and microblades, and 8.2% chunks (Table 2). Six crested pieces were also retrieved. As shown in Table 1, most flakes and chunks (c. 90%) have greatest dimensions between 10mm and 30mm, with a small proportion being larger than 30mm.

The massive number of chips is interpreted as a joint function of the chert’s brittle nature and the site’s character as a quarry pit – usually, a lithic assemblage obtained by wet-sieving the soil from a domestic site would yield approximately one-third chips (Ballin 1999a). The finds from Trench 1 (from the actual pit) include fewer chips and more flakes and chunks than those from Trench 3 (upcast), suggesting slightly
different activity patterns through the excavated parts of the site – coarser material was recovered from the actual pit and finer material from the upcast.

*Fig. 7 (left). Typical blades and microblades.*

*Fig. 8 (right). Two regular microblades.*

Macro- and microblades make up 654 pieces, corresponding to c. 15% of all flake and blade blanks. However, this figure is not a true reflection of the activities taking place at the site. As most of the collection’s ‘blades’ have dorsal faces defined by intersecting fault-planes (giving the pieces triangular cross-sections) many are probably incidental elongated products of the raw material’s inherent flaws (Fig. 7). Attribute analysis suggests that most may generally be waste rather than deliberate ‘target blanks’ – almost none displays trimming of the platform-edge, and very few have parallel dorsal arrises. Only two pieces appear to be standard microblades (Fig. 8).

The proximal ends of most blades and microblades are characterized by either platform collapse, pronounced bulbs or bipolar terminals, which supports the indication that these elongated pieces are not intentional blade or microblade blanks but quarry waste – the Late Mesolithic/Early Neolithic period is generally defined as a phase characterized by the production of such small blades by the application of soft percussion or pressure flaking (e.g., Ballin & Johnson 2005; Saville 2008).

Some chunks (usually defined by several intersecting fault-planes) have a trimmed edge at one end, suggesting that several of these may actually be fragments of disintegrated core rough-outs. Six small crested pieces (Fig. 9) were also found at Burnetland Hill, indicating that production of core rough-outs, or preparation of cores, took place at the site.
Fig. 9. Crested pieces

Chert cores
During the analysis, 52 chert cores were identified (Table 2): Six ‘pre-cores’ (three core rough-outs and three flaked nodules); 16 single-platform cores (five of which are roughly conical); one opposed-platform core; 21 irregular cores; two atypical cores; two bipolar cores; and four core fragments. The average sizes (greatest dimensions) of the main core types are shown in Table 4. This table shows how core types which represent later stages in the reduction process are smaller than cores from earlier stages.

Table 4. Average core dimensions (GD, mm).

<table>
<thead>
<tr>
<th>Core Type</th>
<th>Average Dimension (GD, mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core rough-out/flaked nodules</td>
<td>41</td>
</tr>
<tr>
<td>Single-platf cores (+ 1 opp-platf core)</td>
<td>31</td>
</tr>
<tr>
<td>Single-platf (conical) cores</td>
<td>29</td>
</tr>
<tr>
<td>Irregular/atypical cores</td>
<td>27</td>
</tr>
<tr>
<td>Bipolar cores</td>
<td>21</td>
</tr>
</tbody>
</table>

The core rough-outs are generally characterized by having either one crest or two opposed crests, and occasionally a prepared platform. Flaked nodules are defined by having had at most two flakes detached without any initial preparation of the parent piece.

The larger single-platform cores are in the main defined by little preparation, whereas the smaller single-platform cores (Fig. 10) display some trimming of their platform-edges. This category includes three sub-types, namely cruder forms, as well as small
flat pieces (e.g., CAT 62 and CAT 82) and small tabular pieces (e.g., CAT 59). The difference between the latter two forms is that one had small microblades detached from a broad flaking-front, whereas the other had microblades detached from the narrow ends of tabular pieces defined by parallel coated fault-planes. The conical cores (Fig. 11) are all microblade cores, and they may generally have had their platform-edges trimmed. CAT 48 and 85 retain some neat trimming along parts of their platform-edges.

*Fig. 10 (left). Common single-platform cores.*

*Fig. 11 (right). Conical single-platform cores.*

*Irregular cores* (Fig. 12) are characterized by having been reduced from a minimum of three directions, and as a result they frequently acquired an approximately cubic shape. *Atypical cores* are defined by deviating from standard formal classification. The two *bipolar cores* are standard hammer-and-anvil cores (e.g., CAT 83; Fig. 13).

*Fig. 12 (left). Irregular cores.*

*Fig. 13 (right). Bipolar core.*
Chert tools
The assemblage includes 78 chert tools, namely 23 scrapers (16.3%), one truncated piece, four piercers, two possible burins, one notched piece, and 110 pieces (78%) with some form of edge-modification or macroscopic use-wear. As shown in Table 5, most tools are based on flakes and chunks (c. 45% each), with 13 tools being on blade blanks, and one implement is a modified microblade. The vast majority (70%) of the scrapers are based on chunks. The blades are generally ‘metric’ rather than ‘qualitative’ blades, that is, they are defined by being more than twice as long as they are wide, but they rarely have parallel dorsal arrises. The tools do not have any standardized size, but vary approximately between GD 10mm and GD 40mm.

Table 5. Tool blanks.

<table>
<thead>
<tr>
<th></th>
<th>Flakes</th>
<th>Blades</th>
<th>Microblades</th>
<th>Chunks</th>
<th>Total</th>
<th>Per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>End-scrapers</td>
<td>3</td>
<td></td>
<td>11</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side-scrapers</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td></td>
<td>16.3</td>
<td></td>
</tr>
<tr>
<td>End-/side-scrapers</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>Truncated pieces</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Piercers</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Burins</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Notches</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pieces w edge-retouch</td>
<td>50</td>
<td>12</td>
<td>1</td>
<td>47</td>
<td>110</td>
<td>78.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>62</strong></td>
<td><strong>13</strong></td>
<td><strong>1</strong></td>
<td><strong>65</strong></td>
<td><strong>141</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Scrapers: The 14 end-scrapers (Fig. 14) are mostly based on chunks, with their ‘dorsal’ and ‘ventral’ faces being defined by coated fault-planes. The blanks are generally fairly short and somewhat irregular, with a convex steep scraper-edge at one end. Several working-ends are relatively well-made (e.g., CAT 9, 14, 16, 17, 19, 20), but many are clearly expedient and manufactured by detaching the minimum number of small chips necessary to produce a useful working-edge. The eight side-scrapers (Fig. 15), as well as the solitary end-/side-scraper, are generally expedient pieces with a more or less straight scraper-edge along one lateral side. Half of this category is flake-based and the other half based on chunks, but most seem to rely on whatever fragment was at hand.
**Fig. 14 (left). End-scrapers.**

**Fig. 15 (right). Side-scraper.**

**Edge-retouched pieces:** This category is based on approximately equal numbers of flakes (50 pieces) and chunks (47 pieces), supplemented by 12 blades and one microblade. The modification forms a continuum with, at one end, pieces with ‘proper’ retouch, and, at the other end, pieces with ‘flimsy’ retouch or macroscopic use-wear. It is not always possible to distinguish between light ‘actual’ retouch and use-wear.

**Other tools:** One irregular flake (CAT 1) has a short straight truncation at one end, and three chips detached at the broader opposed end probably also amounts to deliberate modification (truncation). The function of this piece is uncertain, but it is possible that it was used as a knife. The four piercers (Fig. 16) form a highly heterogeneous group, consisting of one flake, one blade, and two chunks. The larger piece (CAT 7) has a GD of 57mm, and it has at one end an obvious piercer tip formed by two merging retouched edges. The smallest piece (CAT 6) has a GD of 13mm, and its tip is a short spur between two closely positioned notches. CAT 4 and 5 are elongated pieces with GDs of c. 25mm, with working-ends made up of merging, minimally retouched edges. The assemblage also includes two burins (CAT 2 and 3). The former is a medial flake fragment with a typical burin-edge at one end. This working-part was formed by detaching a series of short burin spalls from the corner of a proximal break, ventral face (Figs 17-18). The latter is a flake fragment with a series of transverse burin spalls having been detached from the ventral face, distal end. CAT 8 is a small flake fragment (GD = 10mm) with a small lateral notch (chord c. 5mm).
DISCUSSION

Quarry pits are usually associated with heaps of surrounding upcast, which in the present case was investigated by the excavation of Trenches 2 and 3. Quarries in general may be associated with: (1) tailing piles, (2) ore dressing, milling, and transition areas, as well as (3) workshops for the production of preforms and final cores/tools (Schneiderman-Fox & Pappalardo 1996), but no test pitting was carried
out of the area surrounding the Burnetland Hill pit. The only part of this potentially extensive site available for analysis is therefore the quarry pit itself, as well as a sample of the lithic debris from the upcast and the pit.

The general composition of the Burnetland Hill assemblage defines the site as a procurement site, where the main purpose was to obtain raw chert for further reduction elsewhere. Most of the lithic collection is debitage (99.88%), with c. 90% of the debitage being minuscule chips (Table 2). It is thought that most of the material removed from the site would have been in the form of chunks and simple core rough-outs, probably belonging to size category 3 (Table 1). Most of the pieces belonging to this category have average weights of c. 10-70 grams and average sizes of 30-60mm, with rare pieces measuring up to 100mm. In total, only 0.3% of the recovered pieces belong to this largest size category. This composition is probably an indication of the relatively poor quality of the local chert, which is riddled with closely spaced, intersecting fault-planes.

The flakes are generally squat hard-percussion blanks, many of which are highly irregular. Frequently, the ventral faces of these pieces are only partially conchoidal, either beginning or ending in a flat, coated fault plane. Most likely, these pieces were produced as part of the general reduction of the chert beds (using the large hammerstones recovered during the excavation), or in connection with the shaping of chert blocks and plain core rough-outs suitable for exportation out of the site. It is highly unlikely that fire was used in connection with the procurement of chert from the pit, as fire would have disintegrated the chert (Ballin & Johnson 2005).

In total, 179 blades and 475 microblades were recovered, but most of these are irregular metric blades (i.e., more than twice as long as they are wide) without parallel dorsal arrises. The proximal ends of most blades and microblades from the site are characterized by platform collapse, pronounced bulbs or bipolar terminals, which supports the indication that these elongated pieces are not intentional blade or microblade blanks but quarry waste. Only two recovered pieces seem to be standard microblades. They were both detached from their parent cores by the application of soft percussion, which is the form of percussion typically used during the later Mesolithic period (e.g., Ballin & Johnson 2005; Saville 2008). Both are from the basal layers of Trench 1, like the charcoal (Corylus) providing the radiocarbon date of 4045-3975 cal BC (SUERC-17876/GU-16473).

The scarcity of finished ‘proper’ microblades is puzzling, as the site’s cores indicate that some primary production took place at Burnetland Hill. The general size of the cores (which are mostly single-platform cores) corresponds to that expected from an industry focused on microblade production, and microblades were definitely detached from the site’s more regular conical cores. This discrepancy may be explained in one of the following ways:

- Some microblade production took place within the pit, but in unexcavated parts of it, and the recovered cores represent this knapping floor’s toss zone (Binford 1983, 153).
- Microblade production took place outside the pit (possibly on or near its edge), in an unexcavated workshop; the pit may then have been used as a ‘rubbish chute’
after its abandonment, or the cores may have entered the pit when it was deliberately back-filled.

As a relatively small proportion of the pit was excavated, and no parts of the surrounding area (apart from Trenches 2 and 3, covering some of the upcast), it is difficult to determine which of the above scenarios is closest to prehistoric reality. However, the different composition of the sub-assemblages from Trenches 1 and 3 (Table 3), with more cores and considerably more tools in Trench 3 (the upcast) than in Trench 1 (the pit itself), supports the notion that small workshops may have been present immediately next to the quarry pit.

Prior to examination of the assemblage, it was expected that this quarry pit collection would only include small numbers of tools. A total of 141 implements is a surprisingly high number. However, although some scrapers, piercers and burins are regular formal tools, most are expedient pieces, and the 110 edge-retouched specimens include substantial numbers of pieces with minimal modification or use-wear rather than regular continuous retouch. Most likely, these tools represent ad hoc subsistence-related activities of the site’s quarriers.

In his discussion of Late Neolithic site types, Ballin (2011) wrote: ‘Extraction sites are generally characterized by much debris and restricted formal variation. Their assemblages are dominated by the following artefact categories: (1) If the site is based on quarrying rather than collection: extraction tools (e.g., picks and points); (2) raw material stocks (raw nodules or shaped/decorticated core rough-outs); (3) waste from primary production; (4) cores […] and unmodified flake and blade blanks (for export out of the site); and (5) few or no tools (any tools would tend to be informal/expedient)’. This description seems to cover the finds from Burnetland Hill quite well.

In his presentation of a number of similar chert quarry pit locations in the Upper Tweed Valley, Warren (2007, 146) mentions that ‘The sites […] include clear evidence for blade production …’, supporting the suggestion that the Burnetland Hill quarry pit assemblage only represents the truncated part of a fuller picture. Entries in Discovery and Excavation in Scotland (brief contributions by M. Clifford, T. Cowie, B. Finlayson, R.D. Knox, J.C. McKeon, and A. Teale in Discovery & Excavation in Scotland 1989) also indicate the presence at southern Scottish chert quarries of chert-bearing ‘screes’, supporting the idea that a typical Scottish chert quarry would have included tailing piles and workshops in addition to the actual quarry pit(s).

Despite the fact that the Mesolithic and Early Neolithic lithic production of prehistoric southern and central Scotland was heavily dominated by the exploitation of chert, surprisingly few chert-bearing sites and assemblages have been dealt with in the archaeological literature. The following later Mesolithic assemblages (probably all from domestic sites) are available for comparison:

- Glentaggart, South Lanarkshire (Ballin & Johnson 2006)
- Daer Reservoir, South Lanarkshire (Ward 2010)
- Cramond, Edinburgh (Saville 2008)
- Woodend Loch, North Lanarkshire (Davidson et al. 1949)
Midross, Loch Lomond, Argyll & Bute (Ballin forthcoming)

In her work on the microlithic industries of the Tweed Valley, Mulholland (1970, 85) mentions that sites in the southern part of that region are dominated by chert, but it is not possible to get an overview of the specific raw material composition of her sites. Many older papers on assemblages from the region (e.g., Corrie 1916; Mason 1931) are simply too ‘broad-brush’ to be useful in connection with modern archaeological research of chert-bearing sites. In terms of relevance to comparison with the present assemblage, it is possible to divide the chert-bearing sites into two groups, namely (1) those exclusively in chert or heavily dominated by this material (Glentaggart, Daer Reservoir and Cramond), and (2) mixed sites characterized by the presence of a substantial chert component (e.g., Woodend Loch and Midross).

Generally, the chert assemblages include: (1) numerous scrapers and edgeretouched pieces; (2) some (most assemblages) or numerous (Daer Reservoir, Cramond) microliths; and (3) small numbers of other formal tool types, such as piercers, burins, and truncated pieces. The main difference between assemblages from site types (1) and (2) is that, with other raw materials being available, chert tended to become a ‘lower-rank raw material’, with prehistoric people preferring for example flint for their tools. At Woodend Loch, for instance, there are twice as many flint microliths as chert microliths, measured as a proportion of the total assemblage (c. 10% against c. 5%). At Midross, the local chert (probably procured along the Highland Boundary Fault) appears to have been all but avoided for tool production (flint has a tool ratio of 15%, whereas chert has a ratio of only 4%). However, the Midross assemblage may represent a special case, as the local chert is considerably coarser, and with poorer flaking properties, than most known cherts from southern and central Scotland. It is interesting that burins tend to be quite low in numbers, and it would seem that burins are only truly common on Scottish Upper Palaeolithic sites (such as the Hamburgian Howburn site and the Federmesser site Kilmelfort Cave; Saville & Ballin 2010; Ballin et al. 2010).

The difference between the full Burnetland Hill collection and these collections is first and foremost the size of the former’s debitage sub-assemblage. At Burnetland Hill, 154,893 pieces of debitage were recovered, c. 90% of which is in the form of minuscule chips. The other assemblages have from a few hundred to a few thousand pieces of debitage and, as demonstrated in Ballin (1999a), assemblages from wet-sieved domestic sites usually include up to approximately one-third chips.

The core and tool sub-assemblages from Burnetland Hill correspond roughly to what would usually be expected from a traditional Scottish chert assemblage from the Mesolithic period, with the only notable differences being a higher proportion of clearly expedient pieces at Burnetland Hill, as well as the almost total absence of true microblades and the lack of microliths at this site. The most likely interpretation of this is that most of the assemblage is the product of quarrying activities, resulting in a mass of small-sized chert debris and chunks, but that a domestic sub-assemblage (the cores and tools) was produced in connection with the subsistence-related activities of the Mesolithic miners (hunting and gathering, production of tools and retooling, processing of food, etc.). These pieces would probably have been manufactured at a workshop near the pit.
It is quite possible that exhausted pits were used as rubbish pits by quarriers who had by then moved on to new pits, or the pits could, after abandonment, have been infilled (for reasons we may not fully understand today). This scenario would explain why most of a traditional Mesolithic chert assemblage (cores and spent tools) ended up in an abandoned quarry pit, while smaller artefacts (like fragments of microblades and microliths) would have been left where they fell – in the drop zones of the adjacent settlement/workshop’s knapping floors (Binford 1983). It is quite possible that abandoned quarry pits could have been used as shelters (as indicated by the concentration of charcoal at the southern end of Trench 1), with some tool use taking place in them, and the more well-executed cores (in particular the small conical cores) may have been thrown into the pit in connection with it being infilled.

Chert quarry pits are known from other parts of the continent, not least Central Europe. A chert procurement site (Asch-Borgerhau) from the Swäbische Alb, southern Germany, was discussed by Fisher et al. (2008), and the composition of the assemblage is not unlike that of the present assemblage, that is, with much waste, some blades, and low numbers of formal tools. However, this site was based on the exploitation of chert nodules from clay, rather than on the mining of in situ bedded chert. The site of Kleinwalsertal in the Allgäuer Alpen, Austria (Leitner 2008), is a more direct parallel to the Burnetland Hill chert quarry. At the Austrian site, raw chert was quarried from bedded deposits in limestone by pounding the country rock with hammerstones. As the limestone is considerably softer than the Burnetland Hill greywacke, the hammerstones recovered from Kleinwalsertal are generally in softer materials, including sandstone, chert and limestone (ibid., Fig. 6). However, the composition of the Austrian assemblage corresponds to that of the Scottish finds: most chert artefacts are diminutive chips and angular fragments from the mining processes, supplemented by small numbers of waste cores, blades and expedient tools. Leitner (2008, 179) suggests that, as at Burnetland Hill, the main purpose of the work was to produce core rough-outs for transportation out of the quarry site, where the preforms would be transformed into more regular cores, and where the main production of blanks and tools would take place.

Further work is clearly needed to increase our understanding of chert quarrying, and future investigations should include the area around the quarry pits to locate: (1) possible tailing piles below the pits; (2) the workshops responsible for the transformation of quarried blocks of chert into core rough-outs; as well as (3) the camps where the quarriers stayed while carrying out the mining and the down-sizing of the chert blocks. In an ideal world, this work should include substantial parts of the affected slopes, as the quarriers mining one pit could have sheltered in old abandoned pits.

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