CULTURES ET INDUSTRIES LITHIQUES en milieu lœssique

(AMIENS, DIRECTION DES ANTIQUITÉS DE PICARDIE, 9-11 décembre 1986)

ACTES DU COLLOQUE INTERNATIONAL

organisé par Alain TUFFREAU
avec la collaboration de Jean-Claude BLANCHET, Jean-Pierre FAGNART et Jean SOMMÉ

Vue générale des fouilles de Seclin en 1985.

REVUE ARCHÉOLOGIQUE DE PICARDIE

Trimestriel - N° 1-2 (numéro spécial) 1988

Actes du Colloque "Cultures et industries paléolithiques en milieu loessique", Amiens 9-11 décembre 1986. Revue archéologique de Picardie n°1-2, 1988.

FLAKING TECHNOLOGY AT THE ACHEULEAN SITE OF BOXGROVE, WEST SUSSEX (England)

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RESUME

Le gisement acheuléen de Boxgrove (West Sussex, Angleterre) recèle une des plus vastes étendues, pour l'Europe, de dépôts du Paléolithique avec des vestiges fauniques et archéologiques. Ces vestiges proviennent d'une séquence de sédiments du Pléistocène moyen correspondant à un niveau marin de 42 m et à l'apparition de conditions périglaciaires. Le matériel archéologique se compose surtout de bifaces ovalaires et de limandes et comprend aussi quelques rares outils sur éclat. Des remontages d'éclats provenant de plusieurs amas de débitage bien différenciés ont montré que les sédiments ne sont pas remaniés et ont apporté des indications sur la technologie du débitage acheuléen.

ABSTRACT

The Acheulean site of Boxgrove, West Sussex, England, contains one of the largest areas of *in situ* Lower Palaeolithic deposits with both faunal and archaeological remains in Europe. This material is found in a complex series of Middle Pleistocene sediments which represent Marine depositional conditions at 42 m O.D. through to the onset of full periglacial conditions. The archaelogical material is primarily composed of ovate and limande bifaces with few retouched tools made on flakes. Extensive refitting of flakes from several distinct knapping scatters has demonstrated the undisturbed nature of the deposits as well as provided an insight into Acheulean flaking technology.

Introduction :

The Acheulean site at Amey's Eartham Pit, Boxgrove (SU924085), is located in the country of West Sussex in south-east England about 5 km east of Chichester (fig. 1). The excavations are contained within a quarry worked by Amey Roadstone Corporation for the extraction of sand and gravel. Eartham Pit is situated at the northern edge of the upper coastal plain (Hodgson 1967), where the plain abuts the truncated dipslope of the South Downs. The region is well known for its Lower Palaeolithic sites especially those along the line of the 'Goodwood-Slindon' 40 m raised beach : Boxgrove, Lavant and Slindon (Woodcock 1981 ; Roberts *et al.*, 1986).

In 1983 it was decided to examine in more detail the geological deposits at Eartham Pit (fig. 2). The

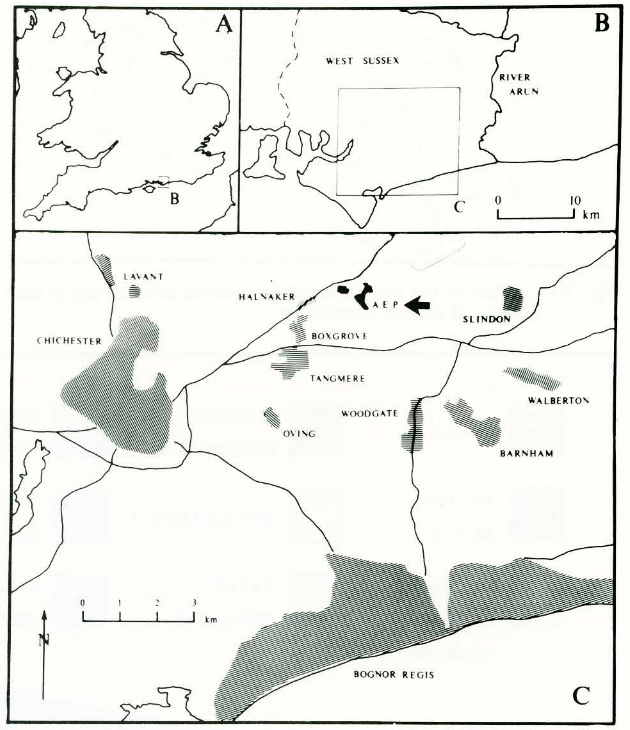

Fig. 1 : Map of southern England with location of Amey's Eartham Pit (A.E.P.), Boxgrove.

results of the initial survey revealed the existence of an extensive archaeological horizon with flint artefacts. As this horizon was under threat from quarrying, the Department of the Environment of England and Wales funded a trial excavation. The excavation uncovered a series of *in situ* debitage scatters associated with biface manufacture. On the strength of these results further funding was obtained and excavation continued over the next three seasons (1984-1986) ; additional work is expected to take place in the summer of 1987.

Geology

The immediate palaeogeography in the area of the site is mainly the result of marine action. An interglacial sea level rise greater than the present level resulted in the planation of the Tertiairy deposits of the lower coastal plain and erosion back into the chalk dipslope in the upper coastal plain. This led

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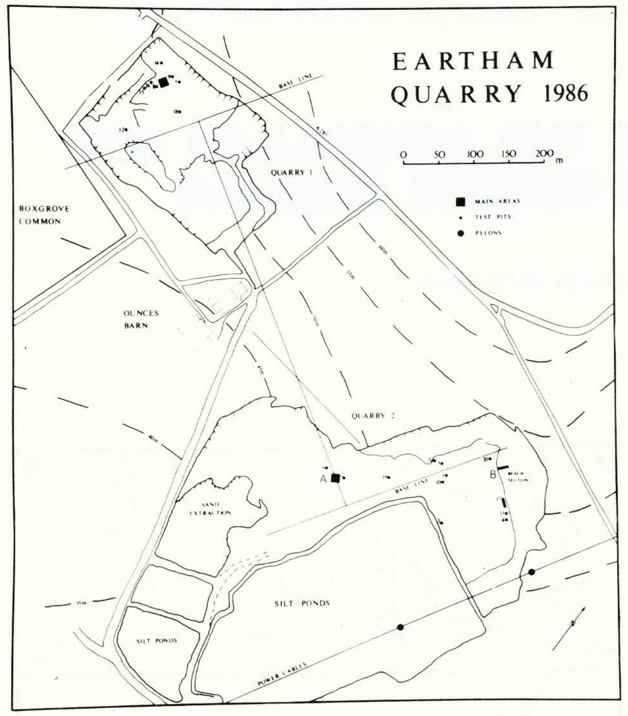

Fig. 2 : Location of the archaeological excavations and test pits in both quarries at Amey's Eartham Pit.

to the formation of a cliff line, which is known to extend as far to the west as Portsdown, Hampshire (Ap. Simon et *al.* 1976), and at least as far east as the River Arun.

Three deposits within the quarry sequence may be related to the marine episode (see table below and figs 3 and 4). The first, unit 2, is a deposit of flint cobbles and coarse sand which develops from a 0.1 m cover over the chalk wave-cut platform to a 3 m thick raised beach deposit at the cliff. This layer is in turn overlain by a marine sand sequence known locally as the Slindon Sand. The sands have an average depth of 4 m throughout the quarry except at their northernmost margin where they thin and die out over the beach. Immediately overlying the sand member of the Slindon Formation are the Slindon Silts. This second member, unit 4, consists of interbedded silt and clay laminae which are interpreted as an intertidal marsh deposit associated with marine regression. The uppermost 50 mm of unit 4, however, displays no visible structure and represents a major Middle Pleistocene land surface which is rich in faunal and archaeological remains. The Slindon Formation is covered by 'brickearth' which is a silty-clay sediment deposited in a still body of fresh water that had built up on

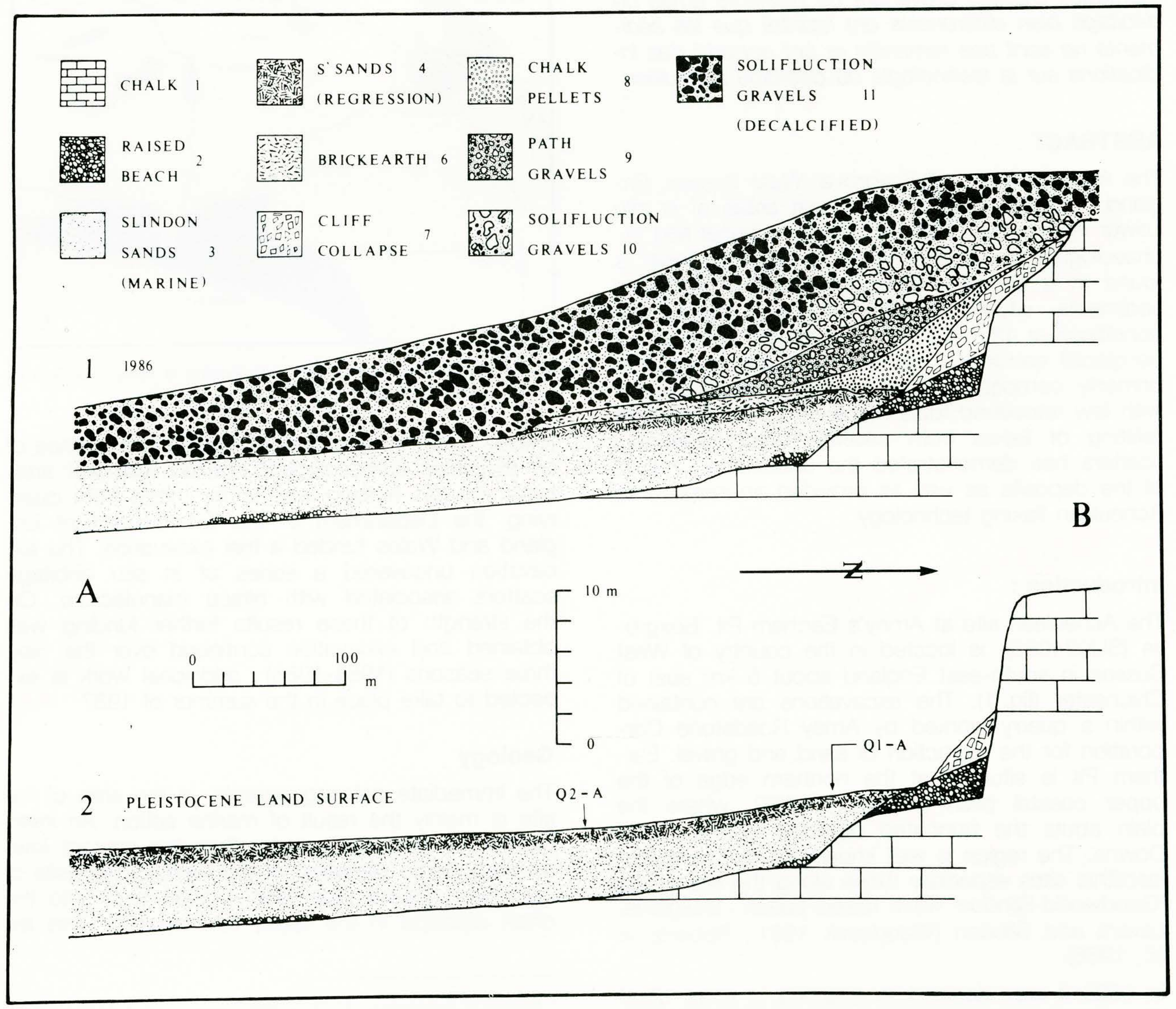

Fig. 3 : Stratigraphic section showing units 1 - 11 described in the text.

the old land surface. The brickearth and overlying gravel suites are believed to represent the onset of periglacial conditions and are the results of hill wash and mass movement from the high ground of the downland onto the coastal plain.

The following table presents the deposits discussed above stratigraphically. They are divided into three groups each of which is composed of several distinct units (Roberts *et al.*, 1986).

A) Marine sequence
1. Cliff and platform cutting
2. Pebble beach
3. Slindon Sand
4a/b. Regression phase / Slindon Silts

B) Terrestial sequence
4c. Terrestial phase / Slindon Silts
5. Fe/Mn layer
6. Lower Brickearth

C) Rock debris and solifluction
7. Chalk cliff collapse
8. Chalk pellet gravel
9. Path gravel
10. Chalky solifluction gravel
11. Decalcified solifluction gravel

The above succession is numbered beginning with the basal units ; number 1 represents the earliest phase. Artefacts have been recovered *in situ* in units 4b and c, while derived material has been recovered in units 7 and 8.

The Flaked Stone Assemblage :

The archaeological material from Boxgrove can be divided into two groups based on its geological context. First, there is the residual or derived material from the chalk pellet gravel and the chalk cliff collapse, and, second, the *in situ* material from units 4b and c of the Slindon Silts.

1) The Residual Assemblages from Units 7 and 8 :

Flint artefacts have been recovered from these horizons by casual collection where material is seen eroding out of exposed deposits, and during the cutting of test pits for geological and palaeoenvironmental evidence. In the beach section cutting (fig. 2 : B) artefacts were recovered amongst the large blocks associated with gradual chalk cliff collapse (unit 7). The bulk of this material consists of large, hard hammer-struck flakes with plain butts ; many of these pieces are cortical. Associated with the flakes are a number of large biface roughouts which have been abandoned in the initial stages of reduction.

Most of the residual material from both quarries comes from the chalk pellet gravels (unit 8). Woodcock (1981) recorded over 400 flint artefacts, including 36 bifaces, from the junction of these gravels with the Lower Brickearth. The archaeological material we collected from this unit is like that reported by Woodcock and consists mainly of ovate bifaces and limandes, many of which are finished with *tranchet* blows. The morphology of these tools is identical to those recovered *in situ* from the excavated areas in quarry 1 and 2 (see below). A number of roughouts also occur, similar to those in unit 7, with both hard and soft hammer-struck flakes from various stages of biface manufacture.

2) The *in situ* material from units 4b and c, Slindon Silts :

In this paper the term *in situ* refers to archaeological material which has not been disturbed in any major geological way (for example, by being incorporated into a river bed and deposited in gravels). While there is differential preservation of the artefact scatters from units 4b and c, there is no evidence to indicate that they have been subjected to extensive horizontal movement by natural agents.

The material from the lower level, unit 4b, is believed to be entirely undisturbed with no horizontal movement. The horizon is thought to represent an intertidal, marsh-like deposit. This hypothesis is supported by information gained from the study of Foraminifera and Ostracoda which include several freshwater species as well as marine species "capable of penetrating in estuaries to fairly low salinities" (Whatley and Haynes in Roberts et *al.*, 1986). The evidence of human activity is sporadic and may represent exploitation of a resource specific to the intertidal marshland. The preservation of the knapping scatters in this level is excellent, a fact that is due to rapid burial in a low-energy environment.

A major occupation horizon occurs in unit 4c some 30 cm above the lower level. This level is interpreted as a developed land surface, running some 50 km east-west in front of a cliff line which extended from the River Arun, W. Sussex, to Portsdown, Hampshire. The majority of the faunal remains come from this horizon and include numerous small mammals (eg. voles, shrews and mice) as well as beaver, wolf, deer, rhinoceros and bovid. Most of this faunal collection probably represents a natural death assemblage but some pieces appear to display features resulting from human butchery with flint tools (S. Parfitt, pers. comm.). The flint artefacts on this surface are 'fresh' and unabraded but the scatters in which they are found are more diffuse and spread out than those in the lower level (unit 4b). This is partially due to the fact that the scatters were exposed on the surface for a period of time and subjected to disturbance by natural agents.

The stone tool assemblage recovered from this unit is dominated by ovate and limande bifaces to the exclusion of the pointed forms like lanceolates or ficrons (Roe 1981 : 156-157). Many of the tools are finished with *tranchet* blows, often on both sides of the tip. In addition, there is a single example of a bifacial cleaver (*hachereau*) as well as a few flake tools, mainly scrapers.

Refitting and Technology :

The material under consideration in this section is from area A in quarry 2 (fig. 2 : A). The artefacts from this quarry occur in unit 4c (the upper level, discussed above) of the Slindon Silts. The sample comes from two apparently distinct scatters lying 2 m apart on the same level. They were partially excavated in 1983-1986 and it is expected that more material will be recovered in the 1987 season. A total of 574 pieces (> 2 cm in size) from both scatters have so far been available for study. The morphology of some of the flakes in the scatters clearly indicates that they are by-products of biface manufacture. Three ovate bifaces were found in close proximity to the scatters.

One of the problems encountered in dealing with the material from area A is the large number of broken pieces. Over 80 % of the 574 pieces examined are broken in at least one place. The table below shows the number and percentage of the individual fragments of flakes from both scatters :

Table I

	Number of pieces	%
proximal	171	29.79
mesial	167	29.09
distal	149	25.96
total broken flakes	487	84.84
complete flakes	87	15.16

Most of the refitting work has concentrated on scatter 1 and the following table illustrates the refits between individual broken fragments :

Table II

Number of refitted breaks in each group	Number of groups
2	27
3	8
4	1
total	82 individual pieces

Some of these pieces were undoubtedly broken during debitage ; breakage due to flexion (cf. Bergman et *al.*, 1983) is quite common when relatively thin flakes are removed from a biface (see Bradley and Sampson 1978 : table 7-14). As part of the experimental programme accompanying work on Boxgrove, a number of bifaces were made of local flint by different knappers. In some cases, between 50 % and 60 % of the flakes produced were broken. This figure is lower than the archaeological sample but much higher than the 24 % reported in similar experiments by Bradley and Sampson (1978) at Caddington. The high percentage of broken flakes in our experimental sample is partly related to the local raw material which is characterised by internal fractures and inclusions.

An examination of the spatial distribution of refitted breaks from scatter 1 shows that some are separated by distances of up to 2 meters (fig. 5). This certainly indicates that these pieces were broken before the deposit formed and are not the result of sediment loading. So far there is only one refitted broken flake which has pieces from both scatters 1 and 2.

The dorsal/ventral refits make up about 32 % of the 386 pieces from scatter 1 (fig. 7). Most of these consist of only two reffiting flakes but there are also three sets made up of 10 pieces each. The number of refits in each group is as follows :

Table III

Number of refits in each group	Number of groups
2	19
3	7
4	6
5	2
10	3
total	123 individual pieces

At first glance the proportion of dorsal/ventral refits seems low. However, it must be remembered that the actual number of flakes involved is much smaller than the sample size of 386 pieces. As can be seen in the first table about 80 % of these artefacts are broken. An individual flake may be composed of two or more broken pieces. The original number of flakes in scatter 1 could therefore be as low as 250 ; in this case almost half of the material has been refitted to at least one other piece.

One of the three groups of ten refitted flakes represents the outer surface of a nodule over 23 cms in length (fig. 8). The dorsal surfaces of many of the larger flakes in this group are part of a major break surface. This is a common feature of the flint nodules collected at the site today which often have broken outer surfaces. A second group of ten pieces is associated with a break surface within the nodule (fig. 9). This may have resulted in the nodule shattering during debitage, causing the flintknapper to reappraise his flaking strategy or abandon the block altogether. Some of the nodules selected for the experimental work also broke and became unusable while being knapped.

Several groups of flakes (eg. thinning flakes) come from an advanced stage of biface manufacture. These pieces have no cortex, are curved in profile and often display removals from the other edge of the biface. Some have thin butts with diffuse bulbs and lips on the ventral surface and were undoubtedly detached with a soft hammer by a marginal blow (Newcomer 1971 ; Bradley and Sampson 1978 ; Ohnuma and Bergman 1982). The blow was aimed close to the edge being worked resulting in a thin flake with a thin butt (cf. the brushing hammer stroke of Bradley and Sampson 1978).

It is interesting to note that relatively few flakes have been detached with a hard hammer (as illustrated in Ohnuma and Bergman 1982 : plate II, 1 and 2). This may indicate that Acheulean knappers did not adhere to a rigid scheme of roughing out a biface with a hard hammer and finishing with a soft hammer. Although no flaking tools have been recovered from the site, experimental work has shown that bifaces can be entirely made with stone hammers. A small round flint nodule with a thick cortical surface can have much the same effect as an antler hammer producing ventral features like diffuse bulbs and lips.

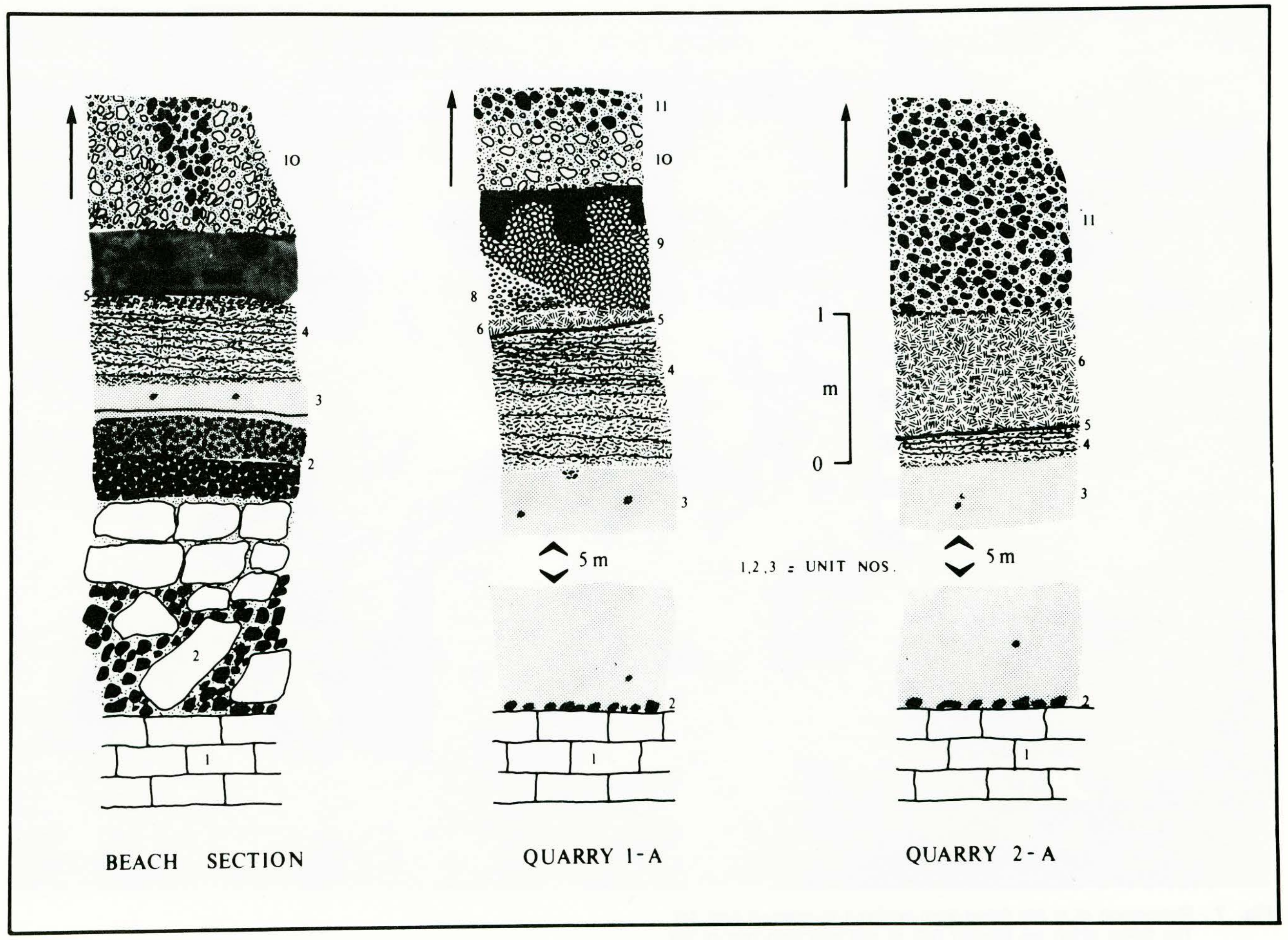

Fig. 4 : Sediment contacts in quarries 1 and 2.

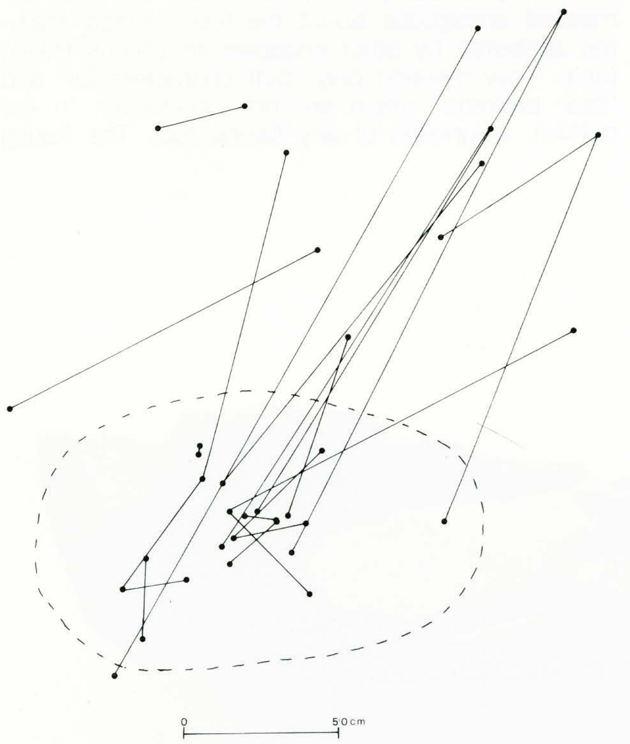

Fig. 5 : Some of the refitted broken flakes from scatter 1 (quarry 2) are spread out over an area of 2 m. The circle indicates the main concentration of debris. It is now known that a second concentration within the same scatter occurs at the top right hand corner of this figure.

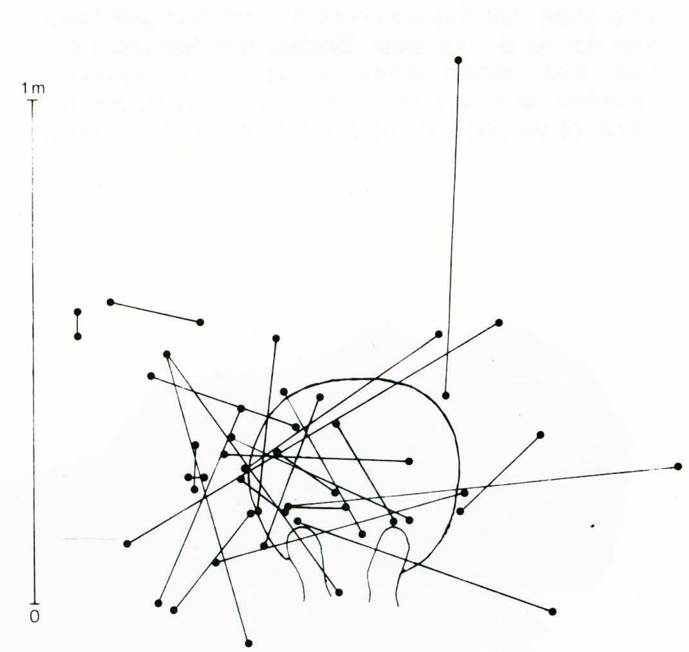

Fig. 6 : An experimental scatter with some of the refitted breaks plotted. The biface was knapped while standing up in order to produce a diffuse pattern of flaking debris. In spite of this fact the broken flakes are still more tightly concentrated than in archaeological scatter 1.

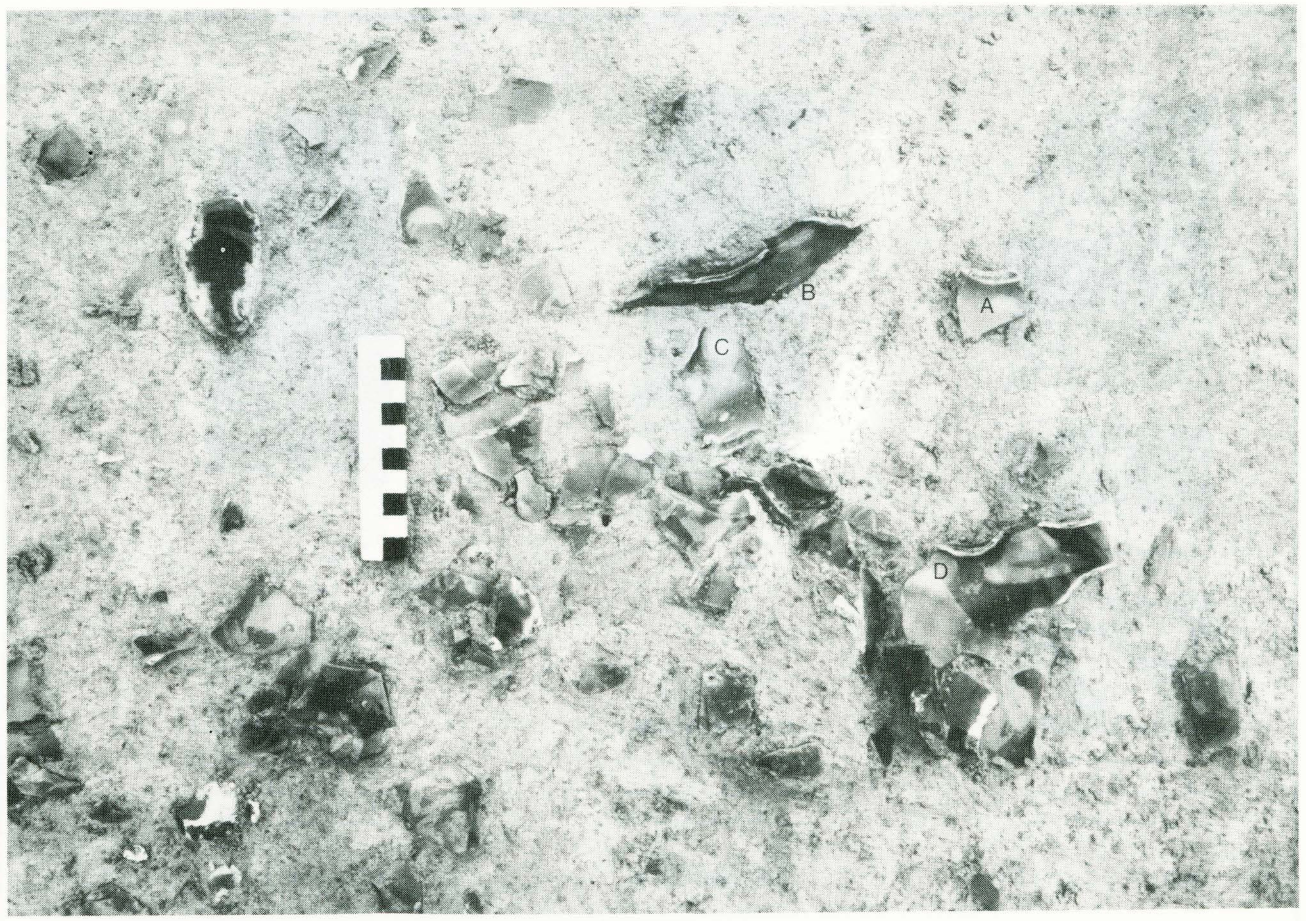

Fig. 7 : Photograph of *in situ* flakes from scatter 1 in quarry 2 (unit 4c). The flakes which are lettered A-D all refit and form part of the group illustrated in fig. 8.

It should be pointed out here that the present authors disagree with Bradley and Sampson (1986) who state that the concepts of hard and soft hammer flaking do not exist. Bradley and Sampson believe that certain attributes on flakes, previously identified as being related to hammer type, are the result of variation in the point of percussion during debitage (eg. marginal and non-marginal flaking). Bradley and Sampson (1986 : 36, 43) are somewhat ambiguous about the technological features attributed by other knappers to various flaking tools. They mention only "butt characteristics" and "scar patterns" which are not necessarily, in our opinion, diagnostic of any flaking tool. The flaking technology of the Clactonian, for example, can clearly be identified as involving hard hammer percussion, almost to the total exclusion of soft hammers, because the flakes have the following *ventral features* : clear points and cones of percussion, pronounced bulbs and conchoidal fracture marks on the bulb. These features have been noted on experimental hard hammer-struck flakes regardless of whether they have large or small butts.

Fig. 8 : Group of 10 refitted flakes form the outer surface of a nodule.

Fig. 9 : Nest of refitted flakes associated with a break surface within a nodule.

In the 1986 season two cores, associated with separate groups of flakes, were excavated in an area about 50 cms away from scatter 1. Although material from both blocks remains to be excavated, a number of flakes have been refitted to them.

The first core (fig. 10) is relatively shapeless and was flaked from two alternate platforms (cf. Brézillon 1977 : 89, fig. 12). One of the platforms is plain, while the other appears to be a break surface which existed inside the original nodule. This second platform has a number of incipient cones (Breuil 1932) at its edge. The refitted flakes were detached with a hard hammer and tend to be rather thick with large butts. The second core (fig. 11) was also flaked with a hard hammer. Most of the flakes removed from this block have been placed back on to it ; it is worth noting that relatively few blanks were detached (*ca.* 15 flakes) and most of these did not yield good cutting edges.

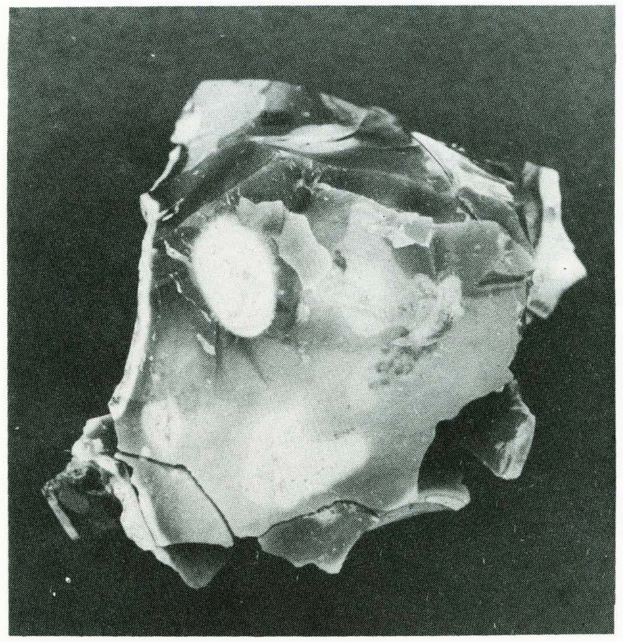

Fig. 10 : Photograph looking down on a striking platform of an Acheulean flake core. This particular example has two alternate platforms and was flaked with a hard hammer. The maximum width of the platform is 95 mm.

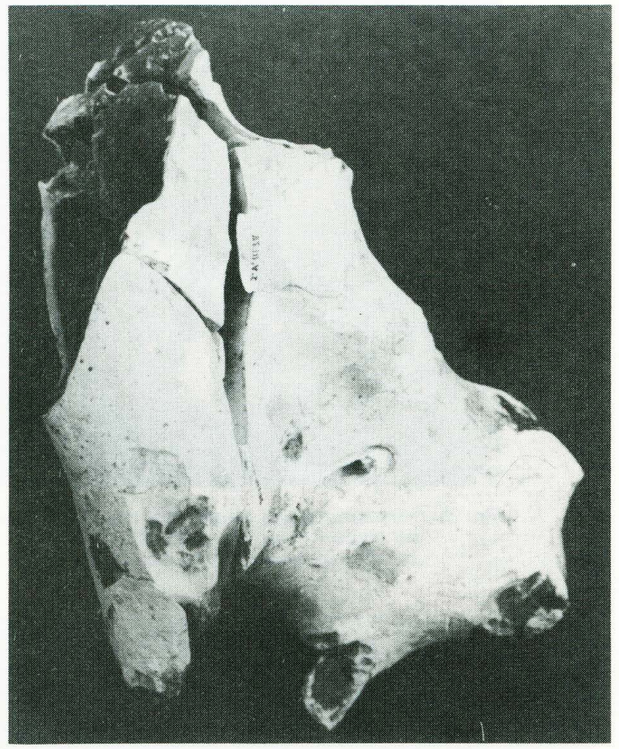

Fig. 11 : Flake core from area A in quarry 2 with most of the blanks it produced refitted. Relatively few flakes were detached from this block and most of these did not yield good cutting edges. The length of the flaking face on the core, including the refitted flakes, is 145 mm.

The only artefacts refitted to any of the bifaces are two *tranchet* flakes (fig. 12). The *tranchet* flakes appear to be unrelated to either of the scatters and are located several meters away from the biface. The handaxe itself, which is an ovate with *tranchet* blows on both sides of its tip, is in complete isolation from the excavated scatters.

The horizontal spread of the artefacts in scatter 1 shows that they are distributed over an area of around 2 meters. It is now believed that there are two main concentrations of flaking debris separated by about 50 cms with relatively few artefacts. A number of refitting pieces join the two concentrations and show that they are part of the same scatter.

To conclude, the large numbers of refitted flakes from area A seems to indicate that the material has not been disturbed by any major geological process. However, the horizontal distribution of the refitted pieces suggests that some artefacts in scatter 1 may have moved short distances. Experiments similar to those described by Newcomer

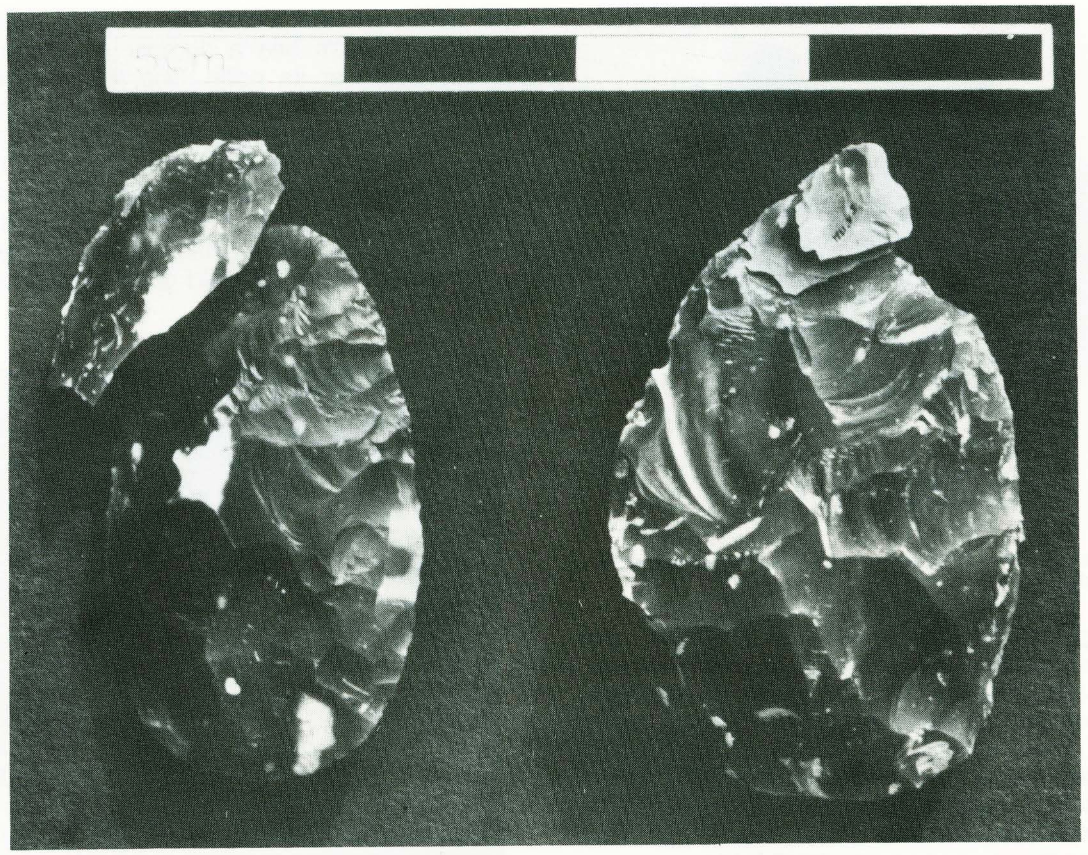

Fig. 12 : Archaeological and experimental examples of bifaces with refitted *tranchet* flakes. The archaeological example is on the right and has two broken *tranchet* flakes refitted to its tip.

Fig. 13 : Knapping scatter from the lower level (unit 4b) in quarry 1. The flaking debris is confined to an area of some 30 x 30 cm. The appearance of the scatter suggests that the knapper was seated on the ground while flaking.

and Sieveking (1980) on flaking scatters have been carried out on flat natural surfaces. One experiment consisted of flaking a biface while standing up which resulted in a diffuse scatter-pattern spread out over 1.5 - 2 meters. The broken flakes were mapped and refitted. The greatest distance between two refitting fragments was about 90 cms which is significantly less than the 2 meters noted at the site (fig. 6).

An interesting and important contrast to the knapping scatters discussed above was uncovered this year (1986) in the lower level of quarry 1, unit 4b. As indicated in the discussion on the site's geology this palaeo land surface was subject to a different depositional history than the upper level found in quarry 2. In this level a compact scatter has been exposed in an area of some 30 x 30 cms (see fig. 13). An important feature of the flaking debris is a dense concentration of 'chips' (cf. Newcomer and Karlin 1986), less than 1 cm in size, which are sure indicators of a knapping zone. The overall appearance of this scatter would seem to indicate both that it is completely undisturbed and that the knapper was seated on the ground while flaking (Newcomer and Sieveking 1980 : fig. 7 ; Barton and Bergman 1982).

Conclusion :

The site of Boxgrove has produced an important collection of *in situ* Acheulean flintwork accompanied by faunal remains. The stone tool assemblage recovered so far is characterised by ovate and limande bifaces, many of which are finished with *tranchet* blows. There is a single example of a bifacial cleaver (*hachereau*) ; retouched tools made on flakes are equally rare with only a few examples noted so far.

Initial work on refitting the flint scatters has demonstrated that the archaeological material has suffered relatively little disturbance. In the lower level (unit 4b) of quarry 1 the appearance of the scatter uncovered in 1986 would seem to indicate that it is completely undisturbed. As work proceeds on the artefacts from both quarries a clearer picture should emerge of Acheulean flaking techniques.

The preliminary work outlined above has shown the potential of the site at Amey's Eartham Pit. It is hoped that the multidisciplinary investigation underway at Boxgrove will provide the means to more fully understand the sedimentological and environmental processes involved in site formation and place the artefacts and faunal remains in a specific context within the Middle Pleistocene.

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