

Survey and excavation at Creag na Caillich, Killin, Perthshire

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ABSTRACT

A five-week fieldwork programme in the spring of 1989, sponsored by the National Museums of Scotland, has shed new light on the nature, scale and duration of stone procurement and processing activities at the Creag na Caillich stone axe source. Palaeoenvironmental analysis of a peat column taken from one of the trenches excavated during this work provides the first high-resolution study of mid-Holocene vegetational change in the uplands of the central Scottish Highlands.

INTRODUCTION

THE BACKGROUND: STONE AXE STUDIES IN BRITAIN

The past few years have witnessed a series of developments in the study of British stone axes. From an empirical perspective, petrological surveys have continued to add to our appreciation of the overall scale of stone axe dispersal, and the publication of the second volume of *Stone Axe Studies* (Clough & Cummins 1988) has redressed an important imbalance in our picture of axe distribution across Britain as a whole, with the inclusion of reports on areas which had hitherto received little systematic attention. Although much still remains to be done, we now have a rather more satisfactory base from which to explore regional differences in the character, scale and context of axe dispersal from a number of known and suspected sources.

Recent studies have begun to address some of the problems facing the interpretation of these broad dispersal patterns. There can be little doubt that the implement petrology programme has made an important contribution to our understanding of the character of relations within and between regions during the Neolithic. Techniques enabling us to link products with identifiable sources are clearly vital components in the archaeologists' descriptive repertoire, and an important prerequisite for the study of prehistoric exchange (Clough 1988; Grimes 1979). However, it is now widely acknowledged that 'dots on maps' do not in themselves provide a sufficient basis from which to draw broader inferences, either about the significance accorded to axes, or about the variety of purposes that may have been served by their circulation and consumption.

To overcome these problems, several recent studies have sought to quantify the degree of morphological variability between the products of particular sources as a possible key to understanding the social roles that axes might have played in contemporary society (Chappell 1987;

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Hodder & Lane 1982). We would not dispute that such research is important: clues as to the various roles of axes may well be derived from the manner in which they were physically treated (cf Kristiansen 1984). However, it is no longer possible to sustain the view that the simple addition of morphological data to our distribution maps will enable us to understand the processes which created a particular archaeological pattern (eg Earle & Ericson 1977; Hodder 1974; Renfrew 1975).

Such studies have also frequently played down the length of time over which particular archaeological patterns may have developed, and interpretations have tended to fall back upon concepts derived from modern economics to explain the 'axe trade' (but see Clark 1965). Indeed, the common use of the terms 'factory' and 'trade' imply that already we have a clear understanding of the social, economic and political contexts of production and circulation, when it is these very contexts that we need to explore. Similarly, research has often been predicated on the idea that the key to understanding the significance of these broader patterns can be found in the practical roles played by stone axes. There can be little doubt that most axes retain features which reflect their employment in practical tasks. However, we should not deny the possibility that axes were also imbued with other meanings, perhaps related to divisions of labour, identity and status, which were reproduced through use, and drawn upon in the context of exchanges within and between different groups.

As argued elsewhere (Bradley & Edmonds 1988), these ideas are of central importance for understanding stone axes in Britain. Indeed, they suggest that our knowledge of the processes responsible for the dispersal of axes, and of the purposes that their passage served, remains limited so long as we separate those patterns from their material and historical contexts. In other words, we need to broaden our analytical focus, to consider not only the form of axes, but also the conditions under which they were produced, circulated and deposited. Furthermore, since an object's significance may change according to context, we must reject the traditional practice of inferring the nature of production and consumption from dispersal patterns alone (Barrett 1989). Such an approach is based upon a series of assumptions about the relationship between production, circulation and consumption when it is precisely this relationship that we wish to understand. It is only by contrasting the evidence for these different stages in the life history of particular artefact categories that we can begin to identify the thresholds across which they might have been engaged in quite different roles. Put simply, 'changes in the relationship between these different kinds of evidence may highlight wider changes in the ways in which axes were consumed' (Bradley & Edmonds 1988, 183).

Whilst studies of the character, context and associations of axes may shed light on changes in the conditions under which they were circulated and consumed, equal attention needs to be given to the circumstances attending their production. Recent research has demonstrated that these data provide a vital context in which to explore the significance of broader dispersal patterns (McBryde 1984). For example, fieldwork at Great Langdale in Cumbria, the source of Group VI axes, has identified a series of changes in the nature and organization of production, which appear to reflect an increasing emphasis upon production for exchange. These shifts in the conditions under which axe-making was carried out appear to have been keyed into broader changes in the social roles played by the products as they circulated in different exchange spheres outside of the source area, even though they continued to be used for practical tasks (*ibid*; Edmonds 1989).

THE CREAG NA CAILLICH PROJECT

It was with this last issue in mind that a programme of survey and excavation was undertaken in 1989 at one of the two known axe production sites in Scotland: Creag na Caillich,



ILLUS 1 View of Creag na Caillich (centre) from Killin village

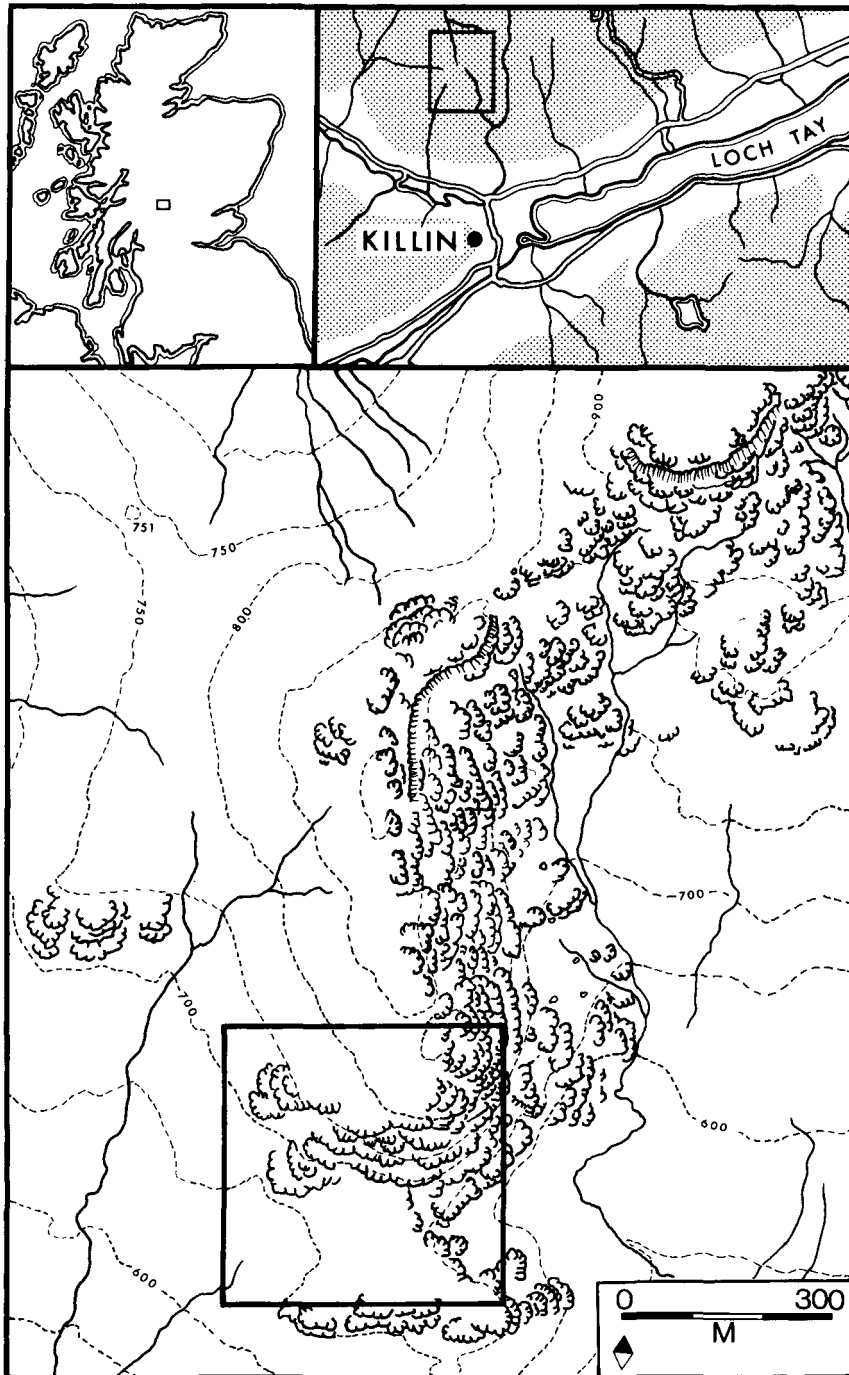
near Killin at the western end of Loch Tay. Creag na Caillich is an imposing peak which forms part of a large corrie, Coire Fionn Lairige, at the western end of the Ben Lawers range (NN 562377; 916 m OD; illus 1). The southern flank of the mountain takes the form of a substantial saddle or shoulder at c 650 m OD, which is covered by an extensive peat bog (illus 2). Although peat extends down to the 500 m contour, there are relatively few problems of access to the lowlands, particularly to Loch Tay to the south-east and Glen Lochay to the south-west.

The existence of a stone extraction and working site here had been known since the 1950s, and important work on investigating the site and its products had already been carried out by Roy Ritchie and Dr Euan MacKie (see below). The aim of the NMS 1989 project was to obtain further information on the character, scale, date and duration of stone tool production, and to place the site within its broader environmental context.

PREVIOUS WORK AT CREAG NA CAILLICH

The site was initially discovered by a botanist, Dr Duncan Poore, during a survey of the area's unusual flora in the early 1950s. This, and the subsequent discovery (but not recognition) of humanly worked material by Hydro-Electric Board workers, has been described by Roy Ritchie (1968, 126; Ritchie & Scott 1988, 90; see also *Discovery Excav Scot* (1955), 35).

Following the site's discovery, Ritchie undertook an archaeological survey in the area on behalf of the CBA Implement Petrology Committee, using W T Harry's account of the geology of



ILLUS 2 Location of Creag na Caillich. Main map (with heights in metres, to nearest metre) shows the general survey area, with the detailed survey area boxed. On the Killin map, the land over 300 metres is shaded. Based upon the Ordnance Survey map © Crown Copyright

the area (1952) as a guide. He noted the existence of an outcrop of 'grey-green indurated rock of very fine grain' – a calc-silicate hornfels – above a sill of appinite at a height of c 760 m OD, and observed that humanly produced flakes could be seen in the gaps in the turf on the terrace abutting the outcrop (Ritchie 1968). He also noted two small areas of scree containing flakes and possible roughouts, running down from the outcrop, and found further worked material on the same slope in water courses and under the turf. Yet more flakes had been found on the saddle below, some of them at the base of the northernmost peat hag, and on the basis of this observation Ritchie suggested that roughing out had taken place on the saddle as well as at the outcrop.

Further fieldwork was carried out shortly after the publication of Ritchie's 1968 paper by Dr Euan MacKie, who sampled the débitage which was eroding from one of the peat hags on the saddle below Creag na Caillich in order to obtain comparative material for his petrological study of Aberdeenshire axes (MacKie 1972). Whilst there, he collected peat samples from above and below the visible layer of debris for dating purposes, and the resulting determinations suggested a date for the activity (which he concluded, on stratigraphic grounds, to be short-lived) of around 2400–2300 BC uncal. The dates, calibrated using the University of Washington program (to one sigma), are as follows:

- peat below chipping layer: 2510±90 BC, 3338–2950 cal BC (UB-371)
- peat above chipping layer: 2250±90 BC, 2917–2655 cal BC (UB-372)

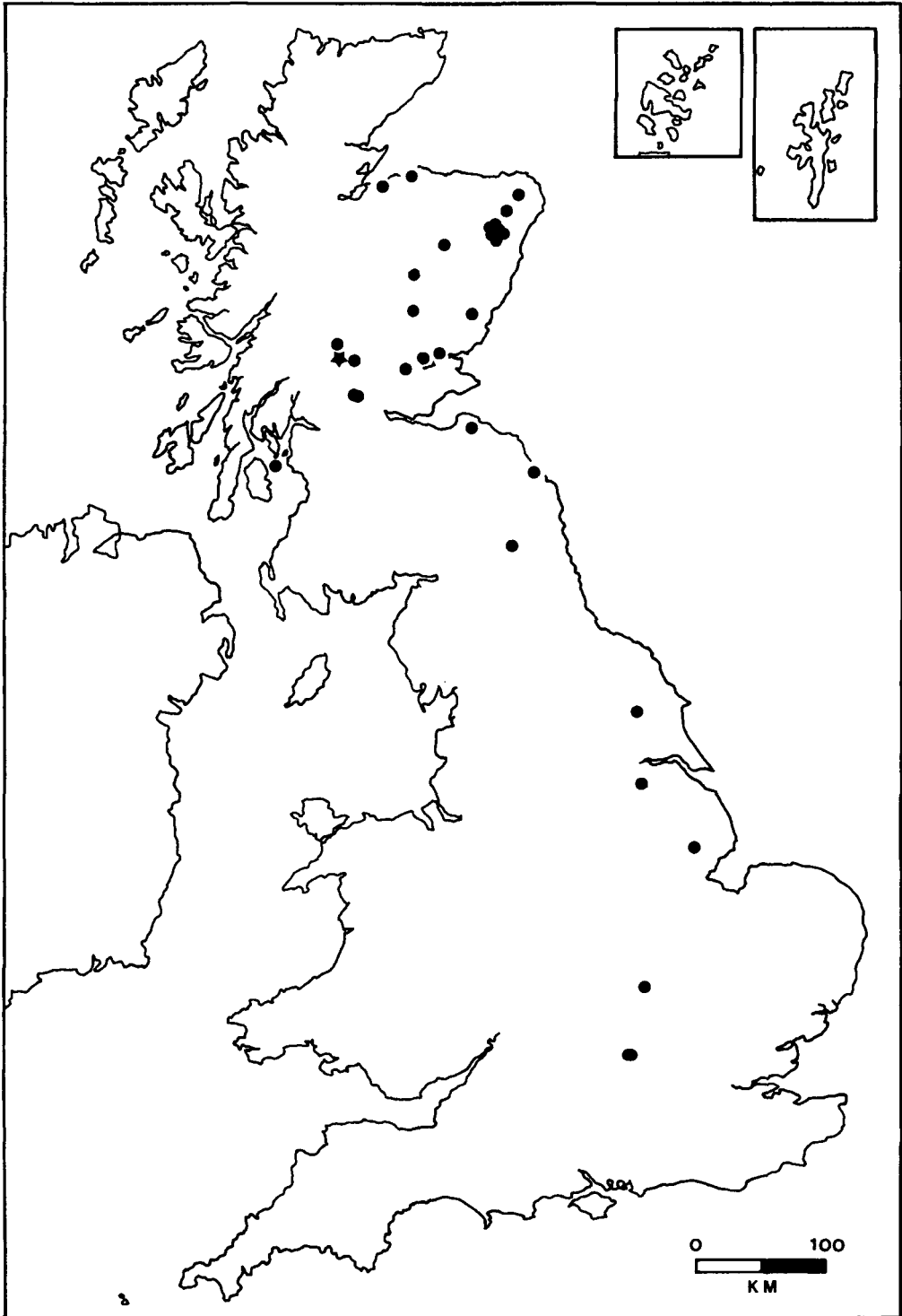
Dr MacKie also arranged for a palynological study of the peat core to be undertaken by Dr Sid Durno of the Macaulay Land Use Research Institute in Aberdeen, and although a pollen diagram for the full depth of the peat hag (1.55 m) was compiled, a report was never published.

In addition to Harry's geological study, further geological reconnaissance of the area was carried out during the 1980s by Dr Graham Smith for the British Geological Survey. These studies made it clear that the calc-silicate hornfels which had been utilized at Creag na Caillich had been created as a result of contact metamorphism of the native Ben Lawers schists by the above-mentioned intrusive appinite sill. Inhomogeneity of the parent material had produced a hornfels of varying texture (and hence varying workability for artefact production).

By 1988 petrological work on suspected Creag na Caillich products had identified some 30 implements (29 axes and one adze) which can be attributed to this source, named as Group XXIV rock (Ritchie & Scott 1988). (This Group encompasses implements which had earlier been allocated to a hypothetical 'Group V', with a suspected source near St Ives, Cornwall (Keiller *et al* 1941); 'Group V' has now been withdrawn.) Their distribution (illus 3) reveals an extensive spread down the eastern side of Britain, with two specimens recovered in Buckinghamshire, nearly 600 km to the south. Higher concentrations have been recognized in Scotland, almost entirely in Grampian and Tayside. Moreover, Ritchie has suggested (*ibid*) that there are further probable examples in existing collections, awaiting petrological confirmation of a Group XXIV attribution. He has also raised the possibility (*pers comm*) that some cushion maceheads might also be made of Group XXIV rock. This point will be returned to below.

RESEARCH DESIGN

These earlier observations were an important starting point for our research, since they provided us with a number of known locations in the vicinity of Creag na Caillich at which debris from extraction and stoneworking could be recovered. However, the simple recognition of isolated deposits of unknown scale and extent within a landscape seldom provides a sufficient basis for



ILLUS 3 Distribution of Group XXIV products, according to Ritchie & Scott (1988). Creag na Caillich is indicated by a star

wider inferences concerning the character, organization and scale of production. As several studies have shown, this often leads to a situation in which undue emphasis is placed upon certain features of production sites, such as rejected artefacts, whilst others, such as the spatial organization of working or the débitage itself, receive little or no attention (Ericson 1984; Purdy 1984; Torrence 1986). For that reason, it was important to design a research strategy which worked from the general to the particular – establishing the physical extent and character of the archaeological deposits before more detailed analyses and sample excavations could be undertaken.

As stated above, the aim of the 1989 project was to investigate in greater detail the character, scale, date and duration of stone tool production at Creag na Caillich, and to place the site within its broader environmental context. Following the approach taken at Great Langdale (Bradley & Edmonds 1988), an initial phase of exploratory survey was undertaken to establish the broad limits of the evidence for the extraction and working of the hornfels. This provided the basis for a more detailed programme of sampling and excavation.

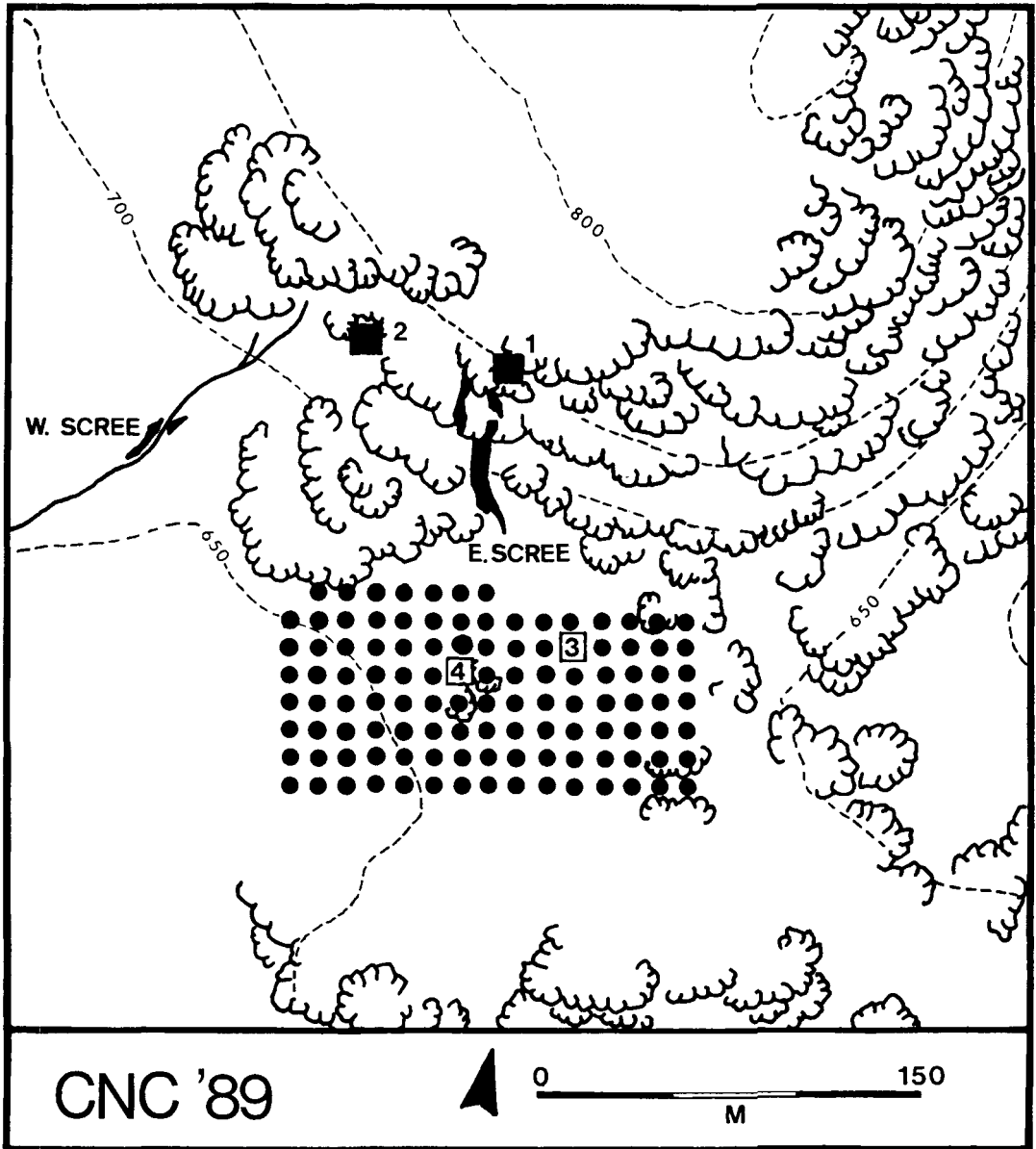
SURFACE SURVEY AND SAMPLING

The first phase of our work encompassed an area of approximately 2 sq km, although more distant outcrops of related material were also examined. No evidence for activities associated with the exploitation of the hornfels was recorded outside the main survey area. Moreover, this phase of reconnaissance, which involved the mapping of flake scars on the surface of rock outcrops, and the probing of exposures in the surrounding peat bogs, suggested that the majority of the evidence for extraction and production was located at a relatively small number of points within the limits of the survey. These comprised three locations retaining evidence for the extraction of stone; scree of working debris to the south and west of Creag na Caillich itself; and a small number of exposures of débitage contained within the peat which lies at the foot of the main crag (illus 4).

The information gained from this general survey was then augmented by a more systematic programme of sampling. Each scree of working debris was examined at 10 m intervals along its longitudinal axis, and samples were retained for technological analysis. In addition, a grid of 1 m-square shovel-pits was laid out across the peat-covered saddle on the south side of the mountain, encompassing the area investigated by Ritchie and MacKie (illus 4). These pits, laid out at intervals of 10 m across the saddle, proved to be particularly valuable. They provided vital information on the spatial distribution of working debris, and enabled us to take further samples for technological analysis.

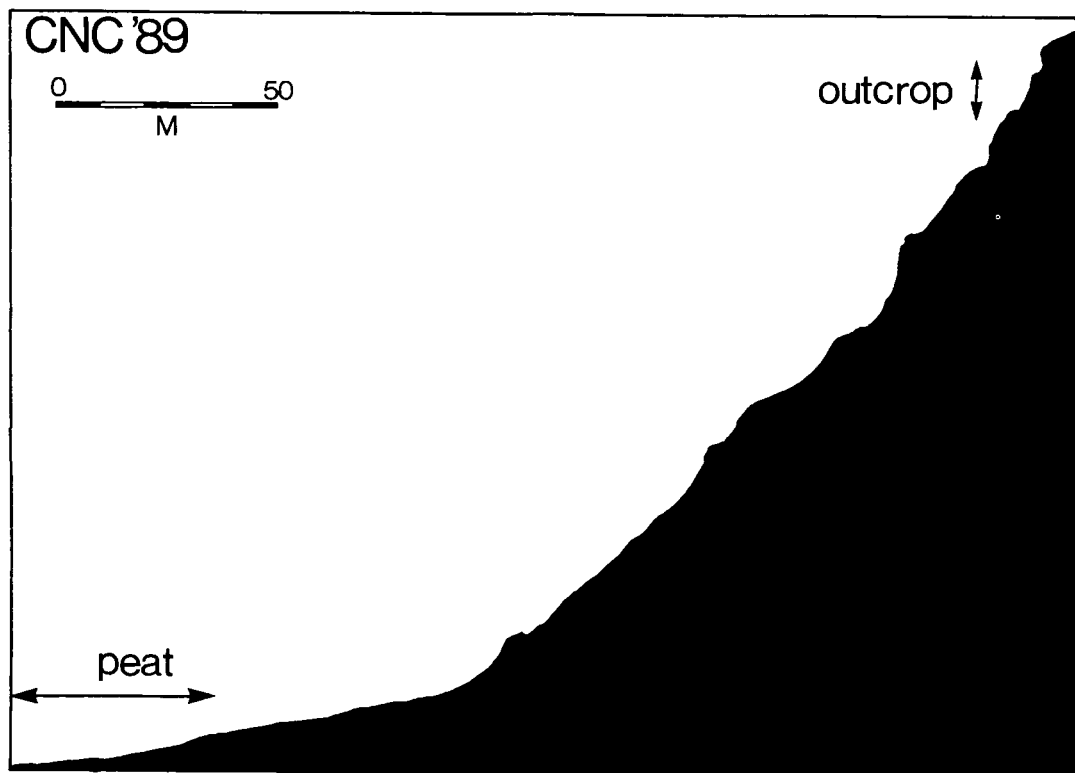
This level of analysis served to define the general spatial structure of the deposits within the study area. The majority of the material contained in the exposed scree appeared to emanate from the extraction sites identified through the mapping of flake scars on the rock surface. Probing of the steep slopes below the two principal extraction sites suggests that deposits of working debris remain intact beneath the rough grass cover which is as yet unbroken by erosion (illus 5). In the case of the western scree, however, which was exposed in the banks of a small stream running down from the crags, it is possible that some of the debris reflects the working *in situ* of material brought down from the higher outcrops.

The analysis of the data from the scree (Table 1a; Table 1b: fiche 1:A5) revealed that much of the variation in the character and frequency of flakes can be explained as a product of size sorting. In other words, whilst the vast majority of the material contained in each scree is likely to have been generated at a higher contour, probably adjacent to the point of raw material extraction, those pieces with the greatest mass have travelled the greatest distance downslope. Such a view is supported by the technological character of these assemblages. In each case, the débitage reveals a



ILLUS 4 Principal survey area, showing the location of the sites and the shovel testing grid

marked emphasis upon waste from the primary stages of production, with large, irregular and often crudely worked flakes and shattered material. There are virtually no flakes which retain evidence for the preparation of platforms prior to flaking, and it can be argued that a percentage of this material may actually be a by-product of the extraction process itself. There is little evidence from these contexts that the later stages of production, such as shaping, thinning and trimming were undertaken at or above the 700 m contour level, the only exception being the material recovered



ILLUS 5 Schematic section of Creag na Caillich, with the extent of the outcrop and of the peat cover indicated

from the scree to the west of the main crags (see above). Here a number of shaping and thinning flakes were present, although the general character of the assemblage reflects a marked emphasis upon the preliminary stages of production (illus 6).

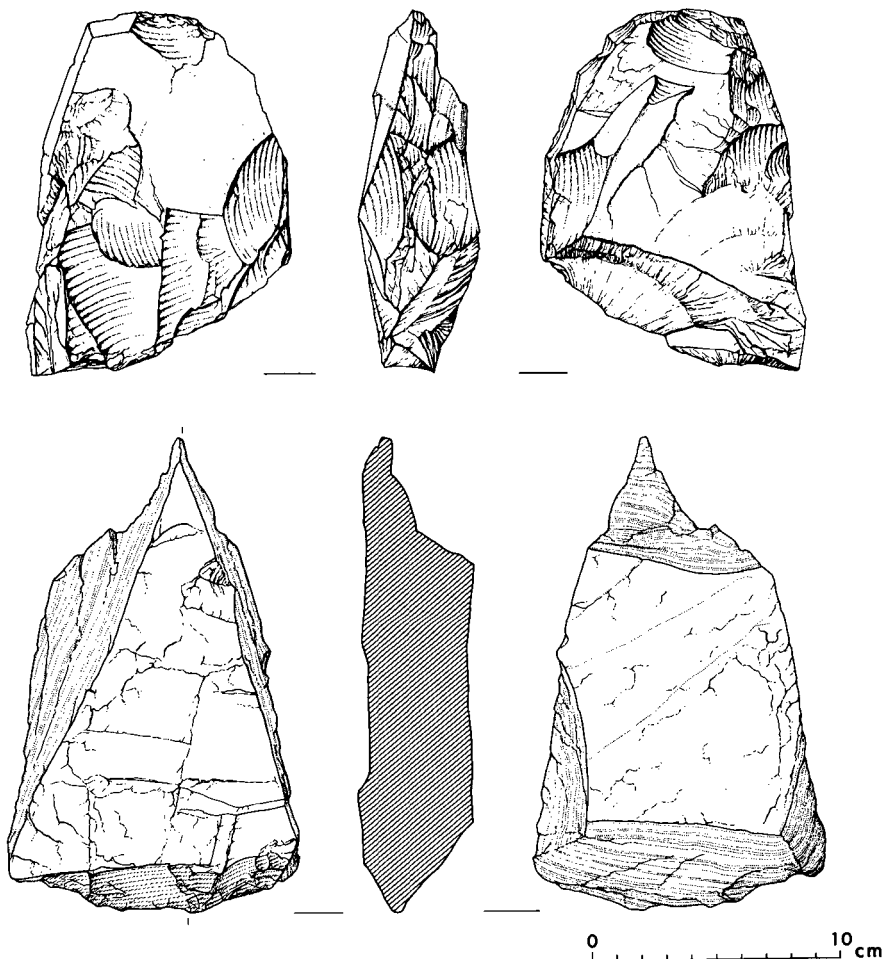
This pattern contrasts with that recovered from the grid of shovel pits on the saddle to the south of the mountain (see illus 7). In spatial terms, the material from these sample squares suggests that the working of stone was generally restricted to the level ground adjacent to the steeper crags. There is no evidence to indicate that the production of axes was undertaken at other locations across the saddle. Substantial deposits of working debris were recovered from sample squares below the main scree originally reported by Ritchie (1968). However, the absence of any material in the squares immediately adjacent to the base of the scree indicates that these deposits represent working *in situ*, and not the accumulation of material derived from above. Further débitage was recovered from sample squares towards the north-eastern limits of the transect, the latter being located near to one of the principal access routes down from the mountain towards Loch Tay.

From a technological perspective, the material recovered from the sample squares is markedly different from the assemblages contained in the screes (Table 2: fiche 1:A6; and see illus 8; cf illus 6, 10, 16, 17). However, where material was recovered from beneath existing peat deposits, the nature of the soil conditions was such that a percentage of the débitage was heavily degraded. Indeed, in a small number of cases (eg squares C13 & D10), this chemical action had reduced a number of flakes to a paste-like consistency. Whilst flakes from the primary stages in

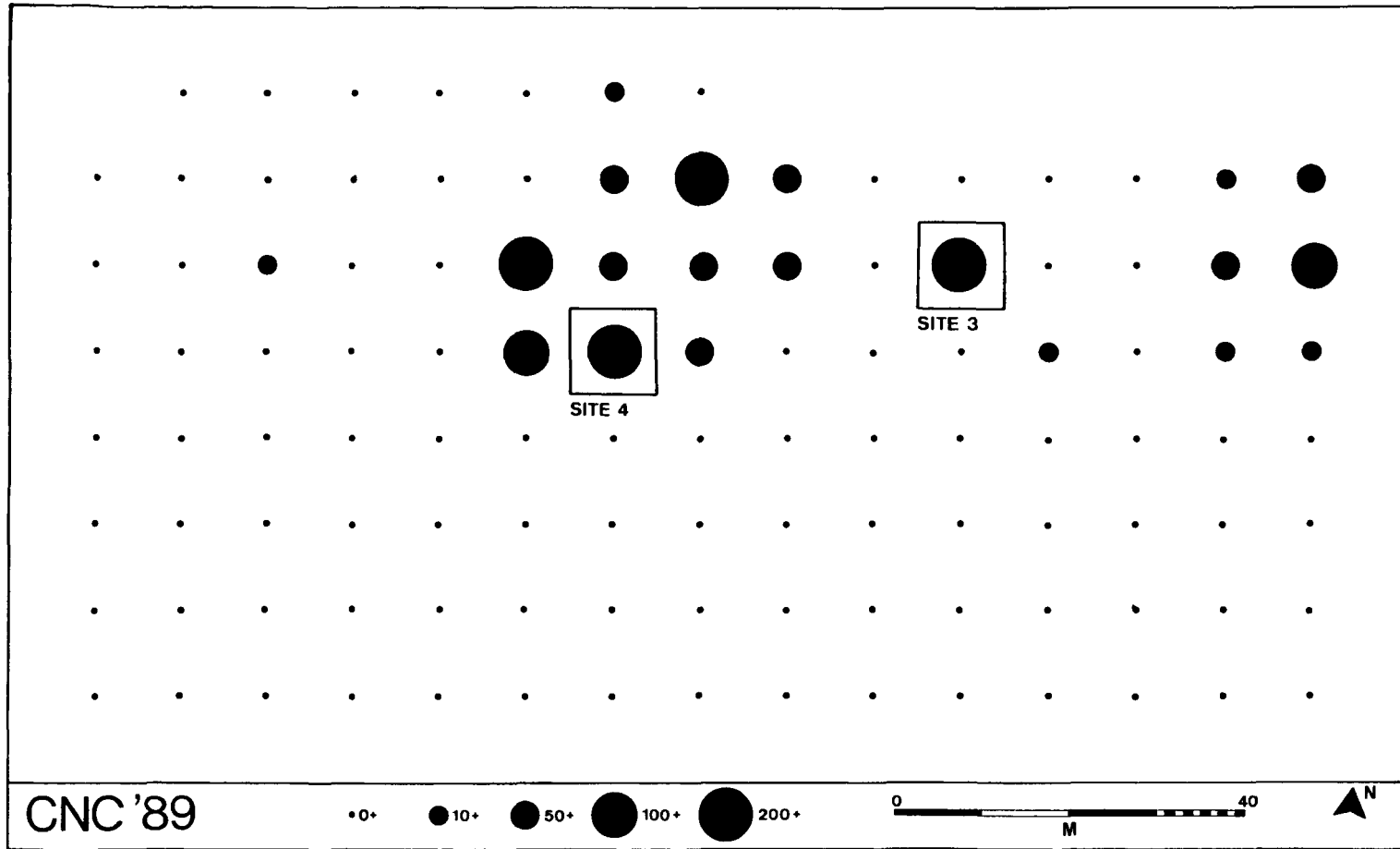
Table 1a

Generalized flake categories created during roughout preparation (source: Edmonds 1989). Table 1b and Tables 2–6, which provide detailed information on the character of the material from Creag na Caillich, are presented on the microfiche.

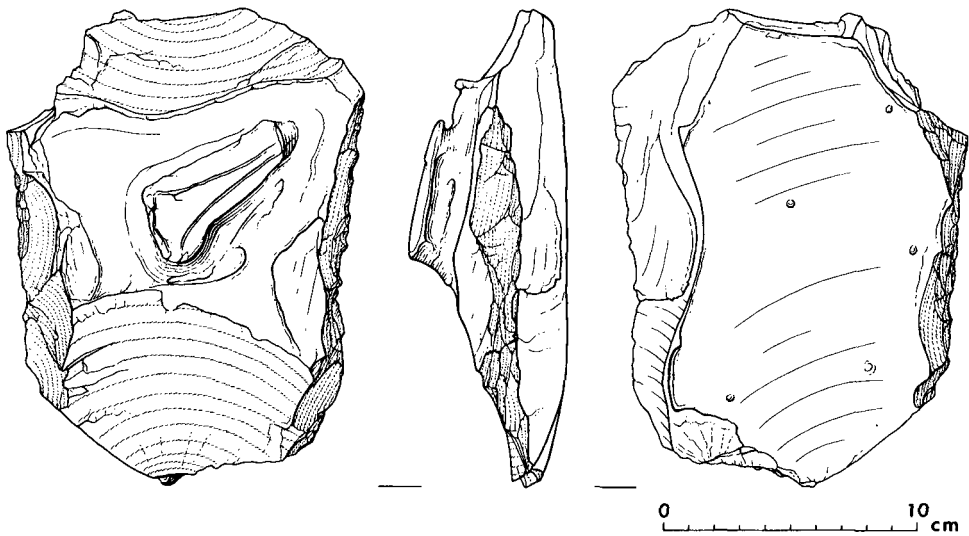
Category	Description	Reduction sequence stages
A	Massive flakes with irregular edge morphology	Preparatory trimming and shaping of raw material
B	Large invasive flakes, thick in section, with an irregular edge morphology	Primary shaping of roughout through invasive alternate flaking
C	Broad, squat flakes, thick in section	Mass reduction
D	Long, thin invasive flakes, often with curving profile	Thinning and final shaping of roughout
E	Small thin platform chips, thin in section and often curved in profile	Platform preparation prior to thinning flake removal, or final trimming and shaping of roughout edge
F	Small angular platform chips, often with large platforms and a marked triangular section	Platform preparation prior to primary and secondary working. May also be generated during later stages



ILLUS 6 Worked stone from Creag na Caillich. Top: broken roughout, western scree; bottom: tabular chunk, test pit C9



ILLUS 7 Distribution of worked stone on southern 'saddle' as revealed by shovel testing. The rows were labelled A-H from N to S, and the columns 1-15 from E to W



ILLUS 8 Flaked piece with natural boss, test pit D2

production are present (illus 6), the vast majority of the material reflects the secondary and tertiary stages in the production of large bifacial artefacts. Here we find a clear emphasis upon mass reduction, and the shaping, thinning and trimming of blocks of raw material. Moreover, those samples recovered from squares beyond the margins of the peat (eg B1, B2, B8, B9, C1, C2, C5 & C8), retained substantial quantities of small chips and shattered material, which are generally reliable indicators of working *in situ*.

SAMPLE EXCAVATIONS

These preliminary observations provided a general impression of the manner in which extraction and production had been organized in spatial terms. The material from the screens, together with that exposed close to the quarries, indicated that the activities conducted in the vicinity of the outcrop were generally restricted to the extraction of stone, the testing of raw material and the preliminary flaking of large angular blocks. By contrast, the data from the sample squares suggested that a far wider range of stages in the production process was undertaken on the saddle to the south of the mountain. In short, it appeared that material extracted from the outcrop was then brought down to more level ground for further reduction (illus 5).

Valuable though these general observations were, it remained difficult to discuss the nature of production in any detail. As Torrence's work on the obsidian quarries of Melos has shown, considerable problems accompany the drawing of inferences from surface deposits alone, not the least of which is the lack of any form of chronological control (Torrence 1986; Purdy 1984). At the same time, the limited scale of many of the surface assemblages was such that it was difficult to draw inferences concerning the particular character of the steps taken in the production of axes. Given these problems, it was decided to undertake a series of small excavations to obtain technological samples and dating evidence at a number of points within the survey area. These consisted of two of the quarries or extraction sites, and two trenches across working floors on the lower ground to the south (illus 4).

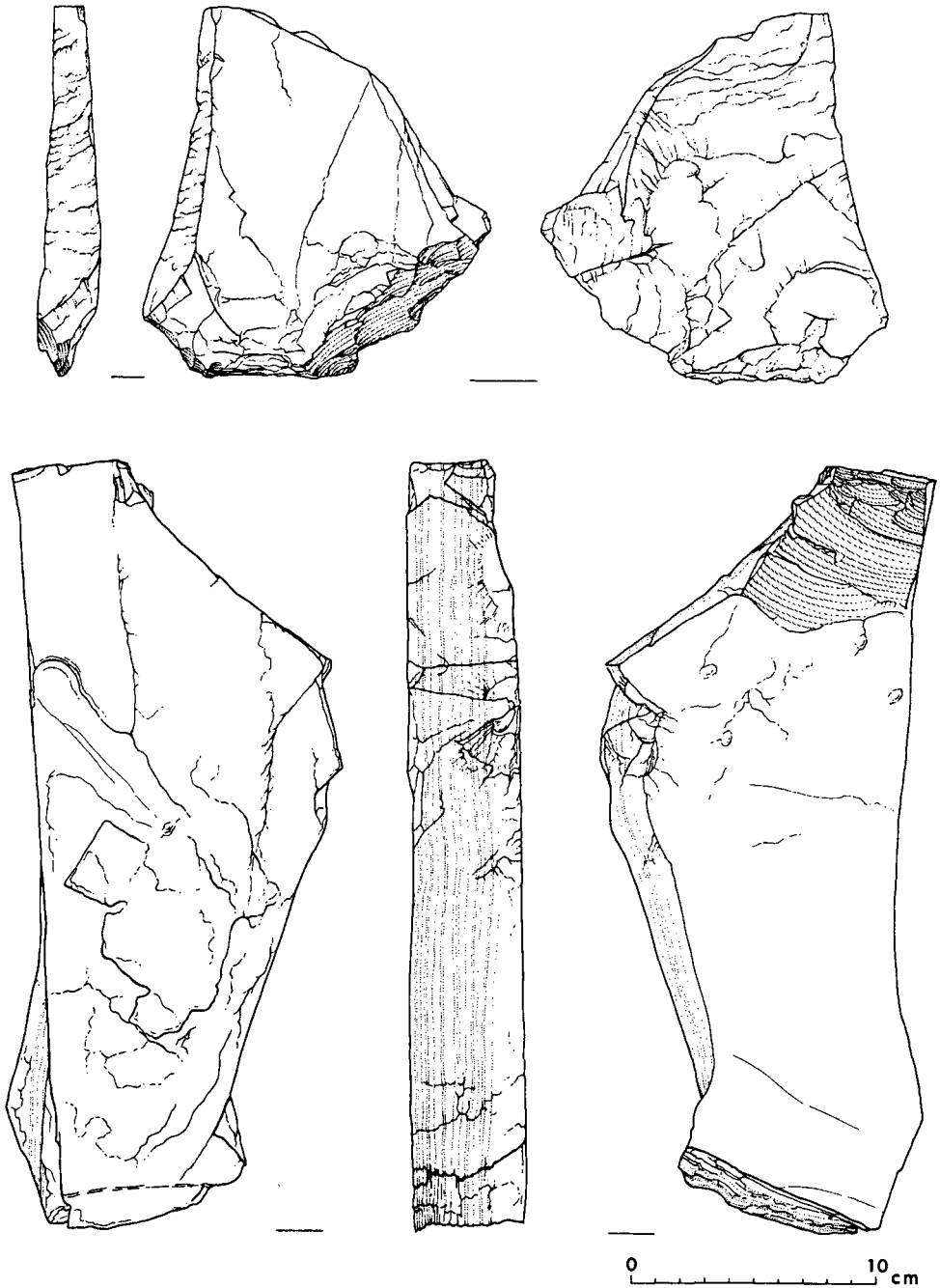
SITE 1: EASTERN QUARRY

The first of the two trenches to be located adjacent to the outcropping hornfels was situated directly above the upper margins of the scree of working debris reported by Ritchie (1968). Here the ground slopes down steeply from two ledges where the raw material outcrops (illus 9). Our preliminary survey had established the presence of conchoidal fracture scars on the parent stone on each of these two ledges, suggesting that the immediate area had witnessed exploitation in the past. Further observations added weight to this idea. On the slopes running down from each ledge, erosion had created a series of small breaks in the vegetation, and in a number of these it was possible to recognize debris indicative of stone working. Indeed, it seems probable that the steep angle of these slopes is itself tied to the occurrence of working in the area. Both lie at approximately 45–50 degrees – the angle of rest assumed by many screees of loose stone. These grass-covered areas are therefore likely to cover substantial quantities of *débitage* and quarrying debris derived from the ledges above. It would be relatively straightforward to establish the character and scale of these deposits through the cutting of sample squares similar to those discussed above. However, the creation of breaks in the vegetation cover on steep slopes can initiate rapid erosion, often on a massive scale. For that reason, we decided to restrict our attention to the immediate area of the ledges themselves.

The 2 x 1 m trench cut against the face of the outcropping hornfels was excavated in 100 mm spits down to the underlying bedrock, with all archaeological material retained for more detailed



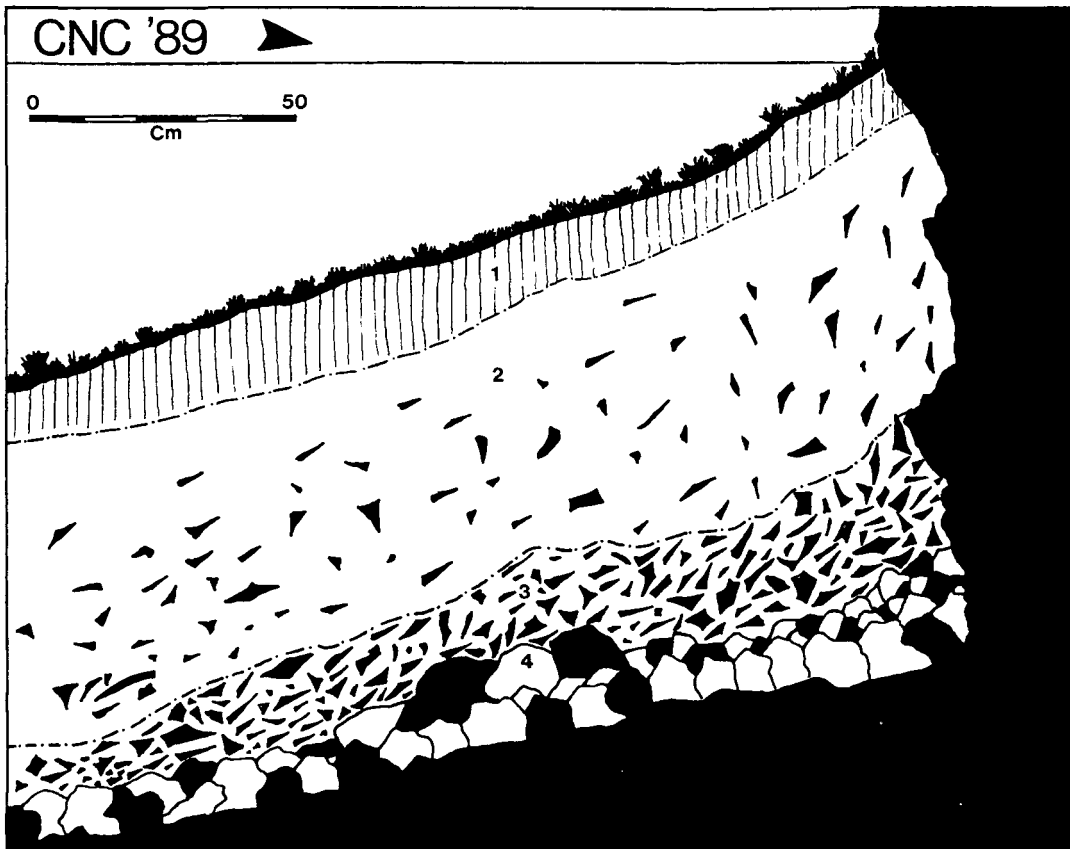
ILLUS 9 View of outcrop at Site 1 (eastern quarry)



ILLUS 10 Top: category A flake (see Table 1a), test pit C1; bottom: tabular block with preliminary flaking, Site 1

analysis (Table 3, fiche 1:A7; illus 10). The material recovered from this context confirmed our initial hypothesis that raw material had been extracted in the immediate area. The basal layer (layer 4) consisted of fractured blocks of stone, many retaining individual flake scars. Above this was the principal layer of working debris recognized at the site (layer 3). This was sealed by a rich, humic soil horizon containing isolated flakes and other quarrying debris (illus 11). The stratigraphic sequence at this site suggests that the archaeological deposits accumulated over a relatively short period, although the upper horizons do indicate that working on a smaller scale may have continued after the main phase of exploitation. The presence of flake scars on the underlying bedrock indicates that earlier episodes of working now lie buried beneath the scree which runs down from the site. This parallels the situation observed at a number of axe quarries in the central fells of Cumbria, where the working of exposed 'steps' or benches of stone generated substantial quantities of debris which effectively sealed earlier working areas situated downslope (Bradley & Edmonds 1988).

With the exception of a granitic hammerstone fragment recovered at a depth of c 0.3 m, the assemblage recovered from the site consists of debris which reflects both raw material extraction and the initial working of stone. The bulk of the débitage is likely to have been generated during



ILLUS 11 Site 1, western section. Numbers refer to layers as described in the text

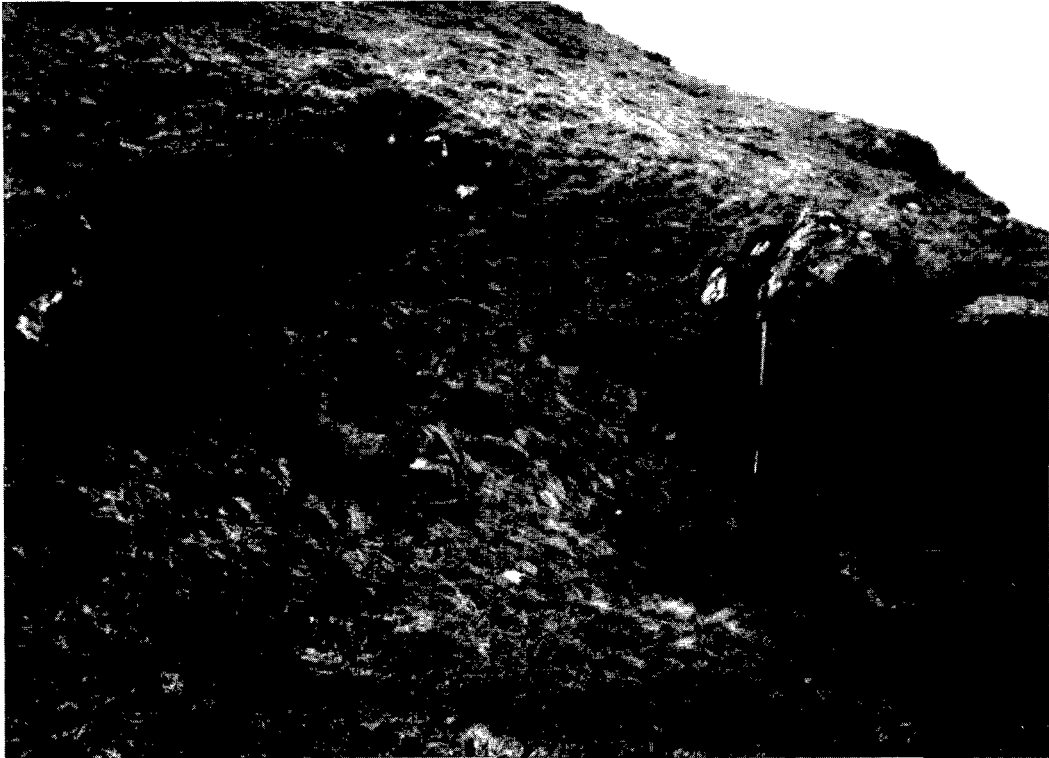
extraction, which appears to have involved the repeated hammering of the parent raw material, and the removal of large irregular blocks and flakes. There is no evidence to suggest that this process involved any degree of preparation or maintenance of the rock face itself. This somewhat *ad hoc* approach to the extraction of stone would have been quite effective, since the raw material is prone to fracturing along pre-existing lines of weakness, a property which also has consequences for the later stages of roughout production (see below). Indeed, the raw material itself displayed a considerable degree of variability, ranging from coarse-grained rock which would have been difficult to work, to a more fine-grained, homogeneous stone which could have been flaked relatively easily. Although small quantities of charcoal were recovered from the site, there is little evidence to suggest that fires were employed in the extraction process. In fact, given the nature of the raw material, it is unlikely that fire-setting would have conferred any particular practical advantage.

In addition to the angular fragments, blocks and shattered material associated with the extraction of stone, the assemblage also contains waste which is diagnostic of the preliminary stages in the preparation of roughouts. This takes the form of large, irregular flakes which appear to have been generated during the initial testing and shaping of larger blocks. Very few flakes have any scars on their dorsal surfaces, which supports the view that they were removed at an early stage in the reduction sequence. At the same time, there is very little evidence to suggest that any concerted attempt was made to create and maintain reliable platforms on the blocks. Scars indicative of platform trimming or abrasion are virtually absent. Those few larger pieces which do bear flake scars indicate that little effort was expended in the creation of good striking surfaces, or in the positioning of hammer blows. This is borne out by the generally large size of flake platforms, and by the high frequency of flakes with large hinge or step terminations.

SITE 2: WESTERN QUARRY

In contrast to the somewhat precarious situation of the ledges which make up the eastern quarry, the extraction site recognized c 70 m to the west is located in an area of rather more level ground. In fact, surface survey suggests that this level area may itself be an artefact of prehistoric activity. The roughly horseshoe-shaped open-cast quarry that can be seen today appears to have been created by working back into the hillside in a northerly direction (see illus 12 & 13). This would have had the effect of enlarging the area of relatively level ground immediately to the south of the outcropping rock. This impression was confirmed during excavation of the 1 x 1.5 m trench, and it seems that this artificially extended area of level ground was consolidated by compacted soil and quarrying debris (illus 14). To the south of the working area, the ground drops away at a slope of approximately 50–55 degrees and, here again, it appears that deposits of working debris generated at the quarry are concealed by the modern grass cover.

By comparison with the eastern quarry, the raw material at Site 2 is relatively coarse grained. Although it retains the properties of conchoidal fracture, the stone extracted from this immediate area would have been difficult to flake in a regular and controlled manner. However, as Table 4 (fiche 1:A8) suggests, the general structure of the assemblage from this site bears a number of points of correspondence with the data recovered from the eastern quarry. The *débitage* reflects a general emphasis upon the extraction of stone and the preliminary testing and reduction of crude blocks of material, albeit on a relatively small scale. This is reflected in the high frequency of small chips, spalls and shattered material throughout the profile, and by the virtual absence of any flakes which can be assigned to secondary or tertiary stages in the production process. Much of this material may, in fact, be directly related to the extraction of stone. Similarly, the high incidence of flakes with large hinge or step terminations may also

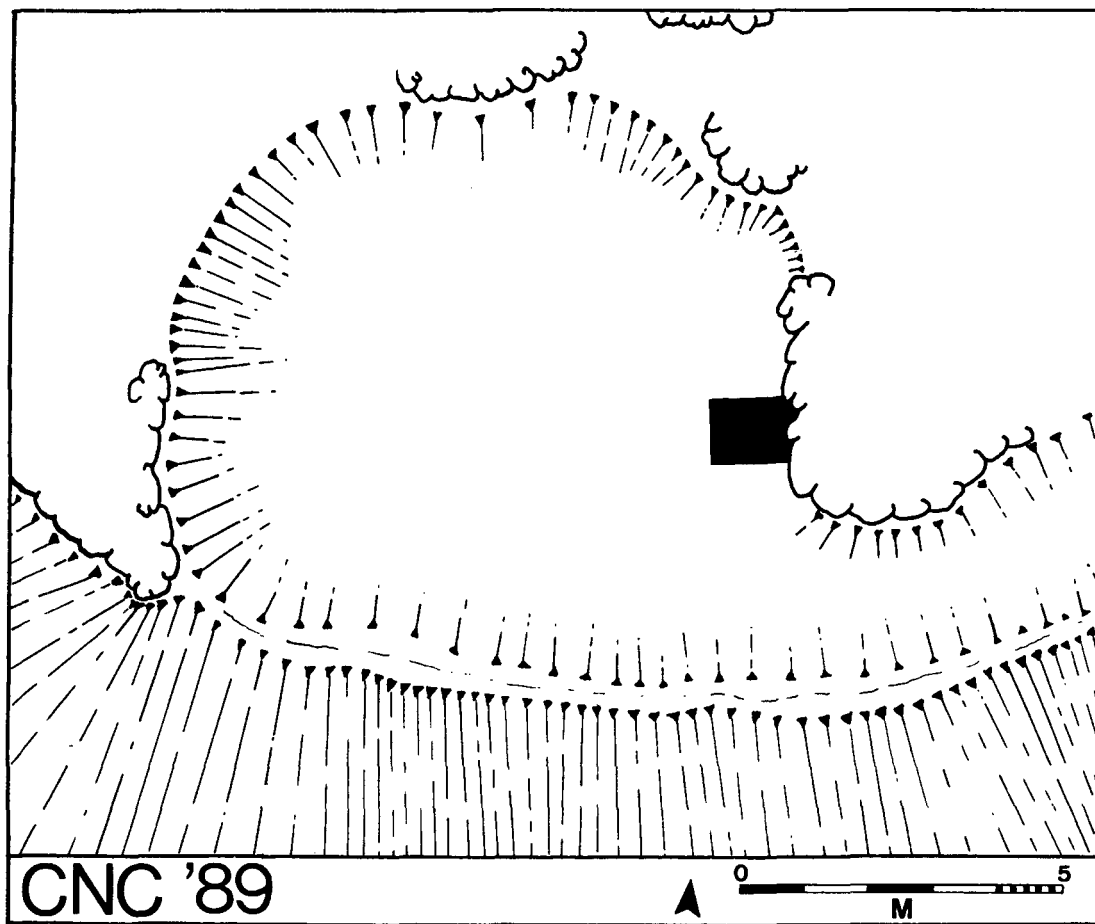


ILLUS 12 View of outcrop at Site 2 (western quarry)

reflect the difficulties that were encountered in separating workable blocks or large flakes from the parent material. Here again, whilst small quantities of charcoal were recovered at a number of horizons, there is little to indicate that fire had been used to prepare the rock face prior to the extraction of stone.

There is no evidence to suggest that the later stages in the production process were undertaken at the quarry. Indeed, the impression given by the data is that whilst a significant quantity of raw material may have been extracted, relatively little time or effort was expended in modifying or preparing the stone before it was removed from the immediate area for further reduction. As with the eastern quarry, parallels for both the scale and character of working at this site can be found on the high fells of central Cumbria. For example, some of the small-scale extraction sites on Scafell Pike contain assemblages which reflect the exploitation of exposed benches of stone and the preliminary reduction of large blocks and flakes (Bradley & Edmonds 1988; Claris & Quartermaine 1989).

In addition to the excavation of two sites directly associated with the extraction of stone, two further locations were selected for detailed investigation. Both were situated some distance below the outcrop of workable hornfels, in the area encompassed by the shovel-testing survey (illus 4). As such, they provided an opportunity to look in more detail at the manner in which the production of roughouts was organized once the raw material had been removed from the point of extraction.

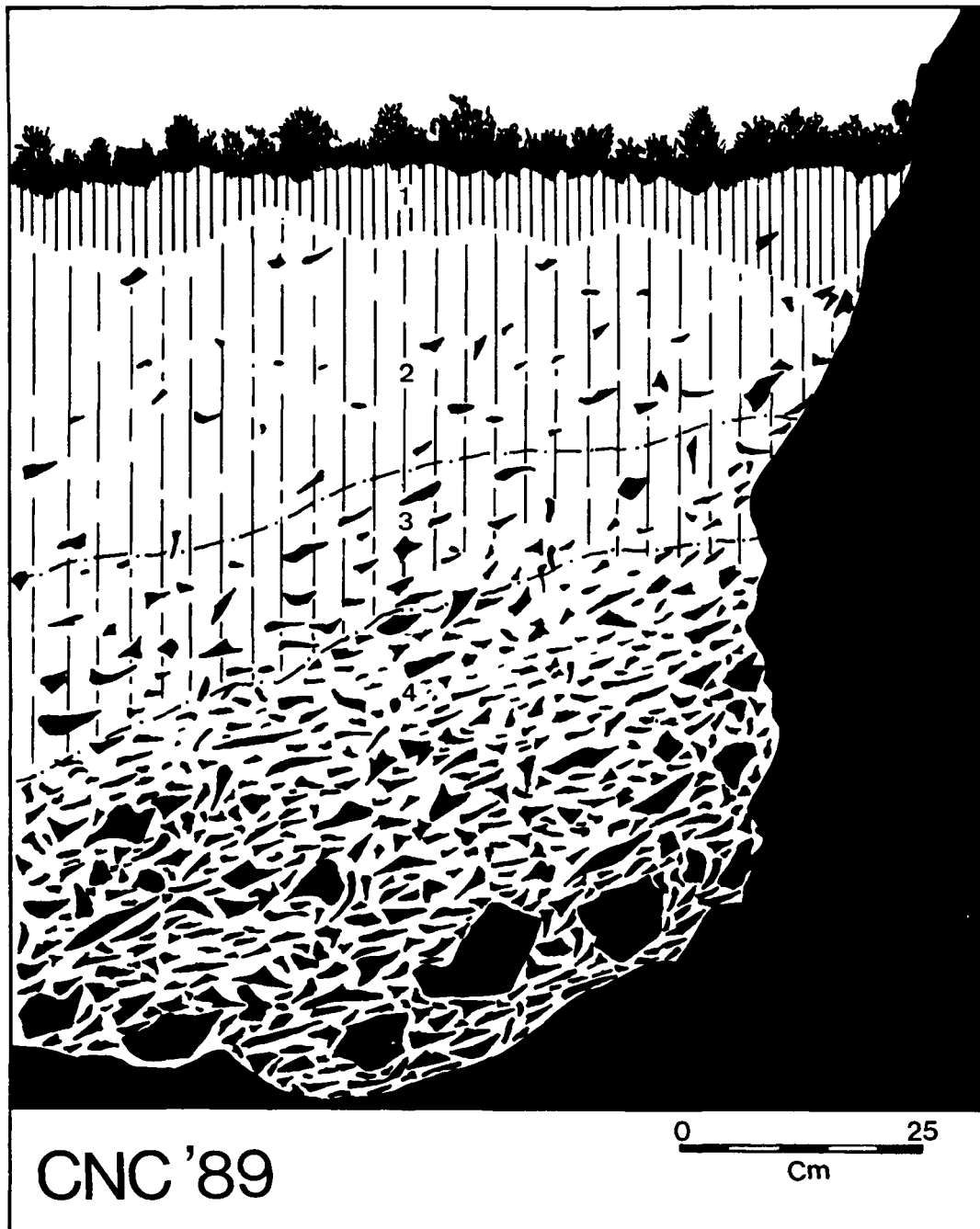


ILLUS 13 Site 2, plan of quarry and location of trench

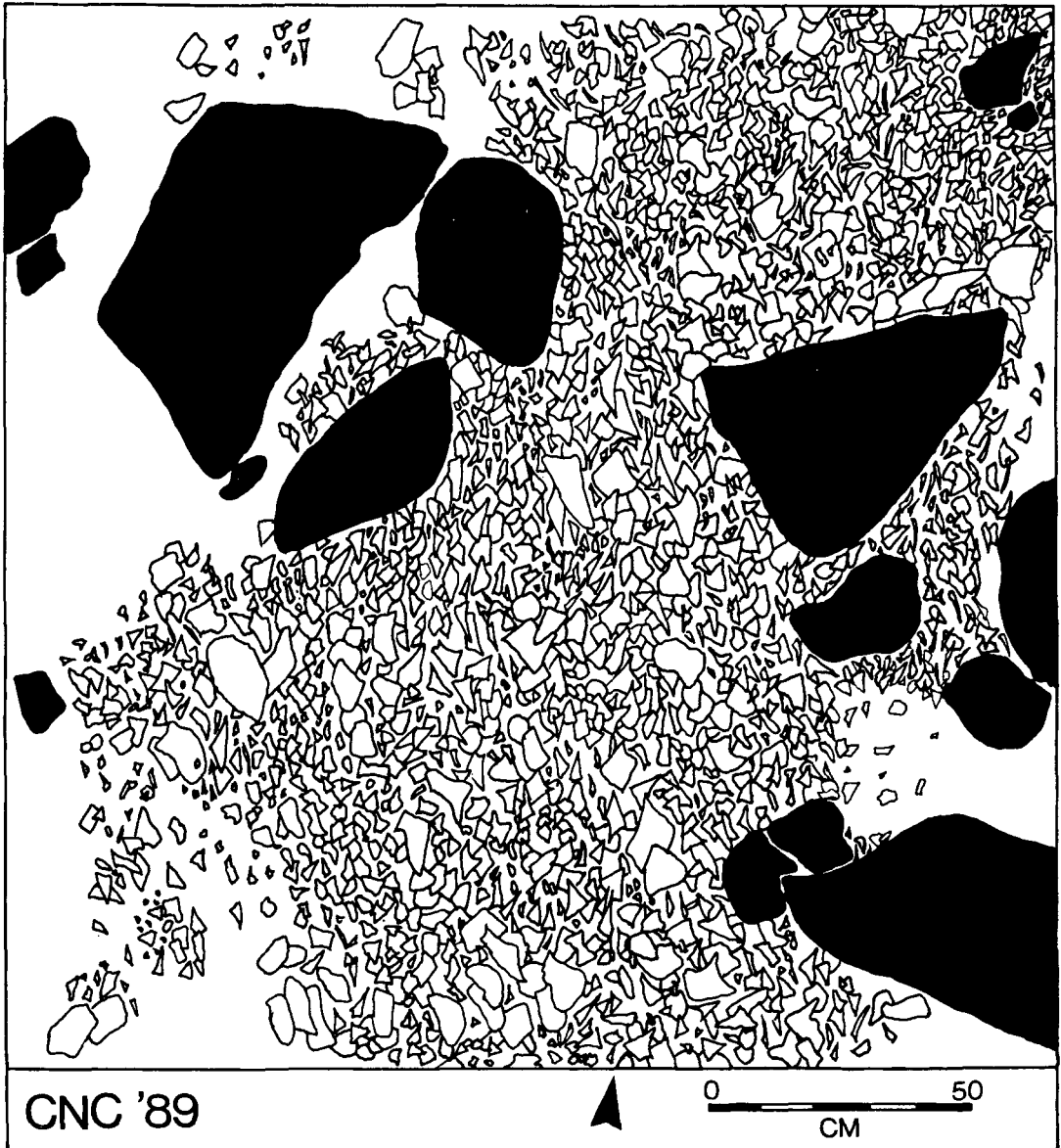
SITE 3: EASTERN WORKING FLOOR

The excavation of the first of these two sites took the form of a 2 x 2 m trench orientated on the same axis as the shovel-testing survey, and incorporating the area originally exposed in sample square C5. The excavation revealed a substantial volume of débris which continued under the northern section of the trench, although it did not extend as far as sample square B5. The southern and western margins of the scatter were visible within the trench, and it therefore seems reasonable to infer that this deposit is not simply a component of the working floor exposed on Site 4, some 20 m to the west, between sample squares D8 and D10. All of the débris was contained within a single dark humic layer (layer 2) overlying a thin mineral soil horizon, and it seems probable that the deposits reflect a single episode of activity. Whilst the trench did not encompass the full extent of the working floor, the patterning recovered during the sample square survey and through probing indicates that the excavated material comprises c 70% of the total débris contained in the scatter (illus 15).

Although no complete roughouts were recovered, a number of different characteristics of this

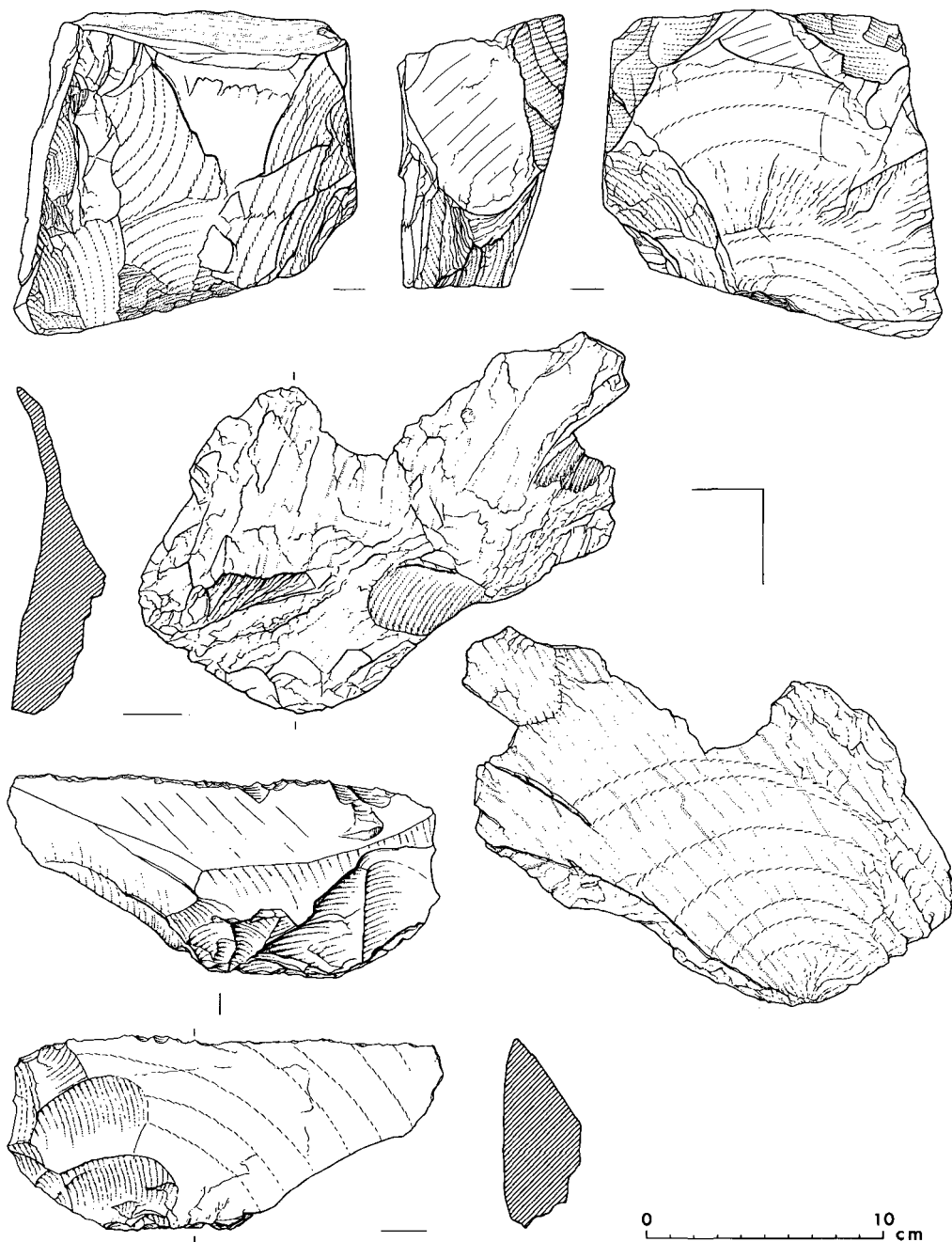


ILLUS 14 Site 2, western section. Numbers refer to layers as described in the text

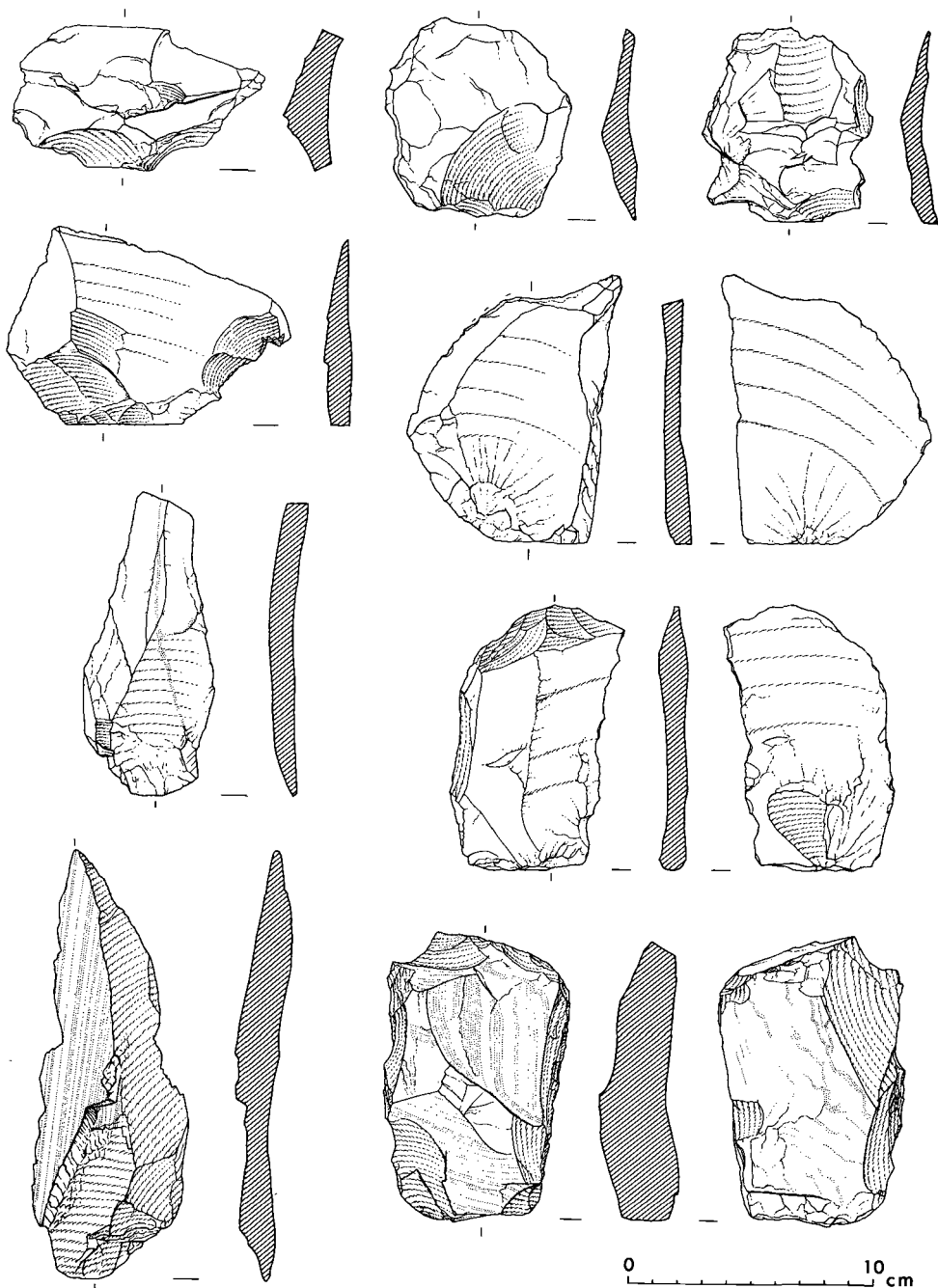


ILLUS 15 Site 3: distribution of worked stone. Shading indicates unworked boulders and cobbles of stone other than the calc-silicate hornfels

assemblage indicate that the deposits were created during the production *in situ* of large, bifacial tools (illus 16–17). Whilst it is notoriously difficult to make reliable estimates of the scale of working, the material recovered from Site 3 probably reflects the production of between 10 and 20 roughouts. The high densities of chips, spalls and small shattered pieces, are precisely what one might expect to find on a working floor, and the larger flakes parallel those observed on other axe-production sites, as well as material generated during experiments (Edmonds 1989).



ILLUS 16 Top: roughout fragment, test pit B9; centre: category A flake, Site 4, layer 5; bottom: retouched flake, Site 3, unit K. (Site 3 units are 0.5 m squares)



ILLUS 17 Flakes, mostly from secondary and final stages of roughout production (categories C–D). Top left: Site 3 (C); top centre: Site 3 (A); top right: test pit B8. Second row left: Site 3 (B); second row right: Site 3 (N). Third row left: Site 4, layer 5; third row right: Site 3 (G). Bottom left: Site 4, layer 4; bottom right: category B–C flake from test pit B8

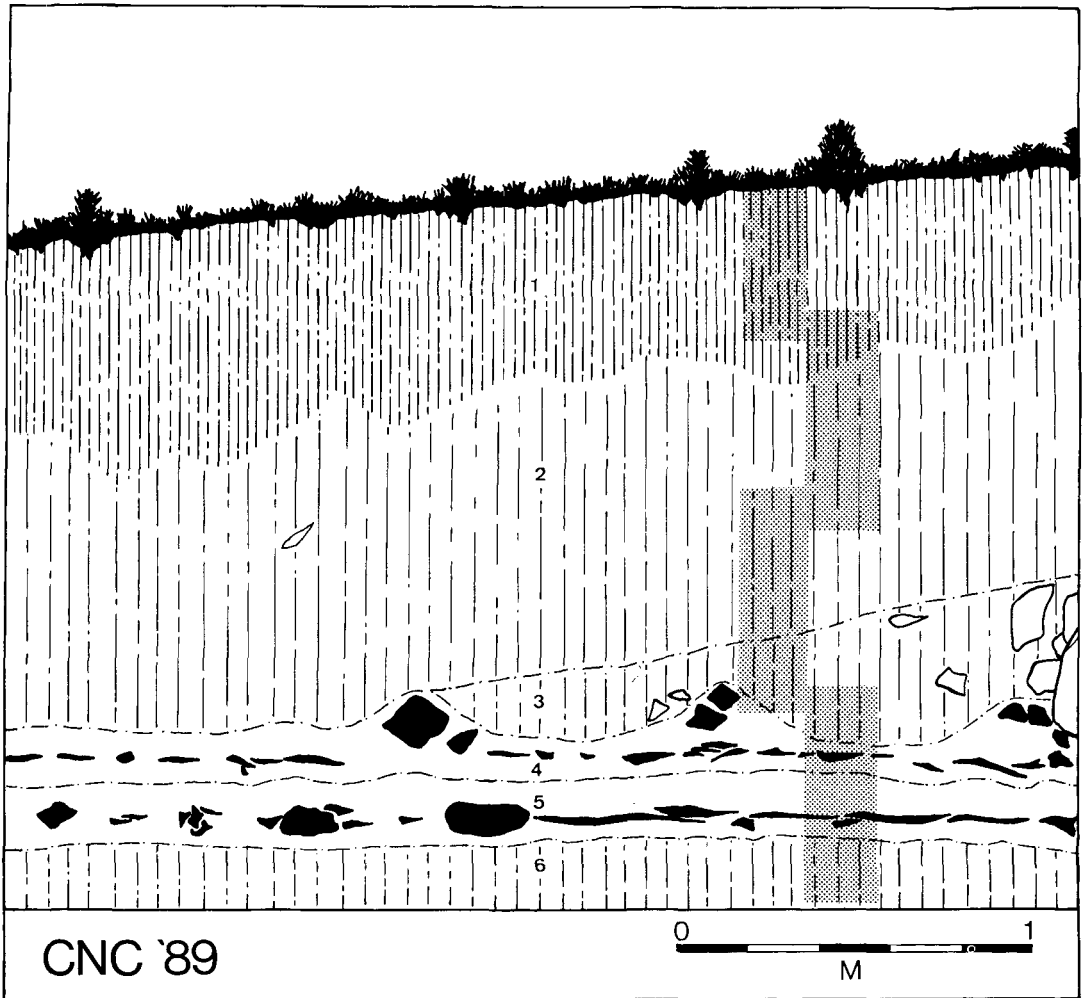
From a technological perspective, the *débitage* from this context is particularly informative. It demonstrates that the majority of stages in the manufacturing process, including the shaping of blocks, mass reduction, thinning, final shaping and trimming, all took place at the site. Moreover, although refitting was not an option that could be explored, the character of much of the waste did provide clues regarding the particular nature of the reduction sequences followed on site (illus 17; Table 5: fiche 1:A9). There can be little doubt that material was introduced to the site in the form of large angular blocks and irregular flakes. Indeed, a number of these were recovered. They indicate that little control was exercised over the character of the preforms that were obtained from the extraction sites. This lack of concern with the form in which the raw material was obtained is reflected in the relatively high frequency of preliminary shaping and mass reduction flakes, which would have served to reduce the raw material to a more workable form. The absence of evidence for the preparation or maintenance of platforms on flakes from these early stages in the reduction sequence suggests that little attempt was made to anticipate and avoid errors during manufacturing.

This impression of a relatively low level of precision and control in working is also reflected in the waste from the later stages in the reduction sequence. Here again, we find a relatively low frequency of prepared or trimmed platforms and very few rejuvenation or recovery flakes. This would account for the high frequency of hinge and step fractures on many flakes. These would have left deep depressions in the surface of the roughout, thus adding to the time and energy required for grinding. In addition, there is a marked lack of faceting on the majority of platforms, many of which bear large hinge fractures and crushing indicative of repeated hammering. Together with the patterning of scars on the dorsal surface of many flakes, these characteristics suggest that the producers did not make any concerted attempt, either to follow a regular routine of flaking around the surface of the roughout, or to correct or compensate for errors made at earlier points in the sequence. This impression is supported by the generally low flake-thickness to flake-length ratios, which indicate that the majority of removals did not travel far across the surface of the roughout.

In certain respects, these patterns are not altogether surprising, particularly given the nature of the raw material itself. Unlike more fine-grained siliceous materials such as flint, the hornfels at Creag na Caillich is particularly prone to crushing and hinge fracturing. The risk of these errors can be reduced significantly through the careful preparation of platforms, and the use of ridges on the roughout surface as guides for subsequent removals. However, these techniques were seldom employed, a fact that is apparent in the generally low flake-length to platform-thickness ratios. In this sense then, the character of the *débitage* suggests that the producers were not overly concerned with the possibilities of failure, or with the final form of the roughouts themselves. In short, the axes which left this site were relatively crude, and perhaps asymmetrical in both section and plan; it seems likely that the realization of the final, symmetrical form of the axe was accomplished at the grinding stage.

SITE 4: WESTERN WORKING FLOOR

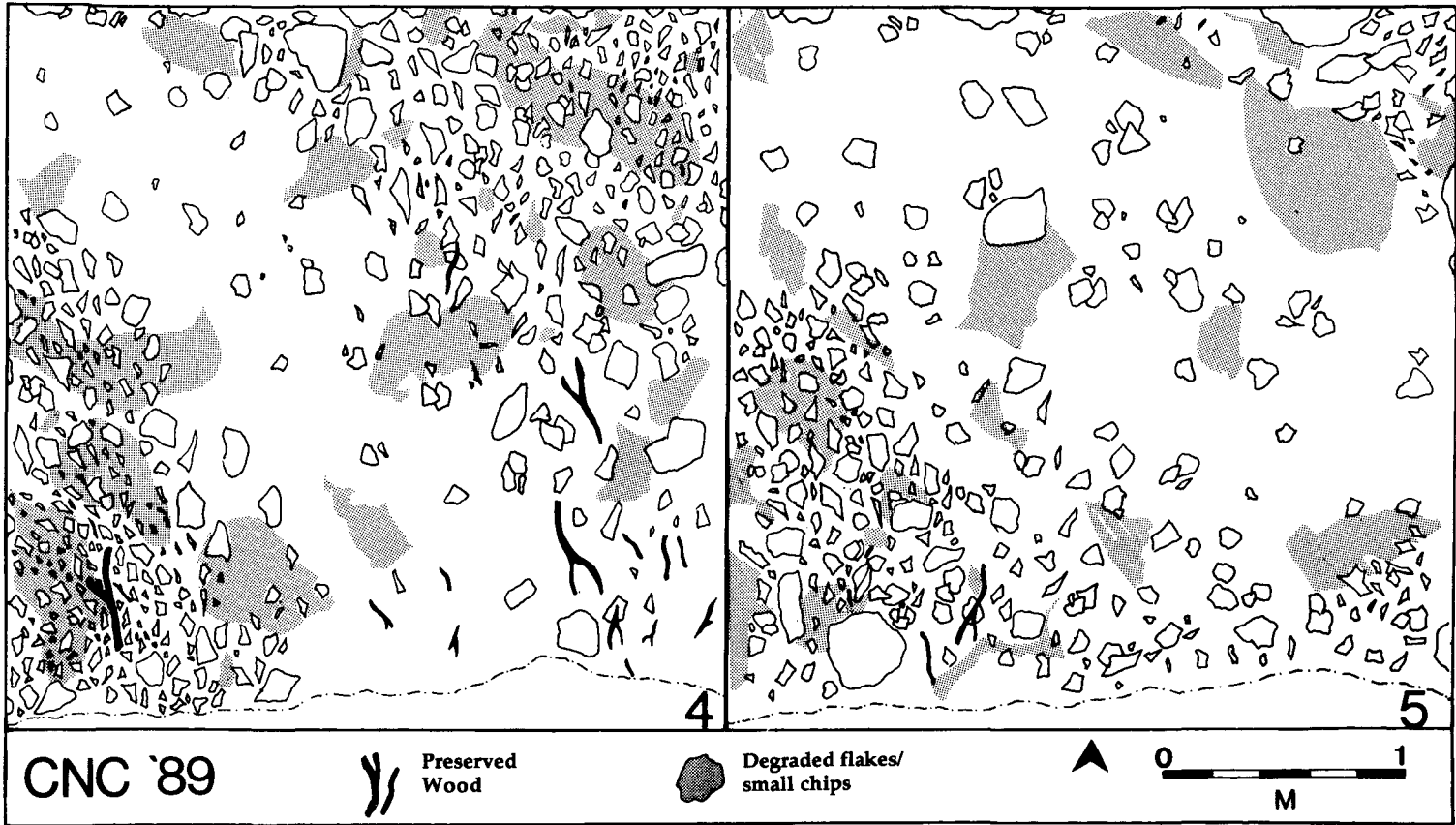
The excavation of a 3 x 3 m trench across another working floor some 30 m to the west of Site 3 provided further data on the spatial organization of working. This site, which had been recognized during our preliminary survey, lies close to the area investigated during the late 1960s (MacKie 1972). In this case, however, the archaeological material was sealed beneath substantial peat deposits, with the result that much of the stone was heavily degraded. Whilst this placed major constraints upon the level of quantitative detail that could be achieved, it was still possible



ILLUS 18 Site 4, northern section, showing location of peat sampling areas. Numbers refer to layers as described in the text

to draw a series of general inferences concerning the nature of the activities which had been undertaken, and the spatial distribution of working across the site as a whole. In addition, samples of charcoal and wood found in association with the layers of working debris were retained for further analysis, and a peat column was taken from the northern section of the trench (see below).

Contrary to the impression gained during the earlier excavations, the stratigraphy at Site 4 suggests two distinct phases of activity in the immediate area, both of which are interstratified with the peat which overlies a thin mineral 'soil' horizon (see below and illus 18). The first of these (layer 5) covered much of the trench, and appears to reflect the *in situ* working of raw material introduced to the site from the quarries. As with Site 3, the recognizable débitage from layer 5 reflects a wide range of technological activities, from mass reduction and shaping through to the thinning and trimming of roughouts. Staining in the peat surrounding these concentrations of waste is all that is left to mark the distribution of the smaller chips, spalls and shattered material that



ILLUS 19 Site 4. Distribution of worked stone in layers 4 and 5

would have been generated during production. A similar technological pattern is apparent in layer 4, separated from layer 5 by roughly 50–100 mm of peat. This constitutes the second working floor on the site.

On the basis of the surviving material, there is little to indicate any major differences in the particular character of the reduction sequences followed during the two phases (Table 6: fiche 1: A10–11). Indeed, those elements of both assemblages that retain sufficient attributes reflect a pattern of working very similar to that observed at Site 3. Here again, there is little to indicate that the producers followed a particularly structured routine during flaking. Instead, people appear to have worked around pieces of stone in a relatively *ad hoc* manner, with little concern for the consequences that particular removals would have had for subsequent stages in the reduction sequence. Flake-length to platform-thickness ratios are relatively low, and the patterning of scars on the dorsal surface of many flakes indicates that removals did not travel very far across the surface of the roughout. There does not appear to have been any great emphasis placed upon the preparation of platforms, or the positioning of the hammer, a feature which is reflected in the high frequency of errors or mis-hits. As with Site 3, it seems reasonable to infer that the final form of the axe was not achieved during flaking.

The principal differences which can be detected between layers 4 and 5 are related to the spatial distribution of activities. In both cases, variations across the trench appear to reflect the existence of at least two foci for knapping. This contrasts with the patterns observed at Site 3, where the débitage appears to have been generated from a single point. In layer 4 for example, particularly high densities of material were recorded in the north-eastern and western areas of the trench, separated by a zone containing only a few isolated flakes. A similar pattern was also recorded in layer 5, although in this case, the highest concentrations of material occurred in the southern and western portions of the trench (illus 19).

PALAEOENVIRONMENTAL ANALYSIS

This section summarizes the results of the analysis of the environmental column taken from Site 4. A more detailed account of the methodology and results is presented elsewhere (Tipping *et al* 1993).

The sequence revealed in the section at Site 4 was sampled using overlapping monolith tins pressed into the freshly exposed surface. The basal 0.6 m of the column (comprising the two débitage horizons, the peat within which they were interstratified and the underlying mineral 'soil') were subsampled for sedimentological, palynological and radiocarbon analyses. Sedimentological analyses were conducted on 10 mm samples of peat taken from between 1.10 m and 1.53 m below the surface of the peat hag. These analyses included: (a) volumetric magnetic susceptibility; (b) dry matter content and (c) organic matter content. Palynological subsamples of the peat (comprising 5 mm slices) were taken at alternate 5 mm intervals from 1.055 m to 1.510 m (close to the top of the mineral 'soil'), and at contiguous 5 mm intervals between the débitage layers. Five 20 mm-thick peat samples were taken for radiocarbon dating: these cover the area from the base of the peat to immediately below the upper débitage layer. Illustration 20 synthesizes the various strands of information obtained from the palaeoenvironmental analyses, and Table 7 lists the radiocarbon dates obtained from the peat.

The results suggest that accumulation of minerogenic sediment probably commenced in the early to mid-Holocene period. The sampling site was always damp, and supported a sedge-rich soligenous mire above the mineral soil. The immediate vicinity appears to have been initially covered by a dense hazel woodland, with rowan, some birch and (probably) elm growing on

patches of drier base-rich soils, and tall herb communities growing either on these soils or on and near the cliffs above the site. Pine is not considered to have grown locally, possibly due to the alkalinity of the soil. This woodland lay close to its altitudinal limit, but at 760 m OD, this is over 100 m higher than the present estimated tree-line on Ben Lawers (Donner 1962). Above it, areas of juniper and willow scrub, with heathers and crowberry, may have existed, while mixed deciduous woodland containing oak and elm probably grew downslope. The peat sample which produced the date of 4377–4280 cal BC (GU-2973) is considered to form part of this minerogenic ‘soil’.

A subsequent decline in hazel pollen may relate to a general deterioration – paludification – of the area, and the establishment of mire conditions on the saddle. The low frequencies of microscopic charcoal and ‘anthropogenic’ pollen types in the sediment suggests that natural climatic conditions, rather than anthropogenic factors, are responsible. The radiocarbon date of 3963–3784 cal BC (GU-2974) is considered to relate to this inception of blanket peat accumulation. With the establishment of mire conditions, a period of stability is recognized in all lines of evidence. The mire appears to have become more water-retentive – probably an autogenic process – and this led to higher rates of peat accumulation. Away from the sampling site, however, the quiescent conditions allowed successful woodland regeneration.

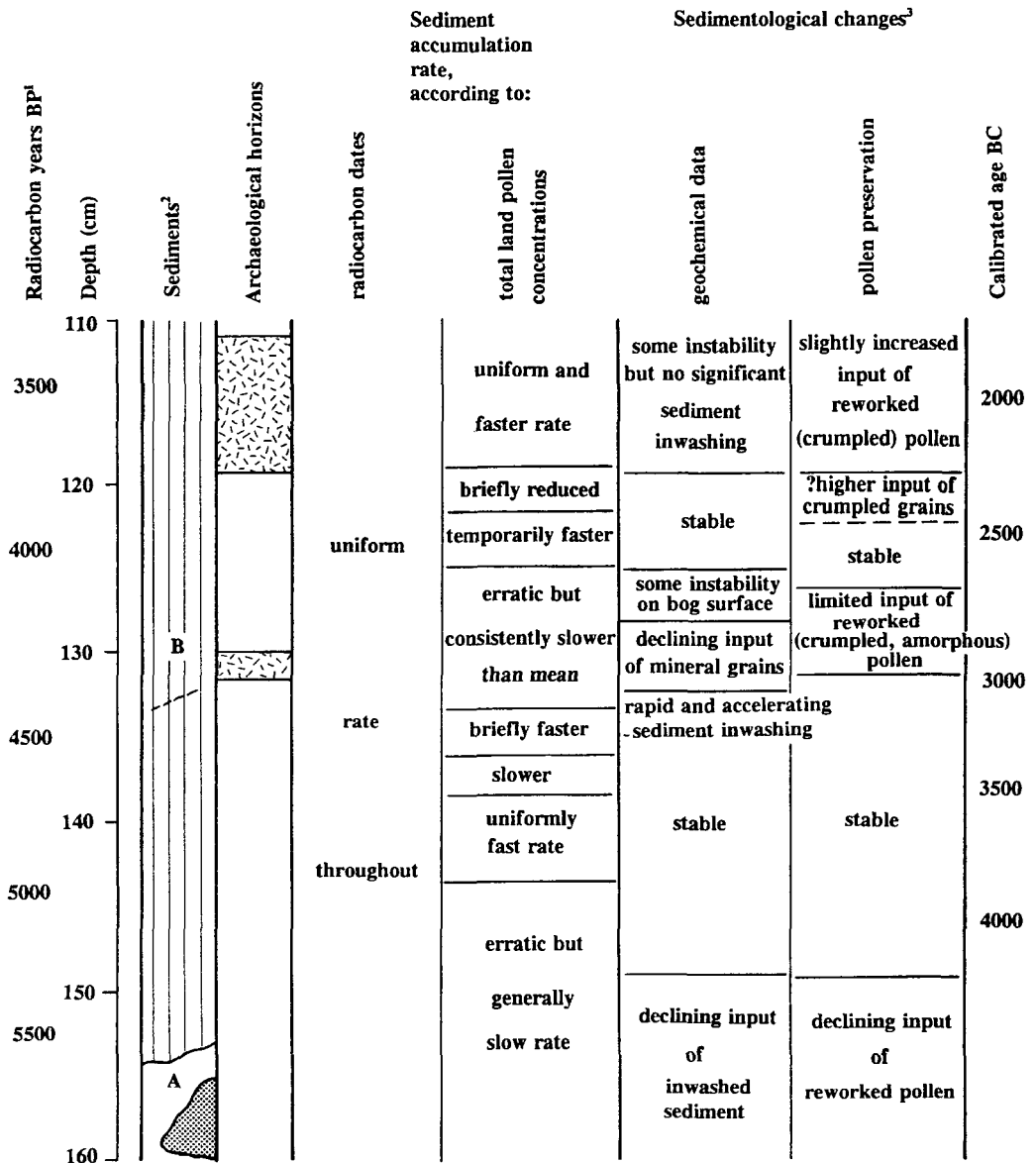
An abrupt change is attested around 3386–3208 cal BC (GU-2975), marked by a rapid acceleration in soil and sediment inwashing over the bog surface, accompanied by pronounced declines in elm and birch pollen percentages and a sharp increase in the frequency or intensity of fire. The local woodland/scrub seems to have changed in composition (although not necessarily declined in extent), and plant communities away from Creag na Caillich may also have been affected, as seen in reductions in oak pollen. An anthropogenic explanation of these changes, in the form of both regional forest clearance and local scrub clearance involving physical disturbance of the soils around the sampling site, seems likely. However, the sporadic records of ribwort plantain suggest that the area around Creag na Caillich was not actively grazed at that time. Although this does not preclude the pastoral use of more distant hillsides, the similar paucity of pastoral indicators at Lochan nan Cat, to the north-east of Ben Lawers (Donner 1962), suggests no upland grazing.

The lowest débitage layer is located towards the end of this phase, and is dated to 2925–2878 cal BC (GU-2976). This difference in age of the elm and birch decline and the archaeological horizon may be more apparent than real; given the vertical spread of worked flakes within the peat, the natural topographic variation of bog and mire surfaces, and the possible effects of human trampling, the interval between the first anthropogenic changes to the landscape and the earliest flaking activity here could be shorter than the radiocarbon dates suggest. Sedimentological

Table 7

Radiocarbon determinations obtained from the peat column taken at Site 4, calibrated using the University of Washington program

Lab no	Sample	$\delta^{13}\text{C}$	Date BC uncal	Date cal BC to 1 σ
GU-2973	Peat from level of minerogenic ‘soil’	–28.7‰	3510±50	4377–4280
GU-2974	Peat representing onset of blanket peat accumulation	–28.6‰	3100±60	3963–3784
GU-2975	Peat marking rapid change: accelerated soil & sediment inwash, elm and birch decline, increase in fire	–28.6‰	2620±50	3386–3208
GU-2976	Peat at lower débitage layer	–28.5‰	2290±60	2925–2878
GU-2977	Peat immediately below upper débitage layer	–28.1‰	1870±70	2413–2170



Notes

- 1 Timescales are derived from the radiocarbon dates in table 7
- 2 Sediment descriptions: unit A (160.0-153.5 cm) - colour 10YR 3/2, very dark greyish brown structureless fine medium sand; gradual wavy boundary to unit B (153.5-100.0 cm), 10YR 2/2, very dark brown amorphous peat with bands of sand and silt
- 3 Derived from interpretations of magnetic susceptibility, dry matter and organic matter contents, and from changes in pollen preservation

ILLUS 20 Synthesis of palaeoenvironmental evidence obtained from the peat column at Site 4

Vegetation changes⁴

Radiocarbon years BP	Depth (cm)	local (on-site)	extra-local	regional	Frequency of fires ⁵	Calibrated age BC	
		TREES		GROUND LAYER			
3500	110	limited colonization	stable woodland cover	cliff-ledge stands disturbed	juniper scrub re-established ?	increasing	2000
				grazing leads to			
	120	by ling heather?	slightly increased cover	anthropogenic grassland		low	2500
4000		mire acidification	birch regeneration	re-establishment of tall herb/grassland communities	instability in mixed deciduous woodland		
	130	increasingly damp/ greater areal extent of mire	elm and birch reduced	soil/peat erosion - habitats disturbed?	loss of juniper scrub ?	high	3000
4500			maximum woodland cover	tall herb communities	reductions in oak woodland?		
	140	formation and expansion of soligenous mire	open hazel wood with limited elm population	limited areas of in woodland	maximum woodland cover		3500
5000			hazel thinned	low-alpine	juniper scrub at higher altitudes	low	4000
5500	150	sedge-rich low-alpine damp grassland	dense hazel with rowan, alder, birch and elm	near/on cliffs grassland	damp alder scrub		
					mixed deciduous woodland at lower altitudes		
	160						

4 Definitions: 'local' = within c 5 m of the sampling site; 'extra-local' = between c 5 m and a few hundred metres; 'regional' = further than a few hundred metres
 5 Frequency of fires is derived from changes in microscopic charcoal amounts

See Tipping *et al* (1993) for further details

evidence for soil inwashing, which is restricted to the peat closest to the scree, is detected below the débitage layer, suggesting that this layer is not the earliest evidence for anthropogenic activity.

At this point there appears to be a temporary recovery of birch, but the correspondence of relatively high amounts of charcoal with fluctuations in the local tree and herb taxa suggests continuing small-scale anthropogenic interference with the scrub-woodland around the site.

The upper débitage layer is dated by a peat sample from immediately below it, 2413–2170 cal BC (GU-2977). The intervening palaeoenvironmental record suggests continuing small-scale human activity in the area, both locally and further downslope, but there is no evidence of widespread disturbance. In the immediate landscape, the montane grass heaths appear to have been modified by grazing, leading to the marginalization of tall herbs to the cliff ledges, the creation of bare ground habitats and the introduction of pastoral herbs. (This grazing activity had little apparent effect on the local tree cover, however, and no physical indications of soil disturbance are detected in the record.) Further downslope there is evidence for continued disturbance of the mixed deciduous woodland.

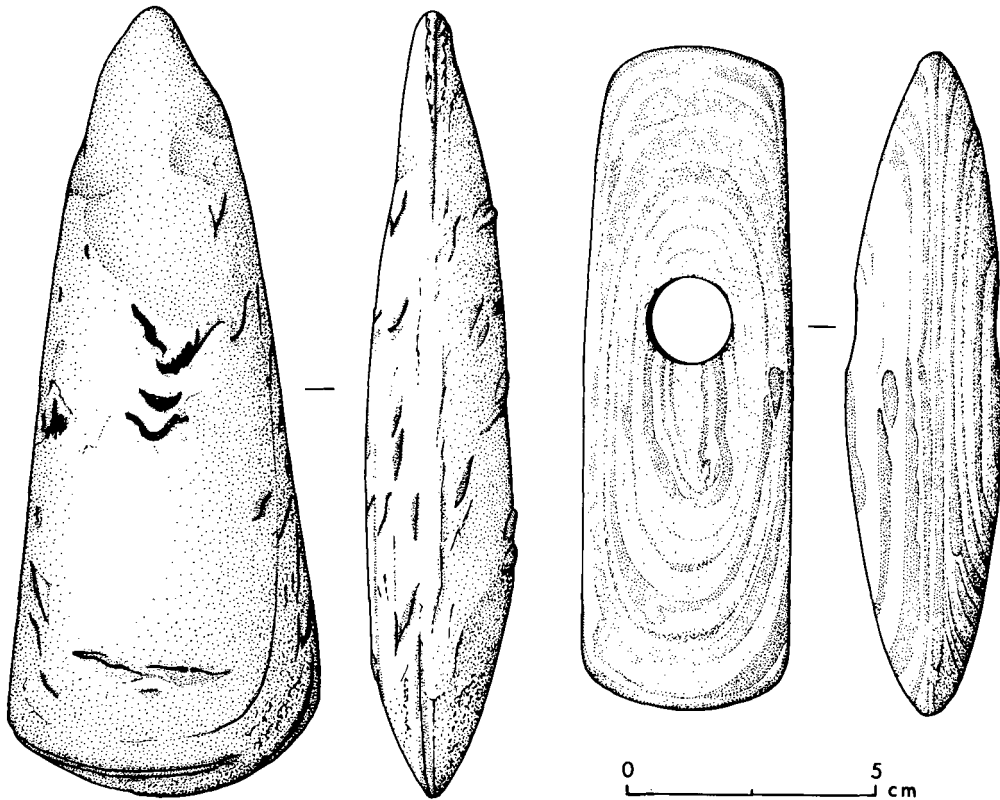
There appear to have been only minor vegetational changes associated with the second episode of débitage production at this site. Principal amongst these is the disruption of cliff-edge tall herb communities, possibly as a result of quarrying. Otherwise, no disruption to the local woodland/scrub is recognized.

To summarize: the earliest attested episode of stoneworking at this location appears to have been slightly preceded by a period of woodland clearance, both local and perhaps regional in extent, and succeeded, probably not immediately, by the use of the saddle below Creag na Caillich for grazing. The second attested episode of stoneworking appears to have disturbed the tall herb communities on the ledges, but is otherwise not associated with any significant vegetational/land use change.

DISCUSSION

Taken together, the analyses of the material recovered during survey and excavation provide a clear impression of the nature of activities in the vicinity of Creag na Caillich. At the most general level, it seems likely that the exploitation of the hornfels was conducted on a relatively small scale, and on the basis of present evidence, it seems that the source was exploited exclusively for the production of roughouts for large bifacial artefacts. The extraction of stone and the production of roughouts was probably undertaken on an intermittent basis by small groups of individuals travelling up to the site from settlements in the lowlands. There is no evidence to indicate the finishing of artefacts on the site, and it is almost certain that this was carried out elsewhere (illus 21). Some indication of the period over which these activities took place is offered by the radiocarbon dates from Site 4, where the two superimposed layers of débitage are apparently separated by some 600 years spanning the period c 2900–2300 cal BC. The radiocarbon determination for the earlier of these two layers corresponds well with that obtained by MacKie (1972).

As we have seen, much of the variability between deposits reflects the distinction that appears to have been drawn between the locations at which raw material was extracted from the outcropping hornfels, and those at which that material was worked down into roughouts. Taken together with the data from the sample squares, the two trenches excavated on the saddle to the south of the outcrop suggest that a series of working floors was established on the level ground immediately below the steeper crags. Since each concentration of débitage contains the full range of waste that we might expect to be generated during the production of axes, it is clear that we are



ILLUS 21 Left: Group XXIV ground stone axe from Kindrochit, Perthshire (NMS AF 888); right: Cushion macehead of Group XXIV stone from Knock, Lewis (Stornoway Museum)

not dealing with some form of 'production-line', in which each stage in the manufacturing process was undertaken by different individuals in discrete locations (see Claris & Quartermaine 1989 for an example of this kind of model). Rather, it seems that once the raw material had been brought down from the quarries, all of the tasks involved in the production of roughouts were undertaken in one place. Given the dates associated with the two horizons of working debris from Site 4, it seems probable that the scatters recognized along the edge of the saddle are the result of several episodes of activity in the area. There is no evidence to suggest that these episodes represent anything more than the exploitation of the source by relatively small groups.

The shift from the quarries to areas of more level ground away from the outcrop has parallels elsewhere. Early work by Warren on the Graig Lwyd (Group VII) source (Warren 1921), and by Knowles near the (then unrecognized) porcellanite source at Tievebulliagh (Knowles 1903) records the presence of scatters of working debris at some distance from the outcrops themselves. In the latter case, however, the picture is complicated by the use of erratic boulders of porcellanite strewn across the area in question. A similar pattern has been recorded in the vicinity of Great Langdale, where a number of 'finishing sites' have been located on areas of more level ground on the principal access routes down from the mountain (Claris & Quartermaine 1989). In the latter case, it has been argued that these sites represent the temporary camps of groups who exploited the

source in the context of activities associated with the seasonal movement of animals to upland pastures (Bradley & Edmonds 1988). Whilst it is tempting to apply a similar model to Creag na Caillich, it seems more likely that the exploitation of this particular raw material source preceded the systematic use of the uplands for animal husbandry.

This last point demonstrates the problems that accompany the 'borrowing' of models developed to describe the exploitation of other sites. However, we would argue that the broader significance of the patterns recognized at Creag na Caillich can best be understood through a more general comparison with the data from the Cumbrian sources. For example, the particular character of the reduction sequences followed at the site parallels the nature of axe production during the first major phase of exploitation in the Cumbrian fells. As we have seen, there is little to suggest that the producers were particularly concerned with the efficiency of raw material use, with the form in which that material was obtained, or with the form of the roughouts that left the site.

What is interesting here is that the Great Langdale complex also contains evidence for the later development of a very different approach to the working of stone. Although the pattern of *ad hoc* extraction and reduction continues, other sites bear witness to a far more structured approach, involving the preparation and maintenance of formal quarries at which every stage in the production process was undertaken. This change is also manifest in the technological character of the débitage, which suggests that the producers attempted to follow clear routines during flaking, at the same time anticipating or compensating for any errors that might occur. As a result, it seems that the products which left these sites closely resembled their intended (polished) form (Bradley & Edmonds 1993). This latter approach to both extraction and production is entirely absent at Creag na Caillich. Indeed, there is no indication that the nature and organization of production changed during the period over which the site was exploited.

Radiocarbon dates suggest that activities at both the Great Langdale complex and at Creag na Caillich probably spanned several centuries, albeit probably on an intermittent basis (*ibid*; Smith 1979). If we accept these dates as reliable, they suggest that exploitation at Creag na Caillich may not have started until after the changes in the nature of production at Great Langdale had taken place. Indeed, given the (admittedly patchy) dating evidence from across the country as a whole, it seems that most of the major sources in Britain and Ireland had already been in use for several centuries by the time activity began at Creag na Caillich.

Other contrasts can be detected if we consider the scale of production. Although substantial deposits of working debris were recorded during our excavations, the entire Creag na Caillich complex is roughly comparable to some of the smaller sites recognized in Cumbria. Indeed, the entire output of axes from the source was probably smaller than that achieved at any one of the large, formal quarries recorded at Great Langdale itself. There is a sense in which these differences in scale reflect the lengths of time over which the two sources were in use. However, given the other contrasts noted above, these differences raise a series of questions about the conditions under which axes were produced at Creag na Caillich, and it is to these that we must now turn.

On the basis of present evidence, we would argue that whilst small groups of individuals probably travelled to the source for the express purpose of making axes, there is little to suggest that production was in the hands of specialists *per se*. Nor does it seem likely that production was closely tied to exchange networks which extended beyond the horizons of the local system. Rather, the deposits at the site probably reflect the production of axes for local use in an area which was relatively poor in raw materials.

Clearly, it does not follow from this that *all* of the products were consumed within the local area. As we have seen, a small number of axes travelled over considerable distances, probably passing through a series of interconnected exchange networks. However, this small number of

cases does not provide us with a sufficient basis for arguing that the relationship between production and exchange developed in quite the same way as it appears to have done in Cumbria, where several thousand products have been found at considerable distances from their source, often in areas that were already rich in raw materials. In the latter case, it does seem as though changes in the spheres in which axes circulated outside the source area contributed to a transformation of the social context of production (Bradley & Edmonds 1993).

One further line of evidence needs to be considered here. Since the conclusion of our fieldwork, petrological examination of a cushion macehead from Knock, Lewis (illus 21), has confirmed that it is of Group XXIV rock, thus vindicating Roy Ritchie's published reservations about its earlier attribution to a Shetland source (Ritchie 1968, 132). Ritchie has suggested (*pers comm*) that several other cushion maceheads may be of Group XXIV stone. Evidence for the date of this particular class of macehead is limited (Smith 1979), but does accord with the period of known activity at Creag na Caillich.

From a technological perspective, it is hard to differentiate between the *débitage* from axe/adze and cushion macehead production. Indeed, given the variable quality of the hornfels at the source, these final forms may have been fully realized only at the grinding stage. However, it is also possible that these maceheads reflect the re-use/reworking of existing axes. Such a pattern of re-use and/or transformation is attested elsewhere. Bradley, for example, has recently drawn attention to the existence of a number of stone axes with perforations, arguing that these may have allowed the artefact to be suspended rather than hafted (Bradley 1990). Moreover, he suggests that this practice may have developed only towards the end of the period in which most of the major axe sources were exploited. In view of the radiocarbon dates from Site 4, the only working debris likely to be contemporary with the period in which cushion maceheads were produced and used is to be found in layer 4. However, given the close similarity between the *débitage* from layers 4 and 5, the present evidence cannot be used in isolation to infer that cushion maceheads were produced at Creag na Caillich. Against this background, we would argue that the creation of maceheads from existing axes should be considered in relation to the evidence for changes in the roles played by a variety of portable artefacts in mediating social relations during the Neolithic (Bradley 1984; Edmonds 1992). It is quite conceivable that these changes in the social role of certain artefacts may also have found expression in the re-use of *sources* traditionally associated with axe production. However, for the purposes of this discussion, it must be stressed that questions such as these can be addressed adequately only when we widen our focus to consider contexts away from the source itself.

These points return us to the themes which were raised at the beginning of this paper, concerning the broader context of axe production and dispersal. The data presented here shed a good deal of light on the specific nature, scale and duration of axe production at the source. Yet there is much which we still need to find out: where the finishing-off process took place, how the exploitation of this rock fitted into the broader contemporary patterns of raw material exploitation, what was the economic and social significance of Creag na Caillich and its products. At present, our knowledge of Neolithic activities in Perthshire is both limited and heavily biased towards funerary and other ceremonial sites (eg Croft Moraig: Piggott & Simpson 1971; Pitnacree: Coles & Simpson 1965), with new discoveries serving to underline their variety and complexity (eg the Inchtuthil mortuary enclosure: Barclay & Maxwell 1991; the Cleaven Dyke, recently re-evaluated as a possible *cursus*: Pitts & St Joseph 1985). These sites may potentially be important for establishing elements of the broader social and historical context within which axe production was situated. However, they have not been rich in artefacts, and none has so far produced a Group XXIV artefact. Moreover, settlement evidence (eg Grandtully: Simpson & Coles 1990) is sparse

and at present not very informative. Whilst some work on the mapping of stray axe finds has been done by Roy Ritchie (pers comm), much basic information gathering is still required to build on the foundations laid by Margaret Stewart (1959).

In short, there is a pressing need to develop our understanding of the location and character of contemporary settlement in the region through systematic survey and environmental sampling. The project described here is really only a first step towards understanding the broader material and historical contexts in which the production, circulation, use and re-use of axes was situated. But at the very least, Creag na Caillich has provided us with a vantage point from which to target areas for future research.

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Our greatest debt, however, is owed to the individuals with whom we undertook the survey and excavations, often under appalling conditions: Mark Bowden, Jan Harding, Neil Oliver, and Niall Sharples.

POSTSCRIPT

After submission of this paper, the results of the investigations by Bradley *et al* into the tensile strength of various rocks used for axe manufacture in Britain and Ireland were published (1992). These revealed that Creag na Caillich produced material of widely varying tensile strength, ranging from rock significantly stronger than the best Langdale tuff, to rock of substantially inferior quality.

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