

7.1 Introduction

Methodological and technical issues have preoccupied the majority of microwear analysts nearly from the start. This is not surprising as the discipline is relatively new, while major problems (cf. *chapters 2 and 4*) became evident quite soon after its introduction. Most researchers were young and unexperienced, working in isolation, and generally with insufficient financial backing. In addition, almost everyone had to start out with the time-consuming task of creating a reference collection. Consequently, many analysts have done a lot of 'navel-staring'. This is, I believe, one of the main reasons why microwear analysis (but also use-wear analysis in general) has failed to become part of mainstream archaeology, despite the fact that, especially in the early phase of the discipline, very current or hotly-debated themes were addressed, such as the 'Mousterian problem' (Anderson-Gerfaud 1981; Beyries 1987), and the Upper Palaeolithic open-air sites of the Paris Basin (Moss 1983a; Plisson 1985a; Symens 1986; Keeley 1987).

Recently, microwear analysts have become aware of their relatively isolated position in the archaeological world at large. In response, a conference was organized at the University of Uppsala, Sweden. The atmosphere was quite optimistic, with everyone confident of a future for microwear analysis, but much of the discussion still centred on methodological and technical issues. It is believed that, even though reflection and work on these matters is essential for the progress of the discipline, it is equally important to seriously start integrating the approach into general archaeological research.

Microwear analysis can be a tool for solving questions regarding the form and function of implements, and the activities and tasks carried out by the inhabitants of a settlement. At an intra-site level, functional data can assist in the search for activity areas, whereas in the case of inter-site studies, functional differentiation between settlements may be elucidated. All of these themes have already been addressed in chapters 5 and 6, and I shall not repeat in extenso the conclusions drawn. In this chapter, I would only like to highlight the potentials of microwear analysis, and illustrate this with some examples drawn from the case-studies.

7.2 Form versus function

Form-function problems were addressed almost immediately after the introduction of use-wear analysis, both from a 'macro'-perspective (a.o. Odell 1981) and from a 'micro' point of view (a.o. Moss 1983c). This is not so astonishing as each one of the approaches seemed to offer an objective method for assessing the validity of (functional) typologies. The latter had usually been arrived at in a rather subjective manner.

Juel Jensen, in her review of West-European research in microwear analysis, has examined the functional homogeneity of two tool types commonly encountered in archaeological assemblages, i.e. the scraper and the burin (Juel Jensen 1988a). With respect to the scrapers, Juel Jensen concludes that in the Upper and Final Palaeolithic end-scrapers are almost solely used on hide. From the Early Mesolithic onwards, inferred contact-materials additionally include wood and, to a lesser extent, bone/ antler. Working edges usually bear evidence of a scraping motion. The results obtained for the Neolithic assemblages of Beek-Molensteeg, Hekelingen III and Leidschendam also show scrapers to be almost exclusively used in a transverse motion. At the Early Neolithic site of Beek-Molensteeg the association between endscraper and hide-polish is very strong, while at the other two, Late Neolithic, sites more variability is displayed in terms of the material worked, with wood and bone/ antler also being present. Borers are virtually absent at Beek-Molensteeg, whereas no 'substitute' flint tool was attested. On the other hand, at Hekelingen III borers appear to be a common occurrence. They turn out to be almost invariably used for boring, although other motions are performed with them as well; the contact-material, however, is extremely variable.

Yet another tool type showed a very significant correlation between its form and function: the *quartiers d'orange* from Beek-Molensteeg. Without exception they exhibited the mysterious polish '23' (see 5.4.2.7). Nevertheless, no exclusive correlation existed between the *quartiers* as a tool type and this unknown polish: two artefacts with a functional edge essentially identical to the ones of the *quartiers* displayed the same traces. It should be noted that but for microwear analysis the significance of these artefacts would

not have been recognized. *Quartiers d'orange* were thought to be absent in Dutch LBK assemblages, and the slightly 'atypical' specimens found at Beek-Molensteeg would probably have been classified as 'blocks', never to be looked at again. The same applies to the two unretouched blades displaying an identical pattern of wear-traces. Now that it is clear which morphological characteristics are important, (i.e. an unretouched, regular, straight or slightly concave edge, with a length of 6-9 cm, and an edge-angle of 70-90°), it has become possible to almost predict the presence of polish '23'. As the polish is also visible with the naked eye, this saves a lot of hours behind the microscope. Although it is, unfortunately, not yet known which contact-material caused these traces (the motion is undoubtedly transverse), the activity responsible for them constitutes an integral part of the LBK cultural complex. The traces were identified in almost every LBK assemblage so far studied for the presence of wear, from Hienheim in Bavaria, West-Germany, to Darion in Belgium, whereas they have, to my knowledge, never been reported for other periods. Hopefully, the functional riddle posed by polish '23' will be solved in the near future.

All other tool types of the assemblages studied displayed great variability with respect to inferred use, although there does seem to be some consistency in the kind of morphological attributes chosen for specific motions (see 5.5., 6.2.5 and 6.3.4). Especially edge-angle and, to a lesser extent, shape of the edge, seem to be important in this regard. This would suggest that, if one is interested in function, it is generally more appropriate to look at the characteristics of the individual edges, than the overall shape of a tool, something which has also been stressed in ethno-archaeological studies (Gould et al. 1971; White et al. 1977; Hayden 1979). This does not imply that our typological notions have become worthless; they remain a very valuable means of classifying otherwise unwieldy assemblages and can also have great use as temporal or spatial markers. However, it would be fallacious to automatically associate a certain tool type with a specific use.

The functional analysis has not only questioned the functional homogeneity of several tool types. It has also demonstrated that many unretouched edges were employed for various purposes. This applies both to the blades from Beek-Molensteeg and to the more irregular flakes from Hekelingen III. In the case of Beek-Molensteeg, activities include the cutting of hide and soft plant, and the scraping of the contact-material being responsible for polish '23'. At Hekelingen III, unretouched flakes were used for splitting plants for matting or basketry. It was also shown that such flakes were considered appropriate for deepening the natural groove of the metapodia of deer; this procedure formed part of the task of bone awl and chisel manufacture (see 6.2.3.2). The information obtained by also examining unretouched flakes and blades has therefore contributed considerably to a

better understanding of the daily activities carried out at the various sites.

Since this study was directed at function, the question of style needs to be addressed, but will only be touched upon. Close (1978) considers style to be independent of function and argues that style can only be inferred by a process of elimination, of all the aspects that do not have a functional reason; Deckers (1985) takes a similar position. Other researchers have proposed procedures to separate style from function (e.g. Meltzer 1981). If we follow them, use-wear analysis would be an indispensable method to distinguish functional from stylistic traits. The underlying assumption is that style is added to the tool, having no other objective than to signal ethnicity or group affiliation. An alternative approach, that appears more credible at least for lithic studies, has been suggested by Sackett in a series of articles (a.o. 1982, 1986). Sackett views style

'not as a distinct realm of form but instead as a latent quality that at least potentially resides in all formal variation that has in one way or another passed through a culture's matrix' (Sackett 1986: 268).

This would mean that use-wear analysis provides no help in separating style from function. However, because there are usually several alternatives to solve a specific (functional) problem, choices must be made, which are, to some extent, bound by tradition. It might be possible for use-wear analysts to track these consistent choices. An example, presented in this study, are the steep-angled *quartiers d'orange*, which consistently display the same use, and almost seem to 'hallmark' the LBK lithic assemblages; however, it is almost impossible to determine which aspects of these tools can be considered functional and which ones stylistic.

7.3 Reconstruction of activities and tasks

In chapters 2 and 3 the way of arriving at a functional interpretation of individual working edges and entire tools was discussed (cf. 2.7.2). In addition, it was outlined how it was sometimes possible to infer, not only the activity (i.e. the motion and contact-material), but also the task in which an implement was involved (see 3.1.2). Remains the question which meaning we can attribute to these results. In the preceding pages it has frequently been stressed that the outcome of a microwear analysis can be biased by the presence of post-depositional surface modifications on the surfaces of the tools. These traces may have obliterated the less well-developed polishes, such as those from contact with meat, fresh green plants or fresh hides, as well as the evidence for short-term uses on other contact-materials. Such might also be the case when the flint the artefacts are produced of, is coarse-grained. Even if all conditions seem favourable, with no pdsms present, while the implements are made of fine-grained flint, there will still be an under-estima-

tion of the activities involving the above-mentioned contact-materials (cf. 3.12). All these factors have to be taken into account when attributing behavioural significance to the results of the analysis.

In addition, there are several taphonomic processes that must be considered when trying to reconstruct the activities important at the site being studied. First of all, tools are being carried around. At certain locations (presumably in the case of longer-term occupations), toolkits are prepared in anticipation of tasks to be performed at other sites, or maintenance and repair activities take place. This results in the deposition of artefacts which were actually used elsewhere. Obviously, it is very difficult to draw a line as to which off-site activities still belong to the activity pattern of a site; hide-scraping being done just outside a settlement clearly is part of this, so would be harvesting in the nearby fields. But what about fishing-gear used a kilometre away from the site and brought home? It is evident that such questions need to be born in mind, especially when there is evidence for curation (Binford 1979), or for hafting and retooling activities (Keeley 1982) (see also below).

Apart from the possibility that tools used off-site are deposited at the site, it can also occur that tools, employed in subsistence tasks forming part of the activity pattern of the inhabitants, but carried out some distance from the settlement, were lost or discarded during use, resulting in those low-density sites which are so rarely addressed in archaeological investigations (Roebroeks 1989). Absence of certain wear-traces can therefore not be taken at face-value. Obviously, negative evidence cannot constitute proof; at most it can be considered 'circumstantial evidence'. Nevertheless, when it concerns traces which are not easily obliterated, I would suggest that the absence of wear-traces indicative of a certain activity may lead to the conclusion that the activity in question was not part of the pattern of tasks of the settlement. Such traces would include those from working bone and from cereal-reaping. At Beek-Molensteeg the absence of bone-working traces was taken as reflecting the 'real' situation; secondary modifications were minimal and bone-working is an on-site activity, with deposition of the used artefacts likely to have taken place within the settled area. At Hekelingen III the absence of cereal-harvesting implements was taken for 'real' as well, and as a confirmation of the palaeobotanical interpretation (Bakels 1986, 1988), although it was realized that this absence might also be explained by loss of sickle blade-fragments in the fields. On the other hand, the absence of wear-traces attributable to fish-processing is probably not reflective of the 'real' situation (cf. 6.2.3.2).

Yet another problem is the fact that we can be dealing with a palimpsest of occupations. Binford (1982) has demonstrated that the function of specific sites may vary from one year to the next, with sites 'changing positions' so

to speak. This posits immense problems when trying to reconstruct the tasks carried out; separating these various use-instances of a site is almost impossible. Only when contextual evidence is present, in the form of other artefact categories, is this feasible, but the relationship between the artefact categories needs first to be demonstrated. When artefact categories are found at the same spot or adjacent to each other, and in the same vertical position (i.e. in 'archaeological association'), it is usually taken for granted that they represent one activity. Obviously, this does not necessarily have to be the case, as such a configuration could also be the result of a palimpsest of several use-instances of a particular location. Use-wear analysis offers a rather direct possibility to examine whether a 'real' association exists. An example comes from the Middle Palaeolithic Belvédère site G (the Netherlands), where a large backed-blade was found amidst a concentration of bones of young rhinoceros. The backed-blade displayed wear strongly resembling experimental traces from butchering elephant, i.e. a pachydermatous animal, making it very likely that this tool was used for the butchering of the young rhinos (Roebroeks et al. 1986; Van Gijn 1989).

With respect to the studies presented in this volume, it can be argued that the microwear analysis has added more detail to our picture of daily life at the sites, part of which could not have been attained any other way. Examples include the plant-splitting, hide-working, and stone-boring activities at Hekelingen III, and the hide-processing, fine wood-working, and the task behind polish '23' at Beek-Molensteeg. Regarding this last site, the absence of bone-working tools from flint may also be significant.

7.4 The search for activity loci

When introduced as a new method, microwear analysis held great promises for those interested in reconstructing past behaviour. It potentially offered the possibility of inferring activity areas within sites, not on the basis of hypothetical functions of specific tool types (for example burin = bone-/antler-working), but based on objective data. In some instances, such as at Verberie (Symens 1986: 220-221) and at Meer (Cahen et al. 1979), these expectations have come true, in that bone-/antler-working areas could be identified around hearth areas. At Hekelingen III we catch a glimpse of them in archaeological units A1, M1 and H2 (see 6.2.4), while at Vaenget Nord hide-working seems to have occurred away from the central area of the site (Juel Jensen/ Brinch Petersen 1985: 49). The configuration of bones of young rhinoceros and a backed-blade with butchering traces at Belvédère site G (described above), forms a good example of an activity locus as well.

Unfortunately, it is not always clear which meaning we should attribute to such spatial configurations. Keeley, in what was actually the first theoretical article to appear

within the subject of microwear analysis, draws attention to the effect of 'retooling' activities (Keeley 1982). He asserts that hafted tools are brought 'home', where new flint implements are inserted into the hafts. The manufacture of hafts is a time-consuming task, so they are re-utilized, while the worn-out flint tools are discarded, far away from the location of their actual use, in the hearth areas of the settlement (whether it be a permanent or temporary one). This would imply that the interpretation of activity loci becomes a very tricky business for those assemblages with evidence of hafting. Dislocation of artefacts not only occurs from retooling; actually it takes place whenever tools are transported from the settlement to their location of actual use and back, i.e. in the case of all the implements used outside the settlement area. We therefore must first take the mobility of tools into account, prior to making any statements about configurations being activity areas.

A second situation in which activity areas are difficult to interpret, is exemplified by the Linearbandkeramik sites. It concerns permanent settlements where apparently a large part of the rubbish produced by the inhabitants was collected to be dumped in pits adjacent to the houses. The samples studied so far include Darion (Caspar 1988), Elsloo (Schreurs 1989) and Beek-Molensteeg (this volume). Despite the fact that most of the assemblage of the nearly completely excavated settlement of Darion was studied, no dissimilarities in the content of these pits which may indicate economic/ task differentiation between households were observed. In Elsloo, the sample was devised to include the pits of houses which showed variations in certain (perhaps socially defined) respects, but also in this case functional distinctions were not evident (Schreurs 1989). Whether these observations are 'real', i.e. have social implications, is difficult to tell. It is equally possible that the pits lay open for anyone to dump garbage into, and that their contents do not necessarily solely reflect the activities carried out in the houses situated adjacent to them.

Yet another situation in which taphonomic processes have to be taken into account when inclined to interpret an artefact concentration as an activity area, is the possibility that in permanently (or long-term) inhabited houses the more frequented areas of the dwelling are cleaned on a regular basis. In ethnographic context it has been observed that the areas which are most intensively used are virtually devoid of garbage or unused tools, while spaces which are seldom frequented abound with junk; when the people move out, the latter material is often not removed, becoming part of the archaeological record in due time (Van Gijn 1986b).

It will be clear that the interpretation of a given spatial distribution, such as an activity area, should be approached with considerable caution. Certainly, use-wear analysis adds an extra dimension to the reconstruction of past behaviour at a site, but the same reasoning about cultural and natural

depositional factors now becoming so common in general archaeological practice needs to be applied to microwear analysis. The data cannot automatically be taken at face-value.

7.5 Tracing functional differentiation between sites

Following Binford's interpretation of Mousterian variability being related to different 'structural poses' of the same group of people, the potential of use-wear analysis to contribute to the question of 'site-typology' was recognized. In fact, in the early days of microwear analysis two theses have been addressed to this very problem (Anderson-Gerfaud 1981; Beyries 1987). The greater part of the more recent studies, however, has been rather site-oriented, although the theme, assessing the character or function of the settlement in question, has continued to be important (cf. Juel Jensen/ Brinch Petersen 1985; Dumont 1988). This emphasis on single sites is not so surprising considering the time involved in the analysis of an assemblage. An additional problem is that smaller (i.e. more manageable) collections have generally been selected for study (see also Juel Jensen 1988: 64-65), presently resulting in a severe under-representation of the larger sites. It is only when we will have data from the total continuum of settlement sizes within a given (micro-)region, that we might be able to conclude something about the 'movement of people through time' (Carlstein 1982). However, before such broad-scale studies are possible, more effective sampling procedures must be devised, involving for instance the use of stereomicroscopes (see next paragraph). The study of the Vlaardingens sites, presented in chapter 6, forms an attempt at establishing such a corpus for the Dutch coastal areas.

In paragraph 7.3 it has been demonstrated that many different factors must be taken into account before we can attribute a meaning to the inferred motions and contact-materials. The next step is to assign a specific *function* to the site: does it concern a permanently occupied settlement, a winter base-camp, a hunting station or a game-watching stand? Binford (1978a; 1978b; 1982) has been instrumental in outlining the great variety possible in types of sites. As has been argued before, we unfortunately have very little grip on the question which activities or tools are 'typical' for which type of settlement (Van Gijn *in press a*). Juel Jensen (1986: 31) has suggested that unretouched used blades should be employed as indicators for functional differences between sites, rather than intentionally retouched tools, as the latter are more likely to have been repaired or resharpened. Ethnographic information is seldom of much help (see *chapter 3*).

Obviously, there are some instances which are self-evident, such as the butchering area of Belvédère site G (Roebroeks et al. 1986), or, at the other extreme, the large, permanently inhabited, agricultural LBK settlements. However, in general

we are dealing with minor variations along this continuum, which nonetheless have significance with respect to past human behaviour. It is very likely that certain settlements, actually different in terms of site typology, will display virtually the same spectrum of inferred tool uses. This was, for instance, the case at Hekelingen III and Leidschendam trench 4 (*chapter 6*). In those instances I would suggest we should actively search for possible variation and its meaning (Van Gijn *in press a*), incorporating as much evidence into our arguments as possible. Even if we have only the lithic component available, no other remains being preserved, I would maintain that use-wear data should be combined with information pertaining to the typological range of tools, technological features, availability and character of the raw material and so forth. With respect to Hekelingen III and Leidschendam, evidence for a different behaviour towards the flint provided an important clue for the inference that the sites had a different function. The people at Hekelingen III had sufficient amounts of exotic raw material at their disposal, which was treated in a rather careless fashion (see 6.2.6.2). At the other hand, at Leidschendam only local flint of small size was available, which was used in a more thrifty manner (see 6.3.5). These observations, among others, led to the conclusion that Leidschendam was occupied on a year-round basis, whereas the site of Hekelingen III was interpreted to reflect multiple visits of perhaps different duration, aimed at the exploitation of wild resources such as sturgeon and game (cf. 6.2.6). Hence, by *actively* combining and confronting such a large variety of *lithic* data we will come a long way towards understanding site function, especially when more settlements are compared.

We now arrive at the final problem pertaining to the subject of site typology, the question of ethnic/ social group homogeneity. Even if it is demonstrated that one settlement was occupied during summer, and another during winter, how certain can we be that both were used by the same group of people? Once more we seem to arrive at the 'Mousterian problem'. Close has argued that only by examining stylistic variables is it possible to determine whether sites with a demonstrably different function were occupied by the same group of people (Close 1978: 234). One drawback to this approach is that, especially in lithics, stylistic and functional variables are almost impossible to separate (Sackett 1982, 1986). Other find categories, especially ceramics, might be of help, but some caution is warranted. For example, Hekelingen III and Leidschendam trench 4 have similar pottery, but seem isolated from each other from the point of view of lithics; does it concern the same group of people or not? Clearly, the line of reasoning will be different for every situation and will greatly depend on the archaeological material at hand.

7.6 The future of microwear analysis

Microwear analysis has gone through a historical development essentially similar to other relatively new disciplines, such as pollen analysis and ¹⁴C-dating. When introduced by Keeley in the mid-seventies (Keeley 1974), expectations were very high. The method satisfied the current need for scientific approaches and seemed to offer a very direct clue to several aspects of prehistoric behaviour. After the initial elation came a phase during which many researchers were confronted with a variety of problems: polishes were not always diagnostic, post-depositional surface modifications occurred frequently, and the inferential leap from wear-traces to statements about prehistoric behaviour turned out to be tremendous. During this period of 'depression' several highly self-critical articles appeared and the world of microwear analysts was rather self-centred. Recently, it seems that the discipline is gradually moving into a third phase, characterized by a more mature, aware attitude.

Uneasiness with the method and its potentials nevertheless still remains. Microwear analysis was thought to hold great promises to become a scientific (read: infallible) approach. In compliance with this idea various 'high-tech' procedures were developed, mostly directed at quantifying polishes (a.o. Grace et al. 1986). As Juel Jensen has stressed, however, such attempts are bound to fail as long as the basic issue, the origin of polish formation, has not yet been clarified (Juel Jensen 1988a: 81). Solving this latter issue requires knowledge most archaeologists do not possess, and it is unlikely that a surface-chemist, specialized in silica, will be willing to solve the problem for us. It is thus to be expected that it will be some time before such results will appear. In the meantime, a formalization of the way interpretations are obtained remains a highly recommendable endeavour (Grace et al. 1988).

Another drawback of microwear analysis is the fact that so many assemblages are being rejected because they are deemed unsuitable. It has been suggested in chapter 4 that we should abandon the distinction between microwear (high-power) analysis on the one hand, and macrowear (low-power) analysis on the other, and, instead, apply a combination of both approaches, called use-wear analysis. The discipline of use-wear analysis would encompass a wide range of techniques, suitable for a variety of approaches, the specific use of which depending on the size and degree of conservation of the assemblage, the questions asked, and the time available. For instance, a stereomicroscope could be employed for the examination of complete assemblages; the results obtained could form a basis for taking samples with respect to a more detailed analysis with an incident light microscope. Although the degree of resolution obtained with low magnifications is not very high, such analyses have the advantage of being able to cope with large quantities of implements, which, in addition, do not necessarily have to

be in mint condition. Despite lower-level inferences (restricted to statements about 'used' versus 'unused', rather than about the specific nature of the contact-material), this approach would lessen the bias that exists in regional site function studies.

When first introduced, microwear analysis was considered to be a viable alternative for palaeobotanical or archaeozoological studies at sites with poor organic preservation. It was thought that at settlements with only flint left, it would still be possible to obtain information about the role of plants and animals. However, it has been shown that use-wear analysis is also able to produce unique information for sites with abundant organic remains (cf. *chapters 5 and 6*). Lemonnier (1986: 154) has recently put forward the suggestion that we should study the interrelationships and interdependencies of the various techniques of a cultural system. In this manner it should be possible to determine regularities

in the sort of choices made, which in turn would reflect social representations. Use-wear analysis of flint tools is potentially a very good method for the investigation of such interdependencies between techniques, as it links two (or more) 'artefact' categories and offers us glimpses of various '*chaines d'opératoire*'. This is indeed a very exciting prospect, and a challenge that needs to be confronted, to be able to contribute to the subject of 'the anthropology of techniques'. In such a way it might eventually be possible to move beyond a purely functional approach of the functional analysis of flint.

note

1 A conference under the same title was recently held in Uppsala, Sweden, organized by Kjell Knutsson and Jackie Taffinder (February 15-18, 1989).