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# TRADITIONS IN TOOL-USE BEHAVIOR : EVIDENCE FROM THE DUTCH NEOLITHIC

RÉSUMÉ. — *Le mode d'emploi des outils en silex est influencé par les traditions de la communauté : c'est un choix culturelle qui reflet l'identité sociale des groupes préhistoriques. Les outils en silex d'un nombre de sites néolithique Néerlandaise sont examinés sur des traces d'usures. On a constaté des differences en activités artisanales et, en plus, une relation entre fonction et matière première.*

## INTRODUCTION

In our western society technology is generally considered a means to enable man to exercise control over nature (Ingold 1990). In line with this vision material culture is regarded as passively reflecting past behavior. Lately, however, more and more people are seeing material culture as not merely reflecting the social and ideological concepts of the past, but also actively constituting them.

It is becoming very evident, partially because of ethnographic fieldwork, that there are always a number of options open to people, all equally suitable from a mechanical point of view and that innovations have to fit in with the existing technological, social and ideological system in order to be accepted (Lemonnier 1986, 1990, 1993 ; Edmonds 1990). These technological choices may have a very long time-depth in the sense of Braudel's *longue durée* and may be reflective of long-term traditions in tool-use behavior.

One aspect of material culture in which I would expect such technological choices to have been made is in the manufacture of various craft products. It is in their houses, fences, pots, baskets, clothing and ornaments that people express their social identity, perhaps even more so than in the way they harvest or butcher [1]. Wear traces on flint implements provide indirect evidence about the manufacturing or processing activities, which were carried out in the past, even if the actual products have not survived. The presence of wear traces can be related to the type of artefact they are seen on, the choice of raw material, various technological features (a.o. modified versus unmodified) and the extent to which the implements are used. Investigating these relationships forms the focus of this paper, departing from the premise that the technological choices made may indicate socio-cultural identity.

The problem of socio-cultural identity is especially relevant for the neolithic period of the Netherlands. Here, and especially in the coastal zones, the shift

[1] Obviously the way an animal is butchered is culturally determined, but cutmarks on bones may be more revelatory about the technique involved than the wear traces on the stone tools.

to a neolithic lifestyle has been a very gradual one, taking considerable time. Several sites in the wetlands have now been investigated, indicating a material culture and a lifestyle which are quite distinct from the inland zone (for an extensive discussion, see Louwe Kooijmans 1993). It is still not clear, how we should interpret this distinct material culture in terms of social groupings : are the wetlands a separate entity with exchange relations with the interior, or are the wetlands actually exploited by interior people ?

The character of the flint assemblages drastically changes from the early-neolithic onwards, both in terms of raw material selection, technology and typology. Additionally, there seem to be substantial differences between the flint assemblages of the coastal and the inland areas. The significance of the diachronic changes, specifically the shift to a less formalized typology, may have to be sought in the change to a more sedentary lifestyle and a concurrent different perception of risk (cf. Torrence 1989) ; this question clearly needs further investigation and forms part of a long-term research project of the author [2]. However, the differences in technological choices between the 'lowland' and the 'upland' may have to be sought in a different direction, i.e. the possible existence of different traditions. The incorporation of functional data into the overall 'lithic picture' may shed some light on this issue.

## Content of the database

The present paper is based on my own functional analyses of the early-neolithic, bandkeramic sites of Elsloo and Beek-Molensteeg (c. 5300-4900 cal. bc), the middle-neolithic site of Brandwijk-Het Kerkhof (c. 4200 cal. bc) and the late-neolithic sites of Vlaardingen, Hekelingen III and Leidschendam (c. 3800-2600 cal. bc). The samples include all retouched implements, as well as all unmodified artefacts with a regular edge with a length of at least one cm [3]. A few pieces from Rijswijk (middle-neolithic) were studied as well. Additionally, information was drawn from published reports of other researchers, all dating to the middle-neolithic : Swifterbant (Bienenfeld 1985, 1986), Hazendonk (Bienenfeld 1986), Gassel (Bienenfeld 1989, re-examined by Schreurs), Kraaijenberg (Schreurs pers. comm.) and Maastricht-Klinkers (Schreurs in press). Because of changed ideas about plant working traces, several of the implements from Swifterbant, Gassel and the Hazendonk, identified as such by Bienenfeld, were re-examined by the author.

The bandkeramic and most of the middle-neolithic assemblages were in mint condition ; only a small number of artefacts displayed postdepositional surface modifications. The material from Hekelingen III and Vlaardingen were affected

[2] "The significance and meaning of flint implements for neolithic and bronze age communities in Northwest Europe" funded by the Netherlands Organization for Scientific Research (nr. N78-95).
[3] The samples were not chemically cleaned. Use was made of a Nikon Optiphot incident light microscope, using 300× magnification for the interpretation of the traces.

to a moderate extent, whereas the material from Leidschendam showed a high incidence of postdepositional surface modifications. The samples are therefore not entirely compatible. In all cases, however, sickle gloss or bone working traces would have been visible, had they been present.

Clearly, this paper is based on incomplete data ; it should therefore be regarded as explorative. Coastal sites contemporaneous with the bandkeramic have not yet been found, due to the fact that they are overlain by meters of sediment. Late-neolithic inland sites generally are stratigraphically mixed deposits and the implements display a very high incidence of postdepositional surface modifications.

## Manufacturing activities demonstrated

In the following, I will discuss those wear traces observed, which I assume to be associated with manufacturing tasks. It should be stressed that only rarely is it possible to infer the exact tasks in which the flint implements were involved. In order to make detailed statements about whether shell beads or shell bracelets were made, or fish traps or baskets, we need corroborative evidence. This may come from the context in which the implements were found : their relationship to features or other find categories. In and by themselves data from wear trace analysis are not sufficiently discriminatory to allow such a detailed differentiation (cf. Van Gijn 1990, 25 ; Juel Jensen 1994, 164).

### *Bone working*

From the earliest neolithic sites so far excavated in the western parts of the Netherlands (dating to c. 4200 cal. bc), all the way up to the late-neolithic (c. 2600 cal. bc), we find evidence for a similar way of making bone tools. It mainly concerns awls and chisels, produced on the metapodia from roedeer or deer. On the basis of the production waste from late-neolithic sites, Maarleveld (1985) has established the production sequence of these implements (fig. 1) ; Van den Broeke (1983), on the basis of a series of experiments, arrived at the same conclusion. First, the natural furrows on the bone are deepened. Then, the distal part is incised and subsequently broken off. The third step involves the splitting of the bone and, last, the bone is ground on a coarse sandstone. Stone tools probably functioned both in the deepening of the groove (a carving motion) and the incising of the distal part (a sawing motion).

My own experiments with replicating this production sequence and the examination of Van den Broeke's tools, revealed a very characteristic wear pattern, especially on the carving implements (fig. 2a). Interestingly enough, this pattern of wear was demonstrated on quite a number of artefacts from Hekelingen III (fig. 2b). Often edge removals were almost completely lacking and the implements were not intentionally retouched ; most of them would have been regarded as waste in a traditional typomorphological analysis (fig. 3).

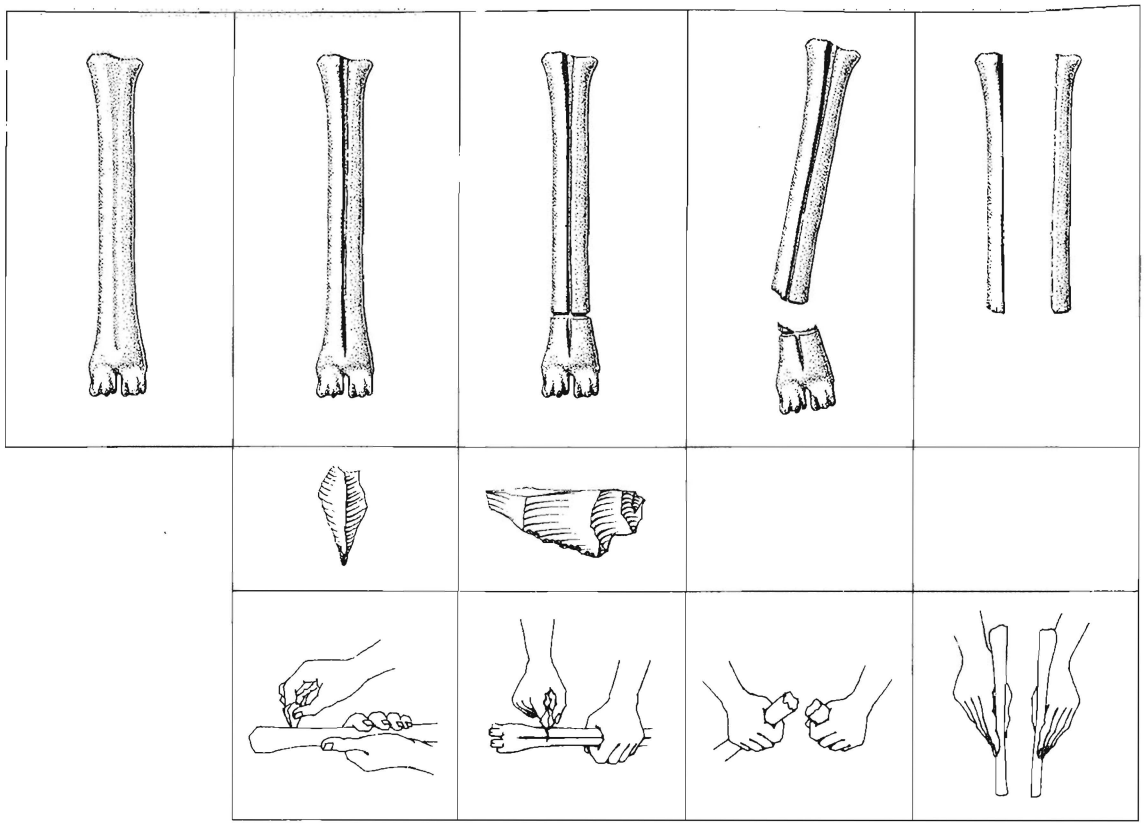


FIG. 1. — Production sequence of neolithic bone awls and chisels (after Maarleveld 1985).

A comparison of inland and coastal assemblages reveals considerable differences. Despite of the fact that well over 3000 bandkeramic flint tools have been studied for use wear (Caspar 1988 ; Flamman 1990 ; Van Gijn 1990 ; Schreurs 1988), traces from the working of bone or antler are rare. This is significant, because bone tools (a.o. combs) are known in bandkeramic context, so apparently, flint tools played no role in their manufacture, an observation which has meaning in terms of cultural preferences.

*Plant working*

Apart from the well-known sickle blades, deriving from bandkeramic context, there are other traces from contact with plants which do not relate to subsistence activities. A first type of wear concerns a very bright, smooth polish, with a fluted topography (Juel Jensen 1994) ; although few striations are observed, the directionality present within the polish indicates a transverse motion (fig. 4a). This polish was observed mostly on middle-neolithic material from Brandwijk-Het Kerkhof, but re-examination of some implements from Swifterbant revealed its presence here as well. It resembles most closely the polish obtained from contact with reeds (*Phragmites*) or cat's-tail (*Lythrum*). Experiments have shown that such polishes can be differentiated from the ones resulting from

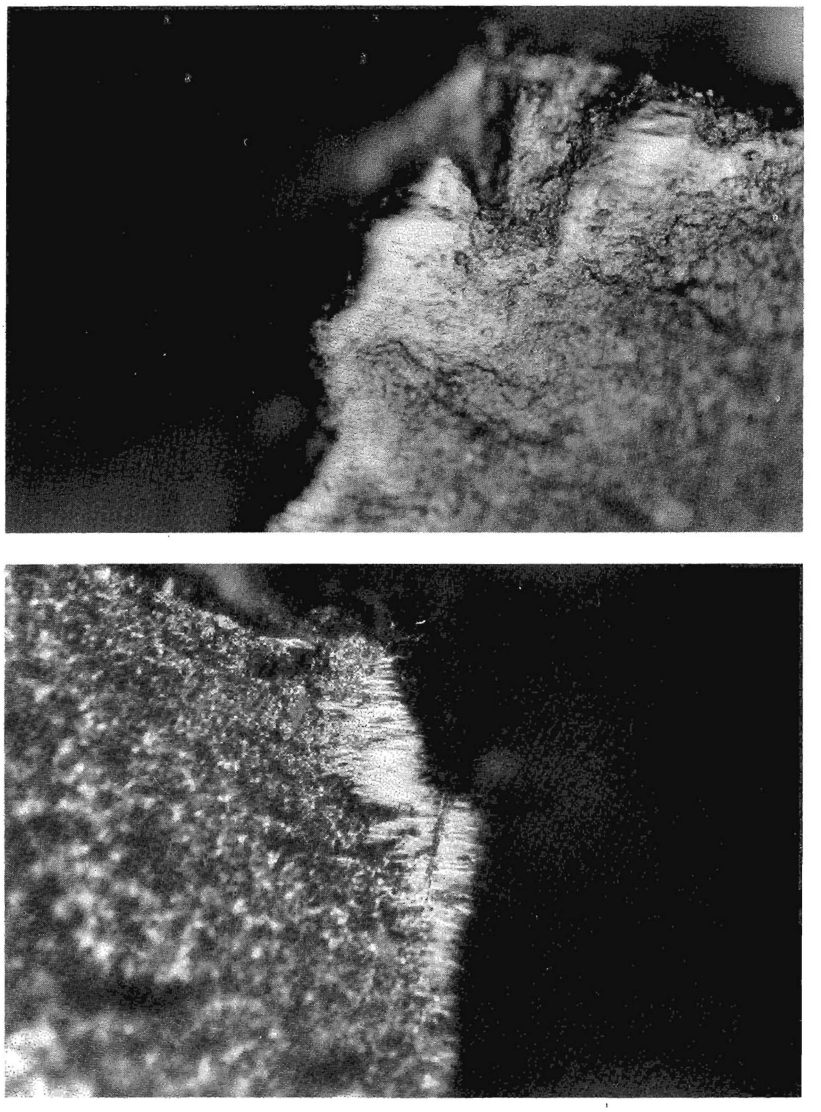


FIG. 2. — a) Micrograph of experimental traces from carving bone (200 ×).
b) Micrograph of bone carving traces seen on an implement from Hekelingen III (200 ×).

contact with domesticated cereals (Van Gijn 1990). What kind of task these wear traces represent, is not alltogether clear. Fresh green reeds are very pliable and easy to use in matting and basketry (Juel Jensen 1994). Scraping them may enhance these properties and facilitate the incorporation of the stems into different craft products.

There is also evidence for the splitting of plants or soft, woody stems ; these traces may be associated with willow. In much of the coastal zone willow must have been abundant (Bakels 1988). We also know that willow shoots

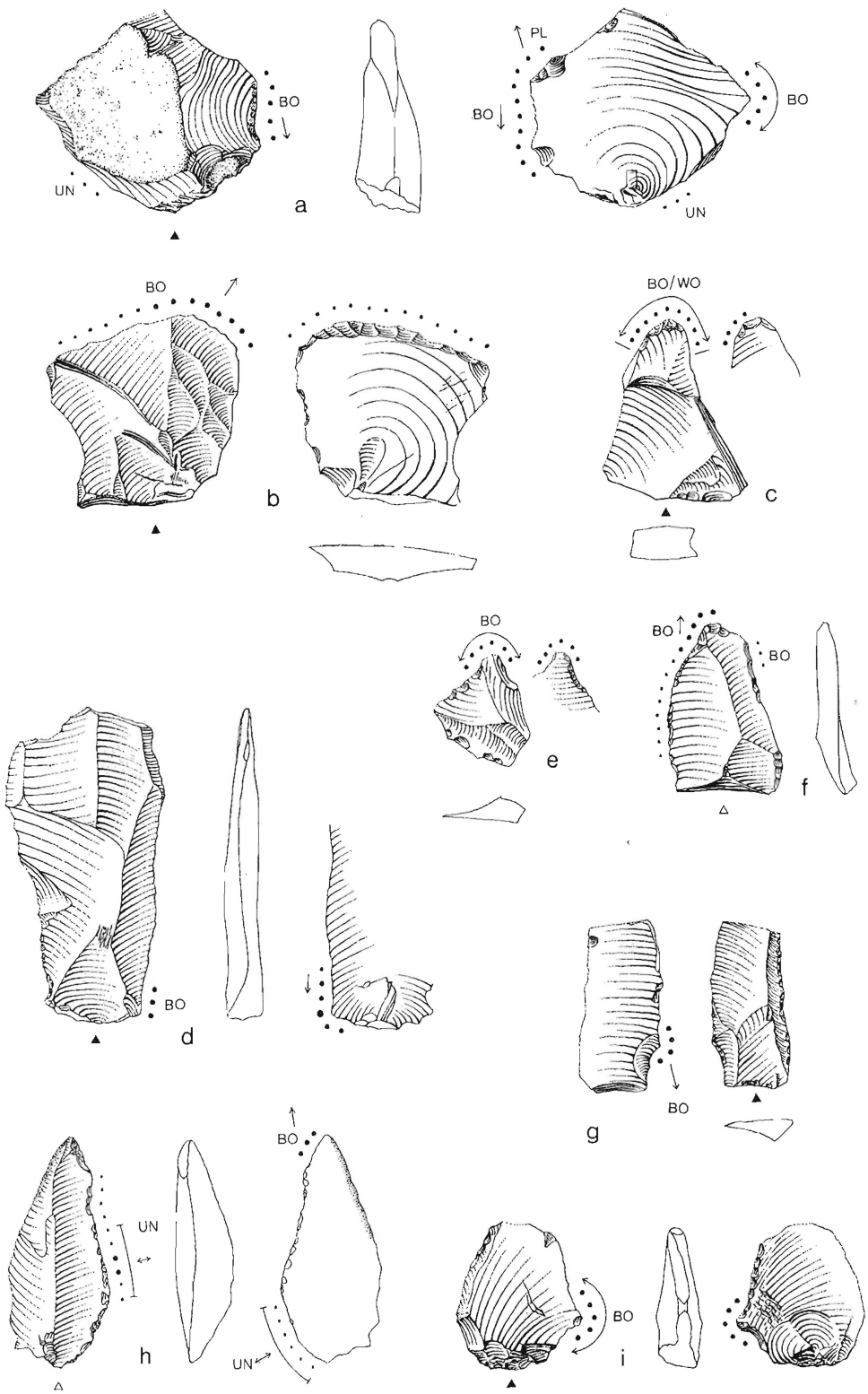
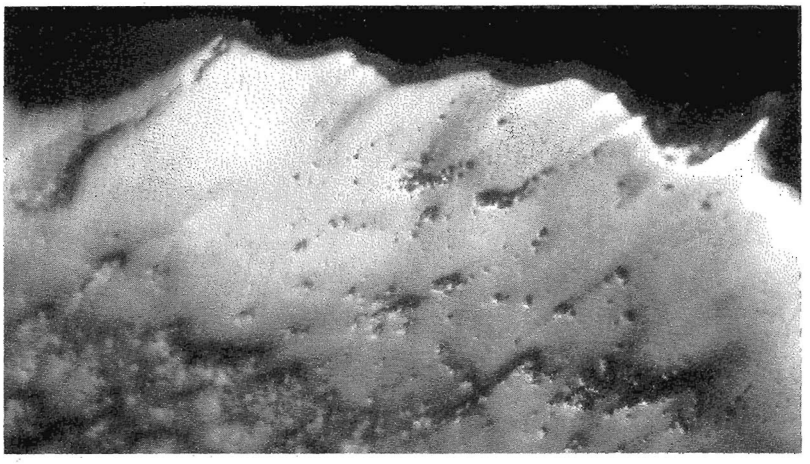



FIG. 3. — Bone working implements from the late-neolithic site of Hekelingen III (scale 1 : 1) ; note the great number of non-formal tools.



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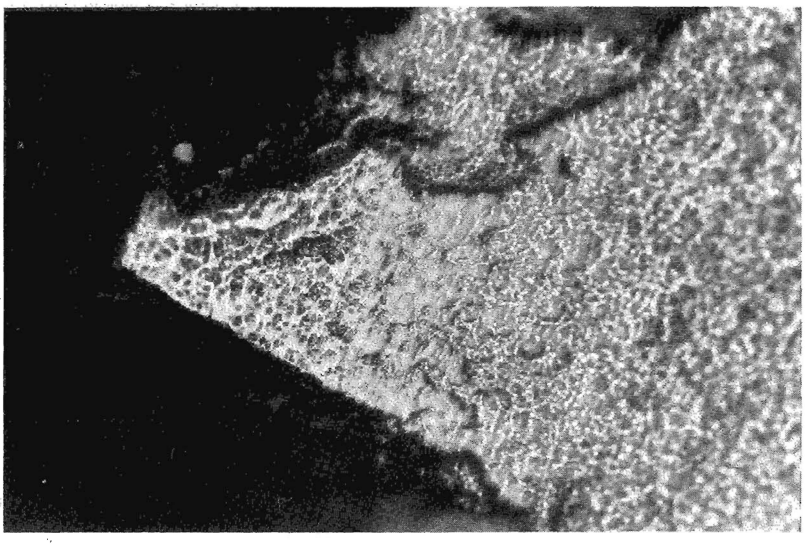

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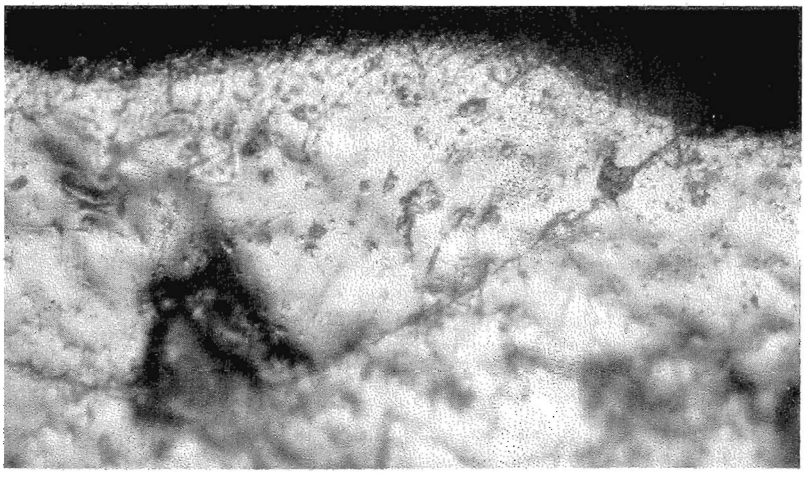

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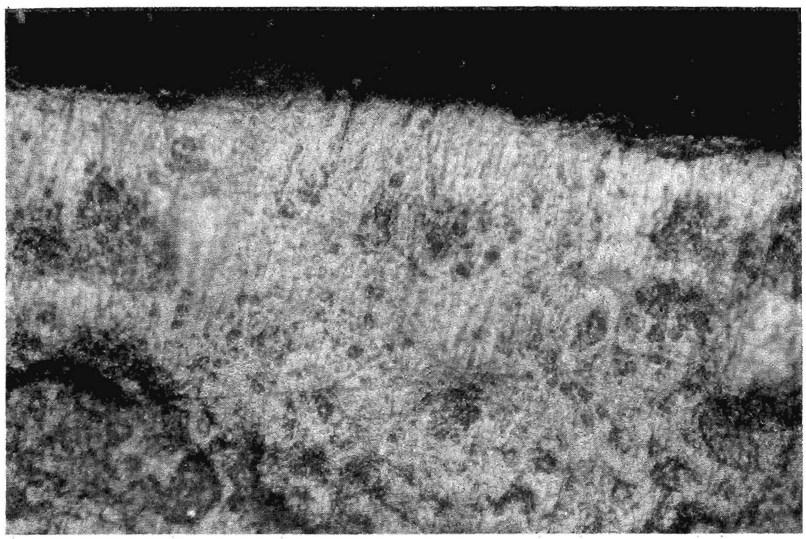

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e

FIG. 4. — a) Micrograph of a highly reflective polish, probably from contact with reeds or cat's-tail, seen on a small blade (length 4.7 cm) from Swifterbant S2 (100 ×). — b) Wear traces interpreted as being the result of splitting plants, perhaps willow (200 ×). — c) Smooth aspect of polish '23' (200 ×), seen on a *quartier d'orange* from the bandkeramic site of Beek-Molensteeg. — d) Rough aspect of polish '23' (200 ×), on the same tool, probably representing the contact surface of the implement. — e) Polish '10' on a blade from Brandwijk-Het Kerkhof (200 ×).

were intensively used for wicker work. The polish is, again, very smooth and bright, has a domed topography and does not extend very far over the piece ; its distribution is confined to the first half mm near the edge. This type of wear was encountered in Hekelingen III (fig. 4b) and was often found on unretouched implements (fig. 5).

On some implements a small band, c. 1mm in width, of bright, sickle gloss like polish was seen on some unretouched flakes from the site of Hekelingen III. This wear was experimentally replicated by cutting thin-stemmed wild grasses. Edge-removals were scarce.

Recent evidence suggests that plant working was not only performed by flint implements : a preliminary analysis of bone points from Brandwijk-Het Kerkhof revealed very fine scratches overlying the coarser manufacturing scratches (determ. by the author). The directionality of these scratches indicated a combination of a rotating and a pushing movement, very much in accordance with a use as awl. Surprisingly enough, traces of 'polish' very similar in optical appearance to the polishes on flint, were present on the tips ; the smooth and bright character is suggestive of contact with a silicious plant. Perhaps, these bone points were used as awls for coiling baskets, to widen the spaces between stems to lace the stitching material through (fig. 6).

The processing of plants such as reeds, grasses and willow, is very common in the coastal sites. Reed scraping is prominent in the middle-neolithic sites of Brandwijk and, based on the small sample studied and the results presented by Bienenfeld (1986), also at Swifterbant. Remarkably enough, plant processing activities are by far not so conspicuous in the bandkeramic sites studied ; this, again, may be a reflection of technological choices.

*Woodworking*

Wood seems to have been worked on a considerable scale, both in the coastal and inland zones, and throughout the neolithic. In bandkeramic context more coarsely shaped flint tools, displaying extensive edge removals, were used for wedging or rough whittling. Smaller flakes and blades, sometimes not retouched prior to use, were also found ; these probably served for finer wood working tasks, such as shaping wooden implements. Both the middle- and late-neolithic coastal sites produced artefacts with less edge damage, probably used for fine wood working. Due to the good preservation conditions here, many of these wooden implements have survived ; at the site of Hekelingen III, for instance, a yew bow, a paddle and an axe shaft made of maple were retrieved (see Louwe Kooijmans 1985). It is tempting to relate the absence of implements used for wedging or other rougher wood working activities on the coastal zone, as compared to their presence in the loess-area, to the heavily-build bandkeramic houses. There may, however, also be other reasons, such as, simply, different technological choices : wedges do not necessarily have to be made of flint, but could as easily be produced on bone or wood.

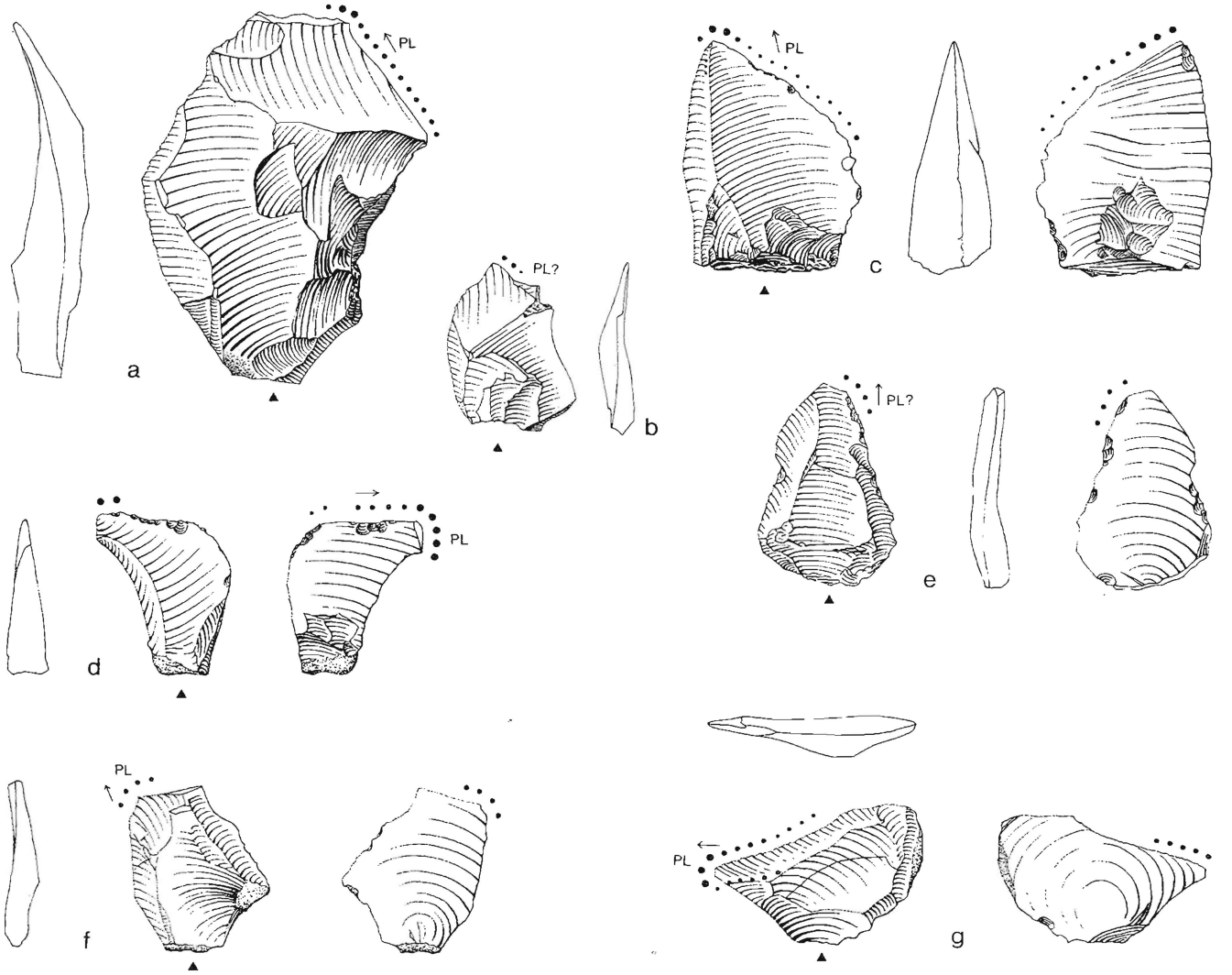


FIG. 5. — Tools from the Late-neolithic site of Hekelingen III, employed in the splitting of plants (scale 1 : 1).

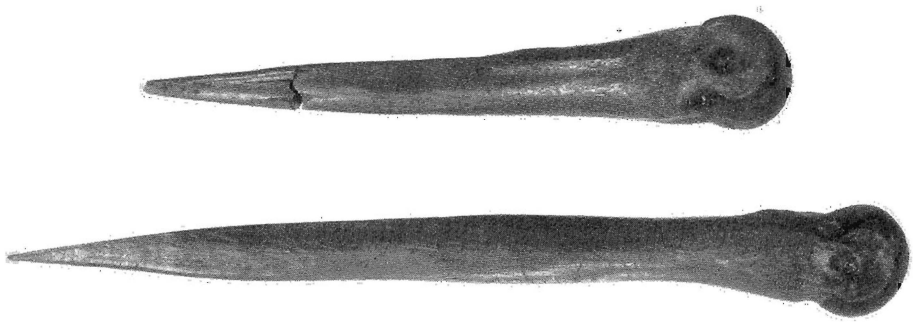

FIG. 6. Bone awls from Brandwijk-Het Kerkhof (scale 1 : 1).

*Enigmatic polish '23'*

Polish '23' is a very distinct combination of wear attributes, invariably found on obtusely angled, unmodified edges (fig. 7). Characteristic is the fact that the ventral and dorsal aspect of the used zone are very different in appearance. One aspect exhibits a smooth, almost 'snowfield'-like, highly reflective polish, extending about 400 μ into the implement (fig. 4c). The other aspect of the tool displays a matt, rough, striated polish, reminiscent of hide polish fig. 4d). The polish has a perpendicular directionality, edge removals are totally absent and the edge is very rounded. The polish extension along the edge is limited to 1.5-2.5 cm.

In Belgium the same type of traces was observed on *quartiers d'orange* or *débitage en frite* (Caspar 1985, 1988) ; it was also seen on a piece from Hienheim, Bavaria in Germany (Keeley 1977). It seems, therefore, attributable to a task which formed an integral part of the bandkeramic repertoire. Both Keeley (Keeley 1977, 71) and Caspar (Cahen *et al.* 1986, 47) propose that the traces are due to the softening or dehairing of hides. Recently, Sliva and Keeley (1994) have suggested that the differential aspects may be due to the treatment of the hide with a 'damp, plant-based compound'. However, the restricted, well-defined polish distribution seems more likely be due to a contact material with a circumscribed, fixed shape (Van Gijn 1990, 85). The preparation of some plant material, perhaps with the addition of ashes, is a possibility which merits more investigation.

Several experiments were done to attempt to replicate the particular combination, directed at tasks which could have been introduced with the arrival of the Linearbandkeramic culture and which involved plant material. The first avenue explored was the keeping of bees, an enterprise which requires attention, and thus a more sedentary lifestyle. Ethnohistoric sources mention that bramble branches are preferred for the construction of beehives, because juices from its stems dispel a species of moths attacking the wax of the

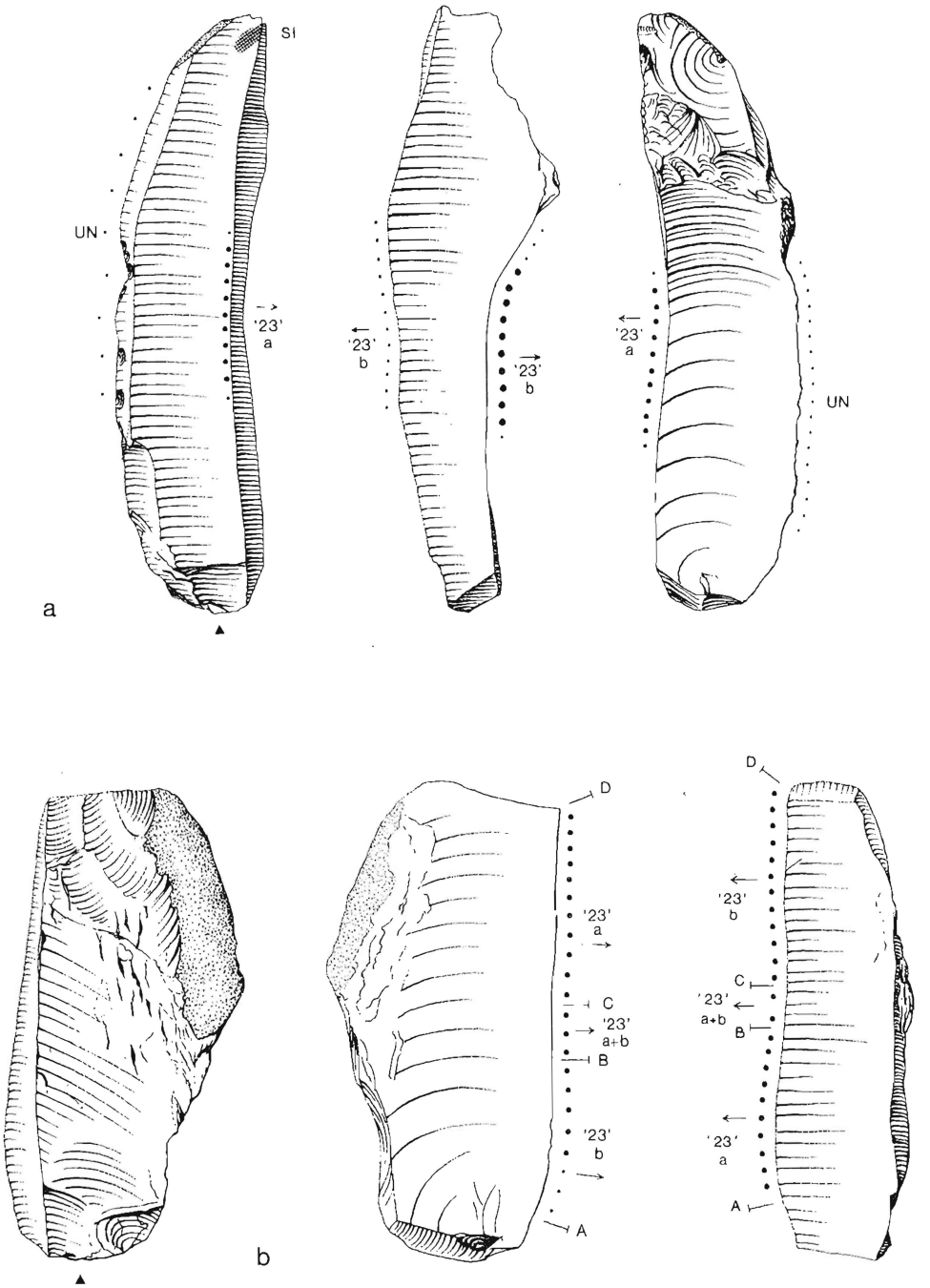


FIG. 7. — *Quartiers d'orange* from the Linearbandkeramic site of Beek-Molensteeg.
a) drawing displaying location of the two aspects of polish '23' (scale 1 : 1).

honeycomb. Prior to the manufacture of the beehives, the thorns should be removed from the branches. Two experimental *quartiers d'orange* were employed in this task, but only showed a slight resemblance to the prehistoric wear pattern ; it may be that much longer working periods are required. A second possibility investigated, is the use of limebark. Limebark is frequently used in the production of ropes and threads, whereas the extract from the bark forms an excellent tanning agent (Stambolov 1969). Several flint implements were used for shredding limebark, but this did not produce polish '23'. The third option studied was the processing of flax (*Linum usitatissimum*). Flax is first grown during the Linearbandkeramic period (Bakels 1978 ; Bakels & Rouselle 1985) and part of the production-process, loosening the inner fibres from the putrefied outer stems, could very well be performed with an obtusely angled tool. Again, the resulting polish only bore a superficial resemblance to the archaeological version.

Remarkably enough, Juel Jensen found similar traces on entirely differently shaped edges, i.e. sharp-angled denticulates, from the Danish Early Neolithic (Juel Jensen 1988). Despite extensive experimental research, she has not been able to unravel the mystery of these traces. She does, however, consider contact with some unspecified plant material the most likely option (Juel Jensen 1994).

Polish '23' is completely absent in the coastal zone and is specifically associated with the bandkeramic, although it is regularly found on middle-neolithic, interior assemblages as well (Maastricht-Klinkers [Schreurs in press] and Gassel [Van Gijn in press]). Whatever contact material is responsible for this particular combination of wear traces, it is possible to conclude that in terms of human choices there are two possibilities :

1. the task associated with this type of wear is specifically connected with some, perhaps agricultural activity which is only possible (that is, from a functional, deterministic point of view) on the dry, high grounds of the south-east ; flax processing may be a possiblity ;
2. the activity concerned did not fit in with the technological tradition of the coastal peoples.

*Enigmatic polish '10'*

Another combination of wear traces which has not yet been experimentally reproduced, is polish '10'. It has first been described for Michelsberg assemblages on the loess by Schreurs (in press). The traces display features resembling both those from contact with plant and those from hide : a rather rough polish, not so very bright with a distribution more like that from plant contact. Edge removals are not frequent and edge rounding is considerable. Although not resembling 'classical' plant-polishes, it is nevertheless likely that polish '10' is caused by plant material (Schreurs in press). Interestingly enough, the contact material responsible for this mysterious polish is worked both in transverse and longitudinal motion, suggesting the tools were used in the processing of

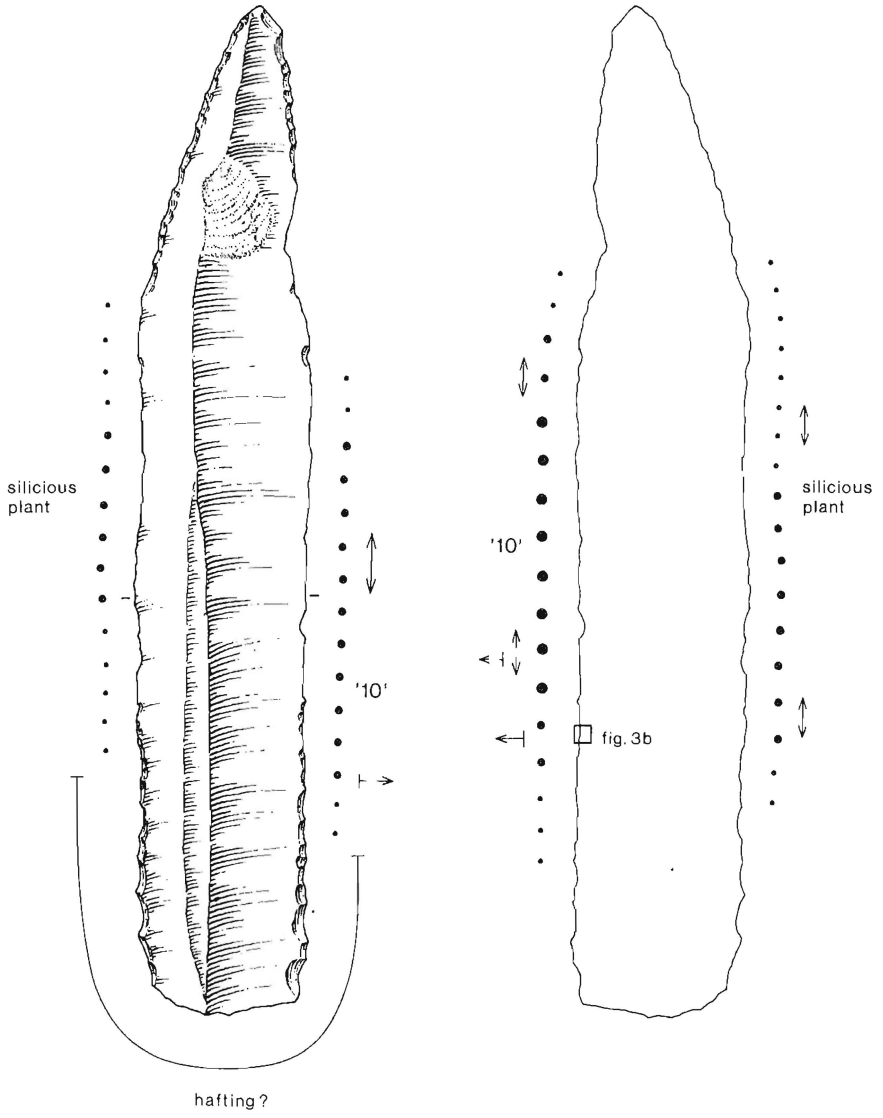


FIG. 8. — Pointed blade from Hazendonk level 3, showing location of the wear traces (scale 1 : 1).

raw materials or in the manufacture of objects, rather than in a subsistence activity.

Although polish '10' seems to be virtually confined to Michelsberg assemblages, it was also seen on an implement from the coastal middle-neolithic site of Brandwijk-Het Kerkhof (fig. 4e). The tool is made on Rijckholt flint and can, on typological grounds, be attributed to the Michelsberg culture. Another middle-neolithic coastal site, the Hazendonk (level 3) revealed the incidence of polish '10' on a large pointed Michelsberg blade made of Rijckholt flint (fig. 8). These tools of Rijckholt flint, displaying 'interior traces', may have

been brought to the coast as curated implements and were thus associated with the people from the inland. Their presence on the coast reflects either exchange of goods, or actual movement of people.

*Hide working*

Although there is not a one to one relationship between scrapers and hide working, it remains a fact that many scrapers do indeed display traces of this activity. It is remarkable however, how much variation exists within the category of hide polish. This is especially so with the bandkeramic hide scrapers. So far it has not been possible to exactly replicate the range of variation, but it seems without doubt that the early farmers of the bandkeramic culture were expert hide workers with a great deal of expertise, knowledgeable of a variety of procedures. Tanning certainly took place on the sites, especially because a certain type of pit demonstrated on a number of sites is best explained as tanning pit (Gronenborn 1989 ; Van de Velde 1973). Craft articles were also made, as inferred from the presence of hide cutting implements and piercers.

At the coast, on the other hand, it seems they were only preliminary treating the hides, cleaning them prior to drying (see Van Gijn 1990, 112). Hide scrapers display much less variety in wear characteristics. Whether they did the further processing elsewhere, or whether they did not do this at all, is hard to determine at this point.

*Shell and stone working*

On a few borers from Hekelingen III traces from stone and shell boring were encountered. This indicates that perhaps they were manufacturing various objects from these raw materials, for example shell beads or stone bracelets. Bracelets made of shale have in fact been found in late-neolithic context.

## Tool typology and functional choices

A first outcome of the functional analyses that needs comment, is the great number of unretouched artefacts with evident traces of use. Material that is usually disregarded as waste by a traditional typomorphological analysis, produced a remarkable amount of information, especially pertaining to activities apparantly not related to subsistence activities, such as the manufacture of bone implements or baskets. It remains to be demonstrated how general this observation is, but it certainly applies to the late-neolithic. Clearly, the fact that so much unretouched tools display wear traces, has important repercussions for the way we are traditionally studying lithic assemblages, with the heavy emphasis we put on retouched (formal) implements. Moreover, if we follow Gero's (1991) line of thought, who argues that the debitage of lithic assemblages reflects women's activities, we may be able to arrive at social information, such as the composition of the social unit inhabiting or frequenting a location.

The use wear analysis of various bandkeramic flint assemblages generally points to the presence of a strong correlation between tool type and tool function. Most end scrapers are used on hide and all of the *quartiers d'orange* or *débitage en frite* on polish '23'. Blades, both retouched and unmodified, seem to constitute a generalized tool.

If the middle-neolithic flint assemblages are compared, it is clear that the inland sites display a stronger correlation beween tool type and tool function than the coastal ones. At the latter, the majority of the implements are produced from rolled pebbles : they are small and made and used in an *ad hoc* fashion. Only the tools made of Rijckholt flint, appearing at the Hazendonk and at Brandwijk-Het Kerkhof as 'import' tools, display a stronger correlation between type and function.

## Raw material selection and tool use

With respect to the bandkeramic assemblages no differences could be established in the relationship between patterns of use and the type of raw material of the tools (Rijckholt, Valkenburg, light grey Belgian) (Van Gijn 1990). No such correlation was found for late-neolithic coastal settlements either (Van Gijn 1990). However, the assemblage of the middle-neolithic coastal site of Brandwijk-Het Kerkhof suggested a very interesting relationship between the type of use an implement was put to and the type of raw material. Analysis of the finds is still in progress so the following results are preliminary (Van Gijn & Verbruggen 1991). All the 'show-pieces' are made of Rijckholt flint and are technologically speaking very similar to the ones of the contemporaneous Michelsberg culture in the southeast of the Netherlands. The bulk of the material, however, is made on small, locally available pebbles and displays less standardized technological features. Remarkably enough, there seems to be a dichotomy in use patterns between the two types of raw material, Rijckholt and local. The tools made of Rijckholt flint display for the most part hide working traces or polish '10'. Several large Rijckholt blades were used as a 'Swiss army knife' for a variety of activities, such as butchering and fish-processing. In contrast, the small, blade-like implements made of local river pebbles frequently display a polish which can be attributed to contact with reeds or cat's-tail ; these tools are used in a perpendicular fashion and can probably be interpreted as having functioned in the preparation of fibres or strips for fish traps, matting or the like.

## Degree of use

Although it is yet too early to make conclusive statements, due to the incomplete nature of the data base, there seems to be a pattern emerging in the extent to which the artefacts have been used. Comparatively, bandkeramic implements are intensively used, certainly those which are intentionally retouched. The

same pertains to the middle-neolithic Michelsberg assemblages. The coastal middle-neolithic find groups display, again, a dichotomy in the extent to which the flint is used between the Rijckholt and the local material. The 'exotic' Rijckholt implements, end scrapers and pointed blades, found in Brandwijk-Het Kerkhof and the Hazendonk exhibit well-developed wear traces. The only 'formal' implement from Rijswijk, made of southern flint of as yet unknown origin, even displays multiple use phases, with intermittent resharpening ; it can clearly be considered a curated tool (fig. 9).

FIG. 9. — Curated retouched flake from Rijswijk (scale 1 : 1).

This patterning cannot be explained by a shortage of raw material. On the contrary, the bandkeramic people, had access to good quality Rijckholt flint ; when, during the later bandkeramic, this was not so easily available anymore (De Grooth 1987), it was possible to resort to Valkenburg flint. During the Michelsberg period, the Rijkholt flint mine was in operation and there was no imperative to be frugal with flint. Evidently, there were other, non-economic reasons why people having access to high-quality flint used their implements to a greater extent than those possessing low-quality raw material.

## CONCLUSION

The brief survey of the use of flint in the Dutch neolithic, however incomplete, reveals differences between coastal and inland flint assemblages in terms of

the technological choices made. These differences lie in the extent to which flint artefacts are modified, the degree of use and even the type of activities carried out with the aid of flint implements. For example, the bandkeramic people chose not to use flint tools to any great extent for the production of their bone implements, in contrast to the coastal inhabitants who had a sophisticated bone working technology. Another difference is in the extent to which objects were manufactured from plant material, such as reeds. This seems to be a typical coastal activity, hardly ever encountered on inland sites. The observed difference cannot be attributed to an absence of reeds in the uplands, because reeds must have abounded in the brooks and river valleys. In contrast, the tasks represented by polish '10' and '23' are clearly inland affairs, only 'appearing' at the coast on 'exotic' implements. It should be stressed, moreover, that what is presented in this paper is our present knowledge ; it is of course possible that in the future polish '23' will be found on local coastal material. However, it is unlikely that we had missed these traces had they been present, because bone- and reed working traces, polish '10' and polish '23' are all very well-developed and not easily affected by postdepositional surface modifications.

It is therefore possible, from a lithic point of view, to differentiate two technological traditions, a coastal and an inland one. Obviously, how 'real' this dichotomy was for prehistoric communities is impossible to assess. It has been argued that the upland-wetland opposition is more apparent than real and a result of our own perception (Louwe Kooijmans 1993). To a certain extent this may be so, but I would contend that the 'hidden traces' on the stone tools, revealed by wear trace analysis, seem to point to the existence of a dichotomy. What remains problematic, however, is the translation of this dichotomy into statements about social dynamics and 'ethnic' groups.

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