Toolkits and technological choices at the Middle Neolithic site of Schipluiden, The Netherlands

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Summary. *The Middle Neolithic site of Schipluiden is located on a coastal ridge near the present day town of The Hague. The 2003 rescue excavation yielded an enormous amount of artefacts of flint, various types of stone, as well as amber, bone and antler objects. A technological and functional analysis of these artefacts demonstrated the presence of different toolkits, thus providing insight into the technological system. The characteristics of these toolkits suggest the existence of a long term tradition of tool making and using in the wetlands of the Rhine/Meuse delta.*

Résumé. *Schipluiden, un site du Néolithique moyen, est situé sur une dune côtière auprès la ville actuelle de La Haye. Les fouilles de sauvetage de 2003 ont produit une quantité énorme des objets de silex, d'autres types de pierres, d'ambre jaune, de l'os et de bois de cervidé. Une analyse technologique et fonctionnelle des outils produit des matières diverses démontre la présence des toolkits pour les tâches différentes. Ces données donnent d'information sur le système technologique préhistorique. Les attributs du système technologique ont individué l'existence d'une longue tradition de production et utilisation des outils dans les marécages du delta.*

Key words: Middle Neolithic, toolkit, functional analysis, technology.

Introduction

This paper starts from the premise that technology is a cultural phenomenon that plays an active part in the reproduction of society and in processes of change. Technological choices have a social-cultural background (Appadurai 1986; Dobres and Hoffman 1994; Lemonnier 1986, 1993). People make choices that may not always be the most effective from an economic point of view, but that fit in the existing technological system. Technological solutions have to be in harmony. Such choices can be studied, not by looking at one category of artefacts that, but rather by incorporating a technological system in its totality.

Use wear analysis is a method *par excellence* to investigate the technological system, provided that not only flint implements are subjected to analysis but also implements made of other materials. In this way material culture can be studied as a coherent system, investigating the technological and functional interrelationships between the various categories of material culture. The addition of use wear analysis to the morphological studies carried out so far makes it possible to also track the more *hidden technological choices* related to the selection of specific implements for specific purposes. I believe that in this way use wear analysis can contribute to issues about cultural tradition and more specifically to the issue of the long term continuities and discontinuities in the technological system.

Obviously, in archaeological context this is never completely possible because of preservation problems. The approach is therefore more applicable to the wetland sites in the western part of the Netherlands, due to excellent preservation conditions. The site of Schipluiden is such a site, providing the opportunity to study material culture from a more holistic point of view, examining the technological and functional inter-relationships between different categories of material culture.

The site of Schipluiden

Schipluiden was excavated in the summer of 2003, financed by the Hoogheemraadschap Delfland who was building a large water cleaning plant on the spot. It dates to c. 3750-3400 cal. BC and can be attributed to the Hazendonk 3 group, which is contemporaneous with the Michelsberg culture further south and east. The site is located on a small dune in the marshlands, behind the coastal barriers (Fig.1). It was surrounded by perfect grazing territory. Hunting, gathering and fishing were probably providing a large portion of the diet, but crops like naked barley were also grown. The dune was continuously inhabited for 200-300 years and the spatial evidence suggests that four, probably complete, households were present on the same spot during the entire period of occupation. The palaeobotanical, archaeozoological and other evidence point to year-round occupation of the dune. A few graves were found as well (Louwe Kooijmans and Jongste 2006).

Sampling and methods

Sampling
All artefacts except the ceramics, the wooden objects and the basketry and fabrics, were brought to the Leiden Laboratory for Artefact Studies. Schipluiden has yielded over 15,000 flint artefacts, 5106 of which were described, including the sieved material. This sample included all artefacts displaying traces of modification or use, as well as all technologically relevant implements such as cores, decortification flakes, core preparation and rejuvenation pieces and so forth. Splinters and pieces of waste were excluded from analysis. All artefacts selected were described for raw material, typology and technological and morphological characteristics. For various reasons the material from the sieve was removed from the analysis, resulting in an operating file of 2666 artefacts (see Van Gijn *et al*. 2006). Out of this number a sample

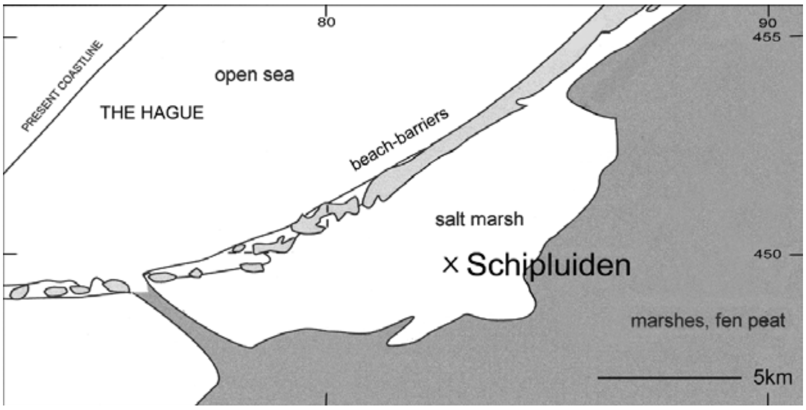


Fig. 1: Location of the site of Schipluiden in relation to the paleogeography (after Louwe Kooijmans and Jongste (eds.), 2006).

contact material / motion	longitudinal	transverse	boring	diagonal	pounding	shooting	transverse / longitudinal	hafting	hafting with tar	indet.	totals
plant											
plant unspec.	-	-	-	-	-	-	-	2	-	-	2
soft vegetal	1	-	-	-	-	-	-	-	-	-	1
siliceous plant	17	8	-	-	-	-	1	-	-	3	29
reeds	1	-	-	-	-	-	-	-	-	-	1
cereals	3	-	-	-	-	-	-	-	-	-	3
wood	2	3	-	-	-	-	-	-	-	1	6
animal											
bone	-	1	-	-	-	-	-	-	-	-	1
hide	1	14	-	-	-	-	1	-	-	-	16
fresh hide	-	2	-	-	-	-	-	-	-	-	2
soft animal	2	1	-	-	-	1	-	-	-	1	5
mineral											
mineral unspec.	1	7	6	1	-	-	-	-	-	-	15
soft stone	1	-	-	-	-	-	-	-	-	-	1
pyrite	-	-	-	-	32	-	-	-	-	-	32
jet	3	-	-	-	-	-	1	-	-	-	4
uncertain material											
bone / wood	2	1	1	-	-	-	-	-	-	-	4
hide / siliceous plant	4	1	-	-	-	-	2	-	-	-	7
soft material unspec.	1	2	1	-	-	-	-	-	-	1	5
unknown use	9	8	3	-	-	2	1	2	-	4	29
hafting											
with tar	-	-	-	-	-	-	-	-	9	-	9
material indet.	-	-	-	-	-	-	-	8	-	-	8
indet.	-	-	-	-	-	14	-	-	-	6	20
Totals	***48***	***48***	***11***	***1***	***32***	***17***	***6***	***12***	***9***	***16***	***200***

Tab. 1: Results of the microwear analysis of the flint tools: contact material versus motion (the figures represent used zones rather than individual artefacts).

motion / contact material	plant unspec.	cereals	wood unspec.	bone	miniral unspec	soft stone	flint	granite	unknown use	indet.	totals
cutting	-	-	1	-	-	-	-	-	-	-	1
scraping	-	-	1	-	-	-	-	-	-	-	1
chopping	-	-	-	-	-	-	-	-	-	1	1
wedging	-	-	1	-	-	-	-	-	-	-	1
pounding	-	-	-	-	-	-	-	-	-	16	16
grinding	-	-	-	-	-	1	19	1	-	7	28
polishing	-	-	-	1	-	1	-	-	-	1	3
rubbing	1	-	-	-	1	-	-	-	-	4	6
milling	-	6	-	-	-	-	-	-	-	-	6
crushing	-	-	-	-	1	-	-	-	1	1	3
hafting	-	-	-	-	-	-	-	-	-	1	1
indet	-	-	-	-	-	-	-	-	-	4	4
Totals	***1***	***6***	***3***	***1***	***2***	***2***	***19***	***1***	***1***	***35***	***71***

Tab. 2: Results of the microwear analysis of the hard stone tools: contact material versus motion (the figures represent used zones rather than individual artefacts).

of 304 artefacts was taken for use wear analysis, taking a random sample from each typological category. The results are depicted in table 1.

Similarly, the amount of hard stone amounted to over 55 kg, a large part of which came from the sieve. All artefacts larger than 2 cm were described, except when it concerned clearly modified artefacts like the ornaments made of amber or jet. A total of 1728 artefacts have been examined for raw material, typology and technological characteristics. Only 60 artefacts were examined for traces of use, taken randomly from the various typological categories. This resulted in 71 used edges, with several tools having three or four used zones. The activities carried out with hard stone tools were quite diverse (table 2) (Van Gijn and Houkes 2006).

Only a relatively small amount of worked bone and antler was found, all of which was studied (no. 90). A total of 50 artefacts were studied for traces of use. Bone tools were for the most part used for chiselling wood and for piercing plant material (table 3) (Van Gijn 2006a).

Methods

The artefacts were described according to the standard code list used at the laboratory, including such variables as tool type, raw material, kind and extent of cortex and various technological features. Attention was especially paid to the flint and hard stone types present in the assemblage because the area is pretty much devoid of stone sources. This means that virtually all the stone material came from afar, obtained either directly or by exchange.

The use wear analysis was done with the aid of a Wild stereomicroscope with oblique light, a Nikon stereoscope with incident light and different types of Nikon metallographic microscopes, one of which with a free arm, allowing the examination of large tools. As has been argued before (Van Gijn 1990) the differentiation between high and

motion / contact materia	boring	chiselling	wedging	piercing	scraping	shooting	unknown	no traces	total
hide	1	-	-	-	1	-	-	-	2
wood	-	5	1	-	-	-	-	-	6
pottery	-	-	-	-	1	-	-	-	1
reed	1	-	-	-	-	-	-	-	1
slilicious plants	2	-	-	1	-	-	-	-	3
soft material	-	-	-	-	-	-	2	-	2
unknown	3	-	1	-	-	1	7	-	12
indet.	-	-	-	-	-	-	3	-	3
no traces	-	-	-	-	-	-	-	20	20
Totals	*7*	*5*	*2*	*1*	*2*	*1*	*9*	*23*	*50*

Tab. 3: Results of the microwear analysis of the bone tools: contact material versus motion (the figures represent used zones rather than individual artefacts).

low power analysis is not considered to be productive. Instead we need both approaches in order to incorporate as much evidence as possible in our functional inferences. The high-power analysis of bone and antler tools is a relatively recent development (Cristidiou 1999; Maigrot 2003; Van Gijn 2005). Hard stone tools have for the most part been studied for the presence of traces of use by means of binoculars (see the excellent study by Hamon 2004). The presence of a metallographic microscope with a free arm has allowed us to explore further the possibilities of a high power approach for the analysis of hard stone grinding-, milling-, and polishing implements. Until recently such tools were too large to fit a metallographic microscope. However, it has now become clear that polishes are indeed visible on hard stone tools and that they show variability consistently related to specific activities (see Van Gijn and Houkes 2006; Verbaas 2005).

The metallographic microscopes were fitted with polarizing filters and Nomarski DIC. All implements, flint, stone, bone and antler, were subjected to the same treatment. The tools were not cleaned except for the use of alcohol for wiping off grease. A few bone implements were still covered with dirt and were therefore briefly immersed in the ultrasonic cleaning tank filled with distilled water. Chemical cleaning was not deemed necessary.

Toolkits

Semenov in his book *Prehistoric Technology* (1964) studied traces of both manufacturing and use. He also incorporated artefacts made of stone as well as bone in his functional studies. This integral approach was somehow lost when functional analysis was taken on in the West. Pioneers like Keeley (1980) and Tringham (Tringham *et al*. 1974) and Odell (1977) concentrated on flint tools only and left the manufacturing traces out of consideration. Most research in the past 30 years has been directed at flint assemblages. "Other" materials such as bone and hard stone have only recently been subject of functional analysis certainly of high power ones (Cristidiou 1999; Maigrot 2003; for bone and antler tools, Dubreuil 2002; Fullagar and Field 1997; and Hamon 2004 for stone tools). However, it is rare that integral functional analyses are done on tools made of different raw materials deriving from the same site. An exception is the cooperation between Maigrot and Beugnier on the bone and flint material from the Neolithic site of Chalain in the Jura (Beugnier 1997; Maigrot 2003).

The integral study of the Schipluiden material is an attempt to demonstrate the advantages of studying the traces of manufacture and use on tools made of different raw materials, in order to see the technological and functional interrelationships between these various tools. By doing such an integrated study it is possible to detect tool kits, sets of tools used in the same *chaîne opératoire*. The composition of these toolkits, the choice of tools for specific tasks, is part and parcel of the cultural identity of past peoples. At Schipluiden a number of such toolkits could be distinguished.

The toolkit for harvesting and processing cereals

The find location, on a dune in the salt marshes, had initially led us to believe that crops were not grown on the spot. However, the palaeobotanical research revealed the presence of both seeds and chaff of naked barley and emmer. The fact that chaff of the free threshing naked barley has been found, indicates local cropping (Kubiak-Martens 2006). This was corroborated by the presence of at least two probable flint sickles with polish from cutting cereals (Fig. 2b). The polish is very smooth, highly reflective and slightly undulating. It is possible that there may actually be more harvesting implements present among the tools with traces from contact with siliceous plants. Although it is possible to distinguish experimental polishes from reeds and cereals, this is not always the case with archaeological tools.

There is also evidence for cereal processing: several querns were encountered, for the most part made of sandstone. The querns were examined for wear traces and display a somewhat matt, rough polish with short striations, resembling the polish observed on experimental grinding stones (Fig. 2a). Phytolith analysis of five querns indicates the presence of spodograms and ground rods (see Nieuwenhuis and Van Gijn, this volume). The querns were probably used for dehusking emmer, as suggested by the presence of spodograms of leaf sheaths. However tiny broken phytolith fragments suggest that the querns were also used for flour making.

Toolkit for making basketry from vegetal fibres

The use of wild plants for fibre processing is testified by the presence of three pieces of basketry (Fig. 3). The fibres were made of bark, possibly from willow. For the manufacture of basket loopings were sawn around a foundation, a process for which it was necessary to make small holes to pass the looping through (Kooistra 2006). Several bone awls displayed a bright polish and striations indicating they were probably used in a rotating motion

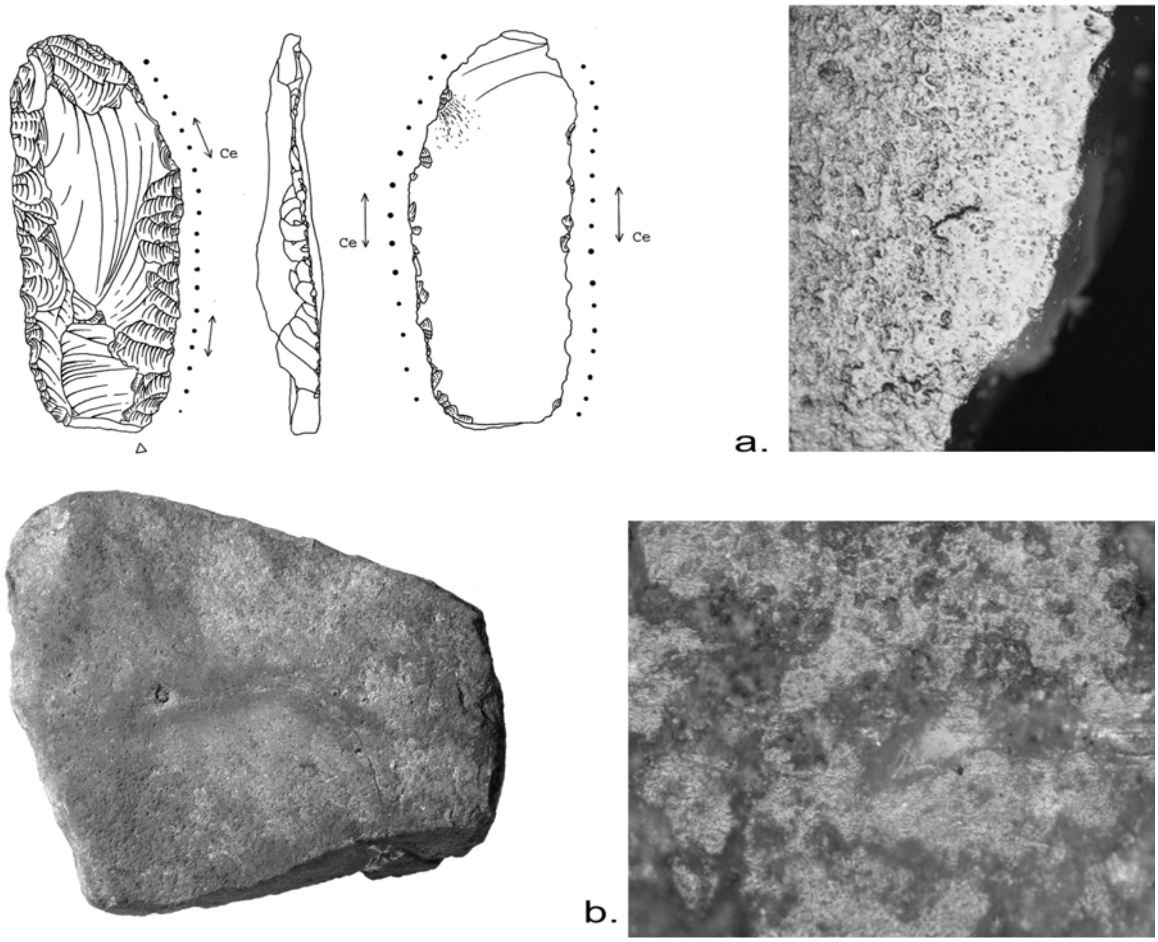


Fig. 2: Toolkit for harvesting and processing cereals; a) quern of sandstone with wear traces (orig. magnif. 200x); b) flint sickle with a picture of the wear traces observed (orig. magnif. 200x).

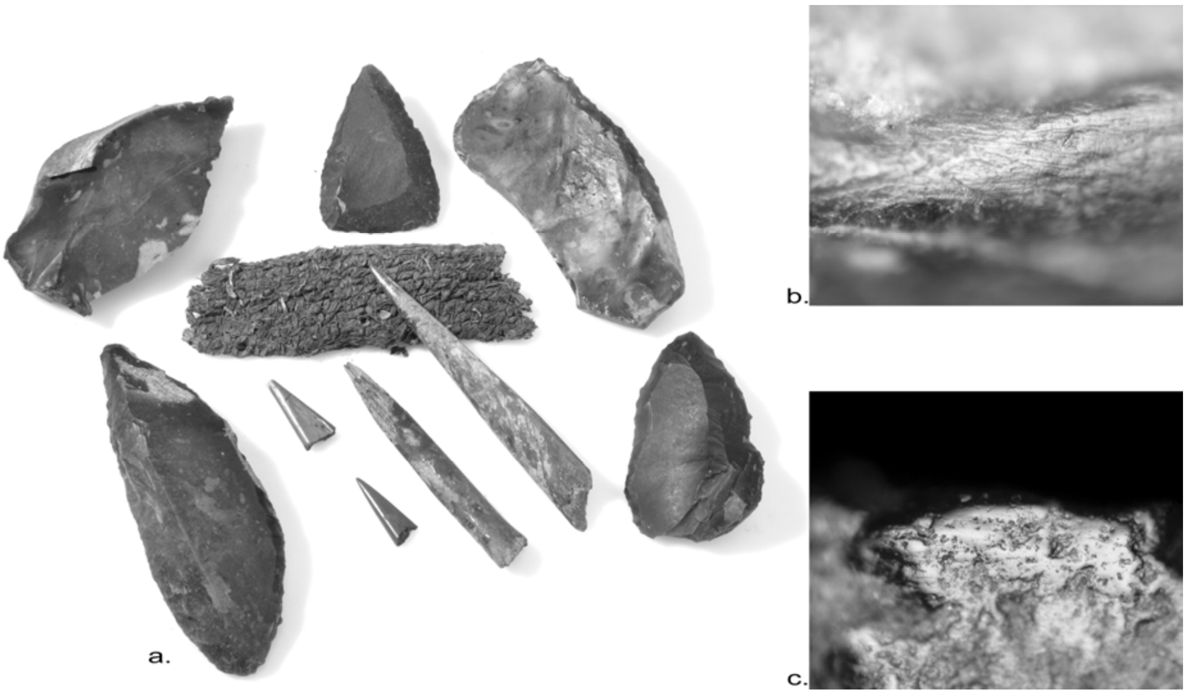


Fig. 3: a) Toolkit for making basketry with basket fragment; b) wear traces from piercing plant seen on a bone awl (orig. magnif. 200x); c) wear traces from cutting plants seen on flint blade (orig. magnif. 200x).

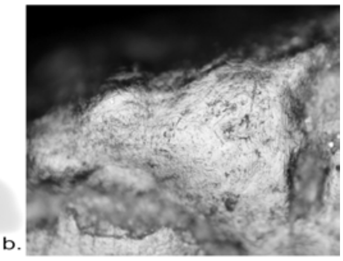
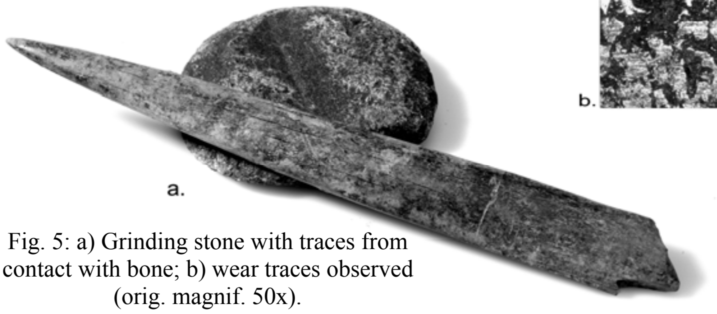


Fig. 4: a) Tookit for fine wood working; b) wear traces observed on bone chisels (orig. magnif. 200x).



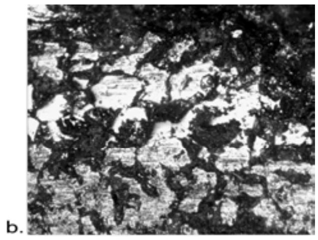


Fig. 5: a) Grinding stone with traces from contact with bone; b) wear traces observed (orig. magnif. 50x).

on (siliceous) plants. They may have been used in the process of basket making, to pierce openings in the foundation to weave the looping through.

We also have quite a number of flint tools that were used to cut siliceous plants. These blades may have been used to gather the raw material for the production of fibres. Remarkably, the very bright, perpendicularly oriented polish, commonly interpreted as resulting from plant processing, was not encountered. This type of wear traces, invariably located on small blades, is highly characteristic for late Mesolithic assemblages and also for sites of the Neolithic Swifterbant culture (Bienenfeld 1986; Van Gijn 1998). It is possible that these blades were associated with subsistence tasks such as peeling roots like *Typha*, but more likely they played a role in craft activities like basketry and matting. The fact that these specific flint plant-processing tools are absent in Schipluiden indicates a significant difference in craft activities compared to the preceding periods.

Toolkits for coarse and fine wood- working

Working wood seems to have been an important activity at the site. We have found objects like paddles, axe shafts and so forth (Louwe Kooijmans and Kooistra 2006). Moreover, the site is partially surrounded by a fence made of small stakes. It is clear that wood-working must have been an important activity for the Schipluiden inhabitants. Not surprising quite an extensive range of wood working tools has been found. A distinction can be made between coarser tasks involving the gathering and rough shaping of the wood and implements used for final shaping. The toolkit for coarser wood-working includes tools as stone and flint axes, stone wedges and big quartzite flakes for sawing. All of these tools may have been involved in collecting the wood necessary for tools and building activities. Some pieces of wood display the marks of the cutting edge of a flint or stone axe (Louwe Kooijmans and Kooistra 2006). Unfortunately it has not been possible to match the marks on the wooden artefacts with any of the axes retrieved. This is not entirely surprising as broken axes were repaired and rejuvenated, and in a last stage even used as core for the production of flakes.

Many of the wooden objects from Schipluiden display fine workmanship and objects are carefully shaped. The tools associated with shaping wooden objects include small bone chisels and flint blades. All of the chisels displayed traces from working wood (Fig. 4). Most of them are broken and are small in size, probably due to recurring re-sharpening. Flint implements played a role in shaving wood.

The production of bone and antler tools

The metapodium technique is a very effective way of producing bone tools such as awls and chisels. Metapodia of red deer or deer are split and further shaped into tools (Van Gijn 1990, Fig. 59). The technique has been in use since the Mesolithic and was also used throughout the Neolithic. At Schipluiden we have found both the waste products from metapodial production, as well as the end products like awls and chisels. Surprisingly enough however, we find very few flint tools with bone working traces. It is of course possible that we missed these implements, but it could also indicate that bone tool making occurred only rarely at the site. Certainly bone awls were polished and sharpened locally, as indicated by a small grinding stone with traces from polishing bone or antler (Fig. 5).

Antler tools were also made on the site, predominantly made on red deer antlers. Very remarkable is the fact that use was made of the groove and splinter technique, a technique so far limited in our region to the early Mesolithic. Even though the cut marks on the antlers clearly derive from a flint blade, no such tools were found at the site. Few antler tools were made into finished tools, with the exception of a few broken antler axes. All in all, it seems that bone and antler tool production was not a major activity at the site, in contrast to the late Mesolithic sites of Hardinxveld-Giessendam Polderweg and De Bruin, where bone and antler tools abounded.

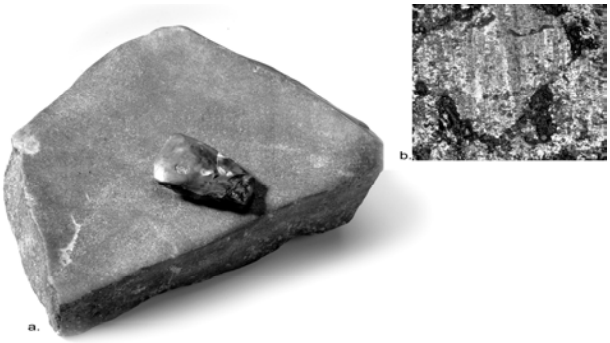


Fig. 6: a) Grinding stone used for grinding and polishing flint axes; b) wear traces from contact with flint (orig. magnif. 100x).

Maintaining and repairing stone axes and other flint implements

A lot of grinding or polishing stones were found, the majority of which displayed traces that were interpreted as being from contact with flint (Fig. 6). Several of them display more than one facet of use. The polish is very flat, bright, metallic and highly striated. These grinding stones were probably used to sharpen and maintain axes, rather than produce them. Virtually all axes were made on import flint, and most likely they were not actually produced on the site, but brought as finished products. The number of complete axes is very limited, and they are invariably small in size. It can be assumed that the large import axes incidentally broke during use, most likely during the chopping of wood. The large broken axes were then transformed into smaller versions, an activity that also involved sharpening and polishing the axes on grinding stones. At some point in their life cycle, it became impossible to shape the broken axes into small versions. Instead, they served as cores from which axe flakes could be removed. Several axe flakes are modified into distinct tool types such as triangular points. The fact that large axes are lacking in the find layers of Schipluiden is not surprising, as such precious tools would have been taken along upon deserting the site.

Other maintenance activities included hafting and repair of flint implements. Evidence for hafting is present on nine tools, mostly points, in the shape of small black spots interpreted as birch bark tar. Another twelve tools displayed friction gloss, rounding or an abrupt ending of the use wear, features that were interpreted as being the result of hafting. Direct evidence of the occurrence of hafting comes form the presence of a piece of birch bark tar, with tooth impressions (Fig. 7). Mass spectrometry revealed the admixture of beeswax (Van Gijn and Boon

Fig. 7: Piece of birch bark tar displaying tooth imprints.

2006). Beeswax is added to make the tar less brittle. The mixture was chewed to make it supple for use as an adhesive

Making beads and pendants

Beads of jet and amber have been produced locally. Most probably the raw material could be collected on the nearby beaches. Amber of Baltic origin could (and still can) be collected along the shores in the North of the Netherlands, but was probably quite rare as far south as Schipluiden. Jet must have been a common occurrence, as we find a lot of blocks of unmodified jet and unfinished waste pieces. The nearest sources are the outcrops near Whitby, Yorkshire, but it is not clear whether this material could have been washed ashore from that direction (Van Gijn 2006b).

Fig. 8: The production of jet beads: unmodified pieces of jet, blanks and flint tools with traces from contact with jet.

The complete production sequence of the jet beads has been found at Schipluiden. Flint tools were used to cut the blocks of jet into blanks. Alternatively, the blocks were first perforated. The perforations were made with a solid drill, resulting in an "hour-glass shape" (Fig. 8). Flint drills were used in this process, amongst which one very large drill made of import Belgian flint, displaying traces closely resembling experimental traces. After perforation the blanks were then ground into their final shape. Experiments have shown that this can be done on a fine-grained sandstone, resulting in a very bright smooth polish. Only one of the grinding stones from Schipluiden displays a polish that resembles the experimental wear, but it is somewhat flatter. The absence of jet-grinding traces may find an explanation in that the grinding stones were multifunctional, also used to grind flint axes, thereby obliterating the jet working traces. The last step of jet bead manufacture was straightening and smoothing the perforation. It is not clear how this was achieved, but it may have been done with some siliceous plant like *Equisetum Hyemale*. A total of seven finished beads were found, three tubular and four disc-shaped.

Amber was only incidentally worked on the site. One piece displays traces from flaking, a technique to shape a piece of amber into a blank. Amber can also be cut into shape, but no traces were found for this practice. After bringing a piece of amber into a rough shape, the blanks were perforated. This seemed to have been done with a hollow drill, possibly a bird bone, as testified by the presence of a plug at the bottom end of one of the perforations. The amount of amber waste was very limited. A total of six, often tiny, beads and three pendants were encountered.

Bird bones were cut up to make bone beads. Two of them were found in a grave of a young child. They display cut marks, probably from flint, but again, we have found no flint blades with bone cutting marks.

Processing hides

Hide working traces were mostly found on flint tools. A total of 16 edges were used on hide, fourteen of which concerned scraping motions. There is a strong relationship between scrapers and hide working. One small piece of bone waste also displayed traces from scraping hide. This is very different from what has been observed on the find assemblage from the late Mesolithic site of Polderweg. Here most hide working was done with bone or antler implements, with flint scrapers being exceedingly rare and flint tools almost never used for this activity (Van Gijn 2005).

Making fire

A considerable number of strike-a-lights were found (No. 34). They always have an elongated shape and one or two rounded points. The use wear analysis showed that several other types of tools, such as an unfinished point, display the same type of wear.

Two of these tools were found in one of the burials, along with a piece of pyrite. The position of the grave goods - in the hand held in front of the mouth - suggests the blowing of sparks when the pyrite is struck with the flint. Because fire traditionally has a special connotation it is proposed that the dead man buried with these objects may have had a special role in society like a religious specialist, e.g. a shaman (Van Gijn *et al.* 2006; Van Gijn and Houkes 2006).

The technological system of Schipluiden

The wide range of activities that took place at the site points to a long-term presence of complete households. This is in support of the outcome of the palaeobotanical and archaeozoological research (Louwe Kooijmans and Jongste 2006). The activities included cereal harvesting and processing, wood-working, the production of beads and pendants, hide working and so forth. Most of these activities involved a toolkit composed of various implements made of different raw materials. Studying the flint tools alone would provide only a limited picture of the range of tasks carried out.

Wood working involved tools made of flint, hard stone and bone. Hard stone axes and wedges are imminently suitable for chopping and splitting large tree trunks because most hard stones absorb impact shocks very well. The flint axes were small in number and size and probably represent the last stage in the life cycle of previously much larger axes imported from Belgium. Large quartzite flakes were used to saw wood, whereas the smaller cuts were done by means of flint implements. Flint implements were also served for shaving wood. Bone chisels were used for the final shaping of implements. The chisels we find all represent exhausted specimens, either broken or re-sharpened to such an extent that their size had greatly diminished.

An important feature of the technological system of Schipluiden is the evidence of harvesting and processing of wild plants. A number of flint blades, often quite large ones, made of imported flint from southern Belgium, displayed traces indicative of cutting siliceous plants. Some must have been used for a very long time as they display extensive gloss. The typical late Mesolithic and early Neolithic plant processing tools with the bright polish oriented perpendicularly to the edge are absent, possibly indicating a different technique of basketry making. This may be an example of a specific technological choice because environmental reasons cannot have been responsible. Bone awls served to widen holes in the foundation of baskets in order to allow the looping through. This tool type was used for the same purpose in late Mesolithic times and continues to be used until at least the time of the Vlaardingen group.

Cereals were grown on the dune and we find both the harvesting implements as well as the stone querns used to process the grain (see Nieuwenhuis and Van Gijn, this volume). Together they form a toolkit involved in agricultural activities.

Hide processing constituted an important activity at Schipluiden but involved only a very limited toolkit: flint scrapers for the most part. Bone and antler tools only incidentally played a role in this task. Again, this can be interpreted as a technological choice.

Other activities include the making of beads and pendants from amber, jet and bone. The toolkit used for this craft includes some flint blades, used to cut blanks out of the

raw material, and flint borers used to make the perforations. There are quite a lot of borers, many of which display polish from contact with mineral material. The grinding stones that certainly played a role in grinding and polishing the beads in shape have not been found. One highly polished bead displays faceting attributable to the polishing on a hard surface, presumably of stone (see Van Gijn 2006b, Fig. 9.1).
Bone and antler objects were most likely made locally because we find production waste from both the groove and splinter technique and the metapodial technique. However, even though flint tools certainly played a role in their manufacturing, such tools were not encountered. The toolkit for bone tool manufacturing consists therefore of only one grinding stone displaying traces from contact with bone.

A last toolkit that could be distinguished is the one to make fire, consisting of strike-a-lights and pyrite. A large number of strike-a-lights were found, many of which were used at both ends. In addition, several other types of tools also displayed traces from such a use (Van Gijn *et al.*2006). Most probably this toolkit was especially valued as one of the dead, a man, was buried with three strike-a-lights and a piece of pyrite in his hand, which he held against his mouth. This evokes the image of someone blowing the sparks resulting from striking the pyrite with the flint. As fire plays an important role in many traditional societies it may be suggested that the man had a special role in society.

The various toolkits observed at Schipluiden only gain meaning in terms of cultural choice if they are compared to toolkits found at sites spatially or chronologically removed. The only sites where a technological and functional analysis of different categories of material culture was performed are the late Mesolithic sites of Hardinxveld-Giessendam Polderweg and De Bruin (Van Gijn 2005), so comparisons are difficult to make. However, the material culture found at these sites, along with the finds from various other Neolithic sites from the Rhine/Meuse delta, seems to point to a specific long term tradition of tool making and using in the wetlands.

The wetland tradition

The study of the material culture of Schipluiden has provided further insight into the tradition of tool making and using in the Rhine/Meuse delta. Some aspects of the technological system seem to display a remarkable continuity with the late Mesolithic, as exemplified by the use of the metapodial technique for the production of bone tools. We find this technique from the late Mesolithic to the late Neolithic. The groove-and-splinter technique may also serve as such an example but we lack examples from the late Mesolithic, the technique being especially characteristic for the early Mesolithic. It may be that we simply have not found examples yet from this period.

Plant processing tools are a distinctive feature of wetland flint assemblages. Initially, during the late Mesolithic and during the Swifterbant period, it concerns small blades or regular flakes used in a transverse motion on most probably reeds. Such tools are absent in the middle Neolithic and instead we find for the most part plant cutting tools. Bone awls with plant working traces occur through the entire period and are almost always associated with the metapodial production. Still, it is clear that many objects must have been made with plant material, such as baskets, fish traps and so forth.

Another feature of the wetland technological system is the dichotomy between import flint and locally produced material. This is visible from late Mesolithic until at least the middle Neolithic. The way people treated the import tools seems different from the way they used the tools made of local flint materials (see also Van Gijn 1998). At Schipluiden this is for example illustrated by the fact that most tools of Belgian flint found are more heavily used than tools made of local material.

The wetland technological system is also characterised by an *ad hoc* use of bone and antler. Pieces of production waste are used as tools if they display a suitable edge for a specific task. Both in the late Mesolithic sites of Hardinxveld and in Schipluiden examples are numerous.

More technological and functional research of flint, hard stone and bone and antler assemblages may point to more characteristics of this apparent wetland tradition. One problem in comparing the technological system of different sites is that locations are not all excavated and sampled in the same manner, and the preservation conditions also differ greatly. However, hard stone and flint are usually preserved and it may eventually be possible to compare the technological traditions of different areas. Use wear analysis, applied to different categories of material culture, can play an important role in this approach, following the direction already advocated many years ago by Semenov.

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Bibliography

APPADURAI, A., 1986. Introduction: commodities and the politics of value. *In*: A. APPADURAI, ed. *The social life of things: commodities in perspective*. Cambridge. Cambridge University Press, 3-63.

BEUGNIER, V., 1997. *L'usage du silex dans l'acquisition et la traitement des matieres animales dans le Neolithique de Chalain et Clairvaux, La Motte-aux-Magnins et Chalain 3 (Jura, France) 3700-2980 av. J.C.* Thesis (PhD). University of Paris X.

BIENENFELD, P., 1986. *Patterns of stone tool used at some Dutch Neolithic settlements*. Thesis (PhD). State University of New York, Binghamton.

CHRISTIDIOU, R., 1999. *Outils en os néolithiques du Nord de la Grèce: étude technologique.* Thesis (PhD). University of Paris X.

DOBRES, M. and HOFFMAN, C. R., 1994. Social agency and the dynamics of prehistoric technology. *Journal of Archaeological Method and Technology*, 1 (3), 211-258.

DUBREUIL, L., 2002. *Etude fonctionnelle des outils de broyage natoufiens; nouvelles perspectives sur l'emergence de l'agriculture au Proche Orient*. Thesis (PhD). University of Bordeaux I.

FULLAGAR, R. AND FIELD, J., 1997. Pleistocene seed-grinding implements from the Australian arid zone. *Antiquity*, 71,300-307.

HAMON, C., 2004. *Broyage et abrasion au Neolithique ancien. Caracterisation fonctionnelle de l'outillage en gr`es du Bassin parisien.* Thesis (PhD). University of Paris I.

KEELEY, L.H., 1980. *Experimental determination of stone tool uses. A microwear analysis.* Chicago: University of Chicago Press.

KOOISTRA, L.I., 2006. Fabrics of fibres and strips of bark. *In*: L.P. LOUWE KOOIJMANS AND P.F.B. JONGSTE, eds. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia*, 37/38, 253-260.

KUBIAK-MARTENS, L., 2006. Botanical remains and plant food subsistence. *In:* L.P. LOUWE KOOIJMANS AND P.F.B. JONGSTE, eds. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia*, 37/38, 317-338.

LEMONNIER, P., 1986. The study of material culture today: Towards an anthropology of technological systems. *Journal of Anthropological Archaeology*, 5, 147-186.

LEMONNIER, P., 1993. Introduction. *In*: P. LEMONNIER, ed. *Technological choices Transformation in material cultures since the Neolithic*. Londen: Routledge, 1-35.

LOUWE KOOIJMANS, L.P. AND JONGSTE, P.F.B., eds., 2006. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia*, 37/38.

LOUWE KOOIJMANS, L.P. AND KOOISTRA, L.I., 2006. Wooden artefacts. *In*: L.P. LOUWE KOOIJMANS AND P.F.B. JONGSTE, eds. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia*, 37/38, 225-252.

MAIGROT, Y., 2003. *Etude technologique et fonctionnelle de l'outillage en matière dures animales. La station 4 de Chalain (Néolithique final, Jura, France)*. Thesis (PhD). University of Paris I.

ODELL, G.H., 1977. *The application of micro-wear analysis to the lithic component of an entire prehistoric settlement: methods, problems and functional reconstructions*. Thesis (PhD). Harvard University.

SEMENOV, S.A., 1964. *Prehistoric technology*. London.

TRINGHAM, R. AND COOPER, G., 1974. Experimentation in the formation of edge damage: a new approach to lithic analysis. *Journal of Field Archaeology*, 1, 171-196.

VAN GIJN, A.L., 1990. *The wear and tear of flint. Pirnciples of functional analysis applied to Dutch Neolithic assemblages.* Thesis (PhD). Leiden University (also appeared as Analecta Praehistorica Leidensia 22).

VAN GIJN, A.L., 1998. Craft activities in the Dutch Neolithic: a lithic viewpoint. *In*: M. EDMONDS AND C. RICHARDS, eds. *Understanding the Neolithic of North-Western Europe*. Glasgow: Cruithne Press, 328-350.

VAN GIJN, A.L., 2005. A functional analysis of some late Mesolithic bone and antler implements from the Dutch coastal zone. *In*: H. LUIK, A.M. CHOYKE, C.E. BATEY AND L. LOUGAS, eds. *From hooves to horns, from mollusc to mammoth. Manufacture and use of bone artefacts from prehistoric times to the present. Proceedings of the 4th Meeting of the ICAZ Worked Bone Research Group,* 26th-31st of August 2003, Tallinn. Muinasaja teadus, 15, 47-66.

VAN GIJN, A.L., 2006a. Implements of bone and antler: a Mesolithic tradition continued. *In*: L.P LOUWE KOOIJMANS AND P.F.B. JONGSTE, eds. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia*, 37/38, 207-224.

VAN GIJN, A.L., 2006b. Ornaments of jet, amber and bone. *In*: L.P. LOUWE KOOIJMANS AND P.F.B. JONGSTE, eds. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia,* 37/38,195-206.

VAN GIJN, A.L. AND HOUKES, R., 2006. Stone: procurement and use. *In*: L.P. LOUWE KOOIJMANS AND P.F.B. JONGSTE, eds. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia*, 37/38,167-194.

VAN GIJN, A.L., VAN BETUW, V., VERBAAS, A. AND WENTINK, K., 2006. Flint: procurement and use. *In*: L.P. LOUWE KOOIJMANS AND P.F.B. JONGSTE, eds. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia*, 37/38, 129-166.

VAN GIJN, A.L. AND BOON, J., 2006. Birch bark tar. *In*: L.P. LOUWE KOOIJMANS AND P.F.B. JONGSTE, eds. Schipluiden – Harnaschpolder. A middle Neolithic Site on the Dutch Coast (3800-3500 BC). *Analecta Praehistorica Leidensia*, 37/38, 261-266.

VERBAAS, A., 2005. *Stenen werktuigen en hun gebruik*. Thesis (MA). Leiden University.