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Appendix I: A functional analysis of the Belvédère flints

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appendix I
A functional analysis of the Belvédère flints

The Belvédère pit has yielded a considerable amount of information about the life-style of Middle Palaeolithic hunter-gatherers and the environment in which they performed their various activities. We decided to perform a functional analysis of the flint assemblage with the hope that this would shed more light on the role of the flint artefacts in the subsistence pattern.

1. Method

Use-wear analysis of flint surfaces is a fairly recent discipline, enabling the interpretation of used area, motion and contact material. Flint surfaces are damaged in use and the traces of this damage can be studied microscopically. Wear traces include edge-removals (generally referred to as 'use-retouch'), edge-rounding, polish and striations. One group of wear analysts emphasizes edge-removals and edge-rounding (Odell 1975, 1977; Tringham *et al.* 1974), whereas for others polish and striations form the basis for inferences about tool use (Keeley 1974, 1980). The method followed here is essentially that outlined by Keeley (Keeley/Newcomer 1977; Keeley 1980) and developed further by Anderson-Gerfaud (1981), Moss (1983a), Plisson (1985) and Vaughan (1985).

The Belvédère implements were studied with a reflected-light microscope (Nikon optiphot) at magnifications ranging from 50 to 560x. At the outset of the study the tools were scanned for the presence of residues prior to cleaning[2]. It soon became clear that this was a fruitless enterprise because all residues had been removed by percolating groundwater or had been consumed by micro-organisms. Initially, the flints were only soaked in soapy water and rinsed off; treatment with HCl was omitted to avoid the danger of damaging the stone. However, because some of the artefacts displayed a sheen which could possibly be a mineral deposit, it was decided in a later stage of the research to subject all artefacts to treatment with a 10% HCl solution in an ultrasonic cleaning tank, followed by a rinse with KOH. The effects of this cleaning procedure will be discussed below (paragraph 2). Throughout the analysis the tools were regularly wiped clean with alcohol to remove finger grease. The use-wear analysis was conducted prior to the refitting programme to avoid possible confusion between traces of use and secondary damage from the refitting attempts.

A total of 55 flakes was examined for the presence of traces of use. The pieces came from various sites within the quarry (table 26) and were initially selected on the basis of one criterion only: whether they still looked reasonably fresh when examined with the naked eye. The other flakes either displayed colour patina or extensive gloss, inhibiting the interpretation of tool use on the basis of polish and striations. Furthermore, all pieces shorter than 5 cm were excluded. It was argued that if the analysis of the larger flakes should prove unsuccessful, the amount of time necessary for the examination of the small debitage would be unjustified. Moreover, as Moss (1983b) has argued, edges shorter than 2 cm are less likely to have been used, certainly not without hafts. Because we may assume that plenty of raw material was available nearby, small pieces are likely to have been discarded unused. It should therefore be stressed that the sample of 55 artefacts was not a random selection, nor was it geared to specific questions regarding behavioural aspects of tool use and discard.

2. Post-depositional surface modifications

Although many of the selected pieces appeared quite fresh when viewed with the naked eye, when examined under the microscope they turned out to be patinated: the surface exhibited a greasy lustre. Sometimes this lustre was confined to a band along the edge, while the remainder of the surface was still reasonably fresh. This band of greasy lustre can easily be mistaken for fresh hide polish as indeed has been the case in the past (cf.Roebroeks 1984b). It is precisely the edges and ridges that are the first parts of the tool to be affected by patination (cf.Keeley 1980; Rottländer 1975a). Besides having a greasy lustre, the surface of many of the Belvédère flints appeared to have been dissolved and had a 'sugary' appearance (fig.144a, 144b), i.e. the surface was no longer a flat plane and had changed into a jumble of ill-defined pits and craters. As a consequence, the surface reflected a large amount of light from all directions and was very difficult to examine. This was the case with all of the stones which had a creamy or light-yellow colour. Some tools had a clear brown patina, but their surfaces had not gone 'sugary' and only displayed the greasy lustre.

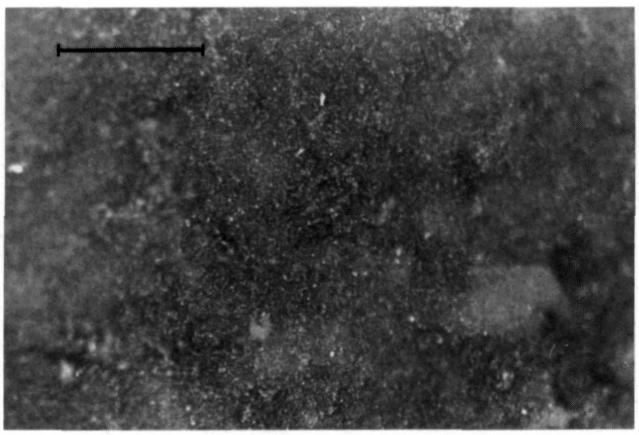
In an attempt to remove the greasy lustre and to improve the appearance of the surface, all tools were immersed in a 10% HCl solution and then rinsed with KOH. This caused

Table 26: Composition of the sample studied for the presence of traces of use-wear.

site	total recovered	length 2-5 cm	length ≥ 5 cm	total examined	lithostratigraphical attribution
B	5	3	2	5*	Unit IV-C
C	3067	684	113	34	Unit IV-C
E	95	57	11	1	Unit VI-D
F	1215	264	45	10	Unit IV-C
G	58	20	11	5	Unit IV-C

* It must be mentioned that 4 of the 5 examined artefacts from Site B derive from a nearby section.

most pieces to turn yellow to varying degrees, probably due to precipitation of the compound KCl (potassiumchloride). After renewed immersion in HCl and 24 hours of rinsing in running tap-water, some of the yellow colour disappeared. The remaining potassiumchloride was lodged in the deep pores of the stone. Remarkably enough, the few flints which had not turned yellow proved analysable. Apparently



a

Fig. 144. Surface of a flint tool from Site K. a) directly after excavation, b) the same surface 5 minutes later; note the 'sugary' appearance. The scale bar measures 100 μ.

b

the surfaces of the stones that turned yellow had dissolved (been patinated) so extensively that deep pores had been formed into which KCl had been deposited.

It is very difficult to understand the exact process of patination and the circumstances under which it occurs. Moreover, patination is a catchall term for a variety of phenomena. Often, mechanical abrasion is also included in the category 'patinated'. Abrasion probably did play a role in the Belvédère pit because some vertical displacement is attested; in some instances it amounts to 25-40 cm (Roebroeks, this volume). The sandy matrix in which the artefacts were embedded could thus easily have abraded the tools. However, these abrasive processes produce 'gloss' and cannot be held responsible for the dissolved flint surface. It is more likely that this is attributable to chemical processes. Rottländer (Rottländer 1975a, 1975b) has argued that gloss-patina can be formed in an acidic environment, such as in a peat matrix. It is unlikely that this was the case with the Belvédère material. The result should be a smooth, shiny plane and not the irregular, cratered and 'sugary' surface of many of the Belvédère flints. Moreover, a pH-analysis of some soil samples indicated that, on the whole, the matrix is alkaline. Close to Site G, the top part of Unit IV yielded a pH of 8.6 ± 0.002 with the H_2O method and of 7.6 ± 0.001 with the KCl variant (pers. comm. J. Vandenberghe, Amsterdam, 1987). A sample from Site C yielded a somewhat lower pH: 6 – 6.5. It would therefore seem that the soil conditions were nowhere inducive to the formation of gloss-patina. It is also noteworthy that in areas where the overlying layer contained chalk, as was the case with Site G, the pieces were in considerably better condition. Perhaps the greasy lustre observed on some flints (for instance those with a brown patina) is due to gloss-patination but even this is doubtful as it has a very rough appearance.

Further information on patination became available during the excavation of the Unit IV-C Site K in the summer of 1987 (not reported on in this paper). Here, artefacts were recovered in mint condition: the tools had a blueish-black colour similar to that of fresh Rijckholt flint. However, they turned grey within a few minutes and obtained the creamy, light-yellow colour characteristic of much of the

Belvédère material after a period varying from two days to a few months. The microscope was put up on the site so as to be able to examine the flint as soon as it was excavated. For the first two minutes or so the stone surface appeared fresh, with a flat plane. However, it quickly dissolved and became 'sugary' (figs .144a, 144b). Apparently, the flint surface had already been altered in such a way prior to its removal from the ground that exposure to light and/or dessication catalysed the dissolution process. Immersion of the artefacts in water and storage in a dark place stopped this process. Water clearly played a crucial role in the patination process, as has already been stressed before (Andersen/Whitlow 1983). The process of patination is irreversible, so it is likely that bound water is removed from the chemical composition of the flint. More research into this phenomenon will be done in the future.

Right now it suffices to conclude that of the 55 selected artefacts examined, 48 exhibited post-depositional surface modifications (dissolved surface or greasy lustre). Of these, 16 had been greatly affected, 22 moderately so, while 10 were only lightly patinated. As for the last category, it was sometimes possible to tentatively state whether a piece was likely to have been used or not.

3. Use-wear traces

Only 7 of the 55 flints which were examined were fresh enough to allow an interpretation in terms of tool function (table 27). Four of these showed no traces of use (Bv 62; 21/23-54; 46/106-1; 47/104-1). This does not necessarily mean that these flakes had not been used: experiments have shown that wear traces resulting from contact with soft materials, such as meat, fresh hide and certain green plants develop very slowly (Unrath *et al.* 1986; Van Gijn 1986; Moss 1983a). Only three tools displayed indisputable traces of wear.

One, a blade-like flake (D-18/5) with tiny edge-removals along its lateral edges (fig.145) and edge-angles of 32° and 35°, exhibited a vague band of rough, greasy polish, about 2 mm wide, which has been interpreted as the result of contact with meat. It was visible on both lateral edges. The polish showed no directionality, striations being absent, but the low edge-angles and the general shape of the tool suggest that it had been used in a cutting motion. The faint traces of retouching are probably to be associated with the tool's former use and do not seem to be intentional, because the areas of polish and retouch coincide exactly. This blade-like flake came from Site C.

Two flakes from Site G displayed traces of use. On one (47/105-3) (fig.146) a matt, vague band of polish was observed, associated with tiny, scalar edge-removals (fig. 147). This tool was interpreted as having been used on meat. The second, a large backed blade (46/106-11) (fig.148), had slightly been affected by patination but the wear-traces were

Table 27: Results of the analysis of the fresh pieces.

artefact	site	chalk matrix	interpretation
BV 62	B (Unit IV-C)	yes	no traces
D-18/5	C (Unit IV-C)	no	meat
21/23-54	F (Unit IV-C)	no	no traces
46/106-1	G (Unit IV-C)	yes	no traces
47/104-1	G (Unit IV-C)	yes	no traces
47/105-3	G (Unit IV-C)	yes	meat
46/106-11	G (Unit IV-C)	yes	hide

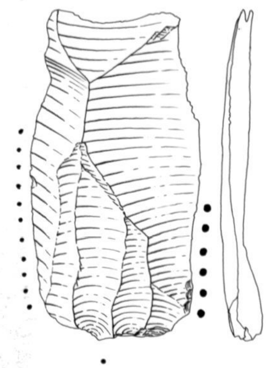


Fig. 145. Position of wear traces on D-18/5 from Site C, Unit IV-C (scale 2:3).

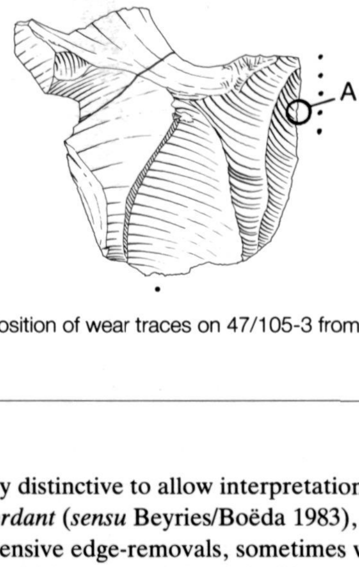


Fig. 146. Position of wear traces on 47/105-3 from Site G, Unit IV-C (scale 2:3).

sufficiently distinctive to allow interpretation. The tool, an *éclat débordant* (*sensu* Beyries/Boëda 1983), exhibited rather extensive edge-removals, sometimes with hinge fractures, which suggested that it had been used on a moderately hard material. Polish distribution varied from isolated spots to a band along the edge. The character of the polish, which was rather pitted, changed from rough and matt to rough and greasy. It displayed a directionality parallel to the edge, which suggested that the tool had been used in a longitudinal motion (fig.149a, 149b). This was corroborated by the presence of a few vague striations running parallel to the edge of the tool. The above-mentioned combination of wear-traces points to hide as the most likely contact material.

It is worth speculating a little on the character of the hide cut with this large backed blade. The greasiness of the polish in some areas suggests that the hide was in a rather fresh state. On the other hand, the polish's matt character in other areas indicates contact with a dried hide. The striations may be due to the presence of sand or dirt particles on the skin, while the rather extensive edge damage points to a medium-hard material. The type of skin that answers this description is that of pachydermatous animals such as rhinoceros and elephant. Their skins contain many dirt particles, are quite hard and the epidermal parts are dry and horn-like.

Three experiments were carried out on elephant skin (fig. 150), one with a large naturally backed blade, two with smaller blades. The former, which closely resembled the archaeological *éclat débordant* in terms of dimensions and edge angle, proved a far more effective tool for the very thick (abt. 1.5 cm) elephant skin than the two smaller ones. Unfortunately, the news of the opportunity to skin such an elephant reached us a full two weeks after the animal had died, by which time the carcass had started to decompose and the skin was probably softer than that of a recently killed animal. Nevertheless, the wear-traces observed on the experimental tools closely matched those on the archaeological ones. The polish was distributed in a band, but its character was most distinctive on protruding points: it was pitted, matt and at times displayed clear directionality (fig.151a). Striations were absent, but this could be due to the fact that the dead animal had been thoroughly cleaned with a high-pressure spray in the anatomical laboratory, which could have removed sand particles from the skin. Moreover, the working conditions in a clean lab differ greatly from those in a dusty landscape. The edge damage of the experimental and the archaeological tools also bore a

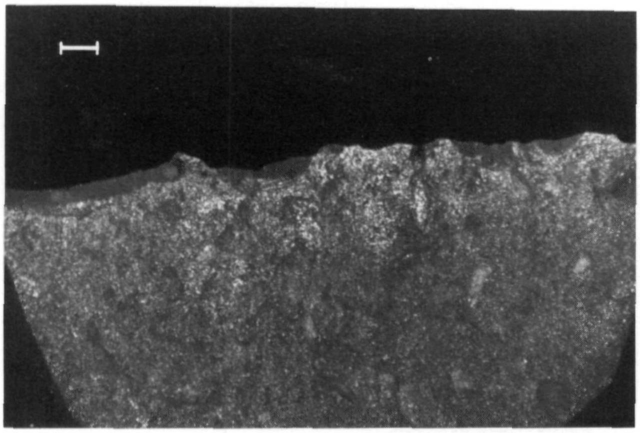
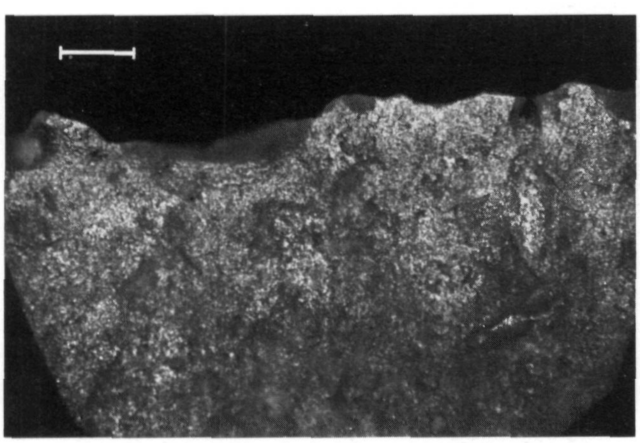


Fig. 147. Wear traces observed at point A on 47/105-3 from Site G. The scale bar measures 100 μ.



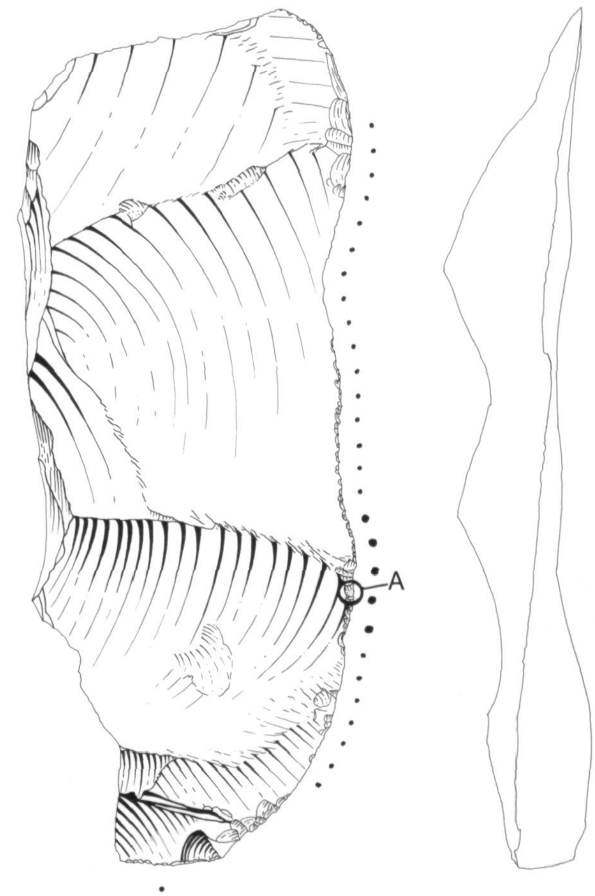


Fig. 148. Position of wear traces on 46/106-11, a large backed blade from Site G (scale 2:3).

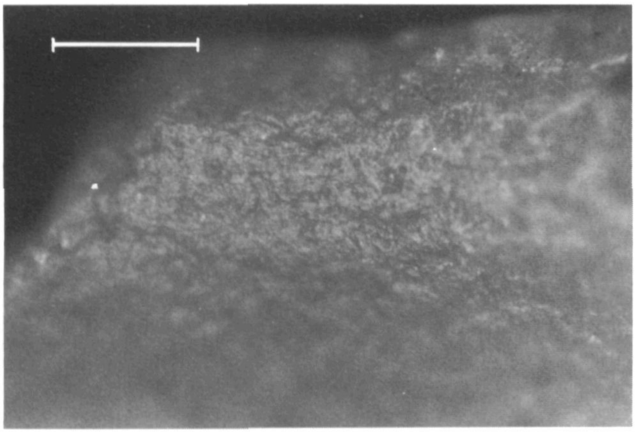


Fig. 149. Polish observed at point A on tool 46/106-11. Due to the slight patination much light was reflected from the tool. The scale bar measures 100 μ.

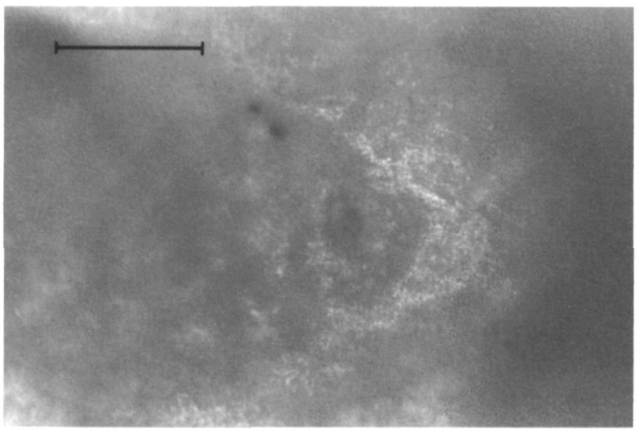
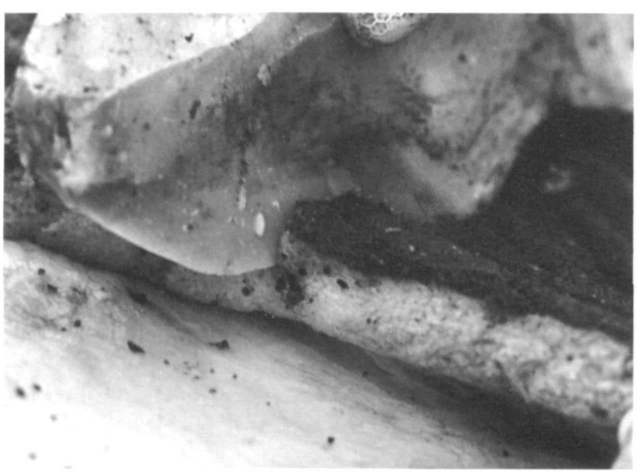
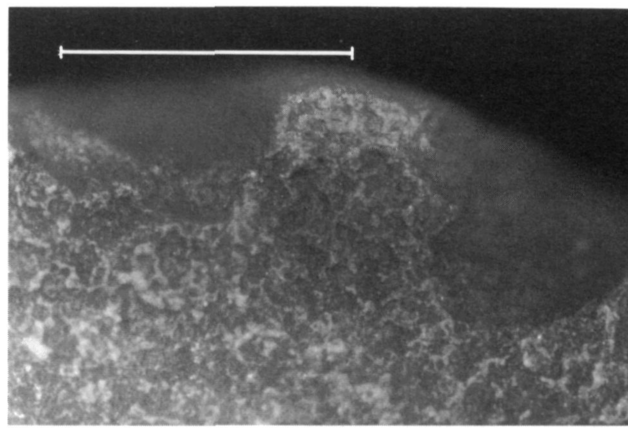


Fig. 150. Experiment with an elephant skin.



close resemblance: on the ventral aspect the retouch was tiny, scalar and overlapped one another (fig. 151b), while on the dorsal side the retouch was spaced more widely. On the basis of these resemblances a pachydermatous contact material could be suggested even though the traces on the archaeological backed blade differred slightly from those on the experimental one (i.e.the absence of striations on the experimental tools). Further evidence corroborating this interpretation is the fact that the tool was found amidst a concentration of juvenile rhinoceros remains (Roebroeks, this volume). It should be stressed that the find circumstances of the tools were not known to the micro-wear analyst prior to the study. The association of the backed blade with the bones was only communicated to her after the analysis had been completed.

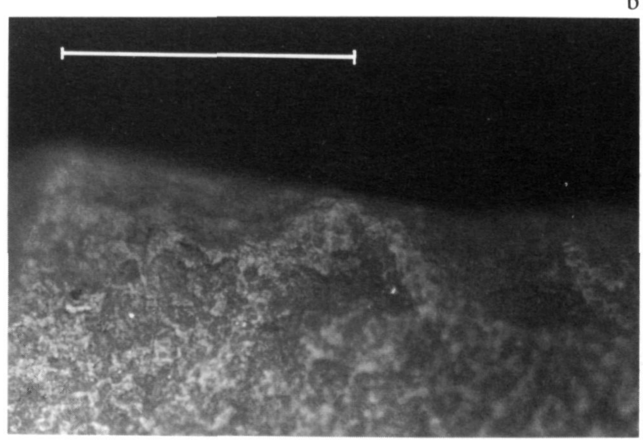
Of course, it is impossible to determine whether the animal had actually been killed by man or whether it was found dead, already killed by other predators. Or, to put it differently, microwear analysis cannot shed light on the question whether (pre-)Neanderthal man was a hunter or a scavenger (cf. Roebroeks, this volume). Roebroeks argues



a

Fig. 151. Wear traces observed on an experimental tool used to butcher (part of) an elephant. The scale bar measures 100 μ.

b



in favour of the latter possibility and in the remainder of this paper reference will be made to the more general term 'meat-collecting'.

In addition to the three tools described above with relatively clear polish, another six tools were recovered that were so lightly patinated (see paragraph 2) that it was possible to distinguish the presence of traces of wear. These are E-17/10, C-21/15, D-21/1, Bv-1265 and Bv-1248, all from Site C, and 23/23-31 from Site F. The wear-traces, however, are so indistinctive that the tools can be described as 'probably used' only. Had the tools been employed on a resistant or abrasive contact material, such as bone, dry hide, antler, silicious plants or hard wood, the resulting traces would certainly have been detected. These tools were thus probably used on a yielding material, such as soft plant, fresh hide or meat.

4. A functional interpretation of the sites from lithostratigraphic Unit IV-C

In the preceding paragraphs we have seen that the majority of the assemblages from the Belvédère pit were affected by patination to such an extent that all possible wear-traces had been obscured. It was therefore not possible to determine the former function of each individual artefact. However, it is worth hypothesizing a little further about the function of the Belvédère assemblages from lithostratigraphical Unit IV-C. The following discussion is based on the analysis of the 54 artefacts selected from this unit for wear-trace examination (see paragraph 1).

The tools exhibiting only light to moderate patination still allow us to *exclude* certain contact materials. Bone/antler, dry hide and silicious plants produce a polish on the flint after only a short period of use. Not only do polishes resulting from contact with these materials develop fast, they are also distinctive and rather well-defined in terms of their constituent polish attributes. Recent blind tests have indicated that bone/antler and dry(ish) hide are quite consistently identified by analysts (Unrath *et al.* 1986). This is also due to the fact that, in addition to a clear polish, other characteristic wear attributes are formed, such as a rounded tool edge when the tool is used on hide, or extensive edge removals in the case of use on bone. Finally, experiments simulating various post-depositional surface modifications have indicated that bone polish is the most resistant to such attacks (Plisson 1983, 1986). Hide polish can be affected to a considerable extent but is often still recognizable as such because of the extensive edge rounding and the preservation of the 'craters' characteristic of hide working (Plisson 1983). The chance of missing bone/antler- or dry-hide-working tools is therefore considerably smaller than that of overlooking tools used on materials whose associated wear attributes develop more slowly, are less distinctive and more vulnerable to post-depositional changes. Had such traces been present on the lightly patinated Belvédère artefacts, they would certainly still have been visible.

Sometimes the manufacture of bone- or antler-working tools and the scraping of dry hide (i.e.making a dried hide supple for example by working grease into it) are described as labour-intensive maintenance activities and thus indicative of base-camps. This is obviously not entirely true because, for instance, bone and antler tools can effectively be manufactured on hunting stands to kill the time while waiting for game (Torrence 1983). On the other hand, the processing of raw hides indeed requires a considerable amount of time because the softening of the hides (in the process of which the 'dry-hide scrapers' are assumed to be used) is very time-consuming.

None of the lightly or moderately patinated tools from Belvédère exhibits traces of wear suggesting bone/antler-working or dry-hide scraping. The degree of patination of these pieces is considered insufficient to have obscured such traces, had they been present. The lack of evidence of 'maintenance activities' such as hide-processing would thus make the Belvédère sites temporary encampments, for example hunting stands. However, this is of course not a valid argument in itself as it is based solely on negative evidence. Dry-hide- or bone-working tools could have been present among the part of the assemblages not selected for use-wear analysis because the tools were too small or too patinated. Moreover, it is quite possible that hides were worked at some distance from the living area in view of the stench associated with this activity: such an area could easily have fallen outside the excavated trenches.

What evidence do we have? Even though no polish was observable on most of the Belvédère tools, other attributes, such as edge damage and edge-rounding, are still interpretable. The sites of the Belvédère Unit IV-C assemblages were covered by fluviatile sediments within a very short period of time (Roebroeks, this volume). Because of this and the fact that the excavation and storage of the artefacts was done in a very careful manner it is considered justified to infer the function of the tools from the distribution and morphology of the edge-removals because the possibility of the formation of edge-removals due to post-depositional processes and careless excavation procedures may be excluded.
The use-retouch on many flakes was scalar with a feather-shaped termination spaced regularly along the edge. None of the flakes showed extensive edge-rounding. This points to a soft and yielding contact material such as meat or fresh hide. It is therefore suggested that the tools were most likely used for butchering purposes.

Butchering is generally believed to cause extensive damage to the tool because of the contact with bones and cartilage, which is reported to produce wear characteristics indicative of use on hard materials (Odell 1980). It is however contended that this is the case. If animals are butchered by an experienced person, the tool hardly comes into contact with bone; there is very little edge damage and polish is formed extremely slowly. Henk Nijland (Research Institute for Nature Management), who dissects animals every day, performed four dismembering experiments using deer and raccoon. The tools he had used for this purpose differed markedly from those used by the author in that they showed very little evidence of use. Even after 60 minutes of work, the tools showed no signs of polish whatsoever, while edge-removals consisted of scalar scars with feather terminations distributed irregularly along the edge and having maximum widths of approx. 1 mm. The tools showed very little edge-rounding; in actual fact the edge was only smoothed. Patterson reports similar wear features observed after the butchering of deer. He too arrives at the conclusion that most animals can be butchered completely without extensive contact with bone (Patterson 1976). The absence of striations is also reported in the literature (Brose 1975; Patterson 1976). Brose (1975) attributes this lack of scratches to the presence of animal fats, which form a protective layer around the stone.

The morphological attributes of the Belvédère Unit IV-C flints support the supposition that they were employed in butchering. Edge-angles are small, generally not more than 40 degrees. The tools have straight edges when viewed in cross-section, which would be ideal for cutting purposes. Both Frison (1979) and Patterson (1976) have stated that butchering can effectively be done with unmodified flakes. These constitute generalized tools which can easily be resharpened. Frison (1979) also argues that hafting would not be very effective in the case of a butchering tool, since the moisture released in the process of butchering would affect the binding. The large size of the Belvédère tools not only made hafting superfluous, but also made the tools very suitable for butchering large animals.

Of course, the functional analysis of the Belvédère Unit IV-C flint suggesting that the tools were most probably used for butchering is only speculative and is not based on firm evidence. However, the tentative supposition is corroborated by other lines of research. Geological survey has revealed that the sites attributed to Unit IV-C are situated close to a marshy floodplain. Such a spot may have served as a drinking area for animals where game could easily be trapped either by man or by other predators. The flint artefacts were found in association with bone fragments, especially at Site G. At Site C the number of unused or hardly used flakes was substantial (Roebroeks, this volume); as Tainter (1979) has argued, stone tool densities are high in areas where butchering activities were carried out. Although the information gained from the functional analysis of the flints is minimal, the evidence does lend additional support to the interpretation of the Unit IV-C sites as butchering and 'meat-collecting' stations.

notes

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[2] There is some argument as to what constitutes residue and how it can be differentiated from polish. This is partially due to the fact that as yet no satisfying definition for 'polish' has been proposed (c.f. Van Gijn 1986: 13; Plisson 1985: 14-15; Vaughan 1985: VIII). In the context of this paper 'residue' is considered anything which can be removed in a weak HCl and KOH solvent, that is blood stains, plant juices, pieces of meat etc.