GB Great Britain

GB 1 Blackpatch
GB 2 Church Hill
GB 3 Cissbury
GB 4 Harrow Hill
GB 5 Tolmere
GB 6 Long Down
GB 7 Lavernt
GB 8 Stoke Down
GB 9 Easton Down
GB 10 Martins Clump
GB 11 Peppard Common
GB 12 Windover Hill
GB 13 Grimes Graves
GB 14 Massingham
GB 15 High Wycombe
GB 16 East Horsley
GB 17 Beer Head
GB 18 Durrington
GB 19 Den of Boddam
GB 20 Skelmuir Hill
GB 20 DEN OF BODDAM NEAR PETERHEAD, GRAMPIAN REGION, SCOTLAND

GB 21 SKELMUIR HILL, GRAMPIAN REGION, SCOTLAND

Prehistoric exploitation of flint from the Buchan Ridge Gravels, Grampian Region, north-east Scotland

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INTRODUCTION

Flint is not generally present in Scotland, except as beach pebbles of small size found in many coastal deposits (Wickham-Jones and Collins 1978). These coastal sources can be locally prolific, with the pebbles derived from adjacent off-shore Cretaceous deposits, as on the west-coast islands of Islay and Mull (Hall 1991:fig. 3). This type of flint pebble was extensively exploited for implement manufacture in the Mesolithic period, but was less suitable for the requirements of Neolithic and Bronze Age flint knappers.

The nearest terrestrial deposits to Scotland with in situ flint nodules of large size and high quality are to the south west in the “White Limestone” of Antrim, Northern Ireland and to the south in the Upper Cretaceous Chalk of the English Yorkshire/Lincolnshire Wolds. Flint from these regions was exploited in prehistoric Scotland, but seems to have been imported in the form of manufactured blanks or tools, rather than raw material (Saville 1994). The nearest location of classic flint mines is of course in East Anglia (Holgate 1991), but there is little evidence to demonstrate the importation of flint-mine products or raw material into Scotland.

There is, however, one inland flint-bearing source in Scotland where flint does occur in sufficient quantity and quality for it to have been extensively exploited in prehistory. This series of deposits, known as the Buchan Ridge Gravels, comprise mainly well-rounded flint and quartzite cobbles and pebbles set in matrices of clay, silt, and sand. The flinty Gravels occur as an intermittent capping on low hills in a small area of north-east Scotland, some 40 km north of Aberdeen and immediately south west of Peterhead (Fig. 1).

The geological origin of these gravels has been a subject of much debate (see Hall 1993 for an up-to-date summary), but recent research has shown they are most
Fig. 1. Location map showing (in solid black) the areas of *in situ* Buchan Ridge Gravels and (shaded) the generalized spread of flinty soils. The extent and limits of the Buchan Ridge Gravels have not been accurately mapped; the distribution shown here is adapted from Gemmell and Kesel (1979:fig. 2). Den of Boddam and Skelmuir Hill are the extraction sites where archaeological excavation has taken place. Drawn by Marion O’Neil.

probably the remains of marine beaches of pre-Quaternary age (Bridgland, Saville and Sinclair forthcoming). Such an age and derivation would be consistent with all the physical characteristics of the flint cobbles, which are identical to those from Tertiary deposits elsewhere (Gibbard 1986).

Flint in the Buchan Ridge Gravels occurs occasionally in large cobbles, up to 250 mm in size, but more normally as pebbles and cobbles below 100 mm. Generally speaking, flint is present throughout the Buchan Ridge Gravels in the area shown (Fig. 1), as well as in superficial Pleistocene deposits and in the modern soils. There is some evidence for bedding within the Gravels, and thus for concentrations of flint, but otherwise the flint cobbles are ubiquitous within these deposits. Preliminary quantification analyses indicate that flints over 50 mm in size constitute some 25 per cent (by weight) of the Gravels. The condition of the flint is inevitably better at depth,
away from the full effects of weathering and Pleistocene permafrost, where it can only be reached by quarrying.

Prehistoric quarrying of the Buchan Ridge Gravels, which has been suspected since the 19th century (Anderson 1896:351), is currently attested at two locations, Den of Boddam and Skelmuir Hill (Fig. 1), but there is every reason to suppose that other locations remain to be discovered. Since 1991 the Archaeology Department of the National Museums of Scotland has been undertaking a research project to study both geological and archaeological aspects of the Buchan Ridge Gravels (Saville and Bridgland 1992; Bridgland and Saville 1994).

DEN OF BODDAM

At Den of Boddam (British National Grid reference: NK 114 415) there is a relict glacial meltwater channel, now covered in rough grass, heather, gorse, and bracken (Fig. 2). It lies near the modern North Sea coast at the east end of the

Fig. 2. GB 20 Den of Boddam. Oblique aerial view from the north west. Photo: Aberdeen Archaeological Surveys, courtesy of Ian Shepherd/Moira Greig.
Buchan Ridge Gravels. At the narrowest and most steep-sided point of the channel, the stream on the channel floor was dammed in the 19th century AD to provide a reservoir.

The steep slopes of the channel have never been ploughed, and retain the physical evidence of extraction in the form of surface hollows and mounds (Fig. 3), reflecting underlying pits and spoilheaps. There are some 458 of these hollows in total, 346 on the west side of the channel and 112 on the east side (Fig. 4). They vary in shape, size, and discreetness, but generally tend towards a sub-circular shape and a present depth of around one metre.

Fig. 3. GB 20 Den of Boddam. One of the hollows near the top of the slope on the west side of the Den. Scales in 0.5 m divisions. Photo: Alan Saville/NMS.

Excavation at Den of Boddam in 1991–3 (Figs 5–6) has shown that extraction pits were formerly more extensive. On the slopes, the present depressions reflect only the latest phase of extraction in any one area, there being many more hollows for which no surface evidence survives, as a result of backfilling, erosion, and contemporary spoil-dumping. Similarly, beyond the break in slope of the channel sides, certainly on the west side and probably also on the east, there are many extraction pits completely invisible on the surface because of the levelling effect of modern cultivation.
Fig. 4. GB 20 Den of Boddam. Location of surface hollows visible on the sloping side of the meltwater channel. Courtesy of the Royal Commission on the Ancient and Historical Monuments of Scotland: Crown Copyright.

Thus the area of extraction around the whole of Den of Boddam is believed to cover about 12 hectares, with perhaps in the region of 1,000 pits altogether. This has not yet been tested by geophysical investigation, but is estimated on the basis of archaeological and geological evaluation of surface and test-pit data.

The excavations have demonstrated that the extraction procedure involved the digging of roughly circular "bell-pits" (that is to say the pits were generally wider at the base than at the surface). This was for the simple reason that such pits required less effort to be expended on removing the unwanted upper deposits, while
maximising the removal of the lower deposits with their desired flint content. At Den of Boddam the Buchan Ridge Gravels are overlain by glacial till. Both deposits produce rather unstable edges when dug, especially where undermined by undercutting, so that the normal picture of infilling of the extraction pits reflects rapid collapse of the pit sides. Thus plans, sections, and photographs of the pits as they currently exist give a misleading impression of wide upper diameters (Figs 6–9).
An example of a pit infill showing many of the recurrent features is given in Fig. 9. The typical indication of collapsed edges occurs on the south side, where a large wedge of mainly till, with surviving segments of capping of buried soil, occupies the fill. Two episodes of infilling with masses of knapping debris are evident from the north side of the section; these deposits are almost exclusively composed of knapped and unknapped pebbles and cobbles, with hardly any matrix. A very similar pattern can be seen in the section of another pit shown in Fig. 10.
Fig. 7. GB 20 Den of Boddam. Pit 46 viewed from the east during excavation in 1993. The upper part of the pit infill has been totally removed, the lower part of the fill has been sectioned. The wide upper shape of the pit reflects the post-collapse situation, not the original shape when first dug. Note the clear contrast between the darker glacial till and the underlying white Buchan Ridge Gravels. Scales in 0.5 m divisions. Photo: Alan Saville/NMS.

In fact, virtually all the artefactual lithic material is restricted to the upper fills of these pits (Fig. 11), the lower fills being almost entirely archaeologically tele accumulations of collapse and backfill. Subsequent to the extraction and flint working phase, the stabilized pit infills have seen peat accumulation, usually directly overlying knapping debris. These peat-filled hollows survive until the resent day on the slopes, whereas on level ground they have been obscured by ploughsoil.

During the course of the recent excavations at Den of Boddam, only four pits have been wholly or partially excavated right to the original bases, with maximum depths below the modern surface of 2.7 m (Fig. 10), 3.0 m (Fig. 9), 4.1 m (Fig. 8), and 4.4 m.

At Den of Boddam, much of the Buchan Ridge Gravels is extensively kaolinized, creating a clayey white matrix surrounding the flint and quartzite cobbles. The flint from this matrix is a “bleached”-looking light-to-medium grey in colour.
SKELMUIR HILL

Towards the west end of the Buchan Ridge Gravels, Skelmuir Hill (British National Grid reference: NJ 986 414) was the focus of some small-scale excavations in 1918 (Graham-Smith 1919), at a time when sub-circular hollows were still visible on the surface (Fig. 12). Subsequent cultivation has obscured these hollows, and no features are now visible on the surface of the part-arable, part-pasture fields. Although the 1918 excavations left little doubt that this was a flint-extraction site, the evidence for pit-digging remained enigmatic, with confusing allusions to the possibility of sunken-floored hut-circles.

Excavations (Fig. 13) in 1994 re-excavated and expanded the trenches dug in 1918, and have shown the existence of pits very similar to those at Den of Boddam, dug to depths of between 2 m and 3 m below the modern surface (Fig. 14). At Skelmuir Hill there is no glacial till overlying the Buchan Ridge Gravels, which occur here in a more sandy facies, with the flint coloured various shades of brown (with red and yellow extremes).

The full extent of the extraction pits at Skelmuir Hill has not yet been defined, in particular the most westerly hollows plotted by Graham-Smith (Fig. 12) remain
Fig. 9. GB 26 Den of Boddam. North-south cross-section through the fill of Pit 46 (for location see Fig. 6).
The cobbles shown in the section are predominantly flint, but include quartzites as well.
Drawn by Alan Saville.
unconfirmed as pits, but it has been shown that pits do extend for a linear distance of at least 180 m in a NW–SE direction across the hilltop. The evidence so far from the excavation suggests that the pits are closely packed, and that in places the hilltop is actually riddled with intersecting pits.

INDUSTRIAL PROCESS

At both Den of Boddam and Skelmuir Hill, the flint obtained from the extraction pits seems to have been subjected to a kind of “quality control”, whereby the cobbles were tested by primary knapping and immediately discarded if unsuitable. This commonly involved bipolar reduction, utilizing the abundant quartzite cobbles from the Buchan Ridge Gravels as anvilstones. These anvils, readily identifiable by the presence of one or more depressions on the cobbles (Graham-Smith 1919:pls II–III) are an absolutely characteristic by-product of the industrial process, and are found in large numbers at both sites.

Flint-knapping debris occurs by the tonne at both sites, in the form of cores and flakes and also more irregularly broken pieces, where the poor quality of much of the flint being tested has resulted in cobbles simply “exploding” on being struck.
There is no sign from any of the excavations to date that secondary-stage processing of flint was taking place at the extraction sites. Virtually no roughouts, retouched pieces, or implements of any kind (other than flint and quartzite hammerstones), have been recovered; the clear implication is that once flint of a suitable quality was located, it was removed from site for further processing elsewhere. Such conclusions must be stated with caution, since the excavations have examined only minute fractions of the total extraction areas, but they are supported by the absence of any known surface finds of implements, with the exception of a single chisel arrowhead found at Den of Boddam in the 1970s.

The size and nature of the flint from the Buchan Ridge Gravels would under most circumstances preclude the manufacture of larger implements such as axeheads. The relatively few flint axeheads (as opposed to the frequent stone axeheads) known from north-east Scotland do appear to have been made on exotic flint, sometimes clearly so, as in the case of the “English” axehead from nearby Cruden (Kenworthy 1977:85). By contrast it is the smaller implement types of the region, most characteristically the arrowheads and scrapers, which are definitely being made on the local flint.
Fig. 12. GB 21 Skelmuir Hill. Site plan reproduced from Graham-Smith (1919:fig. 4). The circles indicate hollows clearly visible in 1918, the broken circles indistinct hollows. Pits I and II were excavated by narrow trenches in 1918 and re-excavated more extensively in 1994. The shaded area shows the surface distribution of anvil-stones noted in 1918. Courtesy of The Prehistoric Society.

DATING AND CULTURAL AFFINITIES

It is not easy to judge the age and affinities of the extraction sites on the Buchan Ridge Gravels. On the one hand, the soils at these sites are acidic, and would not preserve any unburnt organic items (e.g., of bone, antler, and timber), which might be both diagnostic and capable of direct radiocarbon dating. On the other hand, neither excavation nor fieldwork has produced any cultural material in the form of pottery or diagnostic lithic implements directly associated with the pit-digging, other than the surface find of a single Late Neolithic arrowhead mentioned above. Although at Den of Boddam some areas of buried soil contemporary with the flint
Fig. 13. GB 21 Skelmur Hill. Aerial view of the excavations in progress in 1994. Photo: Aberdeen Archaeological Surveys, courtesy of Ian Shepherd/Moira Grieg.

extraction have been preserved (Fig. 6), no fireplaces or other traces of occupation have been observed.

The strategy for dating the flint extraction has therefore been to look for natural deposits, susceptible to radiocarbon dating, which would be capable of providing a bracket within which the human activity took place. Accordingly, at Den of Boddam, a \textit{terminus post quem} of c. 3500–3000 cal BC has been obtained from a buried soil sealed by upcast spoil from an extraction pit, and a \textit{terminus ante quem} of c. 2500–2000 cal BC from peat directly overlying knapping debris infilling a pit. Details of the dates are given in Table 1, and, although the bracket is a crude one, it does point to a Late Neolithic/Early Bronze Age horizon for at least some of the extraction activity on the Buchan Ridge Gravels.

In terms of prehistoric flint exploitation in Britain as a whole, these dates suggest a correlation with the later phases of mining activity, as at Grimes Graves, Norfolk (\textit{floruit} c. 4050–3750 uncal BP: Healy 1984:106), rather than the earlier phase reflected by the Sussex mines (c. 5300–4700 uncal BP: Holgate 1991:39). It must be remembered, however, that the sites on the Buchan Ridge Gravels are so far the only clear examples in Britain of flint quarrying where extraction pits have been dug into secondary, rather than primary, flint-bearing deposits. Although the scale of
Fig. 14. GB 21 Skelmuir Hill. East-west section through Graham-Smith's Pit II, viewed from the south. The narrow 1918 cutting can be seen truncating the base of the peaty infill on the right. Where the section lies in shadow on the left is the edge of another pit, infilled before Pit II was dug. Scales in 0.5 m divisions.

Photo: Alan Saville/NMS

### TABLE 1: RADIOCARBON DETERMINATIONS FROM DEN OF BODDAM

<table>
<thead>
<tr>
<th>Lab.no.</th>
<th>Sample</th>
<th>¹⁴C age uncal BP</th>
<th>Date cal BC (2σd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GU-3438</td>
<td>buried soil (humic fraction)</td>
<td>4580 ± 60</td>
<td>3510–3049</td>
</tr>
<tr>
<td>GU-3439</td>
<td>buried soil (humin fraction)</td>
<td>4530 ± 50</td>
<td>3370–3014</td>
</tr>
<tr>
<td>GU-3440</td>
<td>Pit 19 peat (humin fraction)</td>
<td>3840 ± 90</td>
<td>2573–2040</td>
</tr>
<tr>
<td>AA-12233</td>
<td>Pit 19 peat (humin fraction)</td>
<td>3790 ± 60</td>
<td>2460–2039</td>
</tr>
</tbody>
</table>

extraction at both Den of Boddam and Skelmuir Hill appears impressive, the relative output in terms of quantity and quality of knappable flint cannot compare with those mines exploiting high quality *in situ* seams like the floorstone at Grimes Graves.

The available indications are that the Buchan extraction sites gave a rather poor return for the labour invested, and that the product satisfied a local demand within the north east of Scotland only. However, the north east was not just a focus of settlement during the Late Neolithic and Early Bronze Age, but also an idiosyncratic one in terms of its material culture and ritual monuments (Kinnes 1985; Shepherd 1986).
Perhaps, as seems the case with the curious carved stone balls (Marshall 1977), which hardly occur outside of the north east, and which must relate to a similar phase of prehistory, the exploiters of Buchan flint chose to keep their flint to themselves.

REFERENCES


