

The bone and antler tools from the Wijnaldum-Tjitsma *terp*

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Review data:
Submission 26/10/2010
Revision 23/5/2011
2nd submission 6/10/2011

available online at www.jalc.nl and www.jalc.be

Abstract

As many as 263 bone and antler tools and pieces of production waste were found during the 1991-93 excavations in the Wijnaldum-Tjitsma *terp* (province of Friesland, the Netherlands). They date to Roman, Migration, Merovingian, Carolingian and Ottonian times (AD 175 and AD 900-950), with a hiatus between the Roman and the Migration period (AD 350-425). The sample of bone and antler tools and production waste is fairly large due to using extensive wet-sieving. Fibre and skin processing tools and personal utensils, such as combs, are the most common tools. Personal utensils, bone skates and sledge runners were introduced at the *terp* during the Migration period.

A tuning pin, a flute, a box, two spoons, decorative plates, handles and checkers are very rare finds in *terpen* in the north of the Netherlands. They are considered as indicators for elite inhabitants at the *terp* during Merovingian and Carolingian times. Other indicators of high status are contemporary finds of metal and glass objects. A comparison with the bone and antler tools from contemporary *terpen* underlines the rich character of the bone and antler tools from the Wijnaldum-Tjitsma *terp*. A Roman period sieve made out of a cattle scapula is a unique find and suggests that elite people already lived at the site in that period. The volume of bone and antler production waste is rather low, suggesting that bone and antler processing was not an extensive activity at the site and that most tools were perhaps imported.

Keywords: bone tools, antler tools, Roman period, Migration period, Early Middle Ages, elite, import

1 Introduction

Wijnaldum-Tjitsma is one of a row of seven *terpen*,¹ situated in the former salt marsh area of northern Westergo (fig. 1). The area is rich in metal finds from the Early Middle Ages, especially the Merovingian period (Heidinga 1999). During the large-scale excavations at the Wijnaldum-Tjitsma *terp* in 1991-1993 (Besteman *et al.* 1999) a large number of bone and antler tools, production waste and unfinished tools came to light. They give information on the production, use and possible import of bone and antler tools at the site in the Roman (AD 175-300/350), Migration (AD 425-550), Merovingian (AD 550-750), Carolingian (AD 750-850) and Ottonian



Figure 1 The location of Westergo within the Netherlands and palaeographic map of Westergo in the Early Middle Ages (1. Is the Wijnaldum-Tjitsma terp). Westergo was a large area of unembanked salt marshes in the present province of Friesland. The many terp sites from this period attest to the area's suitability for habitation. Red dots refer to present villages (after fig. 4 in Heidinga 1997).

(AD 850-900/950) periods. The *terp* was not in use for about 75 years between the Roman and the Migration period (Gerrets & De Koning 1999).

The famous gold disc-on-bow brooch found at the Wijnaldum-Tjitsma *terp*, made c. AD 630 in the *cloisonné* technique, is an indication of the inhabitants' high status (Heidinga 1997; Schoneveld & Zijlstra 1999; Nijboer & Van Reekum 1999). Intensive bronze, silver and gold working has been attested in the Merovingian period, perhaps by itinerant metal workers (Schoneveld & Zijlstra 1999; Nijboer & Van Reekum 1999). Glass beads were used and made on site during the Merovingian and Carolingian periods and glass vessels were bought by inhabitants in Merovingian times (Sablerolles 1999a; 1999b). These finds are indicators of high status.

It appears that all inhabitants enjoyed a high status, although the houses and other buildings at Wijnaldum-Tjitsma are comparable to those at other *terpen*. Rather than via architecture, high status was apparently expressed via personal belongings and other small objects (Gerrets & De Koning 1999).

Previous studies on bone and antler tools from *terpen* have mainly dealt with undated finds from non-archaeological diggings (Roes 1963; Kramer & Prummel 2000) or from excavations in which the tools were not dated (Reichstein 1991; Struckmeyer in press). The study of the substantial tool assemblage from Wijnaldum-Tjitsma is important because most of the tools are dated and the context of most of the tools is known, allowing a diachronous and contextual study.

The bone and antler tools from Wijnaldum-Tjitsma will be compared with those from recent excavations at other *terpen* in the provinces of Friesland and Groningen to establish whether the use of bone and antler tools at Wijnaldum-Tjitsma is representative for the *terpen* in general, or – in view of the supposed higher status inhabitants – exceptional. Wijnaldum-Tjitsma differs

from other *terpen* in that it has a much higher volume of bone and antler tools in the migration and later periods (table 1).

2 Material and methods

A total of 263 tools, pieces of production waste and unfinished tools made from bone, antler and horn was found during the 1991-93 excavations at the Wijnaldum-Tjitsma *terp*. About 8000 m³ of soil was excavated. The soil from all features, except from the sod layers (tables 5-6), was wet-sieved using a 4 mm mesh, allowing the retrieval of small fragments (Gerrets 1999, 20). The largest proportion of tools (c.60%) was recovered using wet-sieving. These tools include rather small objects, such as bone needles, which are perhaps overlooked at excavations where less or no soil was sieved. 27% of the objects were collected by hand in 4x4 m squares after machines cleared the area, and the remaining 13% were found during metal detector prospection (Gerrets 1999, 19-20).

The bone and antler tools and the production waste are considered to be representative for all tools and waste once present in the excavated volume, because of the careful excavation and post-excavation procedures. The initial sorting of all find categories was carried out in Harlingen during the excavation season (Gerrets 1999, 21). No bone fragments, not even the smallest, were thrown away. This sorting out appeared to have been done very carefully, since only a few other tools and waste pieces were overlooked and found among the unworked animal remains.

The bone and antler tools were dated by the pottery and other finds in the features in which they were found (Gerrets & De Koning 1999). The largest numbers of bone and antler objects date to the Migration (n = 47), the Merovingian (n = 88) and the Carolingian periods (n = 49) (table 1). Bone and antler tools from the preceding Roman (n=12) and subsequent Ottonian (n=26) phases are less numerous (table 1). The variation in the numbers of tools corresponds to the excavated habitation areas, those from the Roman and Ottonian periods being much smaller than those from the other periods (Gerrets & De Koning 1999, figs 3-22). The Ottonian period, moreover, was shorter than the other periods (50-100 years against 100-200 years).

Over a span of 700 years, the location of the settlement shifted by c. 110m from the north (Roman) to the south (Ottonian) of the *terp*. This made the stratigraphy of the site quite complex, especially for the Migration and later periods (Gerrets & De Koning 1999, fig. 1). This is the reason that 41 bone and antler objects could not be dated to a particular period (table 1).

3 The animal species represented

Bones of four domestic mammal species and four wild species were used to make tools. The domestic species are horse (*Equus caballus*), pig (*Sus domesticus*), cattle (*Bos taurus*) and sheep (*Ovis aries*) (table 2). Because no goat bones are among the identified mammal bone fragments from Wijnaldum-Tjitsma (table 3), the tools identified as 'sheep or goat' are also considered to be sheep bones. The four wild animal species are red deer (*Cervus elaphus*), elk (*Alces alces*), an unknown whale species (Cetacea) and a whooper swan or a mute swan (*Cygnus cygnus* or *C. olor*) (table 2). No elk and whale bones were identified among the bone fragments that were not processed into tools (table 3).

Period Tool type	Roman	Migration	Merovingian	Carolingian	Ottonian	no phase	total	%
fiber and skin working tools	1	9	30	11	6	7	64	24,3
pin beater	-	2	6	1	1	-	10	3,8
needle								
complete	-	3	5	2	-	4	14	5,3
with eye	-	-	7	3	1	-	11	4,2
point	-	-	4	2	3	1	10	3,8
unfinished	-	-	-	2	-	-	2	0,8
awl								
complete	-	1	1	-	-	-	2	0,8
unfinished	-	1	-	-	-	-	1	0,4
spindle whorl								
disc shape	-	-	2	-	-	-	2	0,8
planoconvex	-	-	-	1	-	-	1	0,4
round	-	1	-	-	-	-	1	0,4
caput femoris	-	-	2	-	-	2	4	1,5
caput femoris, unfinished	-	-	1	-	-	-	1	0,4
polishing / rubbing instrument	1	1	2	-	1	-	5	1,9
personal utensils	0	24	34	22	14	18	112	42,6
1-sided composite comb								
type 1	-	-	2	-	-	3	5	1,9
type 2	-	-	1	1	-	1	3	1,1
type 3	-	-	-	1	2	1	4	1,5
type 4	-	1	-	-	-	-	1	0,4
type 5	-	-	-	-	1	-	1	0,4
tooth plate	-	1	4	4	2	4	15	5,7
end tooth plate	-	2	1	2	2	2	9	3,4
side plate	-	7	9	13	3	5	37	14,1
2-sided composite comb								
complete	-	1	-	-	-	-	1	0,4
tooth plate	-	-	3	-	-	1	4	1,5
side plate	-	-	2	-	1	-	3	1,1
fragment	-	1	2	-	-	-	3	1,1
comb								
fragment	-	2	5	1	1	-	9	3,4
unfinished	-	4	-	-	1	-	5	1,9
pin (clothes/hair)	-	1	5	-	-	-	6	2,3
ring	-	3	-	-	1	1	5	1,9
bead, unfinished	-	1	-	-	-	-	1	0,4
amulets	8	5	6	4	1	3	27	10,3
amulet/pendant	-	-	2	1	1	-	4	1,5
amulet/pendant, unfinished	1	-	1	-	-	-	2	0,8
dice (also used in gaming?)	-	2	-	-	-	-	2	0,8
astragalus, used/decorated	7	3	3	3	-	3	19	7,2
musical instruments	0	0	2	2	0	1	5	1,9
flute	-	-	1	1	-	-	2	0,8
costa, sawn (musical instrument?)	-	-	1	1	-	-	2	0,8
tuning fork	-	-	-	-	-	1	1	0,4

Table 1 Numbers of bone and antler tools, unfinished tools and production waste grouped into six categories of tools and a group of waste and unfinished tools from the five phases of the site of Wijnaldum-Tjitsma: Roman period (AD 175-300/350), Migration period (AD 425-550), Merovingian period (AD 550-750), Carolingian period (AD 750-850) and Ottonian period (AD 850-900/950). (Cont. on next page).

Period Tool type	Roman	Migration	Merovingian	Carolingian	Ottonian	no phase	total	%
household utensils	2	1	5	2	0	1	11	3,4
box	-	-	-	1	-	-	1	0,4
spoon	-	-	2	-	-	-	2	0,8
sieve	1	-	-	-	-	-	1	0,4
plate (inlay?)	-	-	1	1	-	1	3	1,1
handle	1	-	1	-	-	-	2	0,8
checker (used in gaming)	-	1	1	-	-	-	2	0,8
transport	0	2	4	4	5	3	18	6,8
skate	-	2	2	2	1	-	7	2,7
sledge runner	-	-	-	-	1	-	1	0,4
point / tip of skating stick	-	-	2	2	3	3	10	3,8
waste and unfinished tools	1	6	7	4	0	8	26	9,9
waste / unfinished, type unknown	1	6	2	-	-	4	13	4,9
waste of horn working	-	-	1	-	-	1	2	0,8
type unknown	-	-	4	4	-	3	11	4,2
Total	12	47	88	49	26	41	263	100,0

Table 1 Numbers of bone and antler tools, unfinished tools and production waste grouped into six categories of tools and a group of waste and unfinished tools from the five phases of the site of Wijnaldum-Tjitsma: Roman period (AD 175-300/350), Migration period (AD 425-550), Merovingian period (AD 550-750), Carolingian period (AD 750-850) and Ottonian period (AD 850-900/950).

Period	Roman	Migration	Merovingian	Carolingian	Ottonian	no phase	total
<i>Equus caballus</i> , horse	1	1	1	2	3	-	8
<i>Sus domesticus</i> , pig	-	2	6	2	-	4	14
<i>Bos taurus</i> , cattle	5	2	12	9	4	8	40
<i>Ovis aries</i> , sheep	1	-	-	2	-	-	3
<i>Ovis aries/Capra hircus</i> , sheep/goat	3	5	7	2	2	5	24
<i>Cervus elaphus</i> , red deer	2	28	38	20	11	17	116
<i>Alces alces</i> , elk	-	1	-	-	-	1	2
Cetacea, whale	-	-	1	-	-	-	1
<i>Cygnus cygnus</i> , whooper swan, or <i>Cygnus olor</i> , mute swan	-	-	-	1	-	-	1
Cattle/horse size group	-	-	6	5	-	-	11
Unknown size group	-	8	17	6	6	6	43
Total	12	47	88	49	26	41	263

in %	Roman	Migration	Merovingian	Carolingian	Ottonian	no phase	%
<i>Equus caballus</i> , horse	8	2	1	4	12	0	3,0
<i>Sus domesticus</i> , pig	0	4	7	4	0	10	5,3
<i>Bos taurus</i> , cattle	42	4	14	18	15	20	15,2
<i>Ovis aries</i> , sheep	8	0	0	4	0	0	1,1
<i>Ovis aries/Capra hircus</i> , sheep/goat	25	11	8	4	8	12	9,1
<i>Cervus elaphus</i> , red deer	17	60	43	41	42	41	44,1
<i>Alces alces</i> , elk	0	2	0	0	0	2	0,8
Cetacea, whale	0	0	1	0	0	0	0,4
<i>Cygnus cygnus</i> , whooper swan, or <i>Cygnus olor</i> , mute swan	0	0	0	2	0	0	0,4
Cattle/horse size group	0	0	7	10	0	0	4,2
Unknown size group	0	17	19	12	23	15	16,3
Total	100	100	100	100	100	100	100,0

Table 2 The animal species that are represented in the bone and antler tools, unfinished tools and production waste and the numbers (above) and percentages (below) for each species in each period.

Species	nisp unworked remains	n tools	total	% tools
<i>Canis familiaris</i> , dog	69	0	69	0
<i>Felis catus</i> , cat	79	0	79	0
<i>Equus caballus</i> , horse	86	8	94	9
<i>Sus domesticus</i> , pig	266	14	280	5
<i>Bos taurus</i> , cattle	1601	40	1641	2
<i>Ovis aries</i> / <i>Capra hircus</i> , sheep/goat*	2881	27	2908	1
<i>Capreolus capreolus</i> , roe deer	1	0	1	0
<i>Cervus elaphus</i> , red deer	6	116	122	95
<i>Putorius putorius</i> , european polecat	1	0	1	0
<i>Halichoerus grypus</i> , gray seal	1	0	1	0
<i>Phocoena phocoena</i> , harbour porpoise	2	0	2	0
<i>Alces alces</i> , elk	0	2	2	100
<i>Cetacea</i> , whale	0	1	1	100
<i>Homo sapiens</i> , human	7	0	7	0
subtotal	5000	208	5208	4
unidentified mammal remains	73000	54	73054	0
total	78000	262	78262	0

* including the remains of *Ovis aries*, sheep

Table 3 The mammal species identified at the Wijncaldum-Tjitsma terp and the proportion used to make bone and antler tools; nisp unworked remains: numbers of identified mammal bone fragments not used in bone and antler working; n tools: number of tools for each species (compare table 2) and the proportion of bone and antler tools.

The majority of tools (44%) are made from red deer bones, specifically antler (table 2). The antler of red deer and – in very small numbers – elk was the favourite raw material for bone tools at Wijncaldum-Tjitsma because it is easily processed, flexible and strong (Ulbricht 1978; Ambrosiani 1981; MacGregor 1985; Rijkkelijkhuizen 2008). The high proportions of red deer from the Migration period onward (table 2: 41-60%) are connected to the introduction of the antler combs at the site in the Migration period. Elk and red deer antler are not very easily distinguished (Ambrosiani 1981). The majority of the antler tools were presumably made of red deer antler in view of the general rarity of elk in the northern coastal region, and listed as such (tables 1 and 4).

Red deer and elk were probably rare species in the salt marsh area (Prummel & Heinrich 2005). The few postcranial red deer bones found at the *terp* (table 3) suggest that red deer was only occasionally hunted near Wijncaldum. Male red deer that were hunted between August and February delivered antler, whereas shed antlers could be collected in February and March. Antlers were possibly also acquired from areas where red deer and elk were more numerous. Most antler objects found at Wijncaldum, however, were probably imported as ready-made tools, since there is no antler waste.

The second and third most common species are cattle and sheep, representing 15% and 10% of all tools. The bone workers preferred the larger cattle bones over those of sheep (tables 2 and 3). Sheep astragali, however, were more often used than those of cattle (table 4). The high proportions for tools from cattle and sheep bones in the Roman period (table 2: 42% and 25%) are mainly the result of the use of astragali during this period (tables 1 and 4).

Pig and horse bones represent 5% and 3% of the bone tools (table 2). Pigs and horses were not very numerous at the site (table 3). Pig fibulae, however, were the preferred bones to make needles at least in the Merovingian and Carolingian periods (table 4). Horse radii, metacarpi and metatarsi were, because of their greater length, were used to make bone skates and sledge runners. Transport on skates and sledges was obviously popular during the Ottonian period (tables 1 and 4).

Tool type	Species, element	Period						total
		Roman	Migration	Merovingian	Carolingian	Ottoman	no phase	
pin beater	Cetacea, mandible	-	-	1	-	-	-	1
pin beater	Cattle/horse size group, long bone	-	-	4	1	-	-	5
pin beater	Unknown size group, long bone	-	2	1	-	1	-	4
needle, complete	Cattle/horse size group, ?	-	-	-	1	-	-	1
needle, complete	Ovis aries/Capra hircus, sheep/goat, long bone	-	-	1	-	-	-	1
needle, complete	Sus domesticus, pig, fibula	-	1	3	1	-	4	9
needle, complete	Unknown size group, long bone	-	2	1	-	-	-	3
needle, with eye	Sus domesticus, pig, fibula	-	-	3	1	-	-	4
needle, with eye	Cervus elaphus, red deer, antler	-	-	2	-	-	-	2
needle, with eye	Cattle/horse size group, ?	-	-	-	1	-	-	1
needle, with eye	Unknown size group, costa & long bone	-	-	2	1	1	-	4
needle, point	Cattle/horse size group, ?	-	-	-	1	-	-	1
needle, point	Unknown size group, ?	-	-	4	1	3	1	9
needle, unfinished	Bos taurus, cattle, costa	-	-	-	1	-	-	1
needle, unfinished	Cattle/horse size group, long bone	-	-	-	1	-	-	1
awl	Cattle/horse size group, long bone	-	-	1	-	-	-	1
awl	Ovis aries/Capra hircus, sheep/goat, metatarsus	-	1	-	-	-	-	1
awl, unfinished	Ovis aries/Capra hircus, sheep/goat, mandible	-	1	-	-	-	-	1
spindle whorl, disc shape	Cervus elaphus, red deer, antler	-	-	2	-	-	-	2
spindle whorl, planoconvex	Cervus elaphus, red deer, antler	-	-	-	1	-	-	1
spindle whorl, round	Cervus elaphus, red deer, antler	-	1	-	-	-	-	1
spindle whorl, caput femoris	Bos taurus, cattle, femur	-	-	2	-	-	2	4
spindle whorl, caput femoris, unfinished	Bos taurus, cattle, femur	-	-	1	-	-	-	1
polishing / rubbing instrument	Equus caballus, horse, metatarsus	-	-	1	-	-	-	1
polishing / rubbing instrument	Bos taurus, cattle, humerus & metatarsus	1	-	1	-	1	-	3
polishing / rubbing instrument	Cervus elaphus, red deer, antler	-	1	-	-	-	-	1
1-sided composite comb, type 1	Cervus elaphus, red deer, antler	-	-	2	-	-	3	5
1-sided composite comb, type 2	Cervus elaphus, red deer, antler	-	-	1	1	-	1	3
1-sided composite comb, type 3	Bos taurus, cattle, metacarpus	-	-	-	-	1	-	1
1-sided composite comb, type 3	Cervus elaphus, red deer, antler	-	-	-	1	-	-	1
1-sided composite comb, type 3	Ovis aries/Capra hircus, sheep/goat, costa	-	-	-	-	1	-	1
1-sided composite comb, type 3	Unknown size group, long bone	-	-	-	-	-	1	1
1-sided composite comb, type 4	Cervus elaphus, red deer, antler	-	1	-	-	-	-	1
1-sided composite comb, type 5	Cervus elaphus, red deer, antler	-	-	-	-	1	-	1
1-sided composite comb, tooth plate	Cervus elaphus, red deer, antler	-	1	3	4	2	2	12
1-sided composite comb, tooth plate	Unknown size group, ?	-	-	1	-	-	2	3
1-sided composite comb, end tooth plate	Cervus elaphus, red deer, antler	-	1	1	2	2	2	8
1-sided composite comb, end tooth plate	Unknown size group, ?	-	1	-	-	-	-	1
1-sided composite comb, side plate	Bos taurus, cattle, long bone	-	-	-	2	-	-	2
1-sided composite comb, side plate	Cervus elaphus, red deer, antler	-	7	8	9	1	4	29
1-sided composite comb, side plate	Ovis aries/Capra hircus, sheep/goat	-	-	-	-	1	-	1
1-sided composite comb, side plate	Unknown size group, costa, long bone & ?	-	-	1	2	1	1	5
2-sided composite comb, complete	Cervus elaphus, red deer, antler	-	1	-	-	-	-	1
2-sided composite comb, tooth plate	Cervus elaphus, red deer, antler	-	-	3	-	-	-	3
2-sided composite comb, tooth plate	Unknown size group, ?	-	-	-	-	-	1	1
2-sided composite comb, side plate	Cervus elaphus, red deer, antler	-	-	2	-	1	-	3
2-sided composite comb, fragment	Cervus elaphus, red deer, antler	-	1	1	-	-	-	2
2-sided composite comb, fragment	Unknown size group, ?	-	-	1	-	-	-	1
comb fragment	Cervus elaphus, red deer, antler	-	2	5	1	1	-	9
comb, unfinished	Cervus elaphus, red deer, antler	-	4	-	-	1	-	5
pin (clothes/hair)	Sus domesticus, pig, fibula	-	1	-	-	-	-	1
pin (clothes/hair)	Unknown size group, ?	-	-	5	-	-	-	5
ring	Cervus elaphus, red deer, antler	-	2	-	-	1	1	4

Table 4 The animal species and the types and numbers of skeletal elements represented in the bone and antler tools, unfinished tools and production waste for each period. (Cont. on next page).

Tool type	Species, element	Period						total
		Roman	Migration Merovingian	Carolingian	Ottonian	no phase		
ring	Unknown size group, ?	-	1	-	-	-	-	1
bead, unfinished	Cervus elaphus, red deer, antler	-	1	-	-	-	-	1
amulet/pendant	Cervus elaphus, red deer, antler	-	-	2	1	1	-	4
amulet/pendant, unfinished	Cervus elaphus, red deer, antler	1	-	1	-	-	-	2
dice (also used in gaming?)	Ovis aries/Capra hircus, sheep/goat, metatarsus	-	2	-	-	-	-	2
astragalus, used/decorated	Bos taurus, cattle, astragalus	3	2	-	1	-	1	7
astragalus, used/decorated	Ovis aries, sheep, astragalus	1	-	-	2	-	-	3
astragalus, used/decorated	Ovis aries/Capra hircus, sheep/goat, astragalus	3	1	3	-	-	2	9
flute	Cygnus cygnus or Cygnus olor, ulna	-	-	-	1	-	-	1
flute (unfinished)	Ovis aries/Capra hircus, sheep/goat, tibia	-	-	1	-	-	-	1
costa, sawn (musical instrument?)	Bos taurus, cattle, costa	-	-	1	1	-	-	2
tuning fork	Cervus elaphus, red deer, antler	-	-	-	-	-	1	1
box	Bos taurus, cattle, long bone	-	-	-	1	-	-	1
spoon	Bos taurus, cattle, cranium (foetus)	-	-	1	-	-	-	1
spoon	Cervus elaphus, red deer, antler	-	-	1	-	-	-	1
sieve	Bos taurus, cattle, scapula	1	-	-	-	-	-	1
plate (inlay?)	Bos taurus, cattle, costa	-	-	1	1	-	-	2
plate (inlay?)	Ovis aries/Capra hircus, sheep/goat, scapula	-	-	-	-	-	1	1
handle	Equus caballus, horse, metacarpus	1	-	-	-	-	-	1
handle	Cervus elaphus, red deer, antler	-	-	1	-	-	-	1
checker (used in gaming)	Cervus elaphus, red deer, antler	-	-	1	-	-	-	1
checker (used in gaming)	Unknown size group, ?	-	1	-	-	-	-	1
skate	Bos taurus, cattle, radius	-	-	1	-	-	-	1
skate	Equus caballus, horse, radius & metacarpus	-	1	-	2	1	-	4
skate	Cattle/horse size group, long bone	-	-	1	-	-	-	1
skate	Unknown size group, long bone	-	1	-	-	-	-	1
sledge runner	Equus caballus, horse, metatarsus	-	-	-	-	1	-	1
point/tip of skating stick	Bos taurus, cattle, radius, femur, tibia & metatarsus	-	-	1	2	2	2	7
point/tip of skating stick	Equus caballus, horse, metacarpus	-	-	-	-	1	-	1
point/tip of skating stick(?)	Ovis aries/Capra hircus, sheep/goat, metatarsus, tibia	-	-	1	-	-	1	2
waste/unfinished, type unknown	Bos taurus, cattle, mandible	-	-	-	-	-	1	1
waste/unfinished, type unknown	Alces alces, antler	-	1	-	-	-	1	2
waste/unfinished, type unknown	Cervus elaphus, red deer, antler	1	5	2	-	-	2	10
waste of horn working	Bos taurus, cattle, horn core	-	-	1	-	-	1	2
type unknown	Bos taurus, cattle, costa	-	-	2	-	-	1	3
type unknown	Cervus elaphus, red deer, antler	-	-	-	-	-	1	1
type unknown	Ovis aries/Capra hircus, sheep/goat, radius, metacarpus & phalanx 1	-	-	1	2	-	1	4
type unknown	Unknown size group, ?	-	-	1	2	-	-	3
Total		12	47	88	49	26	41	263

Table 4 The animal species and the types and numbers of skeletal elements represented in the bone and antler tools, unfinished tools and production waste for each period.

Whale and swan bones were rarely used for tool production. The single whale bone presumably belonged to an animal that was stranded or drifted as a dead animal to the coast. Used and worked whale bones are sometimes found at *terp* sites, for instance in Englum, where a humerus of an unidentified whale with chop marks was found in an undated feature (Prummel

2008), Achlum, where a caudal vertebra of a sperm whale (*Physeter macrocephalus*) with perforations was found (Hullegie 2010; Hullegie & Prummel in prep.) and Jelsum, where a cranium fragment of a whale was found (GIA unpublished).

Cattle horn was also used to make tools. At Wijnaldum-Tjitsma this is represented by two cattle horn cores with sawing marks, one from the Merovingian period and one undated. The nature of the objects remains unknown, but they could have been one-piece combs, which are found in some *terpen*, for example the two presumably Late Medieval horn combs from Leeuwarden-Gouveneursplein, find nos. 329 and 349: De Langen 1992, fig. 116). Horn does not survive well in *terpen*, just like hair, skins and tendons. These animal parts were certainly used at the *terp*. No objects made from teeth, including ivory, or of mollusc shell were found.

4 The contexts in which the bone and antler tools were found

The bone and antler tools and production waste were found in 14 types of contexts. The largest numbers come from refuse pits and ditches (17 and 16% of total NR of processed bones and antler (table 5)). Many of these were found in occupation and sod layers, originating from houses and sunken huts. Other contexts that delivered considerable numbers of bone and antler objects are wells, post holes, sunken huts, sod structures, pits and hearths. The context type of 26% of all bone and antler objects is unspecified, due to the complex stratigraphy of the site (table 5).

Period	Roman	Migration	Merovingian	Carolingian	Ottonian	no phase	total	%
post hole	-	2	-	1	1	2	6	2,3
sunken hut	-	6	3	1	-	-	10	3,8
sod structure	1	-	3	-	-	1	5	1,9
sod layer	-	4	16	4	-	2	26	9,9
hearth	2	-	1	-	-	-	3	1,1
well	-	2	5	-	5	-	12	4,6
small pit	-	-	-	1	1	-	2	0,8
large pit	-	-	2	2	-	-	4	1,5
refuse pit	1	8	10	19	2	4	44	16,7
occupation layer	2	11	6	6	3	1	29	11,0
ditch	-	4	30	4	5	-	43	16,3
arable layer	-	1	2	-	-	-	3	1,1
inhumation burial	-	-	1	-	-	-	1	0,4
cremation burial	-	1	-	-	-	-	1	0,4
top soil	-	1	1	-	-	4	6	2,3
context unspecified	6	7	8	11	9	27	68	25,9
Total	12	47	88	49	26	41	263	100,0

Table 5 The numbers of bone and antler tools, unfinished tools and production waste found in each context type in each period.

Bone and antler tools and waste from the Roman period were found in hearths, pits and house structures. The only finds from hearths are worn astragali and a piece of waste. Many tools and pieces of waste from the Migration period were found in occupation layers and sunken huts. The majority of the tools from the Merovingian period come from ditches and sod layers, whereas the finds from the Carolingian period mainly come from refuse pits. Tools from the Ottonian period were mainly found in wells and ditches (tables 5 and 6). Most bone and antler tools were thus found in habitation contexts (tables 5 and 6), showing that they were used in houses, sunken huts and yards and were lost or discarded there together with other waste.

Context type	post hole	sunken hut	sod structure	sod layer	hearth	well	small pit	large pit	refuse pit	occupation layer	ditch	arable layer	inhumation	cremation	top soil	context unspecified	total
Tool type																	
pin beater	-	1	1	2	-	-	-	-	1	2	3	-	-	-	-	-	10
needle, complete	1	1	-	3	-	1	-	1	2	1	-	-	-	-	2	2	14
needle, with eye	-	-	-	1	-	-	-	-	3	1	4	1	-	-	-	1	11
needle, point	-	-	-	-	-	1	-	-	2	1	3	1	-	-	-	2	10
needle, unfinished	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2
awl	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	2
awl, unfinished	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
spindle whorl, disc shape	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2
spindle whorl, planoconvex	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
spindle whorl, round	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
spindle whorl, caput femoris (fin.+unfin.)	-	-	-	3	-	-	-	-	-	1	-	-	-	-	1	-	5
polishing / rubbing instrument	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	3	5
1-sided composite comb, type 1	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	1	5
1-sided composite comb, type 2	-	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	3
1-sided composite comb, type 3	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	4
1-sided composite comb, type 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
1-sided composite comb, type 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
1-sided composite comb, tooth plate	1	-	1	1	-	2	-	1	3	2	1	-	-	-	-	3	15
1-sided composite comb, end tooth plate	-	-	-	-	-	-	-	-	2	3	1	-	-	-	1	2	9
1-sided composite comb, side plate	-	-	-	2	-	4	-	1	11	1	7	-	-	-	-	11	37
2-sided composite comb, complete	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
2-sided composite comb, tooth plate	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	1	4
2-sided composite comb, side plate	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-	3
2-sided composite comb, fragment	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	2	3
comb fragment	-	1	-	1	-	1	-	-	1	-	5	-	-	-	-	-	9
comb, unfinished	1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	1	5
pin (clothes/hair)	-	1	-	1	-	-	-	-	-	1	2	-	-	-	-	1	6
ring	-	1	-	1	-	-	-	-	1	1	-	-	-	-	-	1	5
bead, unfinished	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1
amulet/pendant	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	1	4
amulet/pendant, unfinished	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	2
dice (also used in gaming?)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2
astragalus, used/decorated	-	2	-	1	2	-	-	-	3	4	1	-	-	-	1	5	19
flute	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	2
costa, sawn (musical instrument?)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2
tuning fork	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
box	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
spoon	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	2
sieve	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
plate (inlay?)	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	3
handle	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	2
checker	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	2
skate	-	-	-	-	-	-	1	-	-	2	3	-	-	-	-	1	7
sledge runner	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
point/tip of skating stick	1	-	-	2	-	-	-	1	-	-	-	-	-	-	-	6	10
waste/unfinished, type unknown	-	1	-	-	1	-	-	-	2	3	1	-	-	-	-	5	13
waste of horn working	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	2
type unknown	-	-	-	1	-	-	-	-	3	1	2	-	-	-	1	3	11
Total	6	10	5	26	3	12	2	4	44	29	43	3	1	1	6	68	263

Table 6 The numbers of bone and antler tools, unfinished tools and production waste in the various types of contexts of Wijncaldum-Tjitsma (combined for all periods).

The variation in the contexts in which the bone and antler objects were found largely corresponds to the frequency of these context types in each period (Gerrets & De Koning 1999, figs 3-22). There is no correlation between artefact type and context class. Sunken huts, for instance, only occurred in the Migration, Merovingian and Carolingian periods. Pits were common in the Carolingian period and wells in the Ottonian period, whereas ditches were found in all phases. For this reason the recovered bone and antler objects are considered to be representative for the use of bone and antler as tools during the occupation history of Wijnaldum-Tjitsma. The bone and antler objects from each period are not connected to particular houses, sunken huts, wells etc.

Two special contexts in which antler tools were found are a cremation burial and an inhumation burial of a young woman. A burnt antler spindle whorl was found in the cremation burial, which dates to the Migration period. A red deer antler amulet or pendant of a type named 'Donar amulet', was found in the inhumation burial of a young woman from the Merovingian period (fig. 21). The object was probably a fertility amulet. They are only found in women's and children's burials (Knol 1988, 122-124; also for an explanation of the name of this type of object). The inhumation burials of six young infants at the *terp* contained no grave goods (Cuijpers *et al.* 1999). These finds indicate that spindle whorls and amulets were valued personal belongings.

5 Six groups of bone tools, production waste and unfinished tools

The bone and antler tools are subdivided into six groups. Each group more or less represents a common type of use or a common sphere in which the tools were used. The assignment to a specific group is not absolute, especially since the function of the objects is not always known or certain. Waste and unfinished tools of unknown type form a seventh group. The groups used in this paper are:

1. fibre and skin working tools,
2. personal utensils like combs, pins, rings and beads,
3. amulets,
4. musical instruments,
5. household utensils,
6. transport: bone skates and a sledge runner,
7. waste and unfinished tools of unknown type.

The most common tools are personal utensils ($n = 112$), mainly combs and comb fragments, and fibre and skin working tools ($n = 65$). Less common are amulets ($n = 27$), transport utensils ($n = 18$), household utensils ($n = 11$) and musical instruments ($n = 5$) (table 1). Many bone and antler tools are decorated, mainly with single lines, combinations of parallel, crossing and zig-zag lines and point-circles. In particular, antler tools tend to be decorated. Details on individual tools as well as on pieces of production waste and unfinished pieces may be found in Halici 1997.

5.1 Fibre and skin working tools

Pin beaters, needles, awls and polishing or rubbing instruments attest to fibre and skin working at the site. Pin beaters, which are bone rods that are pointed at both ends, were made out of large mammal long bones, such as those of cattle or horse (fig. 2). The only exception is a pin beater made of a fragment of a whale mandible (table 4). One pin beater of large mammal bone is decorated with lines (fig. 2). Pin beaters were used in weaving (MacGregor 1985, 188-189).

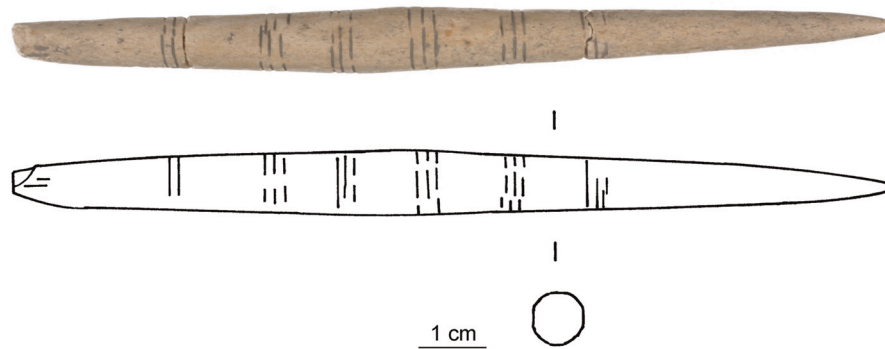


Figure 2 Pin beater made from a large mammal bone (cattle or horse) decorated with lines, find no. 5946, Carolingian period.

Bone needles, which are quite numerous at Wijndaldum-Tjitsma, perhaps because of the water-sieving, were probably used in fibre and skin/leather working and in making or repairing fishing or fowling nets. All needles of which at least the top is preserved have a round or elongated eye. Most needles ($n = 14$) were made out of pig fibulae (fig. 3). The pig fibula is a narrow bone with wider ends, which can be made into a needle without much effort. The distal end of the fibula is the top of the needle in which the eye was made. The top of eight pig fibula needles was made narrower to prevent damage to the material that was sewn.

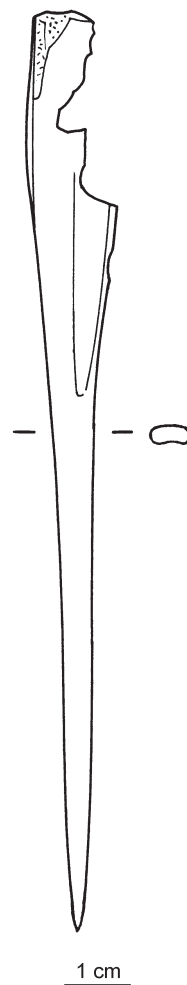


Figure 3 Needle or awl made out of a fibula of a young pig, find number 1525, Merovingian period. The hole, which is broken, was made in the unfused distal end of the fibula.

The top of six pig fibula needles, however, is more than 1 cm wide. Their wide top made these needles unsuitable for sewing cloth. Wear trace analysis on three of them (two dating to the Merovingian period and one undated) at the Laboratory for Artefact Studies, Leiden University (link to report in supplementary material), showed that they were used on plant fibres, for instance in making or repairing fishing or fowling nets or in basketry. Fishing and fowling were more extensively practiced at Wijncaldum-Tjitsma than at other *terpen* and this may account for the rather large number of these needles. Another pig fibula with a wide head was used on various materials.

Needles were also made from cattle ribs and long bone fragments of sheep and unidentified mammals. A wide needle and a narrower needle, both of unidentified mammal long bones, were used on plant fibres, just like the pig fibula needles with wide heads. A needle made from unidentified mammal bones was used on several materials, such as skin, plant materials and possibly wool. An irregular object made out of a bone from an unidentified mammal was used on hide or skin. Metal needles were most probably used for sewing fine linen or woollen cloth. The unfinished bone needles indicate that needles were made at the site. Awls were made out of sheep mandibles and metatarsi and out of large mammal long bones (fig. 4). They were made at the site as well. Awls were probably used in skin and coarse fibre working.

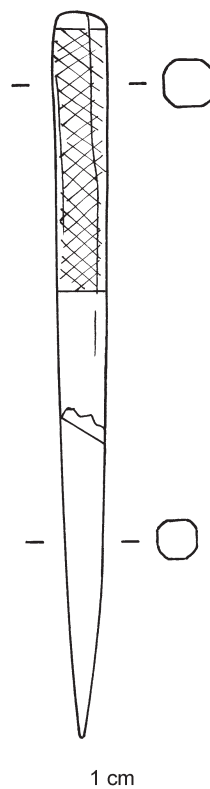


Figure 4 Awl decorated with crossing lines made out of a long bone from an unknown mammal in the cattle/horse size group, find no. 1001, Merovingian period.

Spindle whorls were made out of red deer antler or the *caput femoris* of cattle (fig. 5). Two antler spindle whorls are disc-shaped (fig. 6). The third, that from the cremation burial, is round, with flat upper and lower sides. Both are decorated with lines. An unfinished cattle *caput femoris* spindle whorl shows how these whorls were made: the beginning of the hole through the *caput femoris* is visible in the sawn off bottom of the whorl. The spindle whorls were used for the spinning of wool and plant fibres. Ceramic spindle whorls were also used at the site, including 7th and 8th centuries examples which appear to be made using collected fragments of imported Roman tiles (Galestin 1999).

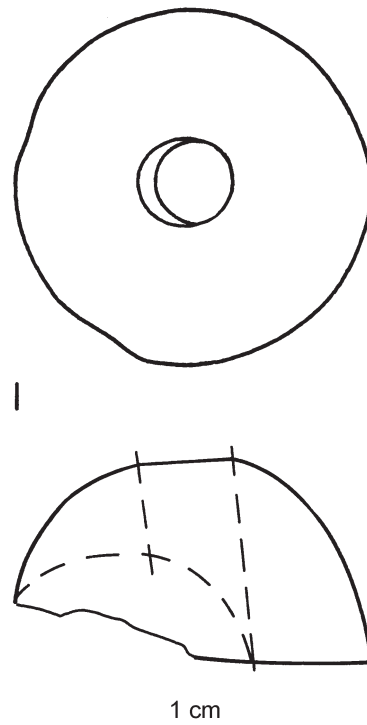


Figure 5 Spindle whorl made of an unfused cattle caput femoris, find no. 1001, Merovingian period.



Figure 6 Spindle whorl of red deer antler, find no. 1001, Merovingian; a. photograph, b. drawing.

Five worn and shiny tools are interpreted as polishing or rubbing instruments to polish, clean or smooth linen² cloth, skins and other materials, or to rub in skins or cloth with fat. These tools are horse and cattle metacarpi, cattle humeri and a piece of red deer antler. The horse and cattle metatarsi were used without any processing: they are informal bone tools. They are worn at the proximal and distal ends and are shiny all around.

Such worn and shiny metapodia are regularly found at *terp* sites (Knol 1983; Nieuwhof & Prummel 2007; Prummel 2008). Experiments at the Groningen Institute of Archaeology in 2010 to remove the hairs of a fresh piece of cattle skin by rubbing modern cattle metacarpi and metatarsi over the skin resulted macroscopically in the same type of wear and shine after a short time of use. It proved to be quite hard work. The skins would have perhaps been left to

decay for a while or soaked in water with lime before the hairs were removed with this kind of tool. An alternative explanation is that these tools were used to rub in skins with fat to make them waterproof (Barthel 1969).

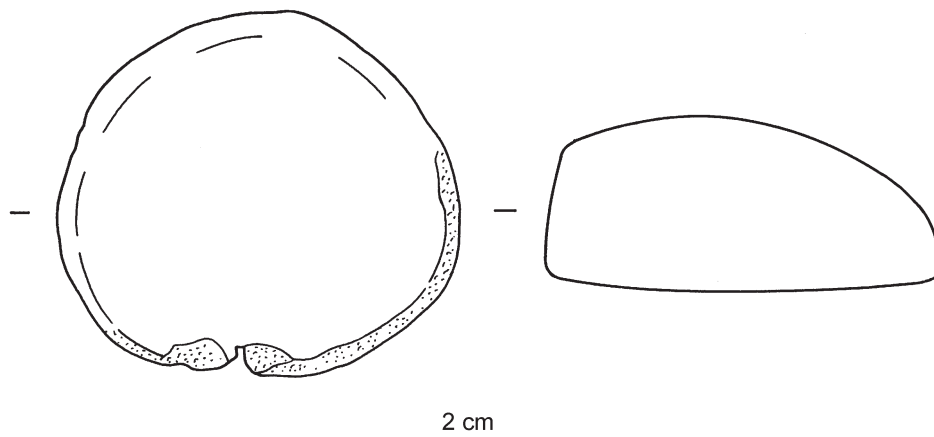


Figure 7 *Caput humeri* sawn from the left humerus of a cattle and used as a polishing tool, find no. 7025, Carolingian or Ottonian period.

Sawn-off proximal articulation heads of the humerus – the *caput humeri* – were also used as polishing tools (fig. 7). They show post mortem wear on the articulation surface, resulting from moving the object over a surface, for instance cloth or a skin, with the aim to polish or smooth this. Similar objects, with wear on the articulation surface, were found in Carolingian Dorestad (Clason 1980; Prummel 1983). Their shape resembles the glass irons found at Dorestad (Isings 1980).

5.2 Personal utensils: combs, pins, rings and beads

All combs found in Wijnaldum-Tjitsma are composite combs made out of a row of tooth plates that were fixed between two side plates with iron or bronze nails to keep the tooth and side plates together. After the tooth and side plates were joined, the teeth were created by sawing the plates (Ulbricht 1978; Ambrosiani 1981; MacGregor 1985).

Most comb finds in Wijnaldum-Tjitsma are fragments of broken combs: isolated tooth plates, fragments of side plates, or tooth and side plate fragments of the same comb. Complete combs are rare (table 1). The fragmentary state of the comb material hampered the attribution of all comb fragments to a comb type.



Figure 8 One-sided type 1 composite comb made of red deer antler, find no. 1145, period unknown. Combs of this type have curved, high-sided plates and extended end tooth plates. The comb is decorated with parallel and crossing lines.

We recognized five types of one-sided composite combs. Type 1 has curved, rather high side plates; the end tooth plates extend at both ends beyond the side plates. The top of the tooth

plates follow the curved top of the side plates. At Wijnaldum-Tjitsma the combs' tooth and side plates were made out of red deer antler. One side plate of each comb is decorated with crossing and parallel lines (fig. 8). The upper edge of the tooth plates is sometimes decorated with lines. Type 1 is represented by five complete or larger parts of combs. Two date to the Merovingian period, the other three are undated. This type of comb was quite common in the Frisian and Groningen Early Medieval *terpen* area (Miedema 1983, 224; Knol 1993, 82-83).

Type 2 of the one-sided composite combs has the same curved, rather wide side plates and is also made out of antler. The end tooth plates, however, do not extend beyond the end of the side plates. Both side plates are decorated with point-circles and lines (fig. 9). Three combs are attributed to this type. One is dated to the Merovingian period, one to the Carolingian period and the third is undated. This type of comb was quite common in Dorestad (Roes 1965).

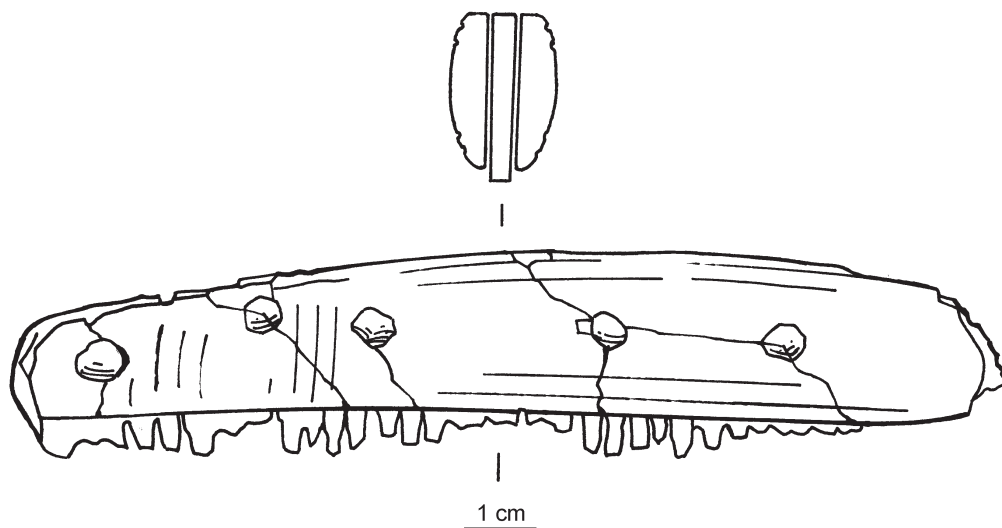


Figure 9 One-sided composite type 2 comb made of red deer antler, find no. 11624, Merovingian period. These combs are similar to type 1 but the end tooth plates do not extend beyond the side plates.

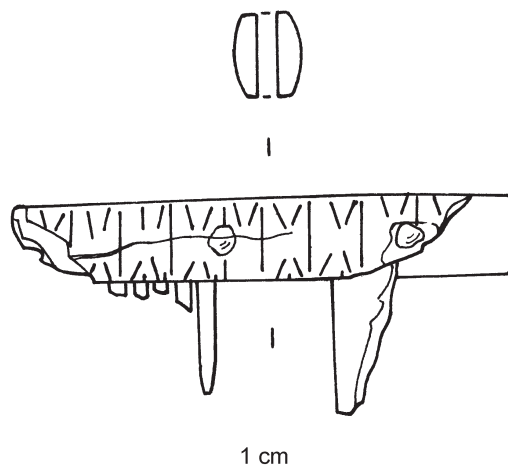


Figure 10 One-sided composite type 3 comb made of red deer antler, find no. 6047, Carolingian period. The end tooth plates of this type extend beyond the ends of the side plates. The side plates are straight and narrow.

The end tooth plates of one-sided composite comb type 3 extend beyond the ends of the side plates, similar to type 1. The side plates, however, are straight and narrow. Four such combs were found, one dates to the Carolingian period, two to the Ottonian and the fourth is undated. The side plates of these combs are decorated with lines and, similar to type 1, only one side plate of each comb is decorated (fig. 10). These combs were made out of red deer antler, cattle

metacarpus and sheep rib (table 3). This type of comb is quite often found in Frisian and Groningen *terpen* (Roes 1963; Miedema 1983, 225; Knol *et al.* 1996, 334).

One-sided composite comb type 4, which is only represented by a fragment, is a so-called winged comb. In this type, the end tooth plates extend as wings above the ends of the side plates. The Wijndaldum comb of this type has straight and narrow side plates, similar to type 3. The wings are small. The comb was made of red deer antler. The end tooth plates and the side plates are decorated with point-circles and there are lines on the side plates. The Wijndaldum winged comb dates to the Migration period (fig. 11). Winged combs are found in other Frisian and Groningen *terpen* (Roes 1963, 19-20; Miedema 1983, 228; Knol 1993, 82-83).

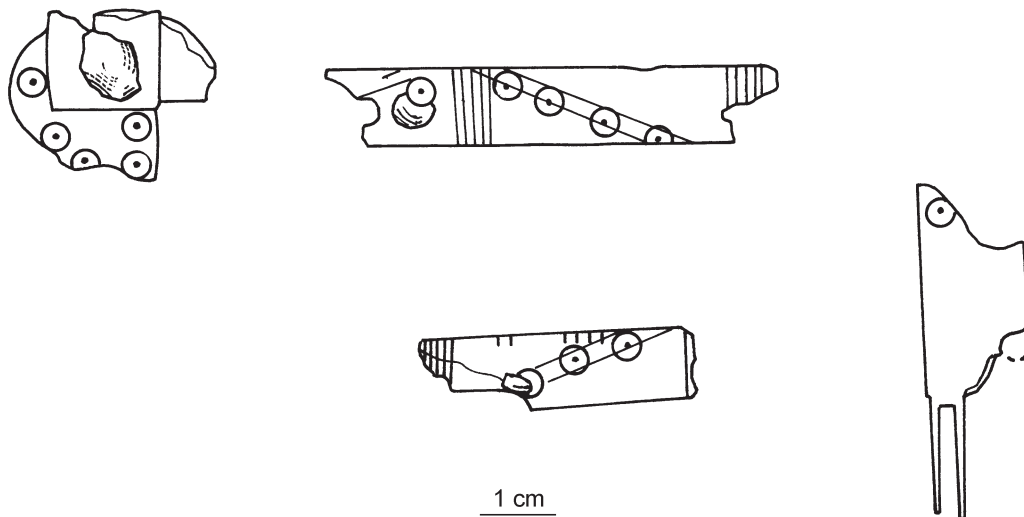


Figure 11 Fragments of a one-sided composite type 4 comb, the so-called winged comb, made of red deer antler, find no. 8018, Migration period. The end tooth plates extend like wings above the straight and narrow side plates.

The tooth plates of one-sided composite comb type 5 extend far above the side plates. Only one example was found in Wijndaldum, dating to the Carolingian or Ottonian period. It was made of red deer antler. The only side plate present is decorated with lines (fig. 12).

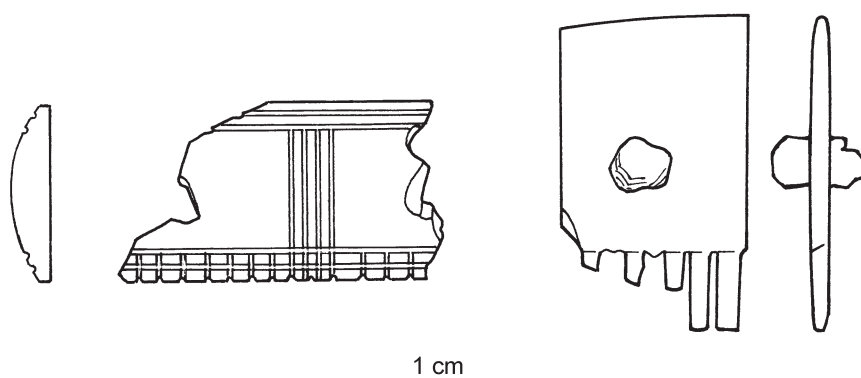


Figure 12 Fragments of a one-sided composite type 5 comb made of red deer antler, find no. 6067, Carolingian or Ottonian period (AD 770-900/950). The tooth plates extend above the side plates.

The many tooth plates and side plate fragments from broken combs mainly come from combs of type 1, 2 and 3. The side plates are either undecorated or are decorated with parallel lines, crossing lines, zigzag lines or point-circles or combinations of these elements. The side plates and the end tooth plates of the only complete two-sided composite comb are decorated with point circles and lines (fig. 13).

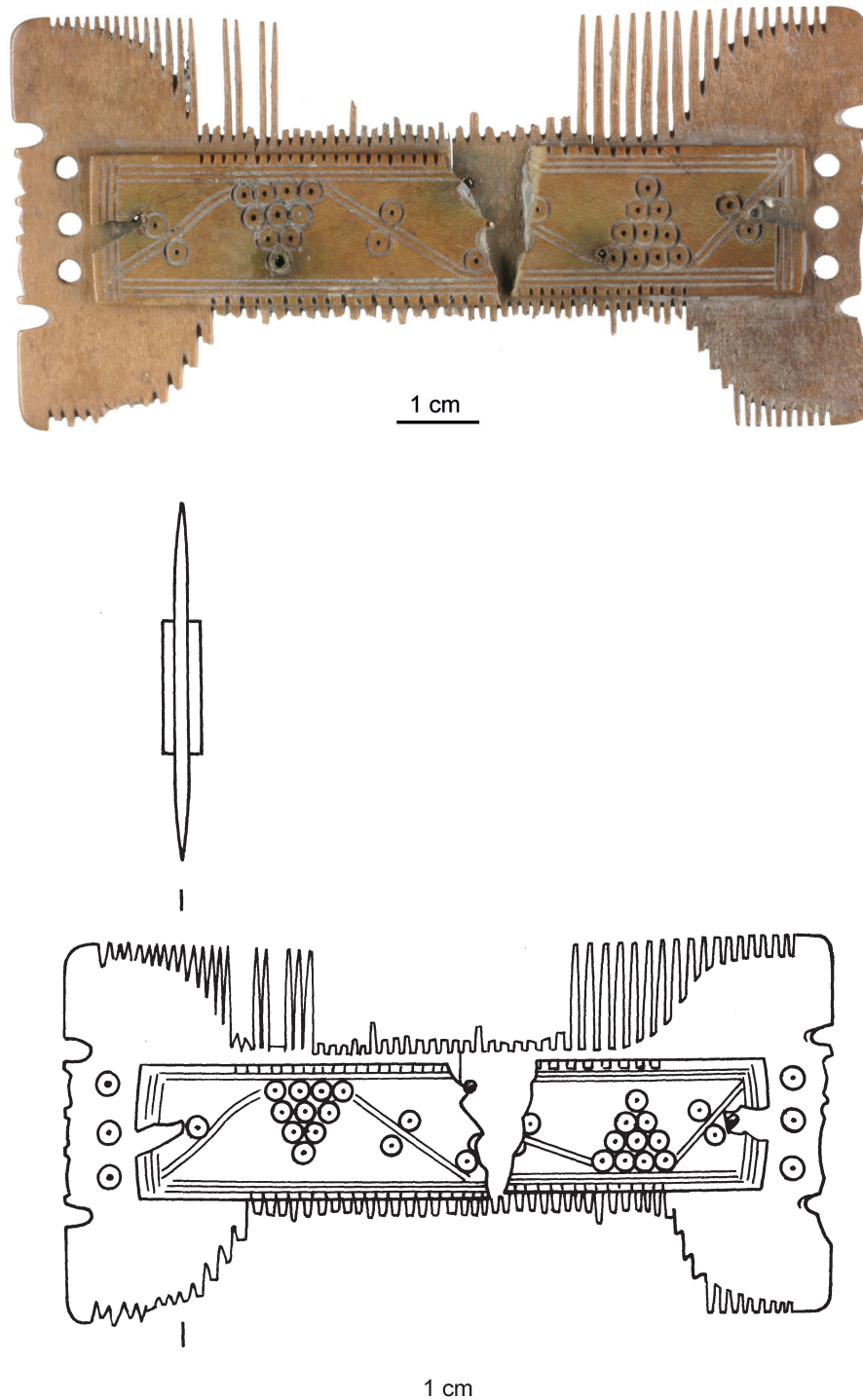


Figure 13 Two-sided comb of red deer antler, find no. 9608, Migration period; a. photograph, b. drawing.

One-sided composite combs are much more common in Wijncaldum-Tjitsma than two-sided ones (table 1: 87% against 13%). A different picture emerges in Late Roman and Early Medieval Maastricht (AD 450-750) in the south of the Netherlands, where 82% of the composite antler combs are two-sided composite combs and 18% are one-sided combs. Of the one-sided composite combs, 91% have triangular side plates (Dijkman & Ervynck 1998). The three (late) Roman composite combs from Wijk bij Duurstede-De Geer show the same distribution: two are two-sided and the only one-sided comb has triangular side plates (Thach & Lauwerier 2010). This type is completely absent in Wijncaldum-Tjitsma but was found in the Hallum, Oosterbeintum and Englum *terpen* (see below) and in some other *terpen* (Roes 1963, plate XIV-XVI; Miedema

1983, fig. 169). Triangular combs are absent in Early Medieval Dorestad and Leidsche Rijn (Roes 1965; Clason 1980; Esser 2009).

Other personal utensils in Wijncaldum-Tjitsma are pins for clothing and hair, rings and beads. One of the pins was made out of a pig fibula (fig. 14). Wear trace analysis (link to report in supplementary material) on a pin made from red deer antler demonstrated that it was used on wool, i.e. on clothing. A pin made from a mammal long bone was presumably a hairpin, since it seems to have made contact with hair, which may have been slightly oily or dirty, at least not very clean. Both pins date to the Merovingian period. The rings are made from antler (fig. 15) and unidentified bone and the bead was made of antler bone (fig. 16) (table 4).

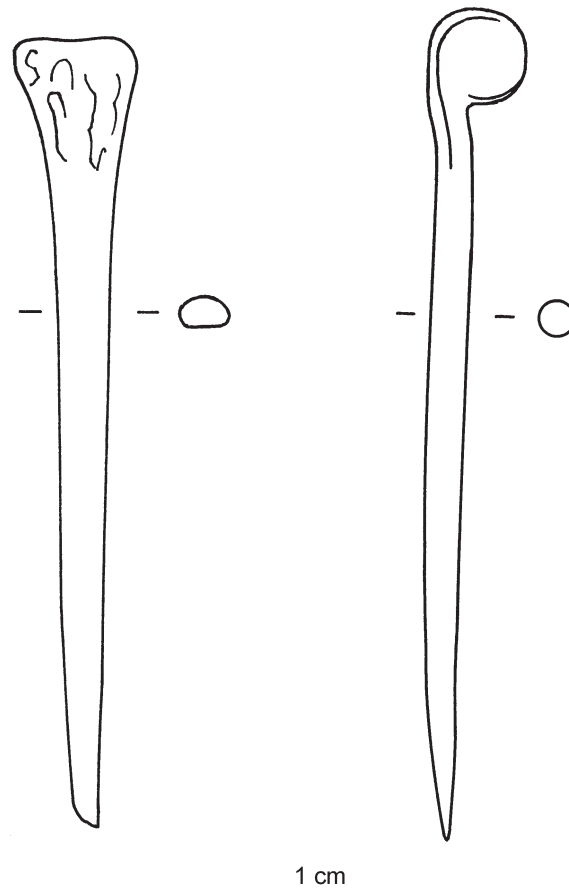


Figure 14 Two hair or clothing pins made from a pig fibula (left: find no. 8021, Migration period) and a mammal long bone (right: find no. 5453, Merovingian period).

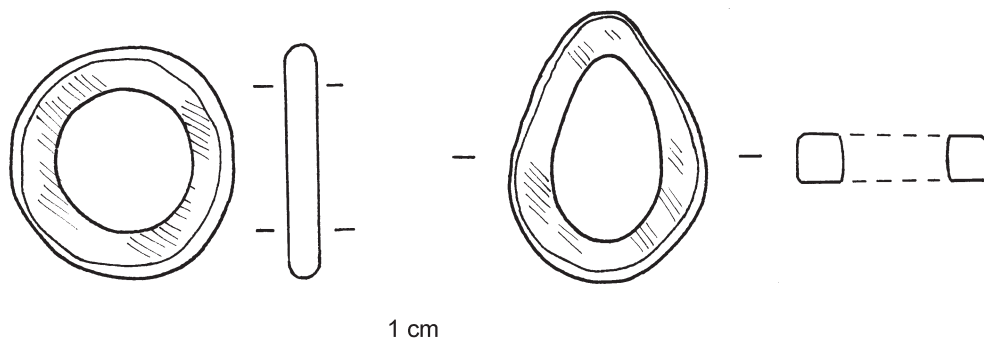


Figure 15 Two red deer antler rings. Left: find no. 1004, Migration period; right: find no. 702, Ottonian period. The last object might be a pendant instead of a ring.

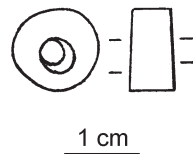


Figure 16 Unfinished bead of red deer antler, find no. 3945, Migration period.

5.3 Amulets

Amulets refer to the symbolic and ritual aspects of life at the site. Sheep and cattle astragali that are worn and shiny due to being used and handled are the largest group in this category. Some of them are perforated (figs 17 and 18), others have little dots (fig. 19). Most of the astragali were not processed, but just used, presumably as amulet or as dice in divination (Knol 1987; 1988), or perhaps in knucklebone-games. The two die found at the site may have been used in divination or games (fig. 20).



Figure 17 Perforated, worn and shiny sheep astragalus, find no. 4057, Carolingian period.

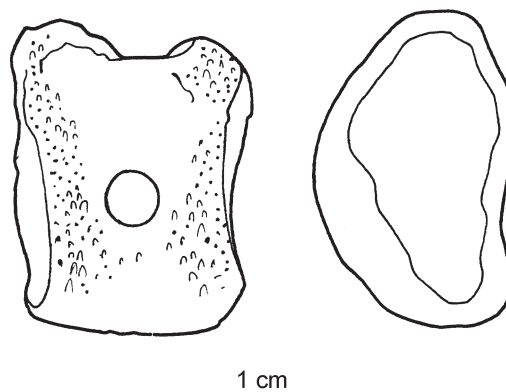


Figure 18 Left astragalus of a neonatal calf, perforated from plantar to dorsal, presumably used in divination, find no. 6564, Migration period.

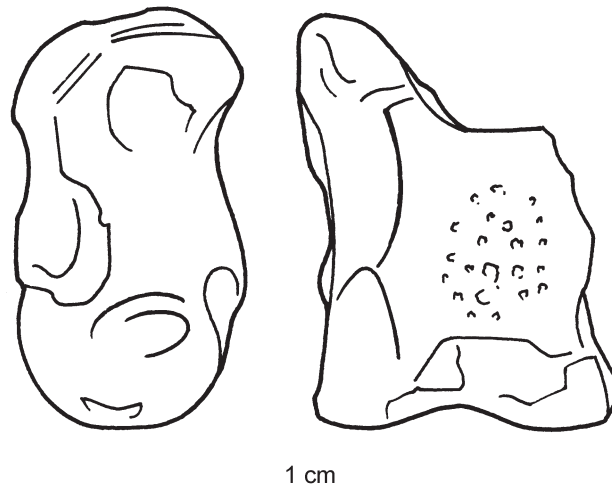


Figure 19 Right cattle astragalus with dots on the plantar side, find no. 6654, period unknown.

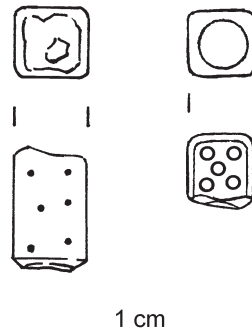


Figure 20 Two dice made of sheep metatarsi, find nos. 8014 (left) and 2664 (right), both Migration period.

Pendants made of red deer antler were probably used as amulets in magic and divination rituals (Knol 1988). This seems to be the case for the nicely decorated 'Donar amulets', which are decorated conical rods of antler with a hole at the top (figs 21 and 22). One of the Wijncaldum 'Donar amulets' was found in the Merovingian inhumation burial of a young woman. It was found between her knees (Cuijpers *et al.* 1999) (fig. 21). Antler amulets were generally placed as grave goods in early medieval graves, for example a round pendant of red deer antler is found in a child burial at the early medieval cemetery of Oosterbeintum, dated AD 450-600 (Knol *et al.* 1996, grave 402).



Figure 21 'Donar amulet' of red deer antler found in the Merovingian inhumation burial of a young woman, find no. 11702.

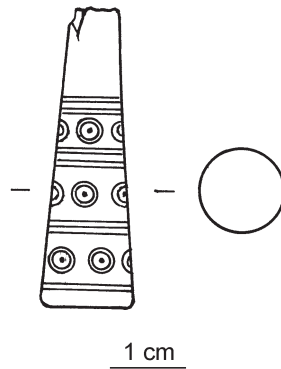


Figure 22 'Donar amulet' of red deer antler broken at the hole, find no. 11694, Merovingian period.

5.4 Musical instruments

Musical instruments made out of bone or antler were found in small numbers in Wijnaldum-Tjitsma. One flute was made out of an ulna of a whooper or a mute swan (fig. 23). The other, unfinished flute is part of a sheep tibia. Two cattle ribs with a serrated edge were perhaps musical instruments (MacGregor 1985; Roes 1963). Sounds could be made by moving the object over a surface (figs 24 and 25). Alternative interpretations for these tools are that they were graters or coarse polishers.

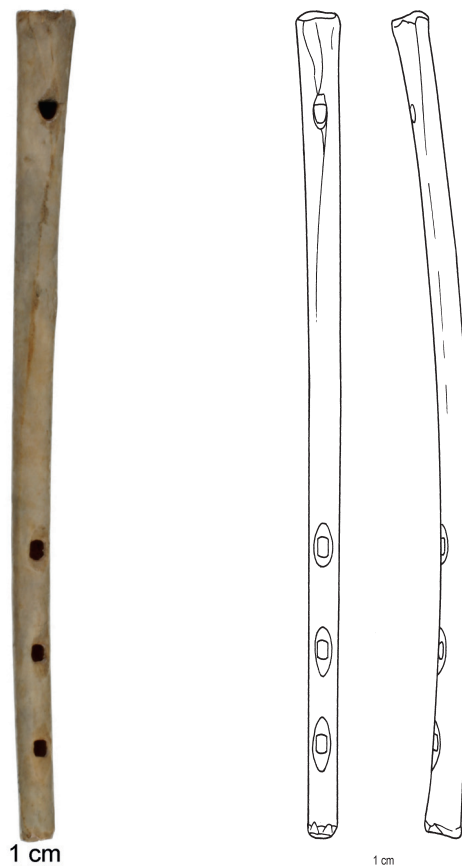


Figure 23 Flute made of the right ulna of a whooper or a mute swan, find no. 11702 Carolingian period; a. photograph, b. drawing.

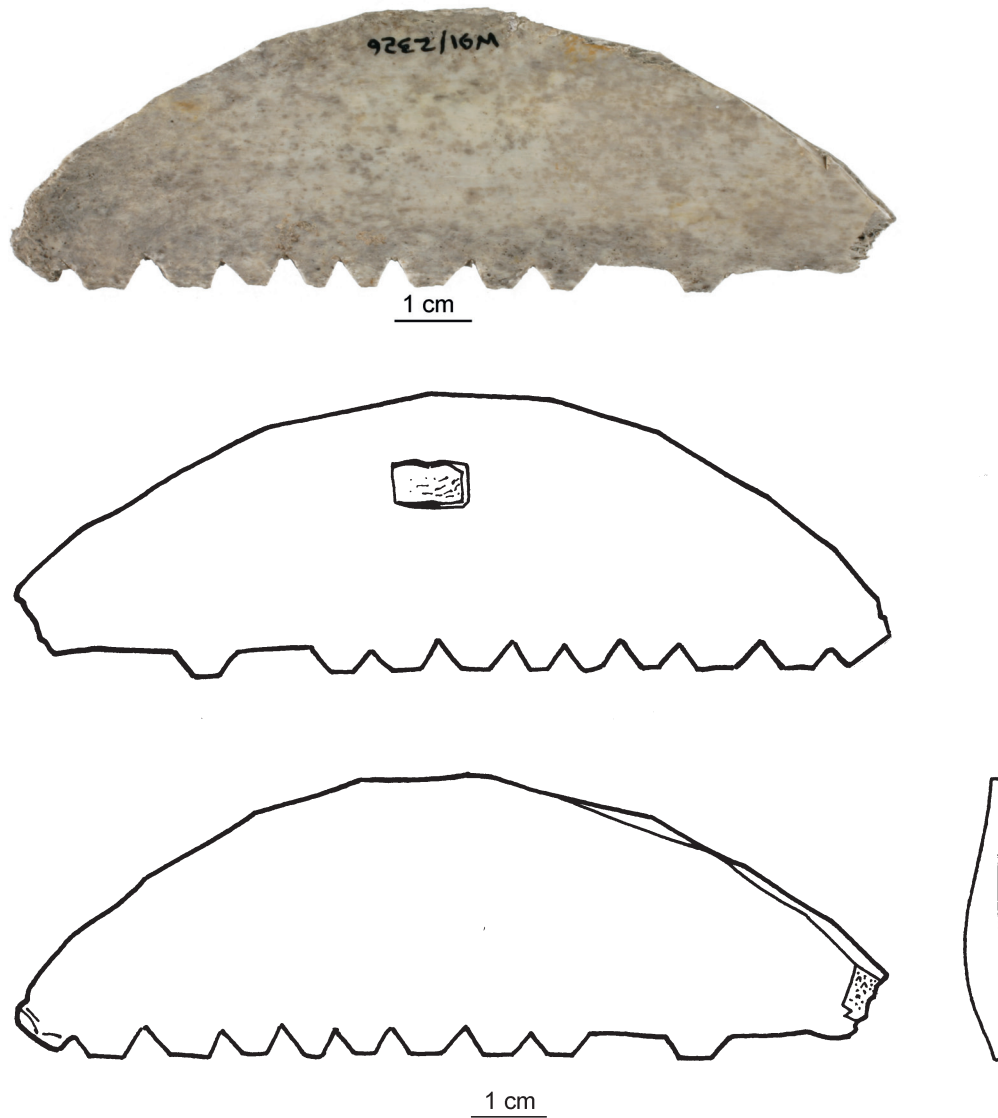


Figure 24 Cattle costa with sawn rim, possibly used as a musical instrument, find no. 2326, Carolingian period; a. photograph, b. drawing.

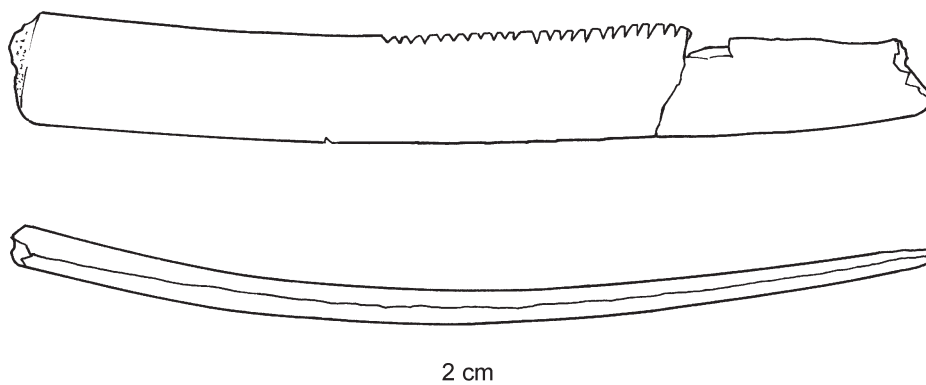


Figure 25 Right cattle costa with serrated edge, possibly used to make music or sounds, find no. 1508, Merovingian period.

Very interesting is an object made of antler, probably a tuning pin for a lyre (fig. 26). Lyres were found in early medieval sites in Britain, for example in the royal or princely graves at Sutton Hoo and Prittlewell (MacGregor 1985, 147; Carver *et al.* 2005, figs 88 and 99, table 21; Hirst 2004, 37). Singers of heroic verses played a lyre as they sang. The exact date of the Wijaldum tuning pin is unknown, but it dates to the Merovingian or the Carolingian period. The tuning pin refers to musicians connected to high status people during one of these periods. Undated tuning pins were found in the *terpen* at Finkum, Hallum and Teerns in Friesland (Van Vilsteren 1987, 56) and in Carolingian Dorestad (Roes 1965, Plate XX).

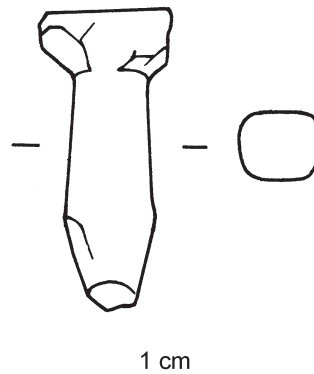


Figure 26 Tuning pin made of red deer antler dating to the Merovingian or the Carolingian period, find no. 2175.

5.5 Household utensils

The objects described as household utensils are a little box (fig. 27), three decorated bone plaque fragments, which could have been used as inlaid decoration of furniture (fig. 28), two handles, two spoons (figs 29 and 30) and a sieve (fig. 31). These are all exceptional for the *terpen* area (see below).

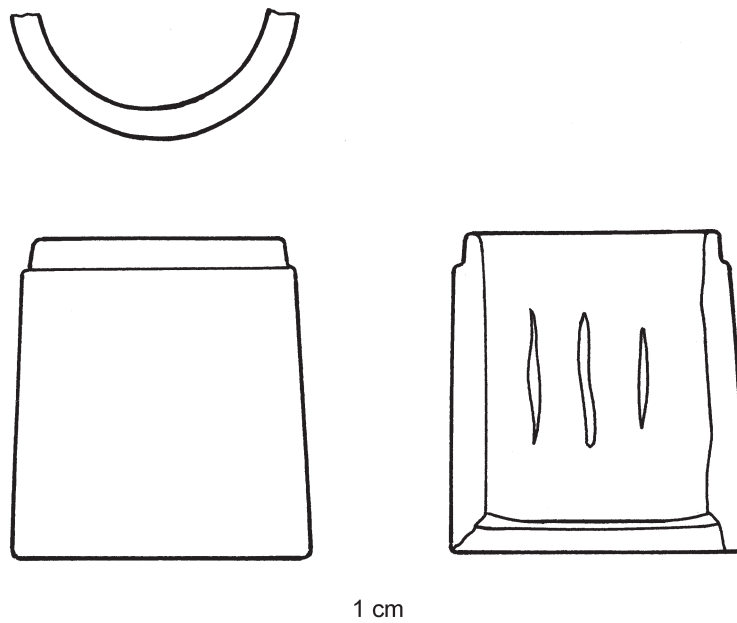


Figure 27 Fragment of a box made from the long bone, for instance a femur, of a large mammal, such as a cow; find no. 9470, Carolingian period, perhaps used to store make-up or jewellery.

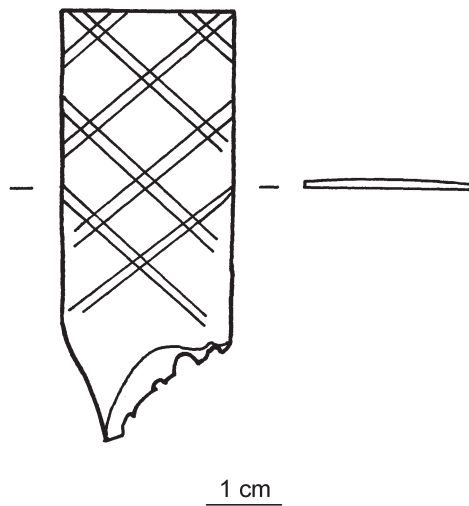


Figure 28 Decorated part of a cattle costa, originally terminating into a triangle, possibly used as inlaid decoration of furniture, find no. 6596-7, Carolingian period.

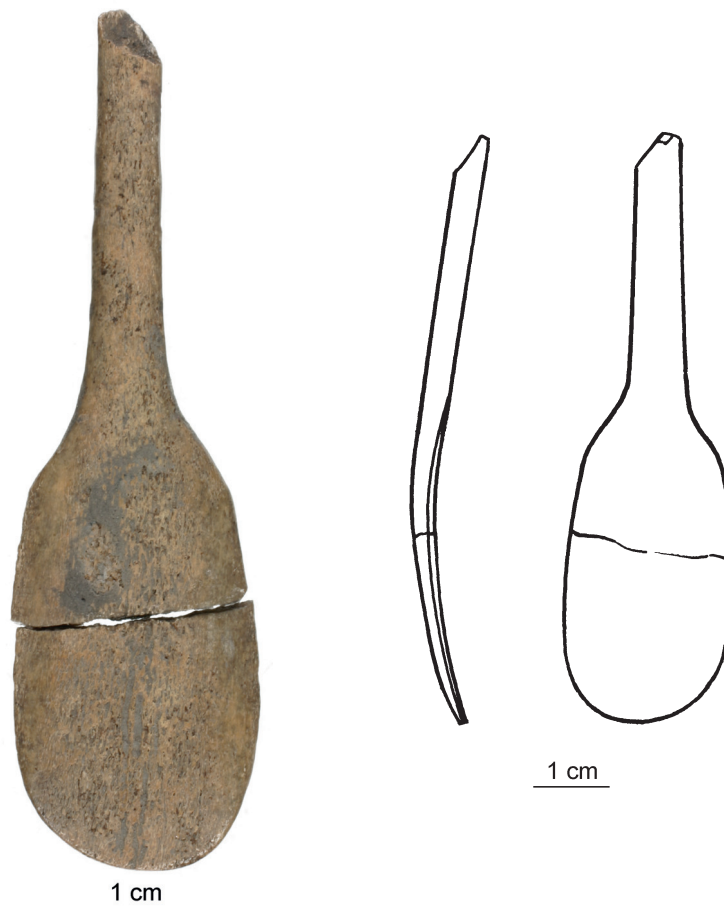


Figure 29 Spoon of red deer antler, find no. 11381, Merovingian period; a. photograph, b. drawing.



Figure 30 Frontale of a cattle foetus, cut around and presumably used as a spoon, find no. 7448, Merovingian period.

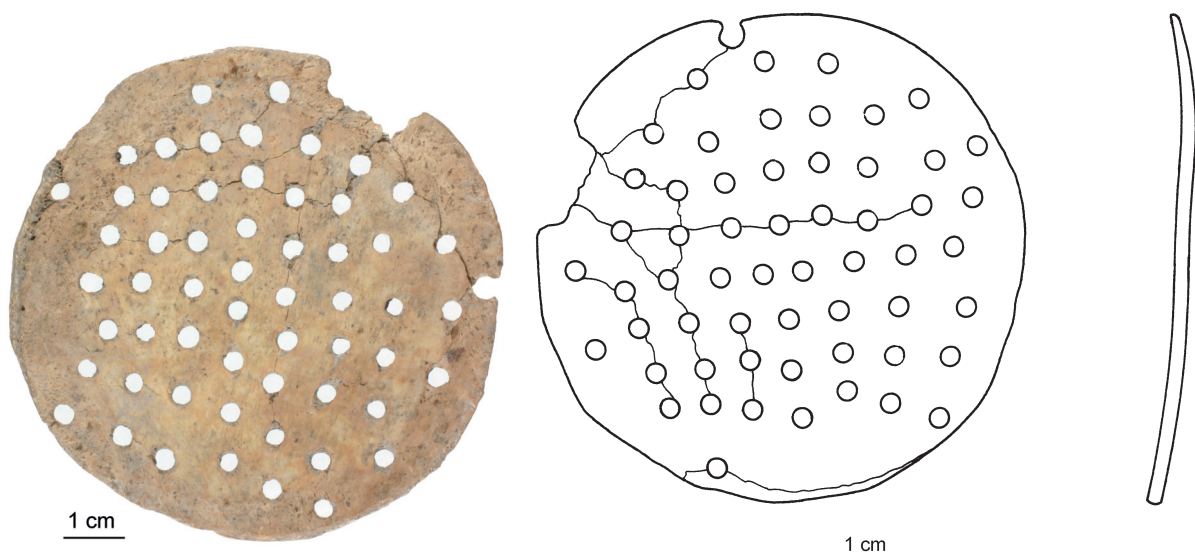


Figure 31 Sieve made of the flat part of a cattle scapula, find no. 9325, Roman period; a. photograph, b. drawing.

5.6 Transport: bone skates and a sledge runner

Bone skates were made from horse radii and metacarpi and a cattle radius. A sledge runner was made out of a horse metatarsus (table 3; fig. 32). That these objects were used on a completely flat and hard surface, i.e. ice, is proven by the flat dorsal side of the bones, which makes straight, sharp edges with the lateral and medial sides of the bones (Becker 1990).

To skate using bone skates, a person would have had to use a stick to push oneself forward and feet were not lifted from the ice during skating (Clason 1980; Becker 1990). This explains why several bone skates found at the site lack holes for ropes to attach the skates to the feet. Ten bone points, made out of cattle, horse and sheep long bones, are identified as the tips of skating sticks (fig. 33) (compare Lauwerier 1995, 203-204; Lauwerier & Van Heeringen 1995, 6-7).

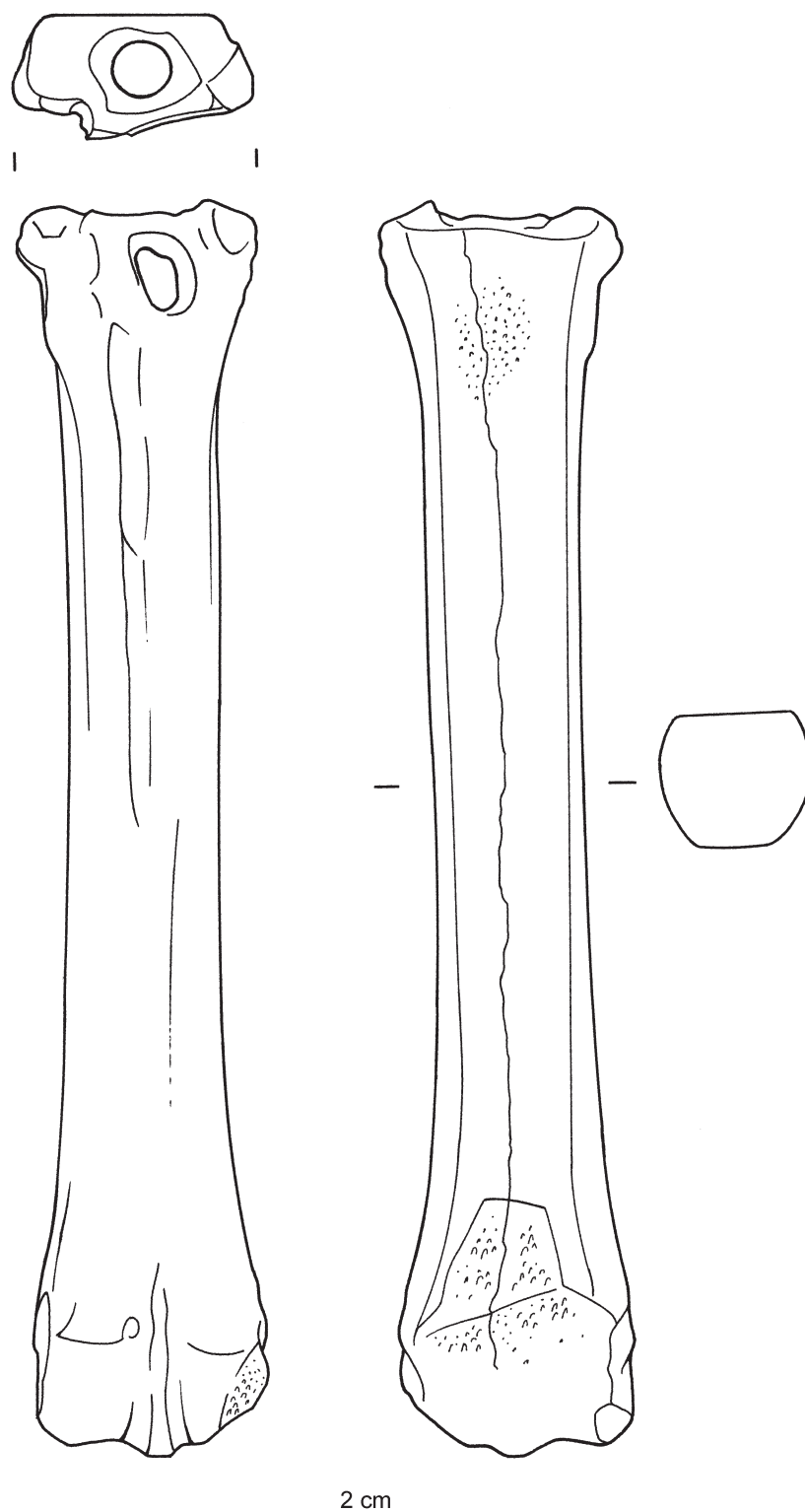


Figure 32 Sledge runner made out of a horse's left metatarsus, find no. 7536, Ottonian period.

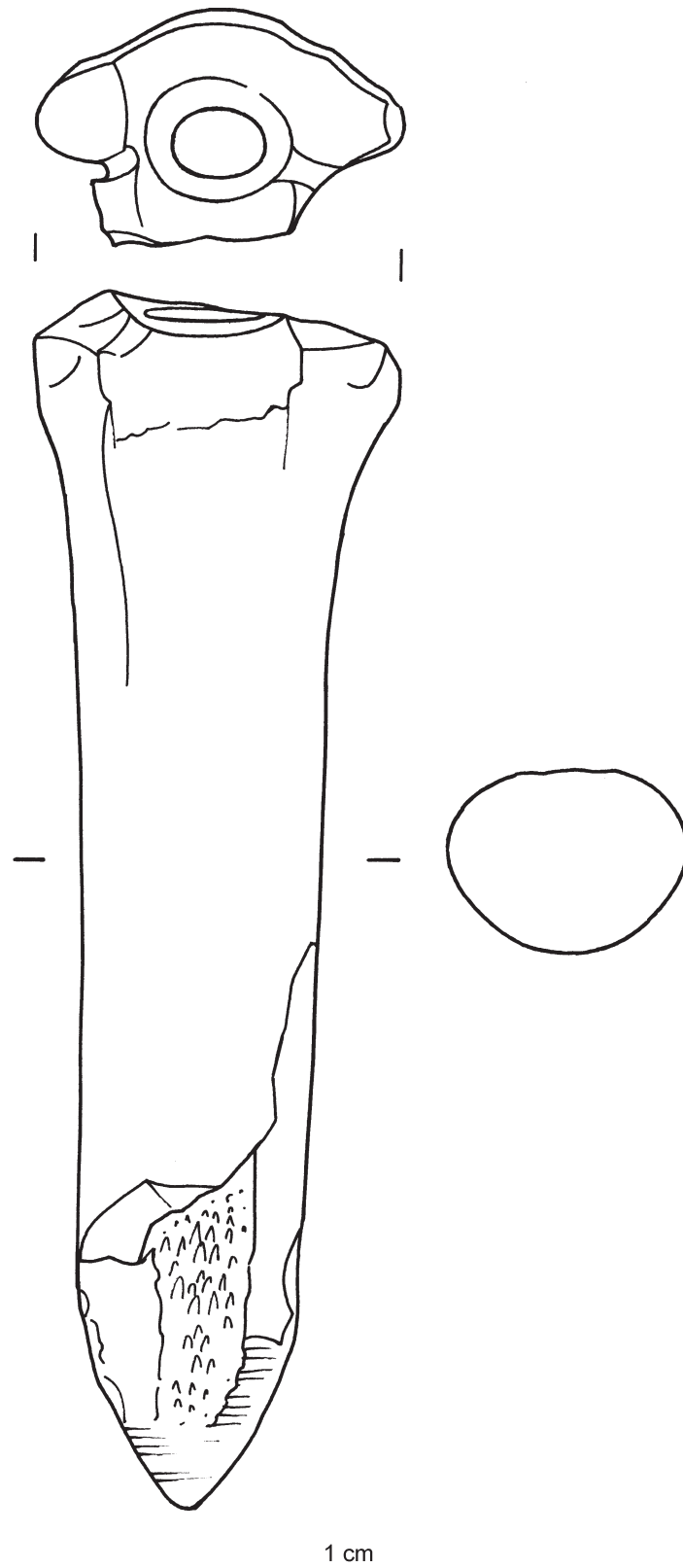


Figure 33 Hollowed out bone point made out of the proximal end of a horse's left metacarpus, presumably used as the tip of a skating stick, find no. 2596, Carolingian or Ottonian period.

6 The bone tools used in the five occupation phases

6.1 Roman period

Eight of the 12 worked bones from the Roman period are divination or playing tools. Seven of them are cattle and sheep astragali that are worn and polished from use. This is the largest number of used astragali in any of the five phases (tables 1 and 4). The other object connected with ritual or symbolic use is an unfinished red deer antler amulet or pendant.

Only one tool from this period may be connected with fibre or skin processing. It is a cattle metatarsus that is worn at the proximal end and has shiny surfaces as a result of handling and the contact with soft materials.

A unique find is a round sieve (diameter 7.9 cm; thickness 0.3 cm) made from the flat part of a cattle scapula (fig. 31). It was found in a sod structure in which metal working was done, but was probably unrelated to that. It has no traces of contact with fire and sieves are not normally used in metal working (S. Pelsmaeker, pers. comm.). So it is likely that this sieve had a domestic use. The last bone tool from the Roman period is part of a handle made out of a horse metatarsus.

6.2 Migration period

Pin beaters, needles and two awls testify to fibre and possibly skin working during the Migration period. This phase is rich in one- and two-sided composite combs and fragments of broken composite combs. The only type 4 one-sided composite comb, with straight, narrow side plates and winged end tooth plates, and the only complete two-sided composite comb were found in this phase.

Three astragali and two die (fig. 20) and perhaps the three antler rings (fig. 15) could be linked to ritual and magic. Two of the astragali are from very young calves, as indicated by the small size and the porous structure of the bones. Both are perforated from plantar to dorsal (fig. 19). The third is from a young sheep (or goat) and has traces of being worked. The two die – the only two at the site – are made out of sheep metatarsi (table 5; fig. 20).

Two skates and an antler checker demonstrate leisure activities. However, skating may have been a form of transport. Six pieces of waste red deer and elk antler show that antler was processed at the site during this phase.

6.3 Merovingian period

This phase is very rich in processed bone and antler. Fibre and skin production is attested to by numerous tools (tables 1 and 4). Antler combs are common in this phase. The only complete one-sided composite comb is of type 2, with wide, curved side plates and non-extended end tooth plates. In this phase pendants and astragali were used as amulets. A checker is related to leisure activities, as is a flute made from a whooper or a mute swan ulna and perhaps a sawn cattle costa. Skating for leisure or transport is attested to by several skates and bone tips.

Household utensils are quite numerous in this phase. This may be an indication of rich and well-supplied households. The only two spoons found at Wijnaldum-Tjitsma come from this period. One was made out of antler (fig. 29), the other from the frontal bone of a calf foetus or neonatus. The bone was cut in a round shape (fig. 30, suggesting use as a spoon. Calf foetus cranial bones are regularly found in *terpen*, for instance in the early medieval phase at the of Birdaard-Roomschotel *terp* (Grefhorst & Prummel 2010). However, a worked and used frontal

bone from a calf foetus is unique. Spoons were not found in any other *terp* (see below) and may have been prestigious objects, only used in rich households in this period. Silver spoons were found in the Sutton Hoo and Prittlewell burials, which also contained lyres (Carver *et al.* 2005, figs 88 and 99, table 21; Hirst 2004, 28-29).

A decorated cattle bone plate was possibly used as inlaid decoration of furniture. A handle made from red deer antler was intended for a knife or another tool. A sawn cattle horn core shows that cattle horn was processed. Two antler waste pieces indicate antler working during this period.

6.4 Carolingian period

The bone and antler tools from this period resemble those from the Merovingian period. Fibre and skins were processed with bone and antler tools. The inhabitants used combs, astragali and amulets or pendants in ritual or magic, made music with a cattle costa and made an (unfinished) flute out of sheep tibia. One of the inhabitants possessed a little box made from a cattle long bone, perhaps to store a precious object or make-up. A decorated bone plate was presumably a piece of furniture decoration.

The two complete one-sided composite combs from this phase are of type 2 and 3. Type 2 was already known in the Merovingian period. Type 3, with straight, narrow side plates and extended end tooth plates, was presumably introduced at the site during the Carolingian period. It was also found in the Ottonian period. This is the only comb type at the site in which cattle and sheep bone were used (table 3). No two-sided composite combs were found in the Carolingian period.

6.5 Ottonian period

The bone and antler tools from the Ottonian phase attest to fibre and skin processing and the use of combs. There were two one-sided type 3 composite combs and one type 5, which has straight, narrow side plates and tooth plates extending above the side plates.

No worn, shiny and thus used astragali were found and there was only one antler pendant. The use of amulets had presumably come to an end in this period, in which Christianity became firmly established in the north of the Netherlands (Knol 1993).

Whereas skates and tips of skating sticks were common in this phase, musical instruments and household utensils are completely lacking. The last two groups indicate the existence of rich households in the Merovingian and Carolingian periods. No proof exists that bone and/or antler processing was done at the site during this period.

6.6 Diachronous development of bone and antler tools at Wijnaldum-Tjitsma

Fig. 34 shows the development in time of the bone and antler tools used at the *terp*. Fibre and skin working tools are not very numerous in the Roman period. They increase in the Migration period and are very numerous in the Merovingian period. This suggests intensified fibre and skin working in the Migration and later periods, especially in the Merovingian period. Personal utensils, mainly combs, were introduced at the *terp* in the Migration period. Their numbers stayed quite constant during the Merovingian, Carolingian and Ottonian periods.

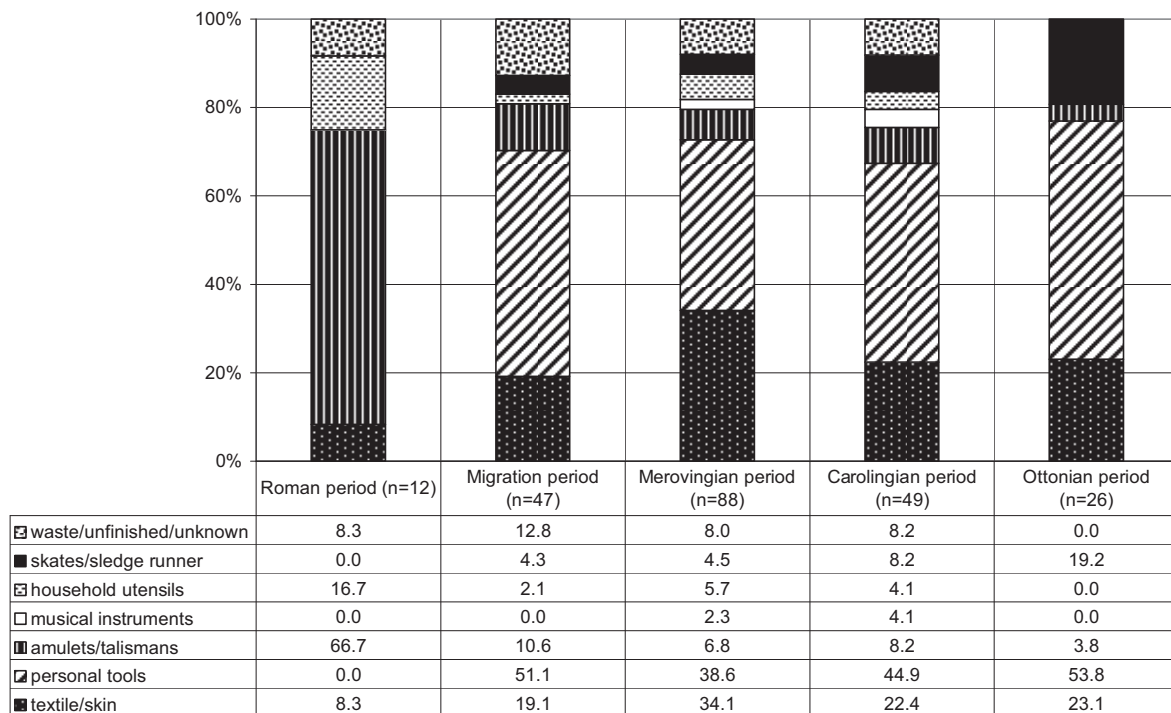


Figure 34 Representation of the groups of bone and antler tools at Wijnaldum-Tjitsma in the five periods.

Amulets were very popular during the Roman period, after which there is a decline. Musical instruments made of bone or antler were only used during the Merovingian and Carolingian periods. This may be related to elite inhabitants at the *terp* during these periods. Household utensils, including the unique sieve, were rather numerous during the Roman period and may be indicative of high status. Some remarkable tools, such as a box, spoons and handles, are among the household utensils from the Merovingian and Carolingian periods and may also be related to elite inhabitants. Skates, skate point tips and a sledge runner were only found in the Migration and later periods. These tools were obviously introduced during the Migration period. They are especially well represented in the Ottonian period.

7 Local bone and antler working or imports?

An important question in the discussion on bone and antler tools is whether they were made at the site or acquired from elsewhere. The presence or absence of production waste and unfinished objects may answer this question. Waste and/or unfinished bone and antler objects are represented in the Roman, Migration, Merovingian and Carolingian periods, but not in the Ottonian period (tables 1 and 4).

Antler working during the Roman period is demonstrated by an unfinished amulet or pendant and a worked piece of antler. Several unfinished objects and waste also point to tool production during the Migration period. These comprise of an unfinished sheep mandible awl, four unfinished antler combs, five other pieces of red deer antler with sawing marks and a waste piece of elk antler, which is presumably comb making waste as well.

An unfinished pendant or amulet and two pieces of production waste attest to the processing of red deer antler during the Merovingian period, whereas a partly perforated, sawn cattle *caput femoris* and a cattle horn core with cut marks attest to cattle bone and horn processing. The unfinished sheep tibia flute also dates to this period. Bone working at the site during the Carolingian period is attested by two unfinished needles. Other pieces of waste could not be dated to a particular period (table 4).

Tool production is thus attested to in the Roman, Migration, Merovingian and Carolingian periods. The small volume of production waste and of unfinished tools suggest small-scale production, mainly for use at the *terp* itself. There is no indication that bone, antler and horn tools were made in large numbers to be traded. An example of a site where many tiny antler waste pieces (353 on a total of 392 worked antler and bone remains) were found and that was perhaps an antler comb production site in the Merovingian and Carolingian periods, is Leidsche Rijn (Utrecht) (Esser 2009, 318-319). Maastricht and Antwerp are other examples of large-scale production sites (Dijkman & Ervynck 1998; Ervynck 1998).

Bone, antler and horn working were most likely some subsidiary activities of the inhabitants, who first and for all would have been farmers. They used the butchery waste that was present at the *terp* in large quantities and some antler. During the Migration, Merovingian, Carolingian and Ottonian periods the site was perhaps visited by itinerant artisans, who sold ready-made products such as antler combs or made or repaired tools on demand during their stay. These artisans could be compared with the goldsmiths who visited the *terp* during the Merovingian and Carolingian periods (Schoneveld & Zijlstra 1999; Nijboer & Van Reekum 1999).

8 The bone and antler tools from Wijncaldum-Tjitsma compared with those from other *terpen* in Friesland and Groningen

8.1 Roman period

The quantities of bone and antler tools in Frisian and Groningen *terpen*, including Wijncaldum-Tjitsma, are low in proportion to the total numbers of animal remains (table 7; fig. 35). The area excavated at most of these *terpen* is comparable with that of the Roman phase of Wijncaldum-Tjitsma. The area of the Paddepoel excavation was, however, much larger, which explains the large number of finds (table 7).

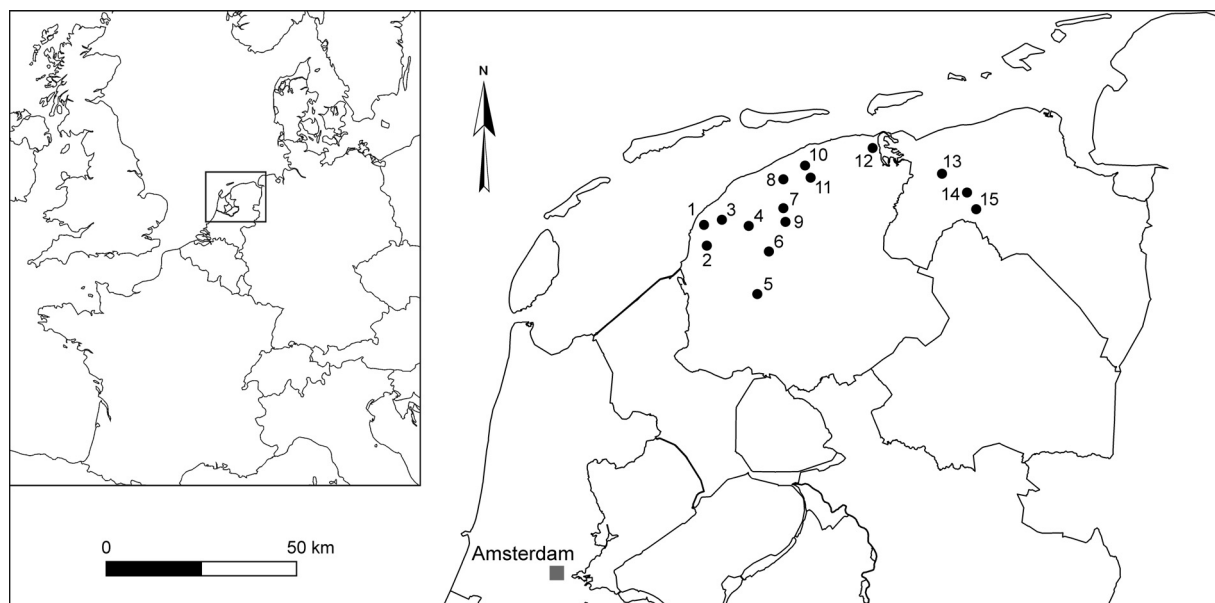


Figure 35 Location of the *terpen* discussed in the text. 1. Wijncaldum-Tjitsma, 2. Achlum, 3. Dongjum, 4. Dronrijp, 5. Sneek, 6. Hoxwier, 7. Jelsum, 8. Hallum, 9. Leeuwarden-Oldehoofsterkerkhof, 10. Oosterbeintum, 11. Birdaard-Roomschotel, 12. Anjum-Terpsterweg, 13. Englum, 14. Wierum, 15. Paddepoel.

No worked or used bones were found at Hallum (Buitenhuis 2009), Birdaard-Roomschotel (Grefhorst & Prummel 2010) and Wierum (Prummel 2006). The only worked bone from Dongjum is a part of a sheep metatarsus of unknown function (GIA unpublished). A cattle metatarsus from Dronrijp shows the same type of wear as those in Wijncaldum-Tjitsma (Halici 2003, 46).

Roman period	fibers/skin	personal utensils	amulets	musical instruments	household utensils	transport	waste/unfinished/ unknown function	total worked bone/antler	total nisp	% worked
Wijncaldum-Tjitsma	1	-	8	-	2	-	1	12	718	1,7
Dongjum	-	-	-	-	-	-	1	1	476	0,2
Dronrijp	1	-	-	-	-	-	-	1	696	0,1
Hoxwier	4	-	-	-	-	-	-	4	144	2,8
Hallum	-	-	-	-	-	-	-	0	594	0,0
Leeuwarden-Oldehoofsterkerkhof	3	-	-	-	-	-	1	4	469	0,9
Birdaard-Roomschotel	-	-	-	-	-	-	-	0	92	0,0
Sneek	-	-	1	-	1	-	-	2	167	1,2
Paddepoel	34	-	-	-	2	-	6	42	2196	1,9
Wierum	-	-	-	-	-	-	-	0	2	0,0
Englum	14	-	1	-	2	-	2	19	1413	1,3
Migration period	fibers/skin	personal utensils	amulets	musical instruments	household utensils	transport	waste/unfinished/ unknown function	total worked bone/antler	total nisp	% worked
Wijncaldum-Tjitsma	9	24	5	-	1	2	6	47	623	7,5
Dongjum	1	1	-	-	-	1	-	3	410	0,7
Hallum	-	2	-	-	1	-	-	3	39	7,7
Englum	-	-	-	1	-	2	-	3	225	1,3
Early middle ages (Merovingian, Carolingian and Ottonian periods)	fibers/skin	personal utensils	amulets	musical instruments	household utensils	transport	waste/unfinished/ unknown function	total worked bone/antler	total nisp	% worked
Wijncaldum-Tjitsma	47	70	11	4	7	13	11	163	3878	4,2
Dongjum	-	1	-	-	-	1	1	3	489	0,6
Hallum	1	-	-	-	-	-	1	2	268	0,7
Oosterbeintum (cemetery)	4	10	8	-	-	-	-	22		
Leeuwarden-Oldehoofsterkerkhof	2	4	1	-	-	6	2	15	2298	0,7
Wierum	-	-	-	-	-	-	16	16	147	10,9
Englum	2	1	-	-	-	-	-	3	155	1,9

Table 7 Numbers of bone and antler tools found in the Roman, Migration and Early Medieval phases at terpen in Friesland and Groningen, with the total numbers of remains (total nisp: unworked and worked; for Wijncaldum-Tjitsma, however, only the numbers of identified mammal remains are given, because of the many small unidentified bone fragments (compare table 3), which would made the comparison with the other sites impossible) and the proportions of worked bone/antler. No total number of identified mammal remains is given for the Oosterbeintum site because the site is a cemetery and the bone and antler tools are grave goods.

The inhabitants of Hoxwier only used bone tools for fibre and skin working, as attested to by three worn and shiny horse and cattle metapodia and a shiny cattle costa fragment worn at both ends (Nieuwhof & Prummel 2007). The latter is regularly found in *terpen* but was not found at Wijnaldum-Tjitsma. A large number of them was found in the German *terp* Feddersen Wierde (1st century BC–5th century AD; Reichstein 1991, 311; Struckmeyer in press), where they are interpreted as fibre or skin working tools, but might have been used to smooth clay (Struckmeyer in press) or as household utensils (scraper).

The worked bones from the Roman period phase of Leeuwarden-Oldehoofsterkerkhof comprise a bone needle made from a pig fibula, two worn and shiny cattle metacarpia and a red deer cranium fragment with sawn antler base (Prummel 2011). The bone tools found in Sneek are a dice made from a sheep metatarsus and a horse phalanx one-sided comb? with point-circles (Clason 1962).

The majority of the bone tools from the late Iron Age to Roman period *terpen* Paddepoel I, II and III are fibre and skin working tools. They are worn cattle costa fragments, spindle whorls, an awl and metapodia used as polishers. Two perforated horse phalanges were identified as toys, but might be amulets (Knol 1983, 172–173). All Roman bone tools at Englum are connected to fibre and skin working: worn and shiny cattle and horse metapodia, costa fragments similar to the Hoxwier and Paddepoel ones, a worn cattle tibia fragment and a worn part of a cattle scapula (Prummel 2008).

Fibre/skin working tools are thus numerous at most of the Roman period *terpen*. Amulets and household utensils that were common at Wijnaldum-Tjitsma in the Roman period are rare in other Roman period *terpen*. Personal utensils and skates/sledge runners are lacking. They were unknown at the Frisian and Groningen *terpen* in the Roman period.

8.2 Migration period

The excavations at Dongjum, Hallum and Englum (table 7, fig. 35) were medium-sized; water-sieving was only done at Englum. The introduction of combs and bone skates during this period will partly explain the higher proportions of worked bones in the Migration and later periods (table 7). An antler comb side plate, a bone skate and a spindle whorl found at Dongjum date to the Migration period (GIA unpublished).

Two antler combs and a cattle costa fragment found together with a piece of wood of the same shape were found in the Migration period phase at Hallum. The combs are a triangular one-sided comb and a two-sided comb (Buitenhuis 2009). Other one-sided triangular combs came to light in an inhumation burial in the Oosterbeintum *terp* (Knol *et al.* 1996, 374–375; Kramer & Prummel 2000, fig. 1). The comb was dated to AD 475–525, i.e. during the Migration period (see table 7, where the comb is listed with the grave goods from the Migration and Merovingian periods). One specimen of the same type was found in Englum, but dated to the Merovingian period (see below).

Dating to the Migration period phase at Englum are two unfinished skates, one made from a cattle radius, the other from a horse metacarpus, and a sawn cattle costa similar to the ones found at Wijnaldum-Tjitsma (Prummel 2008). The use of bone and antler tools was perhaps less extensive in the other *terpen* than at Wijnaldum-Tjitsma, where however there is a broader assemblage which also include personal items. The large number of tools at Wijnaldum-Tjitsma, however, is also the result of water-sieving (table 7).

8.3 Merovingian period

The bone tools from the Merovingian, Carolingian and Ottonian periods from the other *terpen* are shown in table 7 under the heading 'Early Middle Ages' because tools from some *terpen* were not dated precisely enough to place them into a specific period. The excavated early medieval settlement areas at Dongjum, Hallum, Leeuwarden-Oldehoofsterkerkhof, Wierum and Englum were each smaller, but together larger than that of Wijnaldum-Tjitsma. Water-sieving was done at Englum but did not result in many bone and antler tools. The site of Oosterbeintum is a cemetery that was carefully excavated and where wet-sieving was part of the methodology.

At Merovingian Dongjum we find a horse metacarpus skate and a worked sheep costa (GIA unpublished). A bone needle from Hallum dates to Merovingian or Carolingian times (Buitenhuis 2009). Thirteen presumably Early Medieval tuning pins found at Hallum (Van Vilsteren 1987, 56) suggest an elite population at this *terp*.

Graves at Oosterbeintum, which was in use between AD 400 and 750, contained bone and antler grave goods that date to the Migration and Merovingian periods. These are a bone needle, three spindle whorls (one antler and two cattle *capita femoris*), seven composite combs, a pin, two beads, a pendant/amulet, two wolf teeth attached to a chatelaine and 5-7 knuckle bones (Knol *et al.* 1996). These grave goods fall into the categories of fibre and skin working tools, personal utensils and amulets. Two combs can be identified on the basis of the comb typology employed at Wijnaldum-Tjitsma. The two-sided composite comb from grave 422 dates to the Migration period. The comb with narrow, straight side plates from grave 5 belongs to Wijnaldum type 3, dating to Carolingian and Ottonian periods.

From Migration and Merovingian Leeuwarden-Oldehoofsterkerkhof we have a cattle metacarpus used as a polisher, fragments of about four two-sided composite antler combs and a broken skate from a horse metatarsus (Prummel 2011).

Bone working is attested to in the Merovingian phase of Wierum by the sawn distal end of a cattle metatarsus (Prummel 2006). Two fibre or skin processing tools from Englum date to the Migration or the Merovingian period: a cattle metacarpus used as a polishing or rubbing tool and the tip of an awl made from a sheep tibia. These findings suggest that fibre and/or skin working was done at Englum during one or both of these periods. A one-sided composite antler comb with triangular side plates from this *terp*, both of them decorated with parallel lines and point-circles, is Merovingian in date (Prummel 2008). Amulets, musical instruments and household utensils, which are quite numerous at Wijnaldum-Tjitsma in the Merovingian period (tables 1 and 3), are absent in other contemporary *terpen*, with the exception of Hallum (the tuning pins).

8.4 Carolingian and Ottonian periods

A perforated piece of red deer antler was found in a Carolingian or Ottonian feature at Hallum (Buitenhuis 2009). The bone tools from the Carolingian period at Leeuwarden-Oldehoofsterkerkhof are an unfinished needle made of a sheep or pig bone, a dice made of a sheep metatarsus, three skates (two of horse metacarpi and one of a horse tibia) and antler production waste. A horse metatarsus skate and a polished unknown type of tool (Prummel 2011) date to the Ottonian or later phase. No bone or antler tools were found in the Carolingian phase at Anjum-Terpsterweg. However, a side plate from an antler composite comb was found in an undated feature (Prummel & Van Gent 2010).

Bone working in the Carolingian period at Wierum is attested to by several sawn proximal and distal horse and cattle metapodia and radius ends and by a sawn horse mandible (Prummel 2006). Comb fragments made of cattle metapodia were found together with masses of

waste, identical to that in Wierum, at the Tolweg-Zuid/Kinkhornsterweg *terp* (province of Groningen), together with cattle mandible debitage from the manufacture of spindle whorls (Prummel *et al.* 1999). The Tolweg-Zuid/Kinkhornsterweg finds, which date to the 12th–14th centuries, make it plausible that the Wierum sawn fragments are waste from composite comb production and perhaps spindle whorls.

The use and the diversity of the bone and antler tools at Wijnaldum-Tjitsma during the Migration, Merovingian, Carolingian and Ottonian periods was much more extensive than at any of the contemporaneous *terpen*. Several of the objects found at Wijnaldum-Tjitsma, for instance musical instruments and household utensils, were either not found in other *terpen* or very rare, for example personal utensils (table 7). We may conclude that a more prominent society lived at Wijnaldum-Tjitsma during the Early Middle Ages, and perhaps already during the Migration period, than at the other *terpen*.

9 Conclusions

Fibre and skin processing tools and personal utensils such as combs, pins and rings are the most common bone and antler tools found at Wijnaldum-Tjitsma. Amulets, musical instruments, household utensils and objects associated with transport are present in smaller numbers. Antler was the most common raw material since the Migration period. The antler objects were mainly of red deer antler, but some elk antler was also used. Cattle, sheep, pig, horse, whale and whooper or mute swan bones were used to make tools (table 2).

Whereas fibre and skin processing tools were used at Wijnaldum-Tjitsma in all periods, combs, pins, rings, beads and objects associated with transport were unknown in the Roman period. Amulets are well represented at this *terp* in the Roman period and are more common than at contemporary *terpen*. Apart from the amulets, the Roman period bone and antler assemblage at Wijnaldum-Tjitsma is similar to that at contemporary *terpen*, although fibre and skin working tools are better represented in these *terpen* than at Wijnaldum-Tjitsma (fig. 36). A unique find is a sieve, a utensil which possibly belonged to a rather rich household, perhaps a precursor of the later high status of the *terp*.

New inhabitants occupied Wijnaldum-Tjitsma in the Migration period. They introduced personal utensils made of bone and antler, such as combs, pins, rings and beads, and object associated with transport across the ice. Although personal utensils such as combs were found at other *terpen*, they were particularly numerous at Wijnaldum-Tjitsma in the Migration, Merovingian, Carolingian and Ottonian periods (table 7).

The tuning pin, box, spoons, decorative plates, handle and checkers die are remarkable finds from the Migration, Merovingian and Carolingian periods at Wijnaldum-Tjitsma. These objects are rarely found in other *terpen*. They are considered as indicators for elite inhabitants at Wijnaldum-Tjitsma in the Merovingian and Carolingian periods. The bone and antler tools, metal and glass objects confirm the elite status of the *terp* inhabitants during these periods.

Amulets, which were common in the Roman period at Wijnaldum-Tjitsma, were found in small numbers at the site in the Migration, Merovingian and Carolingian periods. They were perhaps mainly used as grave goods, as is indicated by similar finds at the cemeteries at Oosterbeintum (table 7), Hogebeintum and Driesumerterp (Knol 1987; Knol 1988; Knol *et al.* 1996) and in the Migration period inhumation burial at Wijnaldum-Tjitsma. Amulets are completely lacking in the Ottonian period, perhaps because of the introduction of Christianity, which banned divination and magical acts, and thus the use of these objects.

The antler and bone waste shows that some bone and antler were worked on site during the Roman, Migration, Merovingian and Carolingian periods. It was, however, never an extensive activity at Wijnaldum-Tjitsma (table 1). Some bone and antler tools were perhaps acquired in their finished form.

Acknowledgements

The research for this paper was subsidized by The Netherlands Organisation for Scientific Research (NWO) as an Odyssee project. The tools were drawn J.M. Smit and by E. Bolhuis (fig. 35), both from the Groningen Institute of Archaeology, University of Groningen. We are grateful for comments from the editors, the anonymous peer reviewer and Kinie Esser and Jørn T. Zeiler.

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Notes

1. *Terpen* (plural of *terp*) are artificial dwelling mounds in the coastal district of the northern Netherlands and northern Germany, dating from the Middle Iron Age and subsequent periods.
2. Only linen cloth needs to be prepared with fat, not woollen cloth (personal communication K. Struckmeyer, Wilhelmshaven (Germany)).

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Report on the manufacture and wear trace analysis of ten bone and antler artefacts from the Wijncaldum-Tjitsma *terp*.

Annemieke Verbaas

Introduction and Methods

A total of 10 bone needles from Wijncaldum-Tjitsma were analysed at the Laboratory for Artefact Studies, Leiden University with the aim of shedding light on manufacture, residue and wear. The selection consists of six complete needles (of which three are broken, but all pieces are present), one fragment of a bone needle, two pins and one unidentified object. All needles were analyzed using a Nikon SMZ I2 and a Wild Periplan stereomicroscope (magnifications 6,5 to 160x) and a Nikon Optiphot metallographic microscope (magnifications 100-300x). Photographs were taken with a Nikon Fi1 digital camera. The stereomicroscope gives a general overview of traces of manufacture and wear. The metallographic microscope gives a more detailed view of the wear and facilitates a more detailed interpretation of the traces present. The needles did not need any cleaning as no dirt or sediment was present. All needles and their wear traces were well preserved.

It should be stressed that if an object was used for a long time on different materials only the last use or uses would be visible in the use wear. Obviously this will depend on the sequence, but generally the traces from the last contact material supercede the existing traces of wear. For example, if a needle is used with leather for a short period of time and is subsequently used

with plant fibres for a long time, usually only the traces from contact with plant fibres would still be visible.

Manufacture

None of the objects is shaped in a rather rough, ad hoc manner. Almost all objects seem to be shaped by scraping and/or cutting. This can, amongst other features, be seen at places where the scraper or knife dived too deep into the surface, leaving shallow hack marks. An exception is find number 5528 which seems to have been finished by polishing. It is likely that some of the needles were polished after the initial shaping phase by scraping and/or cutting, but no traces of this were visible. Most of the needles still display some part of the original outer surface of the bone. These needles were made out of a thin bone, i.e. a pig fibula and only part of the sides and the front and the back end were modified (find numbers 1, 153, 1001 and 1024). In these cases the spongiosum is visible inside the needles on the fractured surfaces. The perforations can be straight or hourglass shaped. Find numbers 5528 and 1001 have an oblong shaped perforation. On find number 5528 there are two perforations drilled close to each other.

Use

Five of the needles were used on plant fibres (find numbers 1, 1001, 1024, 1065 and 5528). Unfortunately it is not possible to specify the plant species involved. Experimental research has so far not shown enough variability in the polish resulting from contact with different kinds of plants to allow precise identification. These needles might, especially if you take their shape and size into consideration, have been used for the making and repairing of nets or to manufacture containers of different plant fibres. The traces present on the other two needles (find numbers 153 and 2650) display features that can be attributed to contact with different materials, suggesting that they were indeed used on different materials.

Of the two pins one displays traces of wool (find number 5972). It was probably used as a fibula on a woollen mantle or cloak. The other pin shows traces of probable contact with hair and was probably used as a hairpin (find number 3453). The last object, of unknown type, has probably been used to work skin or leather (find number 3869). The entire surface of the object shows the same wear and even the reverse is rounded, indicating the object was pulled through leather in its entirety.

Catalogue

Find number 1. This undated needle was made out of a pig fibula, thus necessitating minimal shaping. Indeed, a large part of the surface consists of the original surface of the bone. Where traces of manufacture are visible, they are due to a scraping and/or cutting motion. The needle is faceted in cross-section. The end of the needle is wide compared to the shaft and has a large drilled straight perforation. The needle was used for the processing of plant fibres.

Find number 153. This needle, dated to the Migration period, was made out of a pig fibula. The reverse of this needle is flared. The needle is partly hollow as the marrow cavity that transports blood through the bone is present in this needle, starting from the tip. The needle was shaped by scraping and/or cutting and in some areas the old bone surface is still visible. The needle was probably used on different materials.

Find number 1001. Also dating to the Merovingian period, this needle was made out of a pig fibula. The flared reverse side of the needle shows traces of manufacture by both scraping and polishing. The needle's tip lower part mostly consists of spongeosum. The perforation is oblong in shape. The tip was probably also shaped but is unfortunately missing. The needle was used on plant fibres. The degree in which the wear traces have developed suggests that it was used for a shorter time than the other needles analysed.

Find number 1024. This needle, dating to the Merovingian period, was made out of a pig fibula. It is complete and faceted in cross-section. From halfway up the shaft it is rather flat with a slightly oblong, hourglass shaped eye. On one of the sides it is clearly visible that two holes were perforated very close to each other. They join into one perforation on the needle's other side. The needle was shaped by scraping and/or cutting and was probably finished by polishing. The needle was probably used on plant fibres.

Find number 1065. This needle, dating to the Merovingian period, was made out of a long bone fragment of an unidentified mammal. It was shaped by scraping and/or cutting and finished by polishing. At the tip the tool is round in cross-section, whereas near the perforation it is flat in shape. The eye is hourglass shaped. On parts of the surface a greyish brown colour of unknown origin is visible on top of which there are use wear traces. The colour therefore seems to be part of the bone. The needle was used for processing plant fibres.

Find number 2650. This needle, dating to the Migration period and made out of a long bone fragment from an unidentified mammal, is very irregularly shaped by scraping and/or cutting. The perforation is slightly hourglass shaped and oblong. The needle seems to have been used on different materials. The wear traces indicate skin/leather, plant materials and possibly wool.

Find number 3453. This pin is dated to the Merovingian period. It was made out of a long bone fragment from an unidentified mammal. The pin is faceted in cross-section and was shaped by scraping and/or cutting. Some hack marks on the surface are indicative of some faults during this phase of the manufacturing process. The shaft shows traces that resemble the traces seen on an experiment used to sew hair. The traces on this archaeological tool are, however, a bit more greasy in appearance. The experiment was done on clean hair and it is possible that the traces on the archaeological tool represent oilier or dirtier hair. The circular shaped end of this pin shows traces that differ from those on the shaft. They are probably the result of frequent handling of this hair pin.

Find number 3869. This unidentified object dates to the Merovingian period and was made out of a bone fragment from an unidentified mammal. Although it appears straight, its shape is irregular. It is shaped by scraping and/or cutting the bone. The object displays traces of contact with hide over its entire surface. This suggests that the object was pulled through hide or skin. The reverse of the object is also rounded.

Find number 5528. This needle is dated to the Migration period. It was made out of a long bone from an unidentified mammal. The needle is completely flat, unlike the other needles in this study. The needle only displays traces from the final polishing phase of manufacture, remnants of the spongeosum are still visible. The perforation of this needle was made by placing two holes close to each other. The needle was used to work plant fibres.

Find number 5972. This pin dates to the Merovingian period and was made out of red deer antler. The pin is faceted in cross-section. These facets are the result of cutting or scraping this

pin into shape. The entire surface displays traces of contact with wool. This pin was probably used as a fibula on a woollen garment.