4 Post-depositional surface modifications

4.1 Introduction

It is to be expected that, since flint artefacts sustain a variety of damage from many contact materials, they are also subject to modifications from 'natural' causes, such as compaction of the soil, soil creep, water transport etc. Keeley fully realized this problem, and he formulated the following criteria:

> 'for an assemblage to be suitable for microwear analysis, the majority of its implements must be in extremely fresh condition, that is, unaffected by any form of natural abrasion. This condition is best fulfilled by only studying collections from archaeological deposits judged to be in primary context' (Keeley 1980: 84).

However, Keeley himself had to discard a large percentage of the assemblages he was studying (see *4.3*), even though the material was considered to derive from primary contexts. It became apparent that many assemblages had to be rejected. More disturbing was the fact that natural abrasion even occurred on assemblages which seemed in fresh condition when examined with the naked eye, such as Etiolles (Plisson 1985a) and Kolhorn (author's determination, not published). Even concerning assemblages generally considered to be in sufficiently good condition for high-power microwear study, the analysts frequently had to conclude that all tools displayed a sheen (Mansur-Franchomme 1983: 188), or, as Moss has formulated it,

> 'the analysis of the first 50-100 pieces in any microwear study using high magnification will be distorted by the necessity of growing accustomed to the post-depositional alterations unique for each site' (Moss 1983a: 144).

Upon microscopic examination, most assemblages yield some uninterpretable artefacts; the presence of sheen can vary within a site and even on one and the same implement. Rarely were archaeological polishes observed which exactly matched experimental traces:

> 'Il est aisé de produire expérimentalement des traces d'usage 'typiques', semblables à celles qui ont été décrites et illustrées par L.H. Keeley et d'autres chercheurs. Il est rare, en revanche, d'observer des polis aussi classiques lors de l'examen de pièces préhistoriques' (Gysels/ Cahen 1982: 221).

Plisson has been engaged in an extensive experimental programme to try to replicate secondary modifications and account for the factors responsible for their development. Plisson's experiments covered the aspects of the problem most easily addressed, and it did not seem useful to duplicate them, especially since they were extensively published (Plisson 1983a, 1985a, 1986; Plisson/ Mauger 1988). Extending upon Plisson's experiments requires detailed knowledge of surface-chemistry which is beyond this author's competence. Instead, a literature search was initiated to get an overview of the conditions under which analysts report their assemblages to be affected by surface modifications (see *4.3*).

4.2 Post-depositional surface modifications: a wide range of phenomena

4.2.1 Introduction

Patination must be one of the most confusing 'dustbin' concepts in lithic studies. In high-power use-wear analysis the term is sometimes used for any modification which hampers a possible functional interpretation. In this section an overview will be given of the various phenomena, and the experiments or other investigations which have been done to shed light on their origin, including the research which was done in this field by the author.

4.2.2 Chemical alterations

4.2.2.1 White or bluish patina

White patina has been described by a number of people (a.o. Schmalz 1960; Stapert 1976). The term refers to a thin layer of whitish colouration covering (part of) the tool. Schmalz (1960) describes the surface of white patinated flint as being 'sugary', highly porous, and reflecting light to all directions. As to its origin, most authors agree that alkaline environments induce white patina; Rottländer (1975a) mentions a pH of 10.0 or higher. Both Schmalz (1960) and Plisson (1985a) have experimented with various alkaline solutions and were able to reproduce white or bluish patina in a relatively short time. Characteristic for patinated flint is a slight weight loss. This is often attributed to a dehydration of water present in the pores between the quartz crystals, but it appears that the latter also dissolve themselves (Schmalz 1960).

A film of patination with a 'sugary' surface has also been observed on many of the flints from the Middle Palaeolithic site of Belvédère, the Netherlands (Van Gijn 1989). One

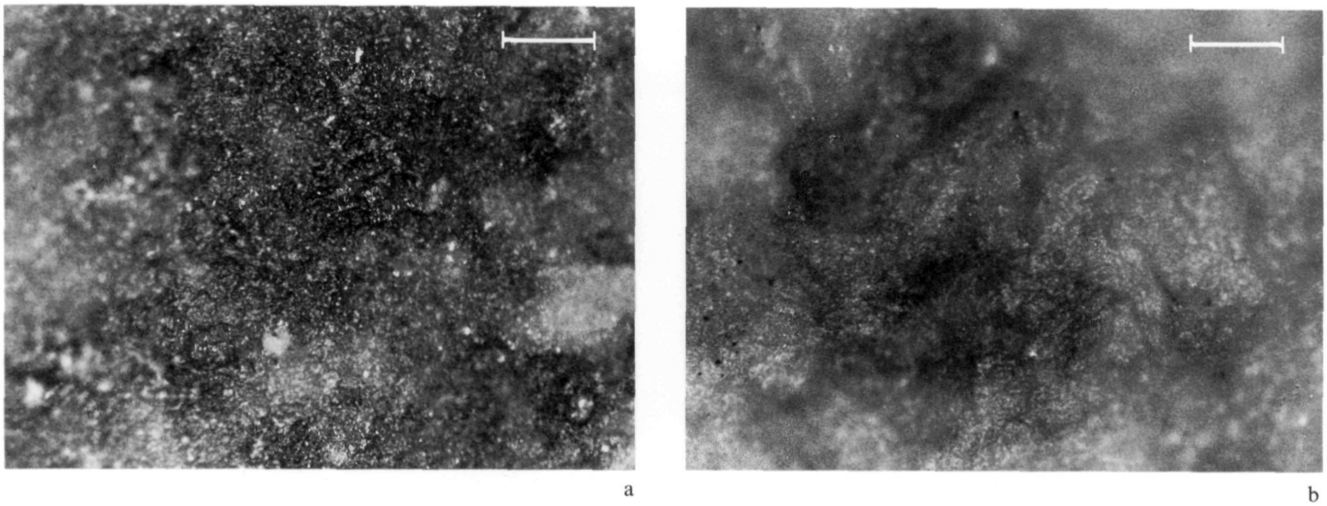

Fig. 34 Surface of a tool from Belvédère site K: a) immediately upon excavation (200x), b) the same tool after a few minutes of exposure to light and air (200x).

phenomenon, observed at site K, must be mentioned here. From site K a large number of flakes was retrieved, all displaying a dark-grey colour similar to fresh Rijckholt flint. However, after some time (varying between two days and a few months) the implements attained the creamy, light-yellow colour (white patina) characteristic for much of the previously excavated Belvédère material. A microscope was set up adjacent to the excavation trench to enable the examination of the 'fresh' flints as soon as they were recovered. For the first two minutes the flint surface of the site K implements indeed looked in mint condition under the microscope, with no sign of the 'sugary' surface (*fig. 34a*); however, the dissolution of the surface occurred after a short while (2-3 minutes), but this could not be observed with the naked eye, as the creamy colour did not appear till later. Apparently, even though the flint seemed to be fresh, the soil-matrix evidently had already altered the structure of the stone in such a way that exposure to light, or desiccation, caused a catalyzation leading to the dissolution of the surface (fig. 34b). This suggests that water plays a crucial role, something which has been argued before (Andersen/ Whitlow 1983). The process of dissolution is not reversible, but can be stopped by immediately putting the implements in water and storing them in a dark place (Van Gijn 1989: 127). The fact that the process is irreversible would indicate that it is not free water present in the pores that disappears, but water-groups bound into the chemical structure of the flint. Rottländer stresses that

> 'light gives the energy to split off water even from a chemical bondage' (Rottländer 1975b: 56).

Hopefully, it will be possible to extend the research into the patination process on the Belvédère material during future excavations.

White patina also seems to develop on flint which is exposed to the sun for extended periods of time, especially in hot climates with large daily temperature amplitudes. During a survey of flint knapping sites on Long Island, Antigua (West-Indies), it was noted that the side of the flint facing upwards frequently displayed white patination, while the opposite aspect was still fresh (Verpoorte/ Van Gijn *in prep.*). It seems unlikely that an alkaline matrix would have been responsible for the patination process, because the stone-surface lying in the soil was still fresh. Texier (1981) notes that at Khor a Qatar (Tunesia) all small debitage has disappeared from the surface of the site, while larger artefacts have been heavily patinated; under the surface of the ground the implements are however still fresh. He attributes this to the alternating phases of desiccation during the hot days and the formation of dew on the pieces in the early mornings. The dew could initiate the dissolution of the quartz crystals under certain conditions (Texier 1981: 167), eventually leading to the total disintegration of the smaller artefacts.

To conclude, it would appear that white patination can occur under different circumstances. First of all, it develops in alkaline environments, secondly, it seems that desiccation and exposure to the elements (a combined effect of sun, dew and temperature differences) can play a role.

4.2.2.2 Colour patina

Colour patinas are generally explained as being a deposit of various minerals present in the groundwater. Already patinated surfaces are more prone to this, due to their increased porosity (Schmalz 1960: 49). An alternative hypothesis is provided by Rottländer (1975a: 109), who suggests that it can also be the result of iron, already present in the flint, oxydizing at the surface. Yet another suggestion is that peat can cause a black or yellowish-brown colour patina. Although most artefacts with colour patina display a waxy texture, some remain dull despite the change in colour. It is perhaps this last phenomenon which is referred to as 'staining' in the archaeological literature (Frame 1986: 354; Dumont 1988: 34).

4.2.2.3 Gloss patina and other sheens

Rottländer has done extensive research into the somewhat elusive phenomenon of gloss patina. It concerns a more or less uniform sheen over the surface of the flint; some variability may be present on one and the same artefact. When examined with a scanning-electron microscope the surface appears smoothed (Rottländer 1975b: fig. 6). Rottländer argues that under the influence of plant juices, the protrusions of the flint are dissolved into a silicious gel, which then flows to the lower-lying parts of the surface, resulting in a smoothed, polished surface. The formation of gloss patina occurs especially in acidic environments such as peat layers, with pH 4 or less (Rottländer 1975a, 1975b). Because gloss patina does not develop uniformly over the tool, depending as it does on very localized groundwater circulation, the phenomenon can be quite confusing for the use-wear analyst. For example, one transverse arrow head from the Bronze Age site of Oldeboorn (Friesland) was initially interpreted as displaying meat-, and wood-/soft plant-polish. However, upon analysis with the SEM, the surface turned out to be smoothed and polished, and quite unlike the original flint surface (*fig. 35*) (Van Gijn 1983: 65).

In reports on high-power use-wear analysis one frequently encounters the term 'soil-sheen'. Unfortunately, this term has rarely been defined. I would suppose that at least part of the observed post-depositional surface modifications subsumed under the category 'soil-sheen' actually concerns instances of gloss patina. Stapert (1976: 14) discusses yet another, possibly related, natural modification, i.e. the rounding of ridges and edges. He considers this rounding to be due to solution, caused by the tools having lain in the soil for a long period. According to Stapert it is seldom seen on Mesolithic or younger flints. However, high-power analyses indicate that at least some solution of edges and ridges also occurs on assemblages from more recent times than the Palaeolithic.

A last observation pertaining to 'miscellaneous sheens', whether they be referred to as soil sheen, solution phenomena or weakly developed gloss patina, concerns the flint assemblage from Belvédère site J, which is currently under study. This assemblage, dated to the Weichselian, displays virtually no white patination nor rounding of edges or ridges. Invariably, however, one side of the artefacts exhibits a sheen which is visible with the naked eye. Presumably, the shiny aspect is the one which has been facing upwards and has been exposed for an extended period of time. The

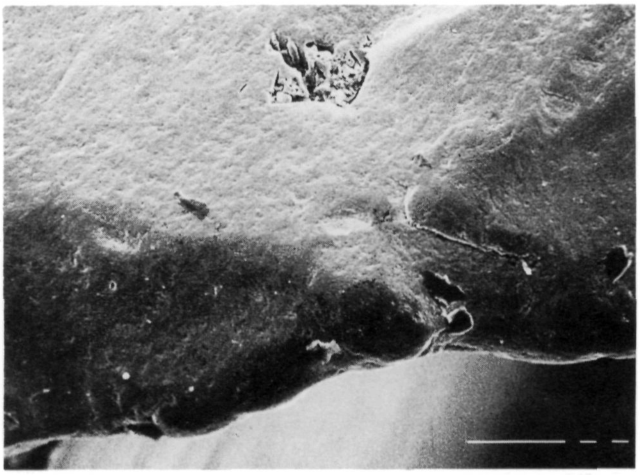

Fig. 35 SEM photograph of an artefact with gloss patina from Oldeboorn, the Netherlands (160x).

influence of light alone does not seem to have been responsible, as this is reported to cause a 'dull gray patination' (Rottländer 1975b: 56). No scratches were visible microscopically, suggesting that abrasion was not the causative factor. However, it is suggested that the sheen is due to the polishing by extremely fine loess-particles being blown by the wind; the very fine grain-size of these particles could have caused a uniform sheen, instead of abrasion scratches. This example shows again how complicated the question of 'soil sheen' is.

4.2.2.4 Friction gloss

Frequently during use-wear analysis so-called 'bright spots' have been observed on artefacts. Their origin is not clear at present. It is possible that friction gloss is a solution phenomenon. It has also been suggested that it is caused by the banging of artefacts against each other (Shepherd 1972), or by hafting (Moss 1987b) (see also *chapter 6, note 2*). Stapert (1976: 30) reports one instance of a patch of friction gloss being interpretable as evidence for hafting. In high-power use-wear analysis these spots are generally not inhibiting a functional interpretation as their distribution is quite localised.

4.2.3 MECHANICAL ALTERATIONS

4.2.3.1 Trampling

Several experiments have been performed to replicate the effect of trampling on the surface of the flint (Tringham et al. 1974; Flenniken/ Haggerty 1979). Generally it is assumed that trampling causes edge-scarring, and the experiments done so far have therefore emphasised this aspect of wear. Tringham et al. (1974: 192) maintain that the edge-damage inflicted by trampling was randomly distributed along the circumference of the artefact and located unifacially only.

This conclusion has been challenged by other investigators. Flenniken and Haggerty report that 37% of 428 trampled unmodified flakes was damaged; some of the scarred flakes (N = 56, i.e. 13% of the total) could even be mistaken for intentionally retouched, 'typological' artefacts (Flenniken/ Haggerty 1979: 211). These authors deny that edge-damage from use can be unequivocally differentiated from the unintentional effects of trampling. They state that

> 'the most conclusive result of our experiment was that, as one would expect, no polish occurred on any of the trampled material. We believe that polish is the only definite indicator of aboriginal flake use' (Flenniken/ Haggerty 1979: 213).

I believe that this last remark has to be modified slightly. Various experiments have shown that a kind of 'polish' does occur as a result of trampling. It concerns an undifferentiated 'sheen', which does not obscure (at least in its initial stages) well-developed polishes from contact with bone, silicious plants or dry hide, but does mask vaguer polishes such as those from meat, fresh hide, and initial wood-polish.

It seems therefore that trampling by the inhabitants of an occupation area, or, for that matter, 'settling' of the soil (due to solifluction, soil creep or simply compaction), does indeed modify the surface of the artefacts to a considerable extent. It is not only abrasion which occurs, but also edge-damage and, in extreme conditions such as peri-glacial environments, the development of deep scratches, pressure cones and cryoturbation retouch (Stapert 1976).

4.2.3.2 Post-excavation damage

Damage inflicted on tools during excavation, find-processing, or during further analysis, has been the subject of some discussion (Wylie 1974; Gero 1978; Plisson 1985b). Vigorous sieving on a metal screen produces edge-damage as well as 'metal-polish', i.e. bright, coloured streaks. This latter feature is irremovable, but fortunately very easy to distinguish from use-polish. However, some caution should be exercised with sieving. Certainly it would be advisable to avoid metal contact as much as possible.

The cleaning of implements constitutes another occasion when artefacts may be damaged. Rubbing off adhering sediments from flint artefacts is a normal cleaning procedure, but unfortunately it is very detrimental to polishes, as it inflicts a mechanical 'soil sheen' on the surface. Brushing off the sediments with a toothbrush has the same effect, even under running water. The brushing itself (with a nylon toothbrush), if done on a clean surface, does not seem to affect the surface (Levi Sala 1988). Best is cleaning the artefacts under running water with as little rubbing as possible. Numbering with ink and nail-polish does not cause lasting damage, but such marks can form a nuisance to analysis (hence, have to be removed), if placed for instance along the ventral aspect of a scraper edge.

Chemical cleaning of implements prior to examination by microscope is also known to cause changes, not only to the appearance of polishes, but, in due course, also to the flint itself. Plisson and Mauger (1988) have extensively described the changes resulting from the use of various chemicals, and I will not reiterate their points here. However, it is clear that we should not use NaOH, due to its desiccating effect on the flint. In addition, contrary to what some researchers believe (cf. Plisson 1985a), but in agreement with others (Mansur-Franchomme 1983), it is suggested that caution is also warranted with the use of HCl. If its application is not followed by a thorough rinsing with tap water, and if it is not neutralized with e.g. KOH, its use can cause a bluish sheen on the flints (as happened with some of the Hekelingen III flints), or else a yellow colouration (cf. Van Gijn 1989). As has been mentioned before (see *2.4*), this effect can be avoided by first soaking the implements in water (H.Juel Jensen *pers.comm.*).

Contact between flint artefacts, whether due to their being stored together in large bags, or refitting attempts, causes quite substantial alterations. They include extensive edge-damage, which sometimes removes existing polish, friction-gloss, linear streaks of polish, and slight rounding of the edges and ridges. It is quite understandable that it is impossible to individually bag in plastic every single tiny piece of debitage. However, considering the already enormous amount of time, money and effort put into excavation, it should not be too much to ask to put all retouched implements, blades, and preferably also larger flakes, into separate plastic bags. As far as refitting is concerned, it would be best to leave such attempts until wear-trace analysis has been performed. Stone might seem resilient, it is, in its own way, as fragile as pottery. In addition, the scattering of large bags of flint onto tables causes extensive edge-damage, friction-gloss etc. It would therefore be advisable to perform a wear-trace analysis prior to an assemblage's 'degradation' to study-collection. A final stage during which flint implements can sustain damage, is during the microscopic analysis itself. Various authors have noted that repeated handling produces a 'meat-polish' (Plisson 1985a: 100; Unrath et al. 1986).

4.2.4 Discussion

From the preceding paragraphs it can be concluded that the number of factors which can be harmful to a piece of flint is substantial. As far as post-depositional surface modifications, such as patination and abrasion, are concerned, the situation is rather confusing at present. As Keeley (1980: 29) already noted, microwear analysts have the tendency to subsume under 'patination' a wide variety of phenomena, the causes of which are still very poorly understood.

4.3 Inventory of occurrences of pdsm in archaeological assemblages

Use-wear analysts have done a considerable number of experiments to replicate various post-depositional surface modifications (Plisson 1985a; Levi Sala 1986, 1988; Plisson/ Mauger 1988), and non-archaeologists such as Rottländer (1975a, 1975b) have tried to shed light on their origins. However, it seems we are still far from being able to predict when assemblages are suitable for microwear analysis.

It was therefore decided that it might be useful to look back upon the results so far obtained by various microwear analyses. It was hoped that, by doing so, regularities might appear which could direct further research into the origins of post-depositional surface modifications. This survey concentrates on research done on West European flint material, as it proved very difficult to acquire an overview of the more obscure references from the United States or Japan. Consequently, the more accessible publications reporting on 'remote areas', such as Koobi Fora (Keeley/ Toth 1981) or Patagonia (Mansur-Franchomme 1984), have also been excluded. Still, I am sure I will have overlooked several references pertaining to the study area.

Factors which are generally considered to be important for the question of natural alterations include the date of the assemblage and the matrix and/or geological condition in which the material was deposited. As most authors have not specified the exact character of the post-depositional surface modifications they observed, table 3 only lists whether or not mention was made of such phenomena (+ or -). In principle, the column 'number of pieces studied' (no st) only includes the implements which were actually examined microscopically. This means that it represents a sample of the total assemblage (the exact number of artefacts, from which the sample was drawn, was often not provided), which was usually selected according to the criterion of freshness. Thus, the percentage of pieces with alterations concerns the implements which, although they looked fresh with the naked eye, appeared to be modified after examination with the microscope. The actual percentage of pieces affected might therefore have been much higher than listed under the column % pdsm in table 3. However, in some cases (i.e. all sites reported in Beyries 1987, and those indicated by *), the numbers studied were unclear and the amounts listed concern the total assemblages. It should be stressed that, due to inconsistencies in the various texts, or to confusion on my part about the numbers provided, some quantities can be misrepresented.

From table 3 it can be observed that the age of the artefacts, and hence the amount of time they have been in their matrix, to some extent does have influence on the quality of the material. Lower and Middle Palaeolithic assemblages invariably seem to display surface modifications of some sort; white patina (by whatever influence it is caused) is most frequently reported. For later periods the situation varies considerably. Magdalenian assemblages are usually in good condition for microwear analysis, with the exception of Etiolles[1]; Plisson (1985a) mentions some sheen on implements from Pincevent, habitation 1, as well. The single category of artefacts which consistently displays only few alterations concerns LBK assemblages. At Darion, Couture de la Chaussée (Blicquy), Liège Place Saint-Lambert, Beek-Molensteeg, Elsloo, Langweiler 8, and Laurenzberg 7, implements are reported to be generally in excellent condition. In contrast, many Middle and Late Neolithic assemblages display quite heavy sheen, while Bronze Age flint from Oldeboorn shows gloss patina. It seems therefore that, apart from the very old assemblages which invariably are somewhat altered, age is not a determining factor anymore from Upper Palaeolithic times onwards.

The substance of the matrix does not appear to be a causal factor, with the possible exception of sand. All assemblages from a sandy matrix are reported to display at least some modifications; Upper Palaeolithic sites in Denmark and Mesolithic sites in the Netherlands, which are in both cases usually located on sand ridges, have consistently been rejected for microwear analysis (H.Juel Jensen *pers. comm.*; observations of the author).

One factor which was believed to be of influence, the pH of the matrix (cf. Rottländer 1975a, 1975b), is so seldom accounted for as to be rather useless for this inventory. Table 4 presents the few instances this feature has been mentioned. The values show neutral or slightly alkaline conditions to have prevailed, but from all five sites patination has been reported. Rottländer suggests an alkalinity of pH $\geqslant$ 10 for white patina to develop and an acidity of pH = 3.5-4.0 for gloss patina formation. The fact that none of the sites fulfills either of these conditions and nevertheless all of them produced assemblages with surface modifications, suggests that other factors played a more important role.

4.4 Conclusion

The picture which emerges from the preceding paragraphs is a pretty negative one: it seems that extremely few assemblages are so well-preserved for microwear analysis to offer representative results. The number of factors which can alter the surface of flints is considerable indeed. Although the Magdalenian assemblages from the Paris Basin are generally in relatively good condition, they do display modifications to some extent, despite the fact that they were quickly covered by sedimentary deposits. The only assemblages which are consistently reported to be in mint condition, are the ones from the loess, dating from the Bandkeramik period. These implements for the most part derive from pits, i.e. dumps. The above-described categories of assemblages represent the two circumstances in which microwear analysis yields the most satisfactory results: 1) material from dumps

Table 3 Assemblages studied (using the high-power method) for the presence of traces of use, indicating percentages of post-depositional surface modifications.

site	date	pdsm	no st	%pdsm	wear-traces	matrix	geol.sit.	publication
Clacton-Golf course	Clact.	+	312	20	butchering	marl, gravel	riverine	Keeley 1980
Swanscombe	Clact.	+	267	75	most used	loam	riverine	Keeley 1980
Hoxne	Acheul.	+	408	29	wood, hide	silt	riverine	Keeley 1980
Arcy-sur-Cure/Renne	Mid.Pal.	+	227	79	wood	variable	cave	Beyries 1987
Corbehem	Mid.Pal.	+	1767	96	wood	loess	open air	Beyries 1987
Grotte Vaufrey VIII	Mid.Pal.	+	?	?	wood	sand, gravel	cave	Beyries 1987
Combe-Grenal III	Mid.Pal.	+	558	79	wood	?	cave	Beyries 1987
Pie-Lombard	Mid.Pal.	+	316	96	no traces	clay	cave	Beyries 1987
Marillac X	Mid.Pal.	+	626	87	wood	clay, chalk	cave	Beyries 1987
Pech de l'Azé 1	Mid.Pal.	+	47	?	wood	sand	abri	Anderson-Gerfaud 1981
Pech de l'Azé 4	Mid.Pal.	+	113	?	wood	sand	abri	Anderson-Gerfaud 1981
Corbiac	Mid.Pal.	+	62	?	wood	sand	open air	Anderson-Gerfaud 1981
Biache St.Vaast	Mid.Pal.	–	?	?	wood	fine fluv.	riverine	Beyries 1988
Belvédère IV	Mid.Pal.	+	55	87	butchering	fine fluv.	riverine	Van Gijn 1989
Paglicci Cave	Mid.Pal.	?	296	?	meat	variable	cave	Donahue 1985
La Cotte	Mid.Pal.	+	367	42	hide, wood	loessic	cave	Frame 1986
Mesvin IV	Mid.Pal.	+	27	?	diverse	coarse river	riverine	Gysels/ Cahen 1982
Verberie	Magdal.	–	192	–	meat, hide	sandy loam	open air	Symens 1986
Verberie	Magdal.	–	43	–	diverse	sandy loam	open air	Audouze et al. 1981
Pincevent 1	Magdal.	+	218	–	diverse	silt	open air	Plisson 1985a
Pincevent 36	Magdal.	–	121	–	diverse	silt	open air	Moss 1983a
Cassegros 10	Magdal.	+	532	18	dry hide	?	cave	Vaughan 1985a
Andernach 2	Magdal.	?	262	?	diverse	loess	open air	Vaughan 1985b
Andernach	Magdal.	–	191	–	meat, hide	loess	open air	Plisson 1985a
Zigeunerfels	Magdal.	–	410	–	animal subst.	?	cave	Vaughan 1985b
La Tourasse	Azilian	+	95	18	diverse	?	abri	Plisson 1982
Pont d'Ambon	Azilian	+	475•	?	diverse	silt, grav,	abri	Moss 1983a
Oldeholtwolde	Hamburg	–	218	–	diverse	sand	open air	Moss 1988
Meer	Tjonger	+	257	25	diverse	sand	open air	Cahen et al. 1979; Keeley 1978
Star Carr	E.Mesol.	+	156•	–	diverse	clay, peat	open air	Dumont 1988
Mt.Sandel	E.Mesol.	+	273•	–	diverse	?	?	Dumont 1988
Vaenget Nord	Konge-mose	+	846	26	diverse	clay	open air	Juel Jensen/ Brinch Petersen 1985
Ageröd V	Konge-mose	+	90	16	diverse	sand	open air	Juel Jensen 1982, 1984
Elsloo	LBK	+	104	14	diverse	loess	open air	Schreurs 1989
Beek-Molensteeg	LBK	+	349	17	diverse	loess	open air	Van Gijn, this volume
Langweiler 8/ Laurenzberg 7	LBK	–	378	–	diverse	loess	open air	Vaughan 1985b
Darion	LBK	–	1992	0.8	diverse	loess	open air	Caspar 1988
Liège Pl.St.Lambert	LBK	–	143	–	diverse	loess	open air	Caspar/ Gysels 1984
Couture d.l.Chaussée	Blicquy	–	215	–	diverse	loess	open air	Cahen/ Gysels 1983
Ringkloster	Ertebølle	–	63	–	hide, wood	peat	open air	Juel Jensen 1982
Ertebølle	Ertebølle	–	100	–	diverse	sand	open air	Juel Jensen 1982
Swifterbant S51	5300 BP	–	223	–	diverse	clay	riverine	Bienenfeld 1986
Swifterbant S4	5300 BP	+	80	7	diverse	clay	riverine	Bienenfeld 1986
Swifterbant S2	5300 BP	?	127	?	diverse	clay	riverine	Bienenfeld 1986
Hazendonk 1	5300 BP	+	17	29	diverse	sand	sanddune	Bienenfeld 1986
Hazendonk 2	5100 BP	+	14	21	diverse	sand	sanddune	Bienenfeld 1986
Hazendonk 3	4900 BP	+	106	12	diverse	sand	sanddune	Bienenfeld 1986
Siggeneben Süd	5000 BP	+	47	32	diverse	sand, gravel	open air	Schulte im Walde/ Strzoda 1985
Gassel	4900 BP	+	95	18	diverse	sand	open air	Bienenfeld 1986, 1988
Hazendonk-VL.1a	4700 BP	–	4	–	diverse	sand	sanddune	Bienenfeld 1986
Hazendonk-VL.1b	4400 BP	+	41	–	diverse	sand	sanddune	Bienenfeld 1986
Hekelingen III	4300 BP	+	337	37	diverse	silt	riverine	Van Gijn, this volume
Leidschendam 4	4300 BP	+	73	56	diverse	sand	open air	Van Gijn, this volume
Sarup	4300 BP	+	161	13	wood, hide	sand	open air	Jeppesen 1984
Oldeboorn	3700 BP	+	101	18	diverse	sand, peat	open air	Van Gijn 1983

Table 4 pH values reported for various sites.

Site	pH	publication
Arjoune (Syria)	7.0	Unger Hamilton 1988
Pincevent habit.1 (France)	8.35-8.60	Plisson 1985a
Belvédère site G (Holland)	8.6	Van Gijn 1989
Belvédère site C (Holland)	6.0-6.5	Van Gijn 1989
Hekelingen III (Holland)	5.9-7.4	Van Gijn, this volume

and 2) assemblages deposited in a place rarely frequented by people (i.e. no trampling) and very quickly (in a matter of years) covered by sediments. The latter instance, a rare occurrence, also provides a very good chance of finding activity areas. However, it seems that such a situation, in which a place is soon deserted, not to be visited again, exemplifies only a very small segment of the human activity spectrum: it excludes permanent settlements, base-camps, and even stations occupied every year to exploit a specific resource. Moreover, the assemblages from the Paris Basin are not consistently in fresh condition, indicating that other factors are of influence as well.

Dumps, where microwear traces stand the best chance of preservation, are unfortunately not ideal in terms of the reconstruction of past behaviour. It concerns secondary deposits which may or may not bear a relationship to activities carried out nearby. A large sample from the pits at the LBK site of Darion was subjected to microwear analysis, but no evidence of differentiation between the content of these pits was found (Caspar 1988); the same pertained to Elsloo (Schreurs 1989). This may mean that 'everyone was living the same life', and one can be tempted to draw far-reaching conclusions about the egalitarian nature of these settlements. However, this is an interpretation we must be cautious with because of the very fact that we can be dealing with predominantly secondary deposits.

The supposition that a microwear analysis can produce representative results only in the two situations described above, does not mean that wear analysis is useless in other instances. Also in those cases wear-traces can be observed, but they will be confined to those which are very distinct and resistant to chemical and/or mechanical attack, i.e. the ones caused by silicious plants, bone, dry hide, and perhaps wood. Although the outcome will not be representative, interesting data can nevertheless be obtained (cf. *6.2*). For those assemblages which we are inclined to reject for microwear analysis, I would argue that it is necessary to broaden our methodology and include explicitly low-power techniques in our approach. Obviously, this is only possible when we can be relatively certain that no or little post-depositional edge-damage has taken place. It is unwise to continue to reject important assemblages because of post-depositional surface modifications. Instead, there should be change in our tactics, emphazising different aspects of wear according to the possibilities inherent in each assemblage. By using the low-power approach in those cases in which polishes and striations have disappeared or become invisible, the possibilities of use-wear analysis can be extended. Clearly, the level of inference will be somewhat lower for assemblages only studied by stereo-microscopy (but cf. Shea 1988), and confined to statements about relative hardness of contact-materials, but such information is still valuable. If we do not adapt our techniques to the preservation-state of the assemblage to be studied, we might even run out of suitable assemblages and/or interesting archaeological problems to solve.

note

1 Etoiles is not included in this table, because it was rejected for analysis (Plisson 1985a).