

TWO 'EPI-AHRENSBURGIAN' SITES IN THE NORTHERN NETHERLANDS: OUDEHASKE (FRIESLAND) AND GRAMSBERGEN (OVERIJSSSEL)

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ABSTRACT: Two open-air sites in the northern half of the Netherlands are described: Oudehaske in the valley of the Boorne (Friesland) and Gramsbergen in the valley of the Vecht (Overijssel). The sites are ascribed to the 'Epi-Ahrensburgian' (after Gob, 1988), a transitional group between the Ahrensburgian and the Mesolithic, which can be dated to the first half of the Preboreal. Sites of this group are characterized by a predominance of simple microliths among the points while tanged points are scarce or absent, and by a 'Late Palaeolithic' blade technology aiming at the production of quite large blades. At both sites, several blades longer than 10 cm are present (but no 'bruised blades'). A refitting analysis of the flint material from both sites was performed by the first author, the results of which are discussed extensively.

KEYWORDS: Late Palaeolithic, Epi-Ahrensburgian, northern Netherlands, refitting analysis of flint artefacts

1. THE 'EPI-AHRENSBURGIAN'

The main aims of this paper are to present the sites at Gramsbergen and Oudehaske (fig. 1) with new drawings of all the tools and cores; to report on the extensive refitting analyses of the flint artefacts from both sites performed by the first author; and to discuss the results of our work in a wider context.

Until quite recently, it was believed that the Ahrensburgian was confined to the southern half of the Netherlands, i.e. to the area south of the zone in which the rivers Rhine and Meuse flow from east to west in the central Netherlands. Quite a number of Ahrensburgian sites are known in the southern Netherlands; the best-known sites in this area are Vessel and Geldrop (Arts & Deeben, 1981; Bohmers & Wouters, 1962; Deeben, 1994; 1995; 1996). The sites at Gramsbergen and Oudehaske lie north of the rivers Rhine and Meuse. Several other Ahrensburgian sites in the northern half of the country (Ede, Lunteren, Kootwijkerzand, Reutum, Havelterberg, St. Johannesga) have also been reported in recent years (e.g. Van Noort & Wouters, 1987; 1989; 1993; Wouters, 1990). It now seems clear that Ahrensburgian people lived also in the northern Netherlands. However, it appears that most of the sites in this area do not date from Dryas 3, as do many of the southern sites, but from the first half of the Preboreal. The climate during Dryas 3 may have been too harsh for human occupation of the north (e.g. Lanting & Van der Plicht, 1995/1996).

'Ahrensburgian tanged points' have always been regarded as 'type fossils' of the Ahrensburgian, and their presence is often considered imperative for ascribing any site to this tradition (most recently: Baales,

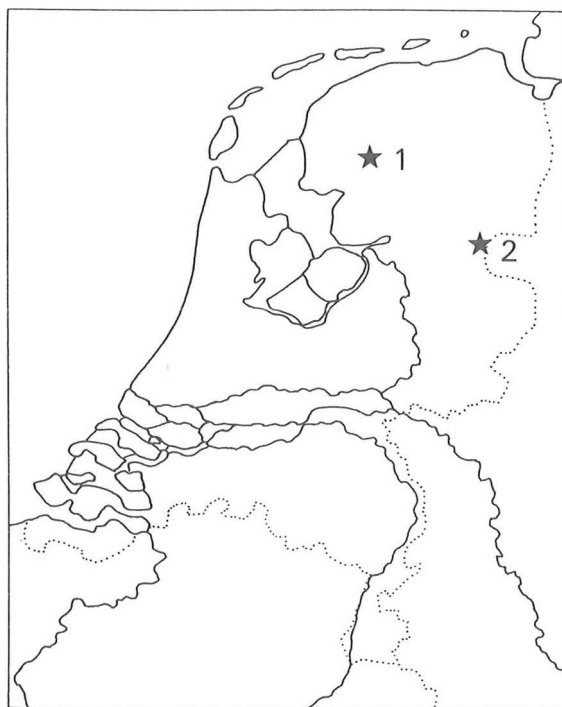


Fig. 1. Map of the Netherlands, showing the locations of the sites at Oudehaske (1) and Gramsbergen (2). Drawing by Lykke Johansen.

1996). These are relatively small tanged points (mostly with lengths between 1.7 and 5.5 cm, according to the classification of Taute, 1968: p. 12). Ahrensburgian tanged points are smaller than the long and sturdy

tanged points of the Brommean tradition in southern Scandinavia, which can be dated mainly to the Allerød. One of the hypotheses concerning the origin of the Ahrensburgian is that it is derived from the Brommean (Taute, 1968), implying not only that the Brommean tanged points 'evolved' into the smaller Ahrensburgian ones, but possibly also that the bearers of the Brommean tradition followed the reindeer southwards during Dryas 3, and became Ahrensburgians in the process. An alternative hypothesis, put forward by e.g. Paddyaya (1971) and Rozoy (1978), views the Ahrensburgian as derived from the *Federmesser* tradition, in which case no movement of groups of people across the landscape needs to be envisaged. If one derives the Ahrensburgian from the Brommean, the *Federmesser* elements occurring in the oldest Ahrensburgian sites may be considered to indicate contacts between migrants from the north and people of the *Federmesser* tradition living in central and northern Europe. Alternatively, the *Federmesser* elements may be seen as indications of a cultural evolution from *Federmesser* to Ahrensburgian on the basis of essentially the same indigenous population. One might summarize these options as follows: tanged points were either brought here, or they were invented here. However that may be, in a general sense it can be noted that tanged points are associated with the hunting of reindeer. Sites including some *Federmesser* elements but otherwise characterized by the presence of many tanged points, such as Vessem-Rouwven (Arts & Deeben, 1981) and several sites at Geldrop (Deeben, 1994; 1995; 1996), seem to represent the oldest phase of the Ahrensburgian. In this connection reference is often made to the radiocarbon date obtained for Geldrop 1: 10,960±85 BP (Lanting & Van der Plicht, 1995/1996). However, this does not necessarily date the Ahrensburgian material at the site; it might in fact date charcoal eroded out of the locally occurring Layer of Usselo; the sample was not taken from a distinct hearth (Deeben, 1994: p. 94). Nevertheless, the site can certainly be dated to Dryas 3 on stratigraphical grounds.

Although the 'classic' Ahrensburgian sites such as Stellmoor (Rust, 1943), up to the end of Dryas 3 or even the earliest Preboreal, are characterized by a predominance of tanged points, microlithic points were present from the start. In the closing phase of the Ahrensburgian, however, it seems that progressively fewer tanged points occurred, while microlithic points increased in importance, until finally tanged points virtually disappeared. It has long been recognized that at some Ahrensburgian sites tanged points are rare or even absent, while microlithic points occur in quantity. Taute (1968: pp. 220-221) included several sites with hardly any or no tanged points in the Ahrensburgian (his 'Diddersse-Lavesum-Gruppe') instead of assigning them to the Mesolithic, especially because of the presence of large blades, including *Riesenklingen*. He suggested that such sites might represent a late phase of the Ahrensburgian, dating from the last part of Dryas 3 or the first part of the

Preboreal (Taute, 1968: p. 236).

The sites to be discussed in this paper, Gramsbergen (province of Overijssel) and Oudehaske (province of Friesland), are here attributed to a late phase of the Ahrensburgian. At both sites we encounter a 'Late Palaeolithic' blade technology, with a tendency towards the production of large blades. The presence of *Grossklingen* (blades longer than 12 cm) is certain or very probable at both sites. Furthermore, both sites show a clear predominance of microlithic points. At Oudehaske a single tanged point of Ahrensburgian type was found, at Gramsbergen none (however, see under 4.4.4 for a stray find of a tanged point near Gramsbergen). Finally, at both sites *Federmesser* elements are absent. Independently of these archaeological arguments, the stratigraphy of both sites suggests that they can hardly be older than the end of Dryas 3. In fact, a dating in the first half of the Preboreal seems perfectly plausible, especially in the case of Gramsbergen.

As noted above, some authors tend to classify sites with only microlithic points (no tanged points) as Mesolithic. Gramsbergen would then have to be placed in the Early Mesolithic. Oudehaske, however, because of the single tanged point, would be classified as Ahrensburgian. Apart from that, however, the two sites are very similar, also with respect to their point inventories. In some respects, the Gramsbergen material makes an even more convincing 'Palaeolithic' impression than that of Oudehaske. It does not make sense to us that, because of a difference of one tanged point, these sites should have to be ascribed to different cultural traditions. Other authors, most notably Gob (e.g. 1988; 1991) have argued that the 'type fossil' approach might in this case be misleading. Gob introduced the term 'Epi-Ahrensburgian' for the last phase of the Ahrensburgian. This phase is characterized by a predominance of simple microlithic points, while tanged points are rare or absent. Sites such as Gramsbergen and Zonhoven (Huyge, 1985) would belong to this phase. It appears that this phase can be dated to the first half of the Preboreal (see also Lanting & Van der Plicht, 1995/1996). An important reason to consider sites of this group as being still part of the Ahrensburgian instead of the Mesolithic, is the occurrence of regularly formed and quite large blades (including, at many sites, *Grossklingen* or *Riesenklingen* as defined by Taute, 1968). The blade technology of the Epi-Ahrensburgian was rather different from that of the 'pure' Mesolithic. In the northern Netherlands, the large blades disappear roughly half way through the Preboreal. In fact, we see a general decrease in the quality of the exploited flint nodules, and blades become shorter and less regular. It is conceivable that there existed a correlation with the vegetation: the more densely the landscape became covered by vegetation, the more difficult it would have been to find good quality flint nodules at the surface (Stapert, 1985).

It seems that the Epi-Ahrensburgian can be dated mainly to the Friesland and Rammelbeek phases of the

Preboreal, during which the vegetation was not yet very dense. The Rammelbeek phase is a brief colder and drier period within the Preboreal (e.g. Van der Hammen & Wijmstra, 1971), which has aptly been called the 'Youngest Dryas' (Baales, 1996: p. 338). According to Lanting & Van der Plicht (1995/1996: p. 83), the Rammelbeek phase can be dated to about 9900-9700 BP. During at least part of the first half of the Preboreal, reindeer might still have roamed the northernmost zones of the North European Plain. From about 9600 BP on, Holocene forest vegetations took hold definitively, and Mesolithic traditions, in this area characterized by smaller blades and axes, took over (e.g. Bokelmann, 1991; Niekus et al., 1997). Bedburg (Street, 1989; 1991; 1993) seems to be one of the earliest 'Mesolithic' sites in the region: the blades are still rather long, but the reindeer had already gone.

2. NOTES ON THE REFITTING ANALYSIS

The work undertaken for this paper is part of a larger project, the 'ANALITHIC project'. A major goal of this project is to develop an integrated computer package for spatial analysis of Stone Age sites. At present, the ANALITHIC package comprises operational modules for cartography, ring-and-sector analysis, density analysis, refitting analysis and use-wear analysis (Boekschoten & Stapert, 1993; 1996; Boekschoten et al., 1997; Johansen & Stapert, in prep.). The refitting module in the package was built on the basis of ideas of the first author (Johansen, 1993; 1998; in press a). Files under the format of the ANALITHIC package, including all refitting data, were built by the first author for both the site of Gramsbergen I (discussed in this paper) and for the Ahrensburgian site of Sølbjerg 1 in Denmark (discussed in Johansen, in prep.; in press c; see also Vang Petersen & Johansen, 1991; 1994; 1996). The Oudehaske site is not suited for treatment with the ANALITHIC package, because of the absence of spatial data. At the end of this paper we will briefly discuss what has been achieved by subjecting three Ahrensburgian sites (Sølbjerg 1, Oudehaske and Gramsbergen I) to refitting analyses by the same analyst, using the same methodology for recording and analysing the results in each case.

Refitting is a multifaceted technique, not only resulting in data on prehistoric flint technology, but also producing insights into 'import and export' of artefacts, and in spatial patterns at the site level. A refitting analysis may significantly contribute to a better understanding of the site's function. An important concept in refitting studies is the *chaîne opératoire*: the complete chain of operations from selection of nodules, through the production of blades and tools, to their use and eventual discarding (e.g. Karlin & Julien, 1994; Pelegrin et al., 1988). Refitting may reveal which parts of the sequence are documented by the artefacts at any site, and which

are absent, thus producing clues to the function of the site. The spatial component of refitting analysis helps to produce dynamic pictures. When the results of refitting are mapped, different types of movement of material across the site can be observed, for example from points of production to activity areas, or from the latter to dumps. Refitting may thus contribute to a better understanding of the processes underlying the static spatial data recorded during excavation (Keeley, 1991). A fascinating aspect of refitting is that it may allow the identification of individual flint knappers on the basis of differences in level of skill (e.g. Bodu et al., 1990; Karlin & Julien, 1994; Boekschoten et al., 1997; Johansen & Stapert, in press).

Although refitting produces unambiguous data (artefacts either fit together or they do not), there are many ways to document and present the results. After a somewhat chaotic period, the presentations of refitting analyses have become more 'standardized', and therefore more comparable, especially through the efforts of Erwin Czesla (Czesla, 1990; see also: Czesla et al., 1990). Since then, refitting analysis has undergone only minor changes in its basic methodology (the interpretation of refitting data is of course another matter). The first author has developed a system of recording and analysing refitting data which is largely based on the principles outlined by Czesla, but with a number of refinements. One of these is the concept of 'refitting clusters' (Johansen, 1993; 1998; in press a): subareas within any site which have a relatively high number or percentage of artefacts involved in refits, and may be compared with each other in several ways. Refitting clusters are especially useful in the spatial analysis of sites which have been carefully and exhaustively excavated. The site of Oudehaske was disturbed before excavation, so any more detailed analysis of its spatial structures is precluded. The situation at the Gramsbergen site is slightly better; in this case the finds were essentially collected by the square metre. In the case of Oudehaske we are dealing with a disturbed site; the artefacts derive from the ploughed topsoil. Moreover, the field must have been burned repeatedly in recent times, resulting in quite a large proportion of burnt flints and also in many fractures. One could therefore wonder why a refitting analysis, a time-consuming task, was nevertheless performed. An important advantage of Oudehaske is that the material from the site was collected more or less completely, by sifting the soil through sieves with a mesh width of 4 mm. We therefore possess a more or less complete assemblage. Because of this circumstance, several types of data produced by refitting will still be valuable, and interesting enough to make the exercise worthwhile. One of these aspects is the study of Late Ahrensburgian blade technology and its *chaîne opératoire*. Another interesting phenomenon that can be studied profitably by refitting is import and export of flint artefacts.

A few terms used in this paper have to be clarified be-

fore we can proceed (for a more extensive discussion, see: Johansen, *in press a*). *Refitted groups* are the working units in refitting analysis: 'compositions' consisting of artefacts fitting together. For each refitted group, a *refitting diagram* is made; it shows the artefacts, represented by symbols per artefact type, and lines of different types connecting them, in schematic form. We employ the Czesla system for classifying and drawing *refitting lines* (Czesla, 1990). The most important types of refitting line are: *sequences* (ventral/dorsal refitting), *breaks*, and *burin/burin spalls*. (In this text, the word *conjoining* is sometimes used for refitting in the ventral/dorsal way.) We use the word *refit* as an equivalent to refitting line: the number of refits is the number of refitting lines. It has to be noted that different systems of generating refitting lines will result in different numbers of refits. Though each refit refers to a refitting line, connecting two artefacts, there is no simple relationship between the number of refits and the number of artefacts involved in refitted groups. It is therefore important always to distinguish clearly between refits, refitted groups, and refitted artefacts. One reason to count the numbers of refits of several types, instead of the numbers of artefacts per refitting category, is the circumstance that artefacts can be involved in all types of refit simultaneously: imagine a sequence, involving among other artefacts a burin consisting of several fragments, with a burin spall fitted to it. Counting the number of lines per refit type, on the other hand, can be done unambiguously once a clear system of generating lines is adopted.

3. OUDEHASKE

3.1. The site and its excavation

The Oudehaske site was discovered in March 1989, by amateur archaeologist Gerrit Jonker of Heerenveen. The site is located in the field south of Jousterweg No. 150, about 2 km west of Heerenveen; the coordinates on the Topographical Map of the Netherlands are: X=188.30/Y=552.34. Jonker (together with an unnamed friend) collected a total of 507 flint artefacts from the ploughed field. An excavation at the site was made possible through the efforts of E. Kramer of the Fries Museum in Leeuwarden, acting as an intermediary. The Fries Museum acquired the artefacts collected by Jonker (including those found by his friend G. Jonker, *pers. comm.* 1989), and all the excavation finds from Oudehaske are also kept at this museum. In the summers of 1990 and 1991, excavations were carried out by the Groningen Institute of Archaeology (then Biologisch-Archaeologisch Instituut) of Groningen University, in cooperation with the Fries Museum at Leeuwarden and the Argeologysk Wurkferbân of the Fryske Akademy. Several brief reports in Dutch about this work have appeared (Stapert, 1989a; 1991; Dijkstra et al., 1992).

In total, 58 square metres were investigated. The site was found to be totally disturbed: no artefacts *in situ* were recovered. All artefacts derive from the ploughed topsoil, or from mole tunnels, root traces and the like just beneath the topsoil. The topsoil and 20 to 25 cm of the sand underneath were sifted by the square metre, using sieves with a mesh width of 4 mm. In total, 2050 artefacts were collected in this way. The richest square metre contained 196 flint artefacts. Together with the collection of Jonker (n=507), and other stray finds from the field (n=64), in total 2621 artefacts are now known from the site. We are convinced that not much remains at the site; the total number of artefacts ≥ 4 mm will originally not have been much over 3000. Of the total of 2621 artefacts collected at Oudehaske, 1706 (65.1%) are chips: artefacts smaller than 1.5 cm (excluding recognizable tool fragments). Of the remaining 915 artefacts, 61 are classified as tools or tool fragments: 6.7% of the total excluding chips (the percentage of tools among all collected artefacts is 2.3%). Since all material comes from the ploughed topsoil, spatial data are of limited value in this case. The spatial component of the refitting data is therefore not considered. The

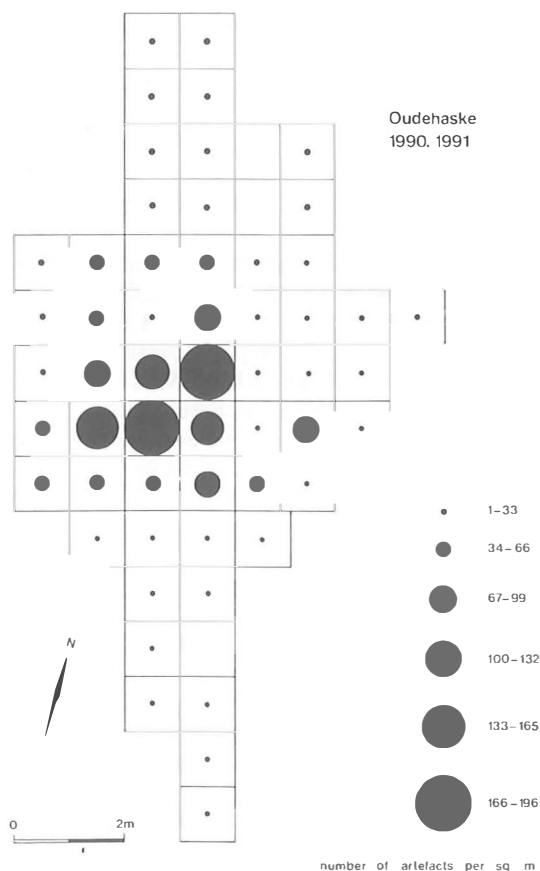


Fig. 2. Oudehaske. Density map showing the numbers of artefacts per square metre, collected during the excavations of 1990 and 1991. All artefacts derive from the ploughed topsoil. Drawing by Dick Stapert/J.M. Smit.

numbers of artefacts per square metre, collected by sifting, are presented in a density map (fig. 2). The map suggests that we are dealing with a relatively small concentration, some 4 to 5 m across. Not much more can be deduced from this map.

3.2. Geography of the region

In the province of Friesland, three areas with different types of landscape can be distinguished: 1) the area covered by marine clays in the west and north, 2) the marshland area in the middle, with many lakes resulting from peat-digging, and 3) the relatively high, sandy area in the south, southeast and east. Oudehaske is situated on the inner flank of the so-called Frisian Coversand Belt, which is part of area 3 (after Veenenbos, 1954; see also: Cnossen & Heijink, 1965; De Groot et al., 1987). This belt, up to about 10 km wide in its central part, is characterized by relatively thick deposits (in many places more than 2 m) of aeolian sands dating from the Late

Glacial ('coversand'). In general, these sands were deposited during both Dryas 2 and 3: 'Younger Coversands I and II', respectively. At many places, these two coversand layers are separated by the 'Layer of Usselo', a palaeosol dating from the Allerød Interstadial (Van der Hammen, 1952; De Groot et al., 1987; Stapert, 1982). The Frisian Coversand Belt lies in the shape of a boomerang around the lowland peat area in the middle of Friesland, to the east and south of it. The Oudehaske site is located on the northern periphery of the southern arm of the belt. Most rivers in this area run from ENE to WSW, and the many coversand dunes also often display this orientation.

A few kilometres north of the site, the Pleistocene precursor of the river Boorne flowed from ENE to WSW (Cnossen & Zandstra, 1965; De Groot et al., 1987), see fig. 3. The Oudehaske site is located near the northern bank of a small stream that most probably was a tributary of the Pleistocene Boorne. This former watercourse is visible neither on the geological map nor on the pedological map. It is evident, however, in a contour map of the field (fig. 4). The site lies on the highest part of a low coversand dune, overlooking the slope towards the valley south of it. This little valley most probably carried water at least during parts of the Late Glacial (see 3.3), though it is partly filled up with Younger Coversand II. Many Late Palaeolithic sites in the northern Netherlands are situated near river banks; as an example the Hamburgian site at Oldéholtwolde may be mentioned, which was located about 10 m from the bank of the Late Glacial precursor of the river Tjonger (Stapert, 1982). At Oudehaske, the river bank must have been much farther away, at some 75-100 m from the site. Perhaps there was a marshy zone between the site and the river bank. Apart from the wish to camp on dry soil, however, the site's location on top of the low dune might also have been chosen because of the better view across the landscape it provided. On the basis of the *Hoogtepuntenkaart van Nederland (blad 11 west)*, a contour map was constructed of the surroundings of the site (fig. 5). Though the picture is not very clear, the site seems to be located on the northern bank of a stream

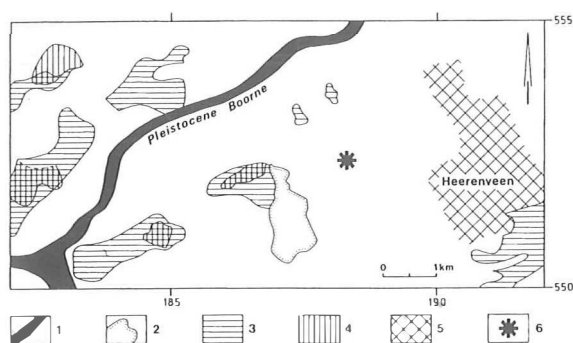


Fig. 3. Occurrences of boulderclay (northerly moraine deposits) in the vicinity of the site at Oudehaske. Key: 1. The Pleistocene precursor of the river Boorne; 2. The Haskerveld, a lake resulting from peat-digging in the 18th and 19th centuries; 3. Boulderclay within 2 m from the surface (after De Groot et al., 1987); 4. Boulderclay within 1.2 m from the surface (after StiBoKa, 1976); 5. The town of Heerenveen; 6. The Ahrensburgian site at Oudehaske. Drawing by Dick Stapert/J.M. Smit.

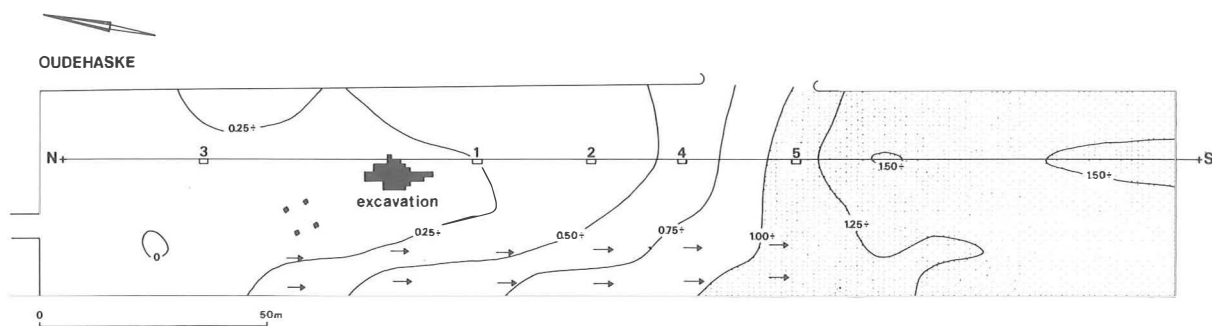


Fig. 4. Map of the field in Oudehaske. Contour lines with intervals of 25 cm. Areas below -1 m NAP (Dutch Ordnance Datum) are stippled. The strip along the western edge of the field indicated by arrows was lowered by sand-digging in recent times. About 15 m northwest of the site, 4 dots indicate the location of a power pylon. N-S: profile represented in fig. 8; 1-5: profile trenches. Drawing by Dick Stapert/J.H. Zwier.

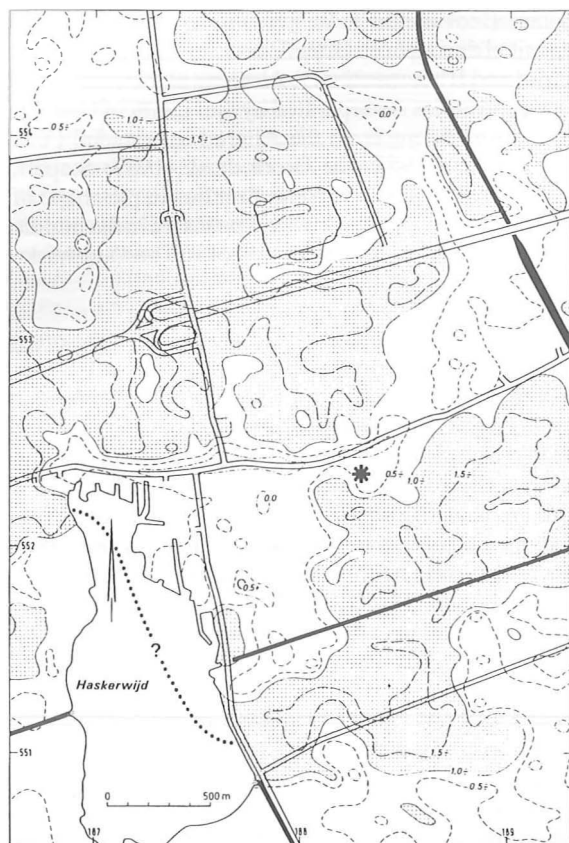


Fig. 5. Contour map of the surroundings of the site at Oudehaske. Contour lines with 0.5 m intervals. Areas below -1 m NAP are stippled. The site (indicated by an asterisk) lies on the northern bank of a small river. Drawing by Dick Stapert/J.M. Smit.

running ENE to WSW. At about 1 km to the west of the site, the Haskerwijd, a lake resulting from peat-digging, seems to have been part of the same valley, which then continues in a northwesterly direction: probably towards the Pleistocene Boorne.

The area around Oudehaske was largely stripped of its cover of lowland peat during the 18th and 19th centuries (De Groot et al., 1987; StiBoKa, 1976). The stippled areas in figure 5, more than 1 m below NAP (Dutch Ordnance Datum), are mainly the result of peat-digging. This is clearly visible on the old topographical map of the Netherlands, sheet 11-III, dating from 1854/55 (republished by Wolters-Noordhoff, 1990). We suppose this is because the peat was thicker within river valleys than on the higher grounds outside the valleys. In some respects, the peat-digging brought back Late Glacial topography: it once again exposed the surface of the Weichselian sand deposits. The contour map seems to suggest that the site was located at a narrow corridor separating two valleys. Such places may have been part of reindeer migration routes. This suggests that the site's location might be connected to the hunting of reindeer during their spring or autumn migration. The

reconstruction of probable reindeer migration routes has contributed much to the understanding of the spatial distribution of Late Glacial sites across the landscape (see e.g. Vang Petersen & Johansen, 1991; 1994; 1996; Baales, 1996).

At the site and in its immediate surroundings, boulderclay—moraine deposits dating from the Saalian—was beyond the reach of Palaeolithic man. The top of the boulderclay lies about 3 m below the present surface at the site. The Ahrensburgian people must have collected their lithic material at places where the boulderclay occurred at the surface. In figure 3, occurrences of boulderclay are mapped on the basis of two sources: a) boulderclay within 2 m (De Groot et al., 1987) and b) boulderclay within 1.2 m (StiBoKa, 1976). The vertically hatched areas in the map especially may be considered possible sources of both the flints and the other stones collected at the site. The flint material at Oudehaske is of good quality; people probably invested quite some energy in locating and collecting good flint nodules. The most probable source is the boulderclay outcrop near the northwestern corner of the Haskerwijd. This would imply that the Ahrensburgian people transported their raw materials over at least 1.5 km. It is to be expected that the first testing and preparation of the collected flint nodules was carried out at the source, in order to reduce the weight of the material to be carried back to the site. Such 'workshops' at raw material procurement sites have not been found near Oudehaske. Although many such sites dating from the Late Palaeolithic must exist, so far only a few have been recognized in the Netherlands (Arts, 1984; Beuker, 1981).

3.3. Stratigraphy at the site

The stratigraphy at the site was investigated on the basis of several excavation profiles, five sections dug outside the find scatter, and by a series of borings on a N-S line across the field (see fig. 4). One of the borings revealed the occurrence of a layer of brown peat at a depth of about 1.5 m, intercalated in sands. Subsequently, a profile trench (No. 3 in fig. 4) was dug at this spot, which is situated some 35 m north of the artefact concentration. The stratigraphy observed in this trench is shown in figure 6. From top to bottom (the vertical scale shows elevations with respect to NAP): 1. Ploughed topsoil; 2. Black peat, Holocene; 3. A2 horizon of Holocene podsol, at the top of a layer of coversand; 4. B horizon of Holocene podsol, and C horizon: a layer of yellowish coversand with thin infiltration bands; 5. Compact, brown *waterhard* level, in the lowest part of the same coversand layer. The coversand layer (3-5) can only be Younger Coversand II, dating mainly to Dryas 3; 6. Brown peat, about 30 cm thick, dating from the Allerød Interstadial; 7. Laminated greyish sand (either Younger Coversand I or Older Coversand).

Radiocarbon dates for the uppermost and lowermost

1 cm of the brown peat were produced by the Centrum voor Isotopen Onderzoek, Groningen. The results are as follows:

Uppermost 1 cm; GrN-18783: $11,120 \pm 70$ BP;

Lowermost 1 cm; GrN-18784: $11,390 \pm 65$ BP.

On the basis of these results, the peat layer can be dated

to the second half of the Allerød Interstadial. A pollen analysis of the peat layer was carried out by Sytze Bottema and Betty Mook-Kamps; their results are presented in a paper appended to this one.

For the purpose of comparison, two other occurrences of Allerød peat in this region, dated by radiocarbon, are mentioned here. In the Haskerveenpolder, north of the Jouterweg, a section with Allerød peat was studied by Cnossen & Zandstra (1965); the peat layer was about 30 cm thick and occurred at a depth of about 2 m. Two samples of the lowermost part of the peat were dated in Groningen:

GrN-2136: $11,600 \pm 70$ BP,

GrN-3585: $11,750 \pm 100$ BP.

At the site of Oldeholtwolde, less than 10 km southeast of Oudehaske, an Allerød peat layer was present in the valley of the river Tjonger (Stapert, 1982; 1986). A pollen diagram of this peat layer is presented in the paper by Bottema & Mook-Kamps (this volume). The lowermost 1 cm of this layer was dated in Groningen:

GrN-11264: $11,340 \pm 100$ BP.

At the type-locality of Usselo in the eastern Netherlands, Van der Hammen (1952) could demonstrate that the so-called 'Layer of Usselo' is a palaeosol, dating from the Allerød Interstadial. At Usselo, this light podsol laterally merged into a brown peat layer that could be dated to the Allerød by pollen analysis (see also Van Geel et al., 1989; Lanting & Van der Plicht, 1995/1996; Stapert & Veenstra, 1988). The same situation of an Usselo soil merging laterally into an Allerød peat layer could be investigated at Oldeholtwolde in the Tjonger valley (Stapert, 1982), and once again at the site of Oudehaske, within the drainage area of the river Boorne.

At the spot of the artefact concentration at Oudehaske, several sections were studied and drawn. One of these is presented in figure 7; the section revealed three layers of coversand. Between about 80 and 90 cm below the surface, the Layer of Usselo is present (fig. 7: e). By means of a series of borings in the field, it could be established that this soil merges into the peat layer described above (see fig. 8). The stratigraphy visible in the excavation section, going from top to bottom, is as follows:

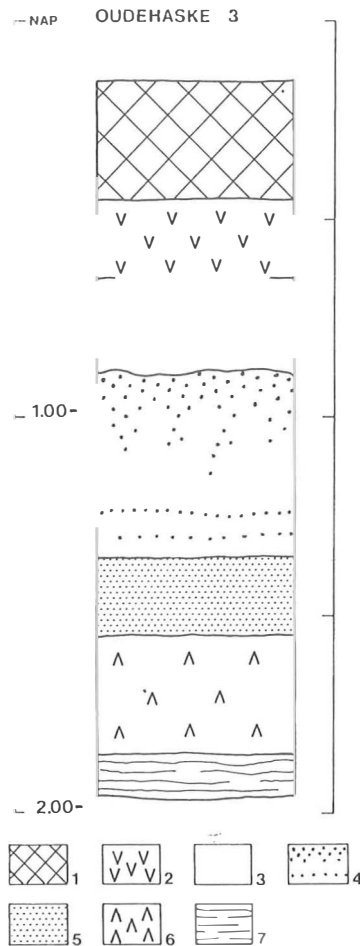


Fig. 6. Oudehaske. Stratigraphy observed in profile trench No. 3 (see fig. 4). NAL = Dutch Datum Level; scale in metres. For key: see text under 3.3. Drawing by Dick Stapert/J.M. Smit.

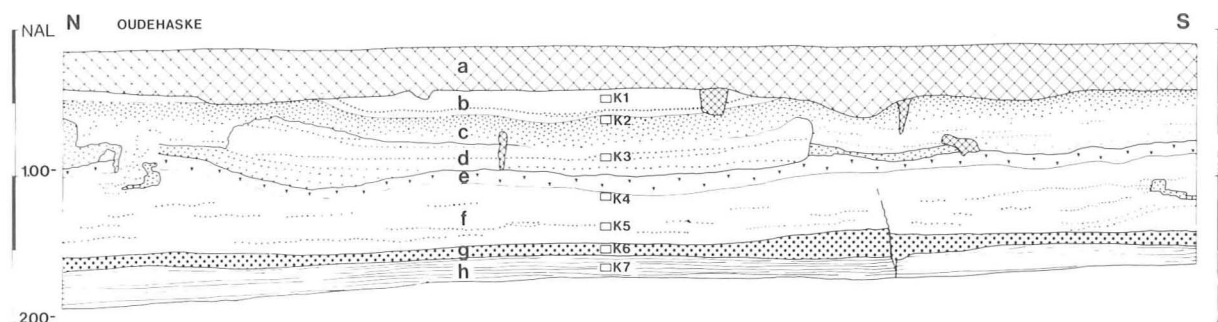


Fig. 7. Oudehaske. Excavation section over a length of 8 m, oriented north-south, in the central part of the excavated terrain. For key: see text under 3.3. Drawing by Dick Stapert/J.M. Smit.

1. Ploughed topsoil, 0-30 cm (fig. 7: a). Locally the topsoil contains peat remnants (black peat, dating from the Holocene);

2. Yellow coversand, 30-80 cm (fig. 7: b-d). At the top of this sand the B horizon of the Holocene podzol is preserved (c), and in a few places also parts of the A2 horizon (b). In view of the stratigraphy as a whole, this layer can only be Younger Coversand II, dating mainly to Dryas 3; it is not distinctly layered;

3. Yellow coversand with vague parallel lamination, 80-140 cm (fig. 7: e-g). In the top part of this layer a palaeosoil is present, known as 'Layer of Usselo', a leached horizon with charcoal particles, 80-90 cm (fig. 7: e). Locally, this horizon is overlain by a hard brown infiltration level, a few centimetres thick. The bottom part of this layer, 10 to 20 cm thick, consists of a very compact infiltration level (fig. 7: g). The sand layer as a whole is most probably Younger Coversand I, dating mainly to Dryas 2;

4. Greyish, fine sand, somewhat loamy, with clear parallel lamination, 140->165 cm. This deposit is most probably Older Coversand II, dating from the last part of the Upper Pleniglacial and Dryas 1.

A small frost fissure is visible in the section; though its upper part is not clearly visible as a result of bioturbation, it is nevertheless certain that it comes from the uppermost layer of coversand. Several frost fissures were observed in other sections at Oudehaske too. These frost cracks most probably date from Dryas 3. Similar frost fissures from Dryas 3 are also known at Oldeholtwolde (Stapert, 1982) and at many other places (e.g. Van der Tak-Schneider, 1968). Compact brown infiltration levels like the one at the bottom of the section (g) are called 'waterhard' by Dutch pedologists, because they do not lose their hardness when permanently wet. The brown material consists mainly of organic material (humus). They are found in sand layers which are, or

formerly were, covered by peat (Dekker et al., 1991). As noted above, it is known that the Oudehaske area formerly bore a layer of Holocene peat; it has largely disappeared through peat-digging. K1-K7 in figure 7 are samples taken and analysed by the Geological Survey of the Netherlands. According to grain-size analyses, both the Younger Coversands I and II show fining upward; the Older Coversand seems to have been deposited mainly in a wet environment (A. Bosch, letter of August 19, 1991).

On the basis of all available information, a schematic (and partly speculative) N-S cross-section of the field at Oudehaske was drawn over a distance of about 260 m (fig. 8). The brown Allerød peat probably accumulated in a small oxbow lake, which was later filled up with coversand – during Dryas 3. The Ahrensburgian site is situated on top of a coversand dune, largely made up of Younger Coversand I (Dryas 2). The Younger Coversand II, dating from Dryas 3, seems to be a more or less continuous layer at this locality, filling up depressions in the landscape. To the south of the site, the small river, noted earlier in the contour-map of the area (fig. 5), is visible in the cross-section; it is largely filled up with riversand. At a depth of about 1 m, a humic level is visible in this sand; it probably represents the Allerød Interstadial. Presumably this small watercourse held water during the occupation of the site.

As noted above, the Ahrensburgian artefacts all come from the ploughed topsoil. On the basis of the observed stratigraphy, especially the occurrence of the Allerød soil at a depth of 80-90 cm, the flint material originally must have lain at the top of the Younger Coversand II. It therefore cannot be much older than the end of Dryas 3. We consider it altogether likely that the site dates from the first half of the Preboreal.

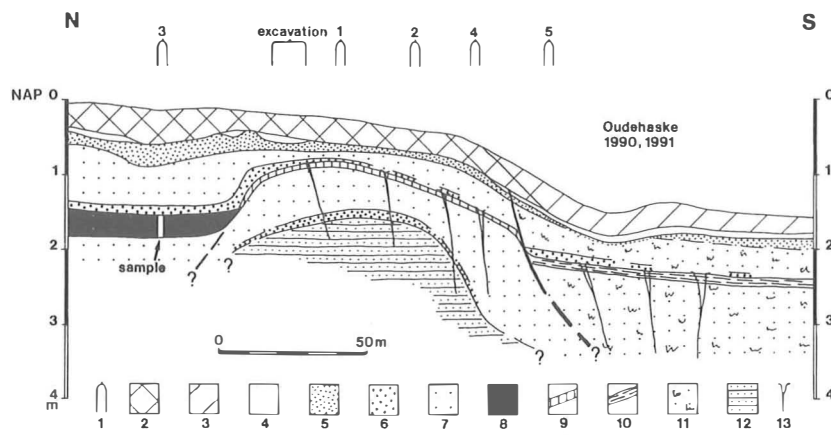


Fig. 8. Schematic sketch of the stratigraphy at the site of Oudehaske, based on borings, profile trenches and excavation profiles; for location see fig. 4. Key: 1. Profile trenches; 2. Ploughed topsoil; 3. Topsoil consisting of sand transported from the levelled part of the field (fig. 4); 4. A2 horizon of the podzol soil; 5. B1 horizon of the podzol soil; 6. Waterhard levels; 7. Yellow coversand; 8. Brown peat dating from the Allerød Interstadial; 9. Layer of Usselo: soil dating from the Allerød; 10. Humic level; 11. Brook sand; 12. Older Coversand, horizontally laminated, light-grey; 13. Frost fissures. Drawing by Dick Stapert/J.M. Smit.

3.4. The flint artefacts, and the refitting analysis

3.4.1. General remarks

All flint artefacts at Oudehaske were manufactured from nodules deriving from northerly moraine deposits, dating from the Saalian. As noted above, sources of flint and other rocks are available locally, though not in the immediate vicinity of the site. In general, the flint is of good quality (Senonian). Most flint artefacts of Oudehaske are hardly patinated and in fact look quite fresh. Some show a very slight white patina, but a clear soil sheen is absent. Dr Helle Juel Jensen (Aarhus University, Denmark) had a look at the flints, and concluded that the material is suitable for a use-wear analysis (pers. comm. 1996). Unfortunately, a functional analysis of the material has not been performed. Below, the various categories of artefact are briefly described, together with a discussion of the refitting results. The reason to arrange the text in this way is that a higher degree of compactness might thus be achieved.

In the case of Oudehaske, a total of 688 artefacts were included in the refitting analysis: all the tools, including waste products from tool manufacture ($n=83$), and unmodified artefacts larger than about 2 cm (excluding some heavily burnt fragments). Blades or blade fragments constitute the largest group among the latter category: 413; furthermore, 187 flakes and 6 cores were included. Of the 688 artefacts subjected to analysis, 185 could be refitted in one way or another. The refitting percentage, based on the sample subjected to analysis, is 26.9% (based on the total number of artefacts larger than 1.5 cm ($n=919$) it is 20.1%). In total, 68 refitted groups were created, the largest of which comprises 9 artefacts. Most of the refitted groups, 51 out of the total

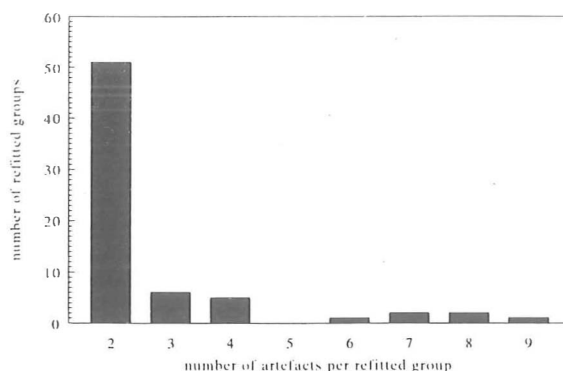


Fig. 9. Oudehaske. Numbers of artefacts involved in the 68 refitted groups. In total, 185 artefacts are in refitted groups. Drawing by Lykke Johansen/Dick Stapert.

of 68 (75.0%), consist of only two artefacts. A diagram showing the numbers of artefacts involved in the refitted groups is shown in figure 9.

If we count the number of refits according to the Czesla system (Czesla, 1990), i.e. the number of refitting lines between pairs of artefacts, a total of 141 results. Refits can be split up according to types of refit, as follows (fig. 10: A): sequences: 88 (62.4%), breaks: 50 (35.5%), and burin/burin-spall refits: 3 (2.1%). Among the 50 refits of breaks, there are 18 cases in which the fracture was most probably caused by heat. Since we assume that most of the burning occurred in recent times, a second diagram showing the numbers of refits per type is shown in figure 10: B, in which breaks resulting from heat are omitted. Of the remaining 123 refits, 71.5% are of the sequence type.

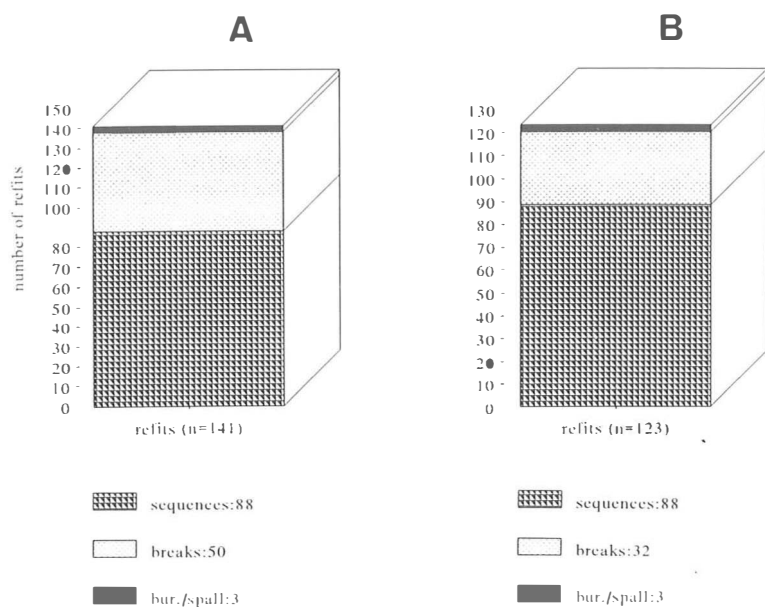


Fig. 10. Oudehaske. A. Types of refit; numbers of refits are counted according to the system of Czesla (1990). B. Types of refit; in this diagram the breaks resulting from heat are omitted because most of these probably occurred recently. Drawing by Lykke Johansen/Dick Stapert.

Table 1. Oudehaske. List of artefacts. Numbers counted before the refitting analysis.

A. Flint tools	N	Percentage of subtotal
Points	39	63.9
Tanged point, (near-)compl.	1	
Zonhoven points, (near-)compl.	5	
B-points, (near-)compl.	6	
A-point, (near-)compl.	1	
Point fragments	26	
Scrapers	12	19.7
Long (blades)	5	
Short? (blade fragments)	3	
Short (3 flakes, 1 nodule)	4	
Burins	7	11.5
On break, A (single: 3, double: 1)	4	
Dihedral, AA (single: 2, double: 1)	3	
Retouched blades	3	4.9
Subtotal	61	100.0
	(2.3% of total)	
B. Flint non-tools		Percentage of total
Burin spalls	11	0.4
'Microburins of Krukowski type'	11	0.4
Blades or blade fragments	471	18.0
Flakes	344	13.1
Chips (< 1.5 cm)	1706	65.1
Blocks	11	0.4
Cores	6	0.2
Total	2621	99.9
C. Other artefacts		
Hammerstones	2	

3.4.2. The tools

The 61 tools of Oudehaske consist of 39 points or point fragments, 12 scrapers, 7 burins and 3 retouched blades (see table 1).

The points (n=39). Tanged points are normally the predominant point type during the Ahrensburgian. In the Epi-Ahrensburgian, however, they are rare or absent (see under 1). Only one tanged point is present at Oudehaske (fig. 11: 1). The remaining points are microliths. The classification of microlithic points employed here is based on Bohmers (1956; Bohmers & Wouters, 1956; see also Arts, 1988). A-points have a retouched side from tip to base; at Oudehaske there is only one more or less complete specimen: fig. 11: 9. B-points only have an oblique truncation at the tip. Zonhoven

points combine an oblique truncation at the tip with additional retouch at the base (B-points and Zonhoven points are called 'Zonhoven points without or with basal retouch', respectively, by Taute (1968)). Two of the complete Zonhoven points (fig. 11: 2 and 3) have a concavely retouched base; the other specimens (fig. 11: 4-6) are more irregularly retouched at the base. Most point fragments cannot be confidently classified as to type. It is noteworthy, however, that several basal fragments have a retouched base (e.g. fig. 12: 19, 22, 25): probably fragments of Zonhoven points. Though it is not possible to be precise, there seem to be somewhat more tip fragments than basal fragments. Of the 13 more or less complete points in figure 11, 6 have their tip at the bulbar end, and 7 at the distal end. When the tip faces upwards, 8 of the points have a truncation at the right side, and 5 at the left side.

Only one point at Oudehaske can be refitted in a dorsal/ventral sequence; it is conjoined with two blade fragments (fig. 11: 13). This point, a B-point, was most probably produced on the site; its tip is missing though we cannot be sure whether or not this is a result of use. The other points, however, were probably all made elsewhere, and imported to the site. At several other Late Palaeolithic sites too, most or all of the points seem to have been imported. For example, none of the points of the Hamburgian site at Oldeholtwolde can be refitted in sequences (Stapert & Krist, 1990). Points were evidently carried during travel, at least partly in a hafted state. At encampments, damaged points would have been removed from their hafts and replaced by newly-made ones (this process has been called 'retooling' by Keeley, 1982). Another possibility is that quite a few of the points were carried as a stock, and subsequently used during occupation. In this connection it may be noted that 26 of the 39 tools classified as points are merely fragments; moreover, 9 of the 13 more or less complete points have damaged tips.

The scrapers (n=12). The scrapers from Oudehaske (figs 13 and 14) were made on different types of blank. One was made on a small nodule of flint with cortex on both the dorsal and the ventral faces (fig. 13: 10). The only modification consists of the retouch of the scraper-edge and a little retouch along one of the sides. This burnt tool is a stray find from the field; we cannot be certain that it is part of the Ahrensburgian assemblage. Another scraper was made on a broad flake consisting of two fitting fragments (fig. 13: 2). It is in fact a double scraper; the scraper edges are located on both sides of the flake, not proximally and distally as is usually the case. A second double scraper is also made of a flake (fig. 13: 3). In this case the scraper-edges are located proximally and distally. The scraper is only 1.8 cm long and 2.2 cm wide. Four scrapers occur in a fragmented state (fig. 13: 4, 7, 8 and 11). One is probably made of a flake (11), while the other three seem to have been made on blades; the largest fragment is only 2.0 cm

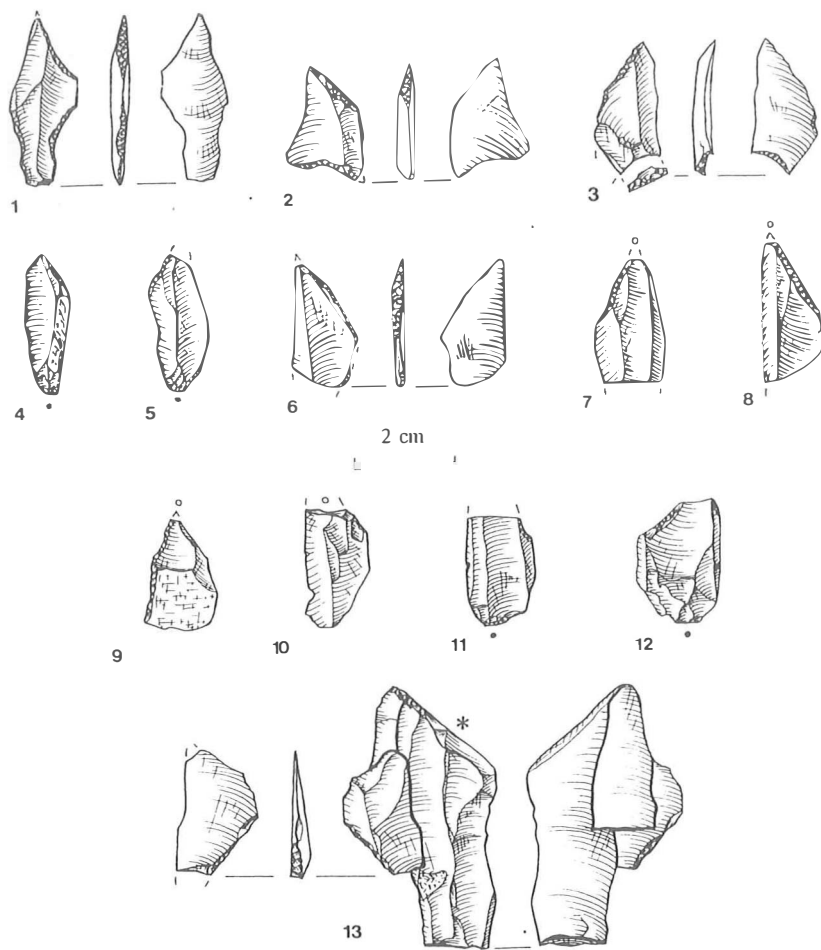


Fig. 11. Oudehaske. 1. Tanged point; 2-6. Zonhoven points; 7-8, 10-12. B-points; 9. A-point; 13. Sequence including one B-point; one blade is burnt, indicated by an asterisk. Drawing by Lykke Johansen.

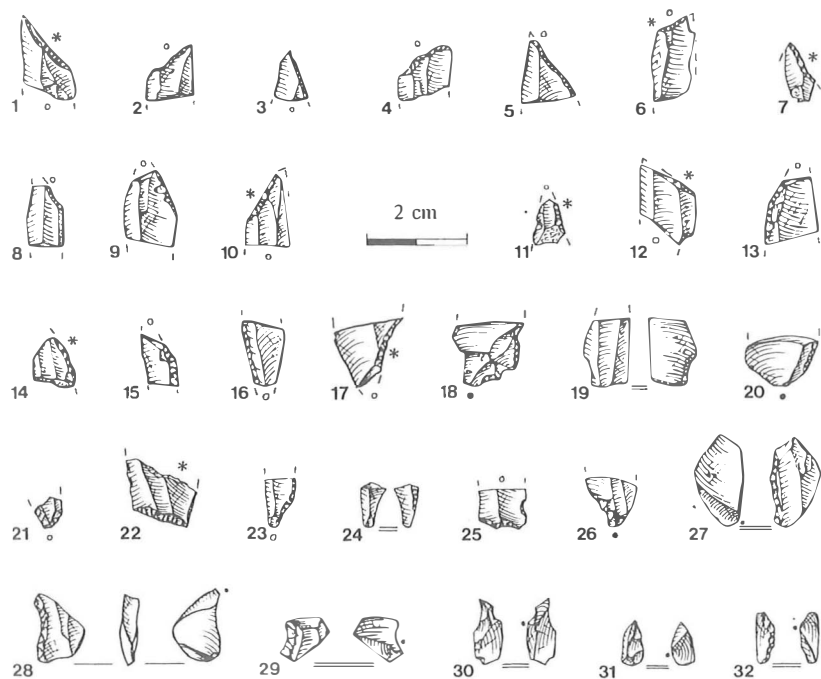


Fig. 12. Oudehaske. 1-26. Point fragments; 27-32. 'Microburins of Krukowski type'. Drawing by Lykke Johansen.

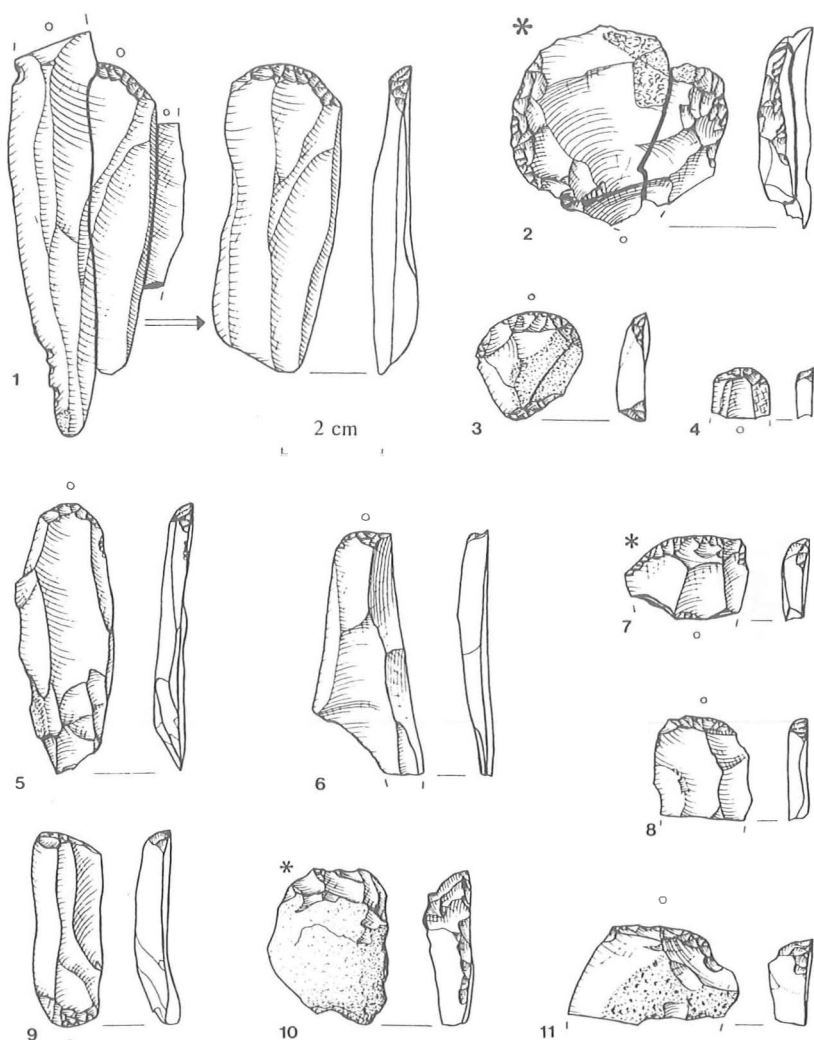


Fig. 13. Oudehaske. 1. Sequence including one blade-scraper; 2. Double flake-scraper refitted from two fragments, the break was the result of burning; 3. Double flake-scraper; 4, 7, 8, 11. Fragments of scrapers; 5, 6, 9. Blade-scrapers; 10. Scraper on a small nodule. Drawing by Lykke Johansen.

long. Two of the four scraper fragments have the scraper-edge at the bulbar end (8 and 11), while the other two have a distally located scraper-edge (4 and 7). Four other scrapers are made on good blades with lengths of 3.8-6.1 cm (one is fragmented). One of these has the scraper-edge at the distal end (fig. 13: 9), the others at the bulbarend (fig. 13: 1, 5, 6). The longest of these four scrapers (fig. 13: 1) is the only one that can be refitted into a sequence, with two blades. This short sequence probably was not produced on the site, because no knapping waste is present. All three blades are of good quality, and suited for the production of tools, which is probably the reason why they were imported to the site.

The last scraper is made on a very long blade, almost a *Grossklinge* according to the definition of Taute (1968); its max. length is 10.8 cm, and its max. width 3.1 cm (fig. 14: 1). It is made of a whitish/greyish, fine-grained Senonian flint of good quality. Apart from this scraper, which consists of two refitted fragments, eight other

blades or blade fragments of the same flint were collected at the site (fig. 14: 2-5). Of these blades, only one short sequence (dorsal/ventral), consisting of three blades, could be refitted. No flakes or chips of this particular flint were found on the site, nor any core. All blades of this flint are quite large; they were probably the best products of a core knapped somewhere else, and imported to the site. Most of these blades occurred in a fragmented state at Oudehaske.

The mean scraper angle is 63° ($n=14$, range 38-75, standard deviation 10.4). It is important to note that most scrapers were probably discarded because they were used up. The angles of used-up scrapers will in general be larger than the angles during the optimal use stage.

In conclusion it can be said that probably none of the scrapers were made of blades or flakes produced on the site. In the case of the long scrapers we can be certain of this; they were either imported as scrapers or made from

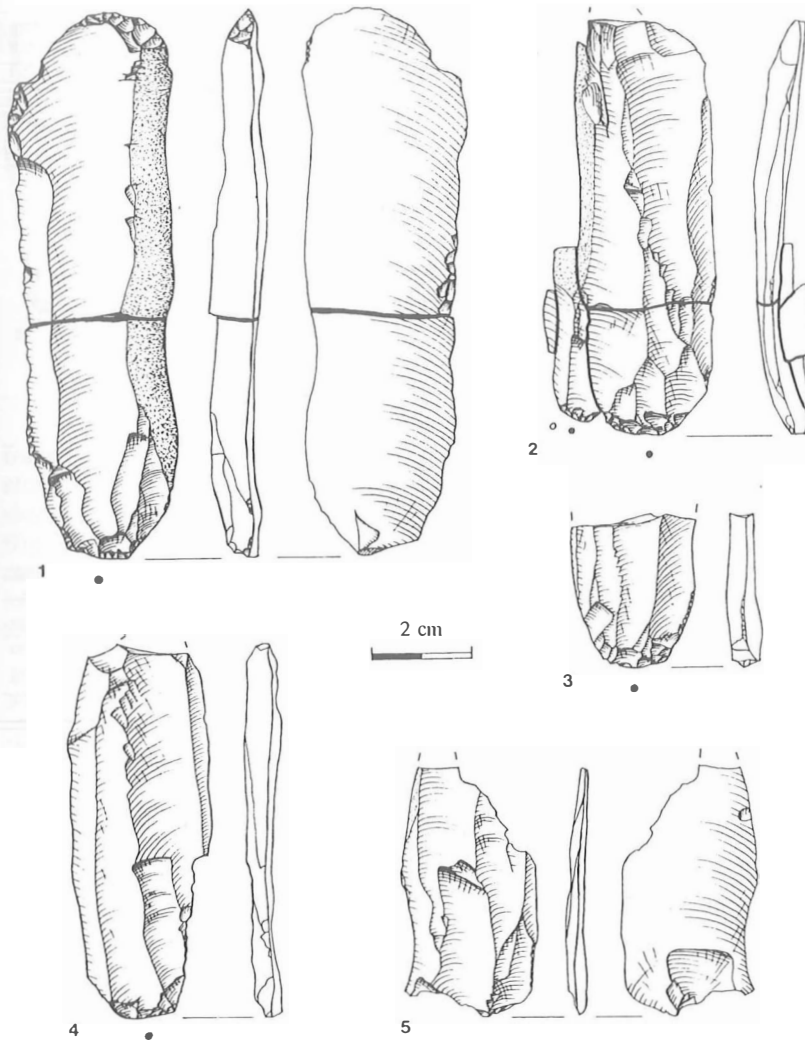


Fig. 14. Oudehaske. Group of artefacts made of a characteristic greyish white, fine-grained flint (one blade fragment of this group is not represented in the figure). 1. Blade-scraper refitted from two fragments; 2. Short sequence of three blades (all fragmented); 3-5. Blade fragments. Drawing by Lykke Johansen.

imported blades. None of the short scrapers could be refitted into sequences, so it seems that most or all of these too were imported to the site.

The burins (n=7). The burins (figs 15 and 16) do not show much variation in the way the burin-edge was created. They are either simple angle-burins (on a break, or on the end of a blade) or dihedral burins (A-burins or AA-burins, respectively, in the classification of Bohmers, e.g. 1956). We apply the term 'dihedral' for burins where the burin edge is formed by the intersection of two burin-spall negatives (this may be called the 'screwdriver type'). Some AA-burins could simply be the result of resharpening an A-burin. There are no burins on truncation (RA-burins in Bohmers' typology), nor any distinct *Querstichel* as defined by Taute (1968).

Two specimens are dihedral burins, with a burin edge created by burin spalls along both sides of the burin (fig. 15: 3 and 5). One of these has the burin edge

at the bulbar end (5), the other at the distal end of the blade (3). One burin (fig. 16: 1) can be described as an atypical, double dihedral burin. The burin edge at the bulbar end is missing due to burning; it must have been a normal AA-burin. The burin edge at the distal end of the blade is partly formed by one of the burin spalls removed from the bulbar end; it is a plunging spall of which only a fragment has been recovered. Only one burin spall was removed at the distal end, using the negative of the plunging spall as a striking platform; in this way a burin edge of the AA type was created. The burin shown in figure 15: 4 is a double burin. The burin at the bulbar end can best be described as a failed dihedral burin; the attempted removal of one of the burin spalls resulted in splintering of the edge. After this unsuccessful attempt at making, or resharpening, a burin edge, the then 6.2 cm long blade was broken, probably intentionally, and a new burin, of the A type, was made by removing one spall from the fracture surface. The

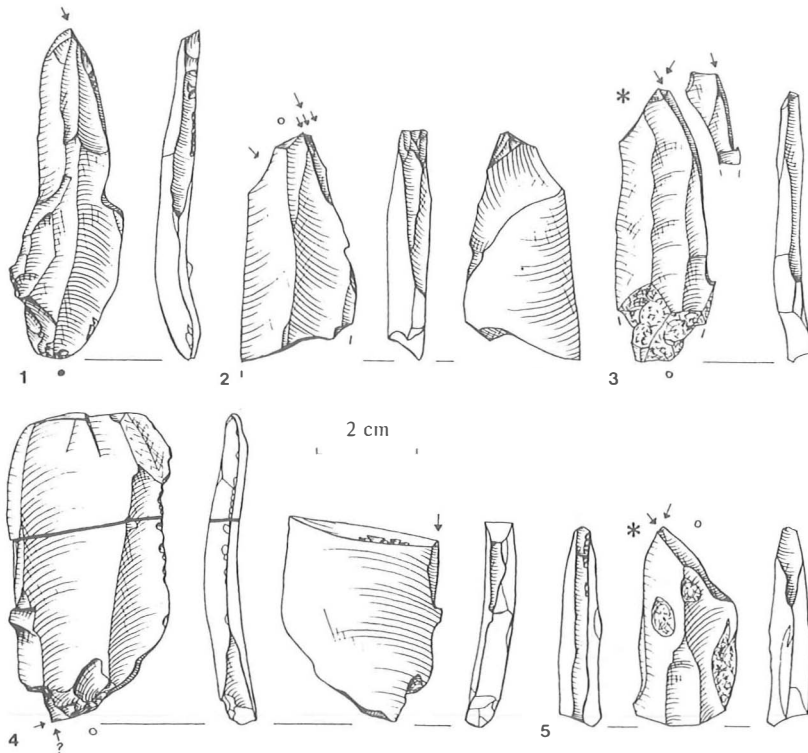


Fig. 15. Oudehaske. 1-2. Burins on break (A-burins); 3. Burnt dihedral burin (AA-burin) with a fitting fragment of the burin spall (unburnt); 4. Double burin on break, made on a blade fragment fitting to another fragment (one of the burins may be a dihedral one); 5. Dihedral burin. Drawing by Lykke Johansen.

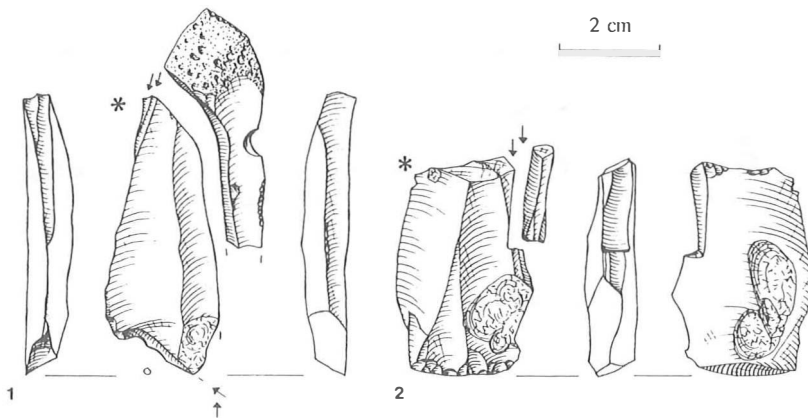


Fig. 16. Oudehaske. 1. Double burin (burnt): burin on break and dihedral burin, the fitting fragment of the burin spall is unburnt; 2. Burin on break (burnt); the fitting burin spall is unburnt. Drawing by Lykke Johansen.

remaining three burins are all A-burins. One of these (fig. 15: 2) shows several burin-spall negatives from an oblique fracture at the proximal end of a blade; the removal of the last burin spall failed, resulting in the destruction of the burin. Two burins are simple A-burins, with only a single burin-spall negative; in one case the spall was removed from a fracture surface (fig. 16: 2), in the other case from the distal end of the blade (fig. 15: 1).

None of the burins can be refitted into production sequences. Three burins can be refitted with in each case one burin spall (two of these spalls are fragmented), which shows that some burins at least were resharpened

on the site. In another case (fig. 15: 4), though there are no fitting burin spalls, it seems probable that an imported burin was transformed into a double burin on the site, after resharpening of the original burin edge failed. Our conclusion is that none of the burins were made from blades produced on the site. Probably most or all of the burins were imported to the site as burins; three or four of them were resharpened or repaired on the site, in one way or another.

Retouched blades (n=3). One blade (fig. 17: 1) is clearly retouched along both sides, though only partially. The two remaining tools are atypical. One is a burnt proximal

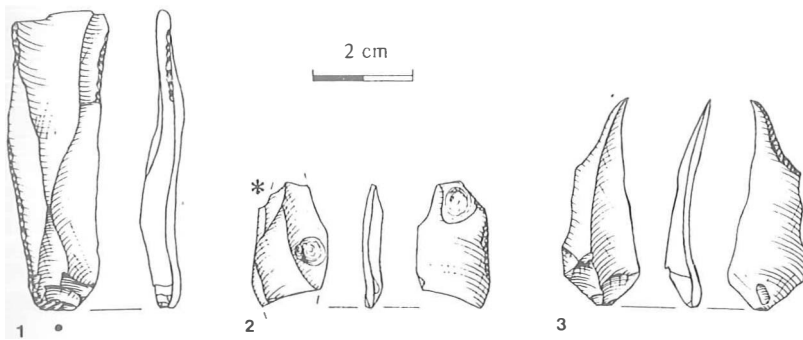


Fig. 17. Oudehaske. 1-3. Retouched blades. Drawing by Lykke Johansen.

fragment of a blade, showing partial ventral retouch along one of the sides (fig. 17: 2). The last specimen also shows ventral retouch, at the distal end of a small blade (fig. 17: 3). In the latter two cases we are not completely certain that we are dealing with intentional retouch; indeed, in the last-mentioned case we consider it possible that the retouch was created recently.

3.4.3. Waste products from tool manufacture

'Microburins of Krukowski type' ($n=11$). In figure 12 (Nos 27-32) six so-called 'microburins of Krukowski type' are illustrated; in all, 11 specimens are known from Oudehaske (for a discussion, see: Brezillon, 1983 (1968)). These are not 'microburins' at all (by the way, the term 'microburin' itself is also confusing; it would be preferable to replace it by 'notch remnant', in analogy to the German *Kerbstre*). 'Microburins of Krukowski type' probably resulted from accidents during retouching (Bordes, 1957). In producing or repairing points, especially in retouching the tips of points, sometimes too large a chip was removed, either by too hard a blow or by a wrongly placed blow. Such a removal carries off a retouched part on the 'dorsal' side, not half a notch as in true 'microburins', and has a 'facet' on the back next to a remnant of the ventral face of the blank. 'Microburins of Krukowski type' are quite common at sites of the Hamburgian, Federmesser and Ahrensburgian traditions. Unambiguous 'microburins' were not observed in the Oudehaske material (a single specimen mentioned in Dijkstra et al., 1992, was reclassified by us as of Krukowski type).

Burin spalls ($n=11$). Small burin spalls, especially if fragmented, will tend to be underrepresented; they are difficult to identify and will moreover often pass through a sieve with a mesh width of 4 mm. Large or plunging burin spalls are more easily found and identified, and also have a greater chance of being refitted to the burins from which they derive. Seven burin spalls at Oudehaske are primary, and four are secondary. One of the primary and two of the secondary burin spalls were refitted to

burins. The remaining burin spalls probably derive from burins that were carried off the site.

3.4.4. The cores

Six cores were found at the site. Somewhat surprisingly, it proved possible to refit blades to only two cores. Probably the last blades struck from the other four cores were taken away from the site. The four cores which cannot be conjoined with any blades or flakes (figs 18 and 19) are quite small: between 4.4 and 5.0 cm long. Three of them clearly have two opposite platforms; one core (fig. 18: 2) shows only blade negatives coming from one platform but a small remnant of a platform is present at the opposite end. The core-angles, between the platform and the core-front, are 70 and 82° (fig. 18: 1), 72° (fig. 18: 2), 70 and 82° (fig. 18: 3), 60 and 77° (fig. 19). It has to be noted that all these cores are used-up ones; core-angles would have been smaller in the optimal production state.

The fifth core (fig. 20) is made of a characteristic type of flint: light-brown, fine-grained Senonian flint containing Bryozoan fossils. The core has two opposite platforms, and shows blade negatives coming from both. The angles between the platforms and the core-front are 55° and 70°. The core is a residual one. Of the same flint there are also 21 blades or blade fragments and two flakes. The two flakes can be refitted ventrally/dorsally to each other, but not to the core. One of the blades is totally covered by cortex dorsally, and many of the other blades or blade fragments also show remnants of the cortex. No tools of this flint type are present at the site. Only one blade can be refitted to the core. Two or three unsuccessful blades were struck off afterwards, all with large hinges. They damaged the core beyond repair, so that it became totally useless. The hinged blades were not recovered. A dorsal/ventral sequence of five blades of the same flint could be refitted (fig. 21). These blades were clearly produced during an early stage of the core's exploitation, though not at the very start of it. They show that the core must then have been longer than 10.2 cm. The sequence suggests that the

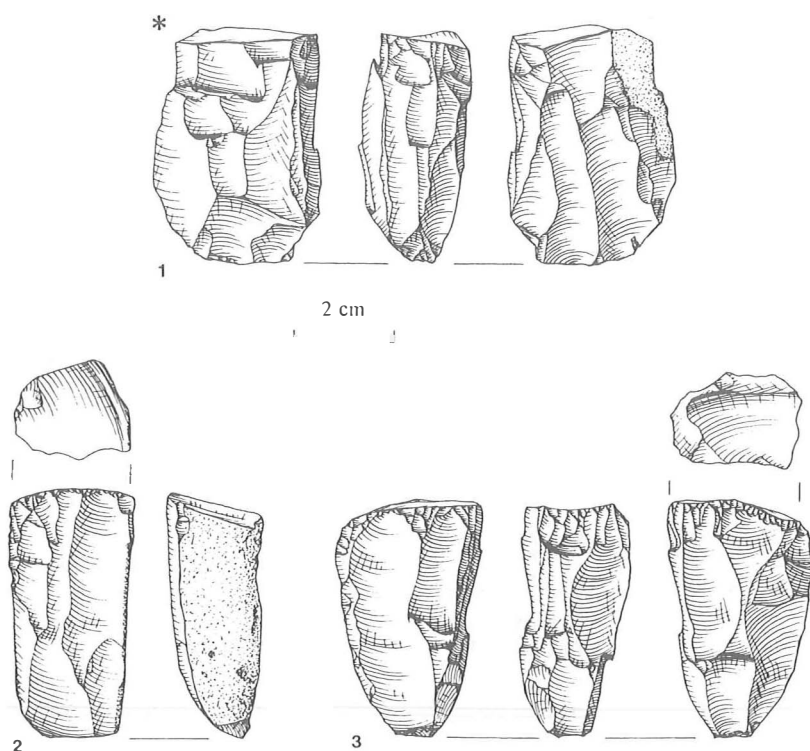


Fig. 18. Oudehaske. 1-3. Cores to which no artefacts could be refitted. Drawing by Lykke Johansen.

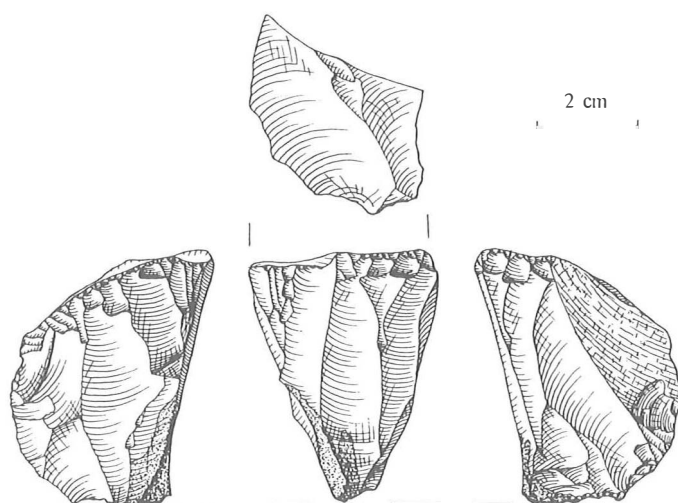


Fig. 19. Oudehaske. Core to which no artefacts could be refitted. Drawing by Lykke Johansen.

platform was prepared before the knapping of each blade. This involved the removal of flakes from the platform resulting in a shortening of the core by two or three millimetres.

The artefacts of this light-brown flint present on the site, and the results of refitting, show that this nodule was worked on the site, probably from the beginning. The two flakes fitting to each other, and especially the

blade totally covered by cortex, seem to suggest this, as does the occurrence of a relatively large number of blades of this flint. The refitted sequence shows that blade production was quite successful, at least in the early stages of exploitation. Some blades broke during manufacture, and most of these were left on the site. Many good and complete blades must have been produced, which are not present at the site. These must

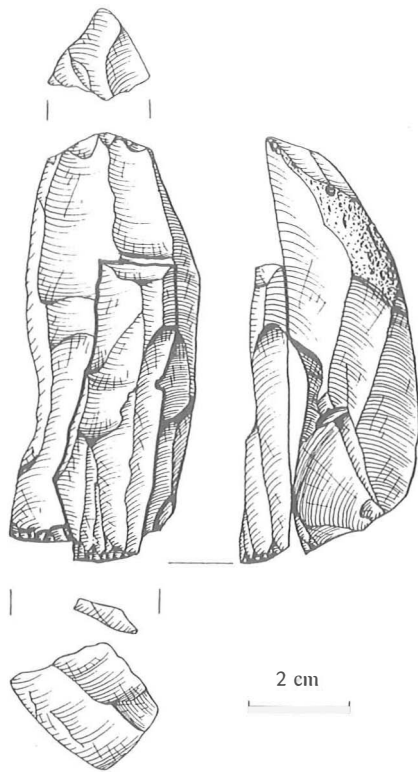


Fig. 20. Oudehaske. Core with one refitted blade. The artefacts shown in fig. 21 are made of the same material: light-brown, fine-grained flint. Drawing by Lykke Johansen.

have been taken elsewhere. It is conceivable that this core was among the last ones knapped on the site, because there are no tools of this flint. The best products of this core may well have been part of the toolkit carried during travel, either in the form of tools or as unmodified blanks.

The last core again has two opposite platforms (fig. 22). Also this core is used up, but in this case not because of accidents during knapping; it simply had become too short to be useful any longer. The core-angles in its used-up state are 70° and 90°. The core is made of light-grey, fine-grained flint, with coarser-grained parts occurring throughout. Of the same type of flint, also 23 blades or blade fragments and two flakes are present. No tools of this flint were recovered. A sequence of eight blades can be refitted to the core. Evidently, none of these was considered suitable for tool-production; they are either too thick, too short, or came off the core in a broken state. Three other blades could be refitted in a sequence (fig. 23); at least two of these are quite sturdy. This little group cannot be refitted to the core. Again, it appears that the platform was trimmed regularly during blade-production. Just like the core described above, it is probable that this one too was knapped just prior to abandonment of the site. The

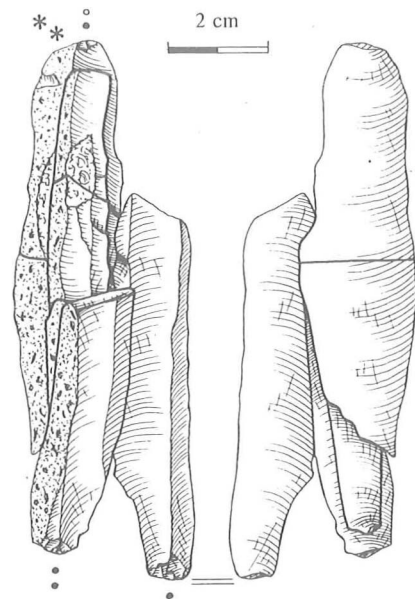


Fig. 21. Oudehaske. Sequence of five blades (some fragmented), of the same material as the artefacts shown in fig. 20; two blades are burnt. Drawing by Lykke Johansen.

best blades struck off this core must have been taken away; only unusable blades were left behind.

Though technically a blade fragment, the piece illustrated in figure 24 is described here. It is the distal part of a heavily plunging blade. Quite a large part of the core was taken away by this blade. It is remarkable that nothing can be fitted to this artefact; moreover, the core is missing. Maybe the remnant of the core was still suitable for blade-production, and therefore taken off the site.

3.4.5. The blades

In total, 413 blades or blade fragments were subjected to the refitting operation. These can be subdivided into several categories as shown in table 2. Only 89 blades are complete (21.5% of the total). A rather high rate of breakage is also suggested by the fact that of the 324 blade fragments, 85 are medial fragments (21%). In principle, all blade fragments larger than about 2 cm were included in the analysis. However, several blade fragments from the site are so heavily burnt that the surface of the flints has splintered off in places; these were omitted in the analysis, because it is impossible to refit such pieces. Among the 413 blades or blade fragments that were subjected to refitting, 72 despite being heavily burnt were nevertheless considered potentially 'refittable'. Two blades or blade fragments are plunging; one of these has already been discussed (under 3.4.4). Distinct primary crested blades, deriving from the first preparation of core-fronts, are absent.

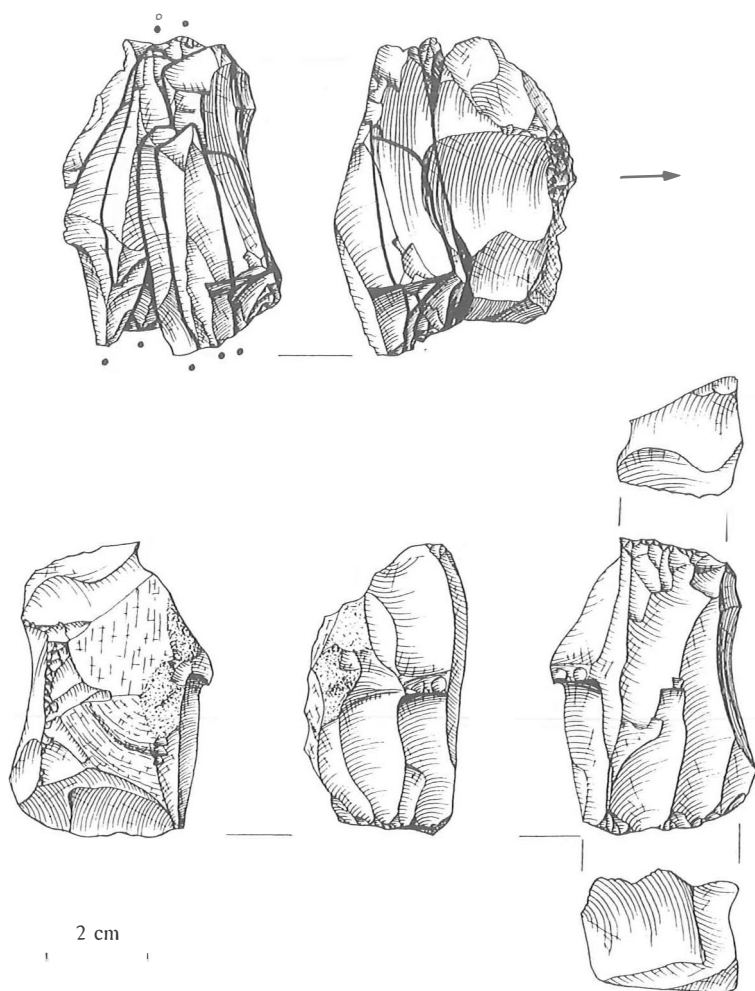


Fig. 22. Oudehaske. Core with refitted sequence of eight blades. The artefacts shown in fig. 23 are made of the same material: pale grey, fine-grained flint. Drawing by Lykke Johansen.

Most of the creasing observed on the dorsal faces of some blades resulted from repairing the core-front during later stages of blade-production.

None of the blades at Oudehaske can be classified unambiguously as *Grossklinge* or *Riesenklinge* in the sense of Taute (1968), though several come close. A blade-scraper (consisting of two fitting fragments) with a maximum length of 10.8 cm has already been mentioned (fig. 14: 1); it cannot be refitted in the ventral/dorsal way. Neither can a complete blade of 10.0 cm (fig. 25: 3) be refitted with any other blade from the site. An incomplete blade of 10.4 cm consists of three fitting fragments (fig. 25: 2); it fits to another incomplete blade, 8.6 cm in length, also consisting of three fitting fragments. A third incomplete blade is 10.8 cm long (fig. 25: 1); this is probably a distal fragment of a *Grossklinge*. It cannot be refitted with any other artefact. A fourth blade, consisting of two fitting fragments, is complete in the refitted state; its length is 10.4 cm (fig. 26). Most probably, none of these 'long' blades was produced on the site. Only one of the five blades

Table 2. Oudehaske: the blades and blade fragments subjected to the refitting analysis.

	N	Percentage
Complete blades	89	21.5
Proximal fragments	130	31.5
Medial fragments	85	20.6
Distal fragments	109	26.4
Total	413	100.0

mentioned above is in a dorsal/ventral sequence, which consists of no more than two blades; both these blades probably broke during the site's occupation.

Some summarizing statistics of the metrical attributes of the complete blades at Oudehaske are given in table 3. Frequency distributions of the length, width and thickness of complete blades are presented in figures 27-29. Most blades are between 3.5 and 6.5 cm in

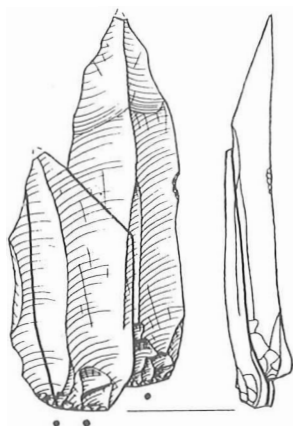


Fig. 23. Oudehaske. Sequence of three blades, of the same material as the artefacts shown in fig. 22. Drawing by Lykke Johansen.

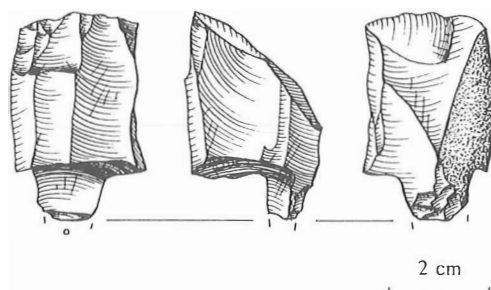


Fig. 24. Oudehaske. Distal fragment of plunging blade. Drawing by Lykke Johansen.

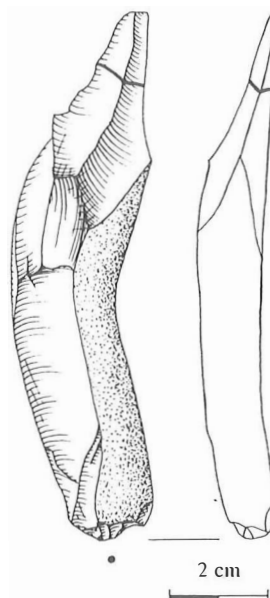


Fig. 26. Oudehaske. Blade longer than 10 cm, consisting of two fitting fragments. Drawing by Lykke Johansen.

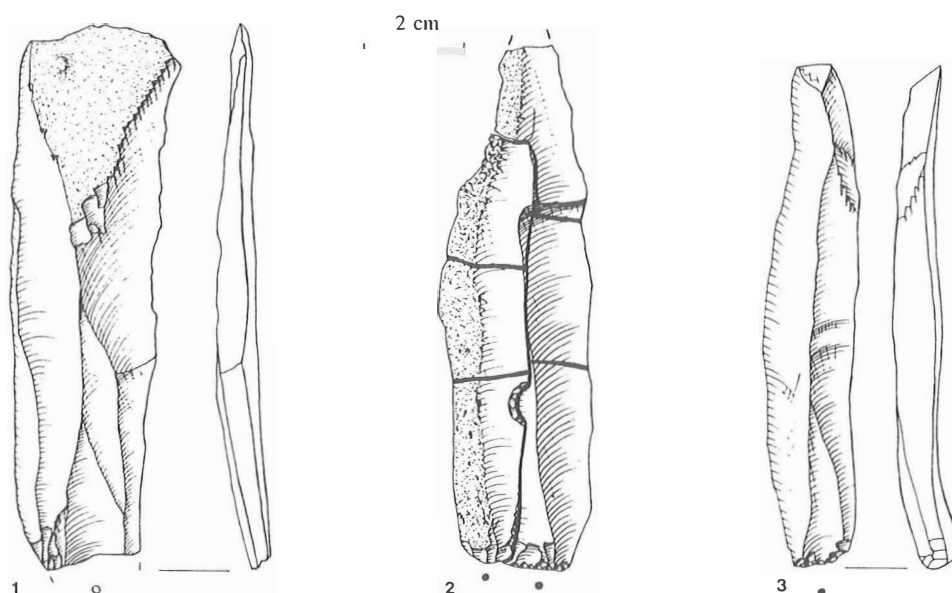


Fig. 25. Oudehaske. Blades or blade fragments longer than 10 cm. 1. Distal blade fragment; 2. Sequence of two blades, both consisting of three fitting fragments; the longer blade, which is still incomplete, is longer than 10 cm; 3. Complete blade. Drawing by Lykke Johansen.

length; the longest blade is 10.0 cm (it may be noted here that several blade fragments, and blades consisting of fitting fragments, are longer than 10 cm). It can be seen that the distribution is positively skewed. The larger blades especially will have played a functional role; by contrast, many of the smaller ones in fact must have been part of the flint waste. Therefore, the 'sample' consisting of all complete blades that were left behind

Table 3. Oudehaske: metrical attributes of the complete blades. N=89. V: coefficient of variation (100 x standard deviation/mean).

	Length	Width	Thickness	L/W	L/Th
Range	28-99 mm	8-33 mm	3-12 mm	2.0-6.2	6.2-18.0
Modal class	41-45 mm	17-18 mm	5 mm	2.5-2.9	8-9
Median	5.2 cm	1.7 cm	5 mm	3.0	10.0
Mean	5.4 cm	1.7 cm	5.5 mm	3.2	10.1
Stand. dev.	1.48	0.50	1.93	0.80	2.50
V	27.4%	29.4	35.1	25.0	26.3

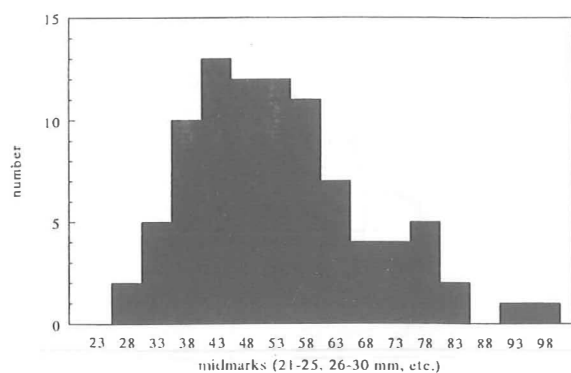


Fig. 27. Oudehaske. Length of complete blades (n=89) in intervals of 5 mm. Drawing by Dick Stapert.

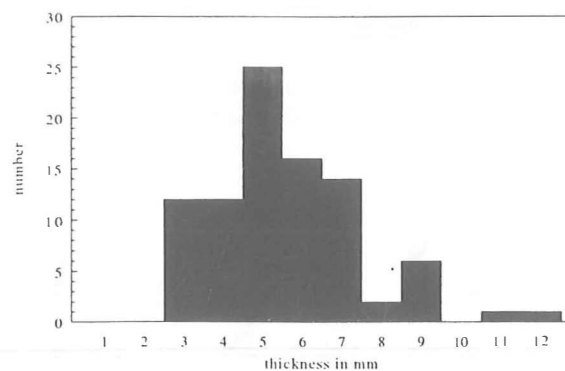


Fig. 29. Oudehaske. Thickness of complete blades in intervals of 1 mm. Drawing by Dick Stapert.

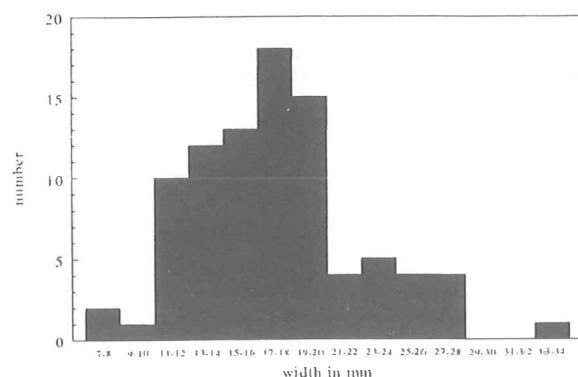


Fig. 28. Oudehaske. Width of complete blades in intervals of 2 mm. N=89. Drawing by Dick Stapert.

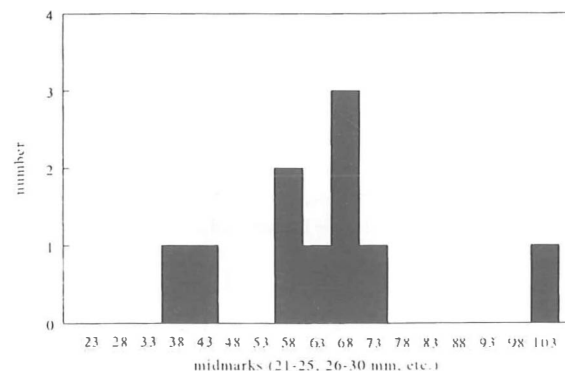


Fig. 30. Oudehaske. Length of complete blades consisting of fitting fragments (n=10). These blades cannot be refitted in the dorsal/ventral way. Drawing by Dick Stapert.

at Oudehaske cannot be taken as being representative of what the occupants of the site considered to be 'good', that is useful blades.

After refitting breaks, 10 blades resulted that are complete in the refitted state and that cannot be fitted into production sequences. Most of these blades therefore were probably imported to the site, and broke during its occupation. This sample, though small, may be considered to represent functional blades as defined by the occupants of Oudehaske. Their lengths are presented in figure 30. It is quite clear that these blades are on

average longer than the 89 complete blades discussed above (means 6.4 and 5.4 cm, respectively). The difference is even more clearly shown by the modal classes: 66-70 mm and 41-45 mm, respectively. Mean width of these blades is 1.9 cm (standard deviation 0.8) and mean thickness 6.4 mm (standard deviation 2.8).

Metrical attributes of all the complete blades left behind at any site may give a misleading picture, as noted above. These are in fact a selection, in which the larger blades, used as such or transformed into tools, are underrepresented. Used long blades will have had a

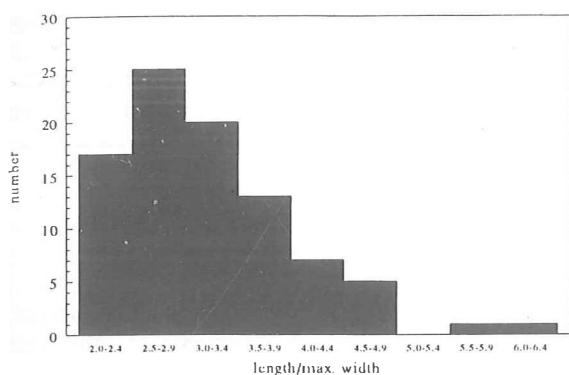


Fig. 31. Oudehaske. Length/width index for the complete blades ($n=89$), in intervals of 0.5. Drawing by Dick Stapert.

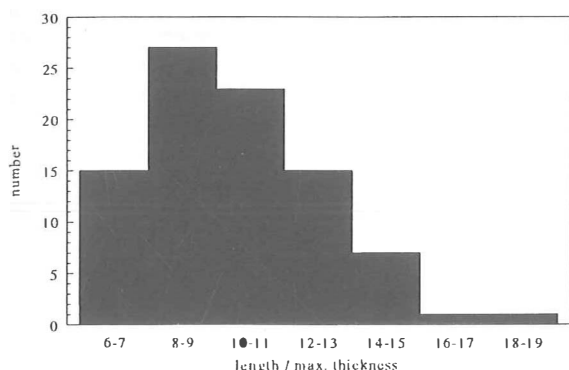


Fig. 32. Oudehaske. Length/thickness index for the complete blades, in intervals of 2. Drawing by Dick Stapert.

relatively large chance of breaking during occupation. Furthermore, a significant proportion of good blades produced on the site will have been taken away. Indices, i.e. ratios of two attributes, might be less affected by this bias, and therefore give a more reliable impression of the quality of the blade technology. Two indices were calculated: ratio of length to maximum width, and ratio of length to maximum thickness. The frequency distribution of the length/width index is shown in figure 31, and that of the length/thickness index in figure 32. Both distributions are positively skewed. Most blades are 2.5-2.9 times longer than wide, and a few are more than 5 times longer than wide, up to 6.2 times. Most blades are about 10 times as long as they are thick, the extreme case being a blade 18 times as long as thick.

In cases such as these, with a moderate skewness, the median values are perhaps the best summarizing measurements of the central tendency. For the length/width index the median is 3.0, for the length/thickness index it is 10.0. These values are indeed not very different from those obtained for the 10 complete blades consisting of fitting fragments: 3.6 and 9.8 respectively. The first index shows a somewhat higher value, which

is probably due to the occurrence of several stepped or hinged blades in the sample of 89 complete blades.

It has been noted above that the blades at Oudehaske were struck from cores with two opposite platforms. The 89 complete blades in total show 276 dorsal negatives whose striking direction can be established. Almost 78% of these have the same striking direction as the blades on which they occur (fig. 33). This proportion may at first sight seem surprisingly high, assuming that the two platforms were used alternately. However, most blades did not extend over the full length of the core-front, but stopped somewhere between half and two-thirds of its length. Therefore the observed proportions are probably roughly what should be expected in the case of bipolar cores.

Of the 413 blades or blade fragments subjected to analysis, 156 are involved in refitted groups: 37.8%. After refitting as many broken blades as possible, 370 blades or blade fragments resulted: 43 fewer than before refitting. In total, 100 blades or blade fragments among these 370 could be fitted into production sequences, 70 of which occur in sequences consisting only of blades. Above, we have already discussed the refitted groups containing blades fitting to tools or to cores. Here we shall consider refitted groups consisting of blades only. In total, there are 53 such groups. Refitted groups consisting only of blade fragments fitting together number 28; most of these consist of two fragments, only two consist of three fragments. There are 17 refitted groups consisting only of sequences. Finally, there are 8 refitted groups involving both refitted breaks and sequences. The maximum number of refits (i.e. refitting lines) per refitted group is 13. In total there are 25 refitted groups involving sequences. If we look at the number of blades in these sequences, counting blades consisting of several fitting fragments as 1, it can be noted that most sequences are very short. Of the 25 sequences, 15 (60%) only consist of two blades, and 6 (24%) of three; the maximum number is eight (one sequence) (see fig. 34). The sequence involving eight

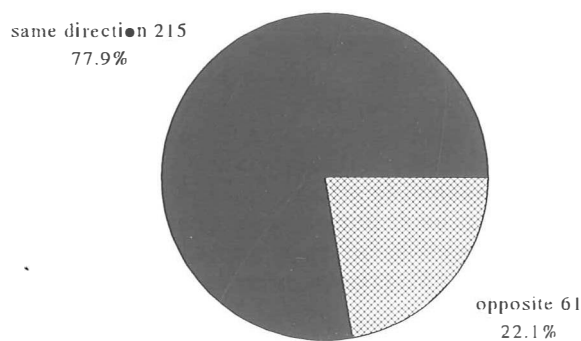


Fig. 33. Oudehaske. Directions of dorsal negatives on complete blades: identical or opposite to the striking direction of the blade. $N=89$. Drawing by Dick Stapert/Lykke Johansen.

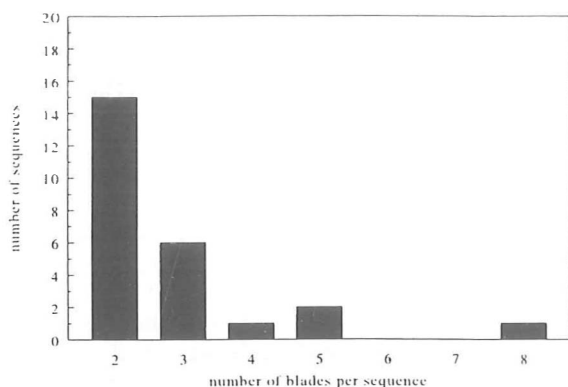


Fig. 34. Oudehaske. Numbers of blades in 25 sequences consisting only of blades; blades consisting of several fitting fragments are counted as one. Drawing by Lykke Johansen/Dick Stapert.

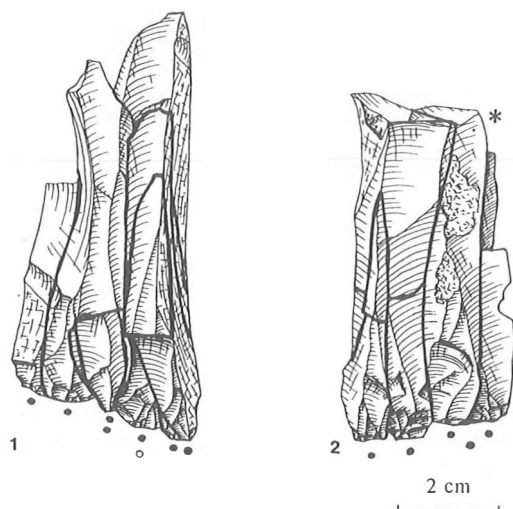


Fig. 35. Oudehaske. Two sequences, consisting of 8 blades (1) and 5 blades (2). Drawing by Lykke Johansen.

blades, and one of the sequences involving five blades, are shown in figure 35. Most of these sequences in fact do not seem to document flint-knapping at the site at all, but are merely little groups of conjoining imported blades, produced elsewhere. The occurrence of so many short sequences can partly also be explained by the removal of many good blades produced on the site. Both explanations boil down to the same general conclusions: the site must have been occupied only for a brief period, and the Ahrensburgian people carried quite a lot of good blades and tools during travel, and also some prepared cores.

Above, in the discussion of the cores with conjoining blades, two distinctive types of flint were noted. On the basis of the refitted groups consisting only of blades, two more characteristic flint types can be distinguished.

One of these is a quite coarse-grained, white flint, with small black spots. Two production sequences of this flint are present, each consisting of three blades. The refitted groups make it clear that the core from which these blades derive was longer than 9 cm. Apart from the two refitted groups, eight non-conjoinable blades of this flint are present (one consists of two fitting fragments). The core is absent, no tools of this flint were collected, nor are there any flakes. Most of the blades of this flint are of quite good quality, suitable for tool production, though some are rather small fragments, mainly bulbar ends. Such fragments of otherwise probably good blades could be waste material from tools made on the site, which were eventually exported from the site. Our interpretation is that the blades of this flint are a selection of blades knapped elsewhere. Another characteristic type of flint is marbly, showing an alternation of light-grey and dark-grey coloured parts. In total, 13 artefacts of this flint are present. Eight blades or blade fragments can be refitted into a long sequence (fig. 35: 1), showing that the core must have been at least 9 cm in length. Several fragments of thin and narrow blades, not suitable for tool-production, occur in this sequence. The other artefacts in this sequence are three blades or blade fragments and two chips. No tools of this flint type are present, nor is there a core. Because of the quite long knapping sequence, and the presence of chips and fragments of poor quality blades, at least part of the exploitation of the missing core must have taken place on the site. The core was probably still usable for blade production, and therefore taken away from the site.

It is difficult, on the basis of the refitting analysis, to estimate how many of the blades present on the site were knapped there. Most sequences are rather short, however, and many blades cannot be fitted into sequences at all. This state of affairs suggests that quite a number of blades were imported to the site, and also that many blades produced on the site were subsequently 'exported'. Though this cannot be quantified precisely, the proportion of blades made, used and discarded at the site seems to be quite small. This points to a fairly short occupation period.

3.4.6. *The flakes*

In total, 187 flakes or flake fragments were included in the refitting analysis. Very small flakes and chips were excluded. Some 66 of the included flakes are quite heavily burnt, the rest not or only slightly. Only 11 flakes can be refitted, exclusively into sequences. The longest sequence consists of 7 *tablets*: core-rejuvenation flakes, reshaping the platform. The two remaining sequences consist of only two flakes, and one of these again involves platform-renewing flakes. None of the refitted flakes show dorsally only cortex or old frost-split faces. Some of the larger flakes resulted from shaping or repairing the front of a core. The smaller

flakes were produced during preparation of core-platforms, prior to the detachment of a blade.

3.4.7. *The chaîne opératoire*

The flint nodules exploited at Oudehaske were mostly brought to the site in an already prepared state ('pre-cores'). This is suggested by the presence of only very few cortex flakes; one cortex blade is present. The first testing and preparing of the nodules must have been done at the place where they were gathered. The blade-cores at Oudehaske are bipolar, with two opposite platforms used in alternation. Preparation of core-fronts by creasing was absent or rare. In a few cases, however, core-fronts were repaired by creasing at later stages in the blade-production process; this kind of creasing never covers the whole core-front but only parts. Platforms were regularly repaired, prior to the detachment of almost each blade. Most flakes produced in repairing platforms are rather small, often no more than chips.

Blades were the blanks from which nearly all Ahrensburgian tools were made (except a few flake-scrapers). The Ahrensburgians sought to produce quite long blades, and probably one or two *Grossklinge* in the sense of Taute (1968) were present, given the occurrence of for example a blade fragment 10.8 cm long. Probably all of the long blades left behind at the site, 10 cm or more in length, had been brought to the site. The blades were

struck off by direct percussion, using soft hammerstones. On the ventral faces of some blades, near the bulbar end, it can be observed that a 'bulb-flake' split off when the blade was struck off the core. The negatives of such 'bulb-flakes' are very different from bulbar scars. Bulb-flakes leave negatives with the same striking direction as the blade itself, unlike bulbar scars. The presence of 'bulb-flakes' seems to be characteristic of knapping with a soft hammerstone, for example one of sandstone. Some examples of blades with 'bulb-flake' negatives are illustrated in figure 36. Blades were knapped from both platforms, often in alternation. This was probably done to keep the core in functional shape for as long as possible without much repairing. Core-angles, between the platform and the adjacent part of the core-front, were mostly between 50° and 70° during the blade-production stage. Many good blades produced at the site were eventually taken away, either as blanks or as tools, and this is one of the reasons why the majority of the production sequences as reconstructed by refitting are quite short.

3.5. Other artefacts

Two hammerstones were found at Oudehaske. One is made of rather compact sandstone; it has a weight of 90 gr (fig. 37: 1). A larger hammerstone consists of hard quartzite; its weight is 240 gr (fig. 37: 2). If also hammerstones of softer rocks were used, as is suggested by the presence of 'bulb-flakes' as described above, then these must have been taken away from the site. Apart from the two hammerstones, several stones of various kinds were collected from the topsoil at Oudehaske. We cannot be sure that they were part of the Ahrensburgian assemblage. Materials dating from more recent periods were also present in the topsoil, including sherds of pottery and fragments of clay pipes. Two rounded flint pebbles with diameters around 5 cm are remarkable, however (fig. 38). Neither pebble shows any traces of use or other modifications. Such flint pebbles seem to occur only rarely in the boulder clay. Perhaps they had been collected out of curiosity. Similar rounded flint pebbles, mostly with diameters of 3-5 cm, are known from several other Late Palaeolithic sites in the Netherlands (e.g. Westelbeers; Arts & Deeben, 1976).

3.6. Some conclusions

The period of occupation at Oudehaske must have been quite brief. Although the refitting analysis shows that flint-knapping was done at the site, complete production sequences, spanning the whole of the *chaîne opératoire*, are absent. There probably were no cores whose blades were all used and discarded at the site; this is in contrast to, for example, several completely refitted nodules at Oldeholtwolde (Boeschoten et al., 1997; Johansen, in press b). Most of the tools and long blades at the site

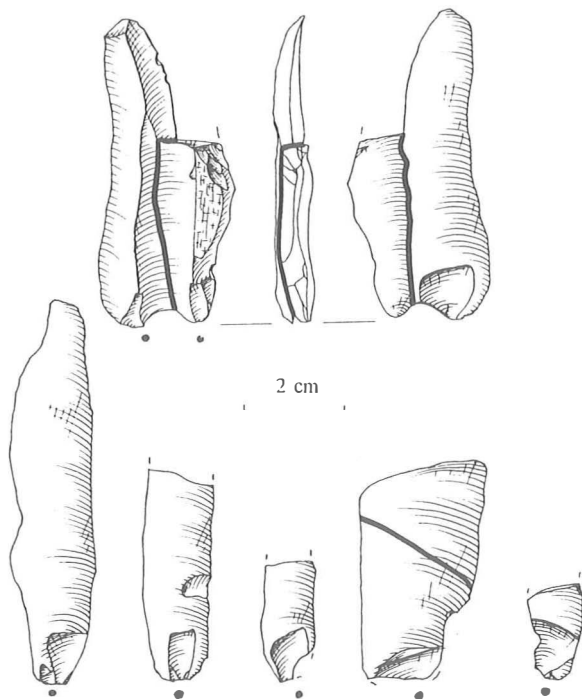


Fig. 36. Oudehaske. Blades showing negatives of 'bulb-flakes' on their ventral faces, suggesting the use of soft hammerstones. Drawing by Lykke Johansen.

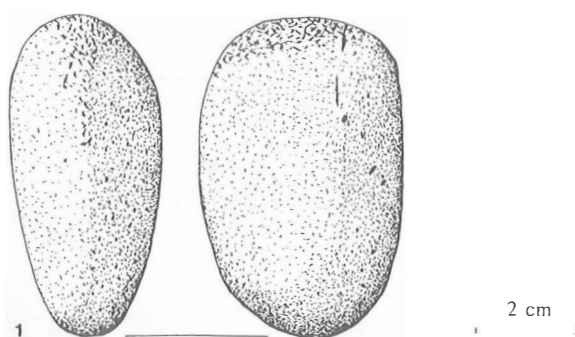


Fig. 37. Oudehaske. Two hammerstones.
1. Sandstone; 2. Quartzite. Drawing by
Lykke Johansen.

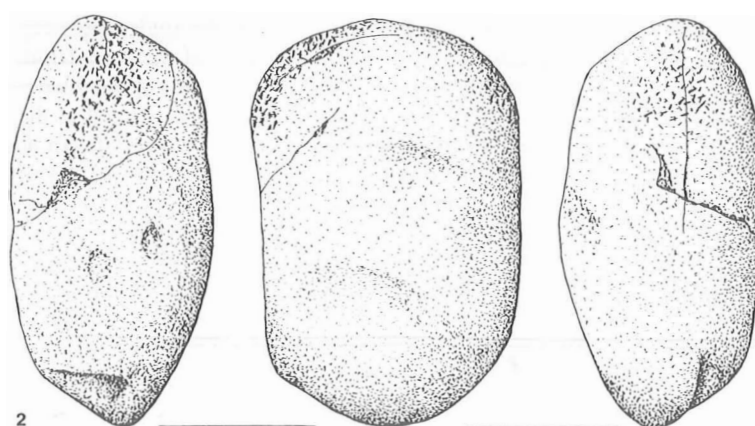


Fig. 38. Oudehaske. Two rolled flint pebbles (*Wallensteine*), showing no traces of use: brown (1) and grey (2). Drawing by Lykke Johansen.

must have been made elsewhere, and imported to the site. Good blades produced on the site must have been taken away when the occupants left. The site at Oudehaske does not seem to have been a 'base camp' used for any extended length of time. In view of the predominance of points in the tool assemblage it is suggested that the site was briefly occupied in connection with hunting activities, by only a few individuals.

4. GRAMSBERGEN

4.1. The site and its excavation

4.1.1. *Gramsbergen II*

The Gramsbergen site complex is situated in a new housing development area, called 'De Esch' (or 'De Hoge Esch'), southwest of Gramsbergen (fig. 39). The first concentration of flint artefacts (somewhat confusingly named 'Gramsbergen II') was discovered by amateur archaeologist A.G. Kleinjan (Den Ham) during Christmas 1972 (A.G. Kleinjan, letter to D. Stapert, March 1st, 1977). Some 190 flint artefacts, and

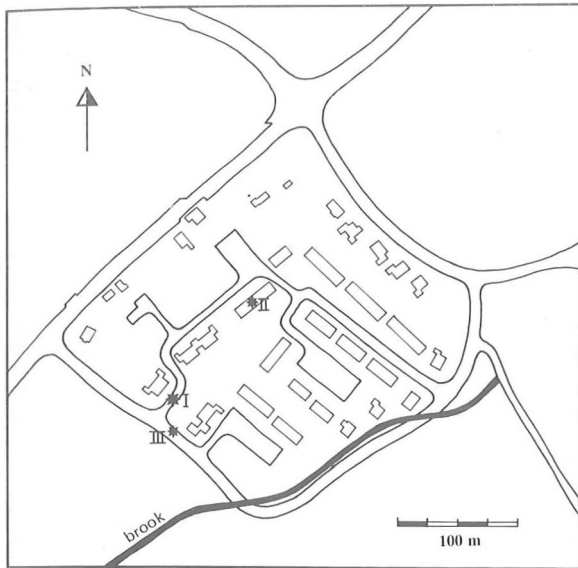


Fig. 39. Gramsbergen. Housing development area 'De Esch', southwest of Gramsbergen. Houses are indicated by their outlines. Asterisks: Flint concentrations (I and II: Ahrensburgian, III: Neolithic?). Drawing by Lykke Johansen.

a possible *retouchoir* made of quartzite, were collected from loose soil of a building pit for a house (for a brief description and drawings of the artefacts, see 4.7). This was done partly by sifting the soil, by a team of local amateur archaeologists including H. van Dorsten, A. Goutbeek, R. Klarenbeek, A.G. & G. Kleinjan and J. Wijnberger (see: Goutbeek, 1974). Later, about 20 flint artefacts were collected at the same spot by Kars of the municipal works department of Gramsbergen. No excavation was carried out at Gramsbergen II. We are convinced that the collection of some 210 flint artefacts is only a small part of the original assemblage. According to the discoverer, A.G. Kleinjan, a roundish spot with a black colour was observed in the building excavation: possibly a hearth. The finds include a small series of microlithic points very similar to those of the large artefact concentration found later, which is called 'Gramsbergen I'. It is therefore conceivable that the sites of Gramsbergen I and II are (more or less) contemporaneous. The first author has attempted to refit flint artefacts between the two concentrations, but without any success.

4.1.2. Gramsbergen I

Gramsbergen I, located about 100 m to the southwest of Gramsbergen II, was discovered in May 1973 by A.G. Kleinjan and B. van Daalen (Ens) during the digging of a sewer trench in the same development area (Goutbeek, 1974). In this case it was evident that a large part of the concentration was still present in an undisturbed state. The first finds were shown to district archaeologist A.D.

Verlinde (of the R.O.B., Amersfoort). The R.O.B. was unable to carry out an excavation at the spot, however, and Verlinde advised Kleinjan and his friends to excavate the site themselves. With the support of the local authorities and of Verlinde, an excavation was carried out in the second half of May and the first half of June of 1973 by a group of amateur archaeologists including R. van Beek, H. van Dorsten, A. Goutbeek, R. Klarenbeek, A.G. Kleinjan and J. Wijnberger. The topsoil was removed by a machine, and the terrain was divided into grid cells of 1 x 1 m. The finds were indicated by dots on maps of each square metre (with a scale of 1 to 10) but not individually numbered. On each find, however, the square metre from which it derived was marked in pencil, by a combination of a letter and a number. The letters were used on the NE-SW axis, and the numbers on the SE-NW axis (see fig. 40). In the distribution maps in this paper, a numerical division of both axes is employed (NE-SW axis: A=0-1 m, B=1-2 m, etc.; SE-NW axis: 1=0-1 m, 2=1-2 m, etc.). No sifting of the soil was carried out at Gramsbergen I. In total, an area of about 91 square metres was investigated in this way. Essentially, the spatial data in this case consist of frequencies per square metre. Because of this, horizontal distributions of artefact groups are mostly represented in this paper by density maps, using a grid with cells of 1 x 1 m.

Within the area excavated by the group of amateur archaeologists, an irregularly formed pit was found (in squares X=0-1/Y=9-10 and X=0-1/Y=10-11, see fig. 40), containing both flint artefacts and charcoal particles. The cross-section of the pit was asymmetrical, one of the sides being much steeper than the other. Most of the flint artefacts collected from the pit occurred at its bottom. The pit certainly does not represent a hearth; the most probable hypothesis is that the pit was created by a tree fall. The charcoal particles were studied by Dr W.A. Casparie (formerly of the Biologisch-Archaeologisch Instituut). He concluded that they consisted of *Pinus*; several showed small holes bored by insects indicating that the wood had been dead for some time (Casparie, pers. comm., 6 June 1975). The charcoal was dated by the Radiocarbon Laboratory at Groningen: 9320±60 BP (GrN-7793). During the pretreatment procedure in the laboratory it turned out not to be pure charcoal but instead partly carbonized wood. Because of this, recent humic contaminations could not with certainty be removed completely, so the date is probably too young (Lanting & Van der Plicht, 1995/1996: p. 115). Given this, and the circumstance that the pit most probably resulted from a tree fall after human occupation at the spot, the date must be considered as at best a *terminus ante quem* of the Ahrensburgian material. The flints collected by the group of amateur archaeologists from the fill of the pit comprised: 1 blade, 4 blade fragments, 2 flakes and 2 chips. Of the 9 artefacts, 6 were burnt. This is a high proportion, but elsewhere in these two square metres burnt flints were not very

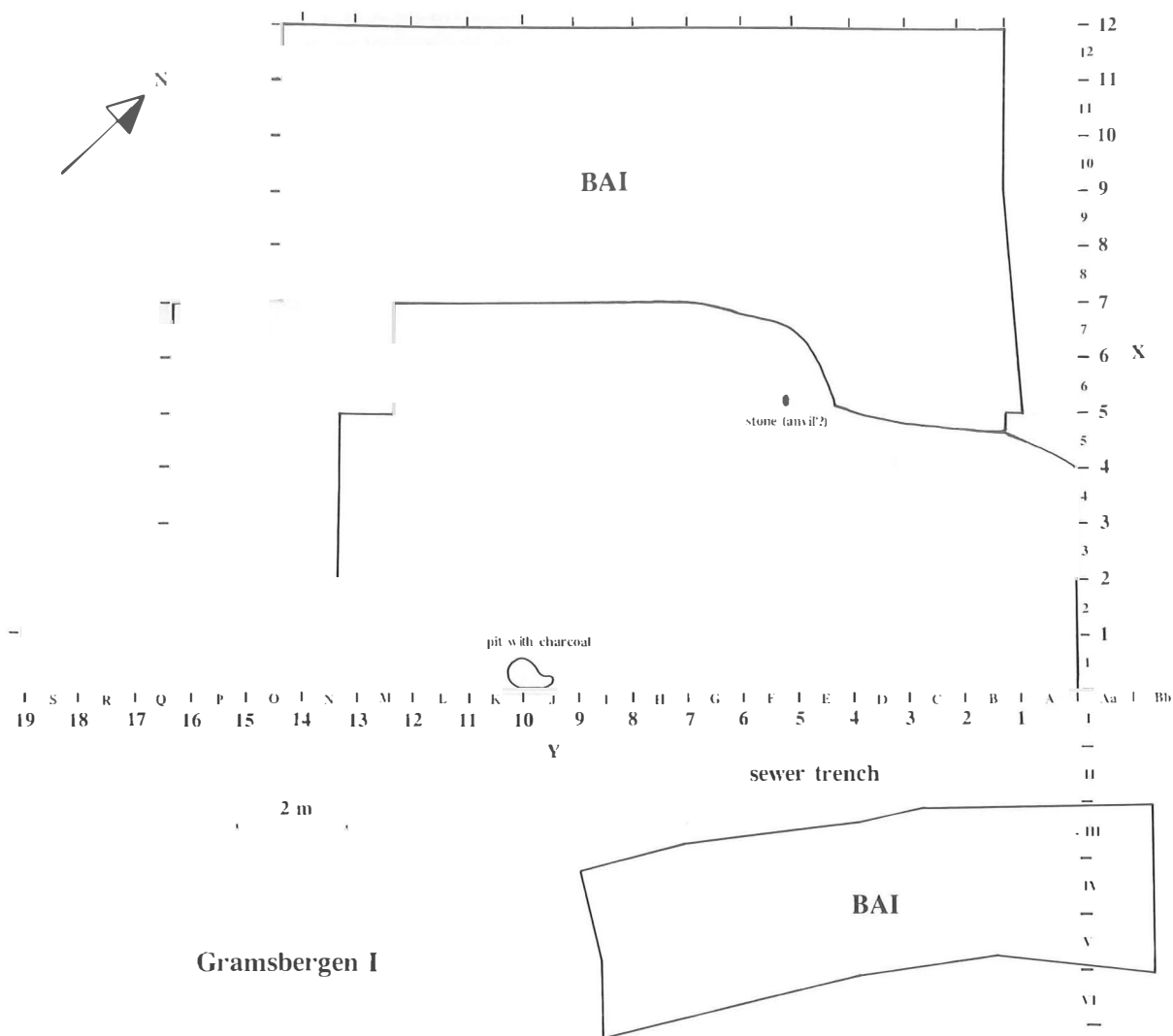


Fig. 40. Gramsbergen I. Excavation areas of the group of amateur archaeologists and of the Biological-Archaeological Institute (B.A.I.) in 1973. The coordinate systems of both excavations are given along the axes; the letters and numbers between the dashes were used by the group of amateur archaeologists. Drawing by Lykke Johansen/Dick Stapert.

common. For a discussion of the horizontal distribution of burnt flints at Gramsbergen I, see 4.4.2.

In the second week of June, 1973, Verlinde contacted the Biologisch-Archaeologisch Instituut of Groningen University (now Groningen Institute of Archaeology), with the request to supervise the excavation. On 12 June, the second author visited the site, in the company of R. van Beek, P. Houtsma, A. Meijer (formerly of the B.A.I.), and A.D. Verlinde. Most of the concentration had by then been dug away. It was nevertheless decided that the B.A.I. should excavate the remaining part. This excavation took place from 18-26 June, 1973. The team included two assistants of the municipal works department, and K. Klaassens (B.A.I.), E. Kramer (then a B.A.I. student, now of the Frisian Museum, Leeuw-

arden), A. Meijer, D. Stapert (B.A.I.) and J.H. Zwier (B.A.I.). A pit of about 93 square metres was opened immediately to the northwest and southwest of the area already excavated by the amateur archaeologists (see fig. 40). It soon became clear that the central part of the concentration had already been excavated; only parts of the periphery of the artefact scatter could be investigated. Some 100 artefacts were measured individually; the soil was not sifted. Several sections, both within the excavation trench and outside it (in house-building pits) were drawn (fig. 44), and several borings were done (for details about the stratigraphy, see 4.3). Several preliminary reports were published (Stapert & Verlinde, 1974; Stapert, 1979). Immediately southeast of the trench excavated by the group of amateur archaeologists, the

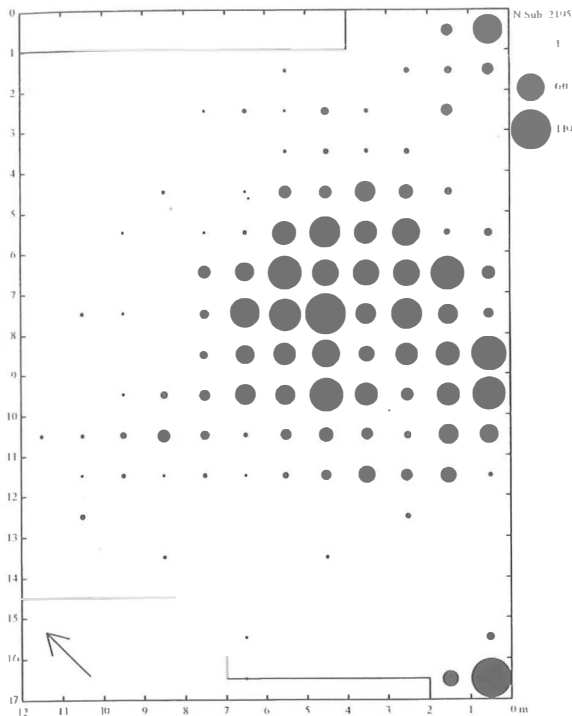


Fig. 41. Gramsbergen I. Density map (grid-cells of $1 < \text{maal} > 1 \text{ m}$) of all flint artefacts in the main excavation trench (north of the sewer trench). The map is based on all the flints bearing readable identification labels as to the square metre from which they derive. No classes are employed in the density map, and the diameters of the circles are drawn according to the peripheral option, stressing lower cell frequencies. Drawing by Lykke Johansen/Dick Stapert.

soil was totally disturbed over a width of 2 to 3 m by the sewer trench mentioned above (the digging of which led to the discovery of the concentration). To the southeast of the sewer trench, an area of about 30 square metres was investigated, but hardly any artefacts were collected (a total of 4: a flake, a blade 6.8 cm in length, a block and a burnt core fragment). The density map of all the flint artefacts from Gramsbergen I west of the sewer trench (fig. 41) makes it clear that quite a few artefacts must have been present in the area that was destroyed by the sewer trench; the concentration could therefore not be fully excavated (see also 4.4.1).

Apart from flint artefacts, quite a few potsherds were also found at Gramsbergen, mostly directly underneath the *Plaggen* soil (*es* layer) (see Stapert & Verlinde, 1974). These include: one TRB sherd, a few sherds of *Kiimmerkeramik*, and several hundred sherds of La Tène pots. The La Tène sherds derive from an Iron Age arable layer underneath the *Plaggen*-soil deposit. Represented are pots of Ruinen-Wommels types I-III. At the eastern margin of the *es*, a concentration of finds dating from the Roman period was found, near to remnants of a round well. Finally, some sherds of *Kugeltopf* and Pingsdorf ware were found, dating from the Middle Ages.

4.1.3. Gramsbergen III

Gramsbergen III is a collection of 30 flints, collected some 25-30 m south of Gramsbergen I (see figs 39 and 43). These finds derive from loose soil excavated from a sewer trench and from cleaning the section in the sewer trench. Most of the artefacts were gathered by Kleinjan in May 1973; some others were found by Van Beek in June 1973. A few charcoal particles were noticed at the spot. The artefacts of Gramsbergen III most probably have nothing to do with the Ahrensburgian occupation at Gramsbergen I and II. They are made of pale greyish flint of poor quality (with a lot of internal frost cracks); part of the artefacts are patinated white. The finds include: 1 small 'scraper', 2 cores, 13 flakes, 6 chips, 6 blocks, 1 unclassifiable burnt fragment and 1 nodule. The scraper is very small (19/14/4 mm) and was made of a frost-split piece of flint. Our guess is that this material dates from the Neolithic or Early Bronze Age.

4.2. Geography of the region

Gramsbergen is located in the valley of the river Vecht. Many remnants of old meanders of the Vecht can be discerned in the topography. Oxbow lakes must have formed also during the Late Glacial; in some of these, peat dating from the Allerød is preserved, as at the site of Gramsbergen (see 4.3). This area features many sand dunes, mainly dating from the Late Glacial: Younger Coversands I and II (Dryas 2 and 3, respectively). The site of Gramsbergen is located on one of these dunes, within the valley (fig. 42). It is probable that the formation of at least some of the dunes in the valley, 'river dunes' made up of local sands, continued for some time during the Preboreal. If this was also the case at Gramsbergen, then the Ahrensburgian artefacts most probably were left behind during the Preboreal, since they were present in the podzol soil at the top of the sand dune. The river Vecht deposited clays, loams and sands. In the low areas surrounding the sand dunes, peat accumulated during the Holocene, also outside the valley of the Vecht. At about 80 m to the south of the site, a small brook, a tributary of the Vecht, is still clearly visible in the landscape (figs 39, 42, 43); we presume that it held water during the site's occupation. The Ahrensburgian sites of Gramsbergen I and II are not located on the highest part of the sand dune, but about halfway down the slope to the brook, on a slight shelf (fig. 43). Nevertheless, the view across the landscape must have been good. Gramsbergen is located in an area with ice-pushed hills, mostly consisting of moraines (boulder-clay), dating from the Saalian (see fig. 42). These hills are the most probable sources of flints and other rocks during the Late Glacial. Several of these outcrops of boulder clay are situated about 3 to 4 km from the site — on the other side of the river Vecht, and these were probably the nearest sources of lithic raw materials for the Ahrensburgians. Another source, on the same side of the Vecht, is located about 10 km south of the site.



Fig. 42. Geological map of the surroundings of Gramsbergen (based on the 1930 geological map by the Geological Survey). Key: 1. Boulderclay at or near the surface; 2. Coversand; 3. River sediments (mostly clays, locally sands); 4. Driftsands, Holocene; 5. Peat; 6. Towns; 7. Location of the site near Gramsbergen. Drawing by Lykke Johansen.

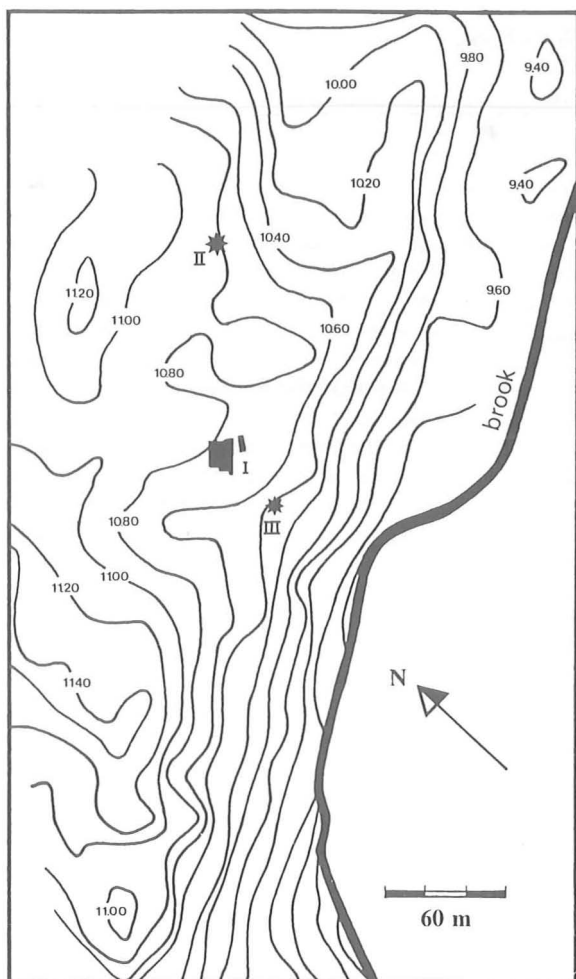


Fig. 43. Contour map of the vicinity of the sites at Gramsbergen, based on information provided by the Municipal Works Department of Gramsbergen. Intervals of 20 cm. Drawing by Lykke Johansen.

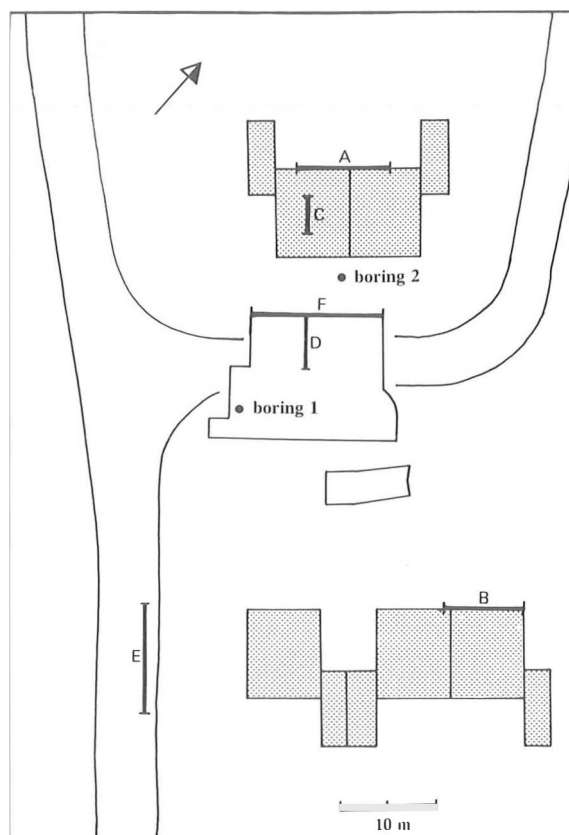


Fig. 44. Gramsbergen I. The excavation trenches, and their position with respect to two building excavations for houses (stippled) in 'De Esch', 1973. Six sections were drawn: in the main excavation area (D, F), in the two building excavations (A-C), and in a road cutting (E). One of these, A, is shown in fig. 46. The locations of two hand borings are also indicated. Drawing by Lykke Johansen.

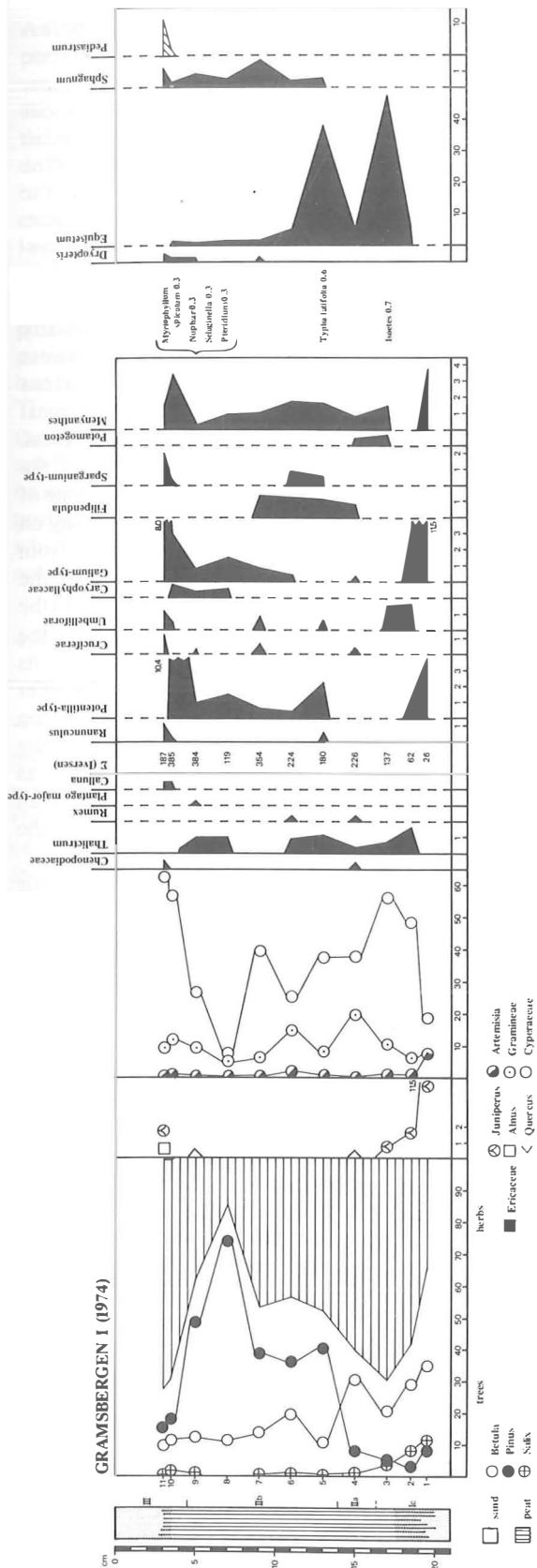


Fig. 45. Pollen diagram of the Allerød peat layer at Gramsbergen I (see under 4.3). After the original diagram made by W.A. Casparie in 1974. Drawing by W.A. Casparie/Lykke Johansen.

4.3. Stratigraphy at the site

The second author performed several borings at Gramsbergen I (the locations of borings Nos 1 and 2 are indicated in fig. 44). The stratigraphy is as follows, from top to bottom:

- Ploughed topsoil, c. 0-20 cm;
- *Es* layer (*Plaggen* soil), down to about 60 or 70 cm;
- Podzol in sand, in some places with an intact A1 horizon, and with a B horizon to about 1.3 or 1.4 m; the flint artefacts occurred in the A2 horizon and in the top part of the B1 horizon;
- Yellow coversand (C horizon), down to about 2.2 or 2.3 m;
- Greenish loam with plant remains, 10 to 20 cm thick;
- Coarse sand, c. 1 cm thick (in boring 1, not in boring 2);
- Brown peat, 15 to 20 cm thick, to a depth of about 2.6 m;
- Yellow coversand, to a depth of about 3.3 m;
- Coarse sand with gravel particles; end of the borings at about 4 m below the surface.

In June 1974, the brown peat at a depth of about 2.5 m below the surface (= c. 8.5 m +NAP) was sampled by E.A. van de Meene of the Geological Survey (district East), for radiocarbon dating and for pollen analysis. Several borings were done at a little distance from the excavation site at Gramsbergen I (we were unable to retrieve the exact locations). The observed stratigraphy was virtually the same as in borings 1 and 2, described above.

A pollen analysis was performed by Dr W.A. Casparie; the following information is based on his report (8 August 1974) and a letter by him to the second author (3 March 1998). The pollen diagram is presented in figure 45. Especially the *Pinus* phase of the Allerød Interstadial, and the transition to Dryas 3, seem to be well represented. Samples 1-3, provisionally placed in Dryas 2, might alternatively date to the first half of the Allerød. At the beginning of Dryas 3, *Pinus* seems to have disappeared rather quickly: within 100-200 years,

or even more quickly. In the top part of the pollen diagram, many plants indicating wet conditions are represented (*Nuphar*, *Myriophyllum*, *Menyanthes*, *Pediastrum*). Possibly, a permafrost was briefly present during the transition of IIb/III, as was also suggested in the case of Een-Schipsloot by Casparie & Ter Wee (1981). The locally occurring coarse sand layer and the loam layer, both lying immediately on top of the peat, must have been deposited in open water, possibly connected to the existence of a permafrost. Evidently a reversal of topography occurred here during Dryas 3: an oxbow lake became filled with coversand, and gradually a dune developed here. The variations in the thickness of both the loam and the peat between the various borings (in one boring by the Geological Survey no peat was encountered) can be explained by cryoturbation, dating to the Dryas 3. Casparie's interpretation of the pollen diagram was supported by a radiocarbon date of the peat: $11,130 \pm 60$ BP (GrN-8074). The sand lying on top of the loam/peat complex must therefore date from Dryas 3 and possibly also from the first part of the Preboreal. The artefacts lay in the A2 horizon and in the top part of the B horizon. This probably means that the artefacts were left behind on top of the dune, after its formation was completed, and therefore cannot be older than the last part of Dryas 3. If coversand deposition indeed continued for some time into the Preboreal, the finds could date from the first half of the Preboreal, as the radiocarbon date seems to suggest. At any rate, it can be definitely excluded that the artefacts date from the first half of Dryas 3.

Several sections were studied at the site, both inside the excavation pit and in its surroundings (see fig. 44 for locations). Only one of these, profile A, is shown here (fig. 46). At the top we find a *Plaggen*-soil deposit; below that an arable layer mainly dating from the Iron Age is locally present, on top of the coversand. The base of the *Plaggen*-soil deposit runs quite horizontally. Below it, however, the situation is more complicated. The surface of the coversand originally showed an irregular topography – with many depressions and dunes.

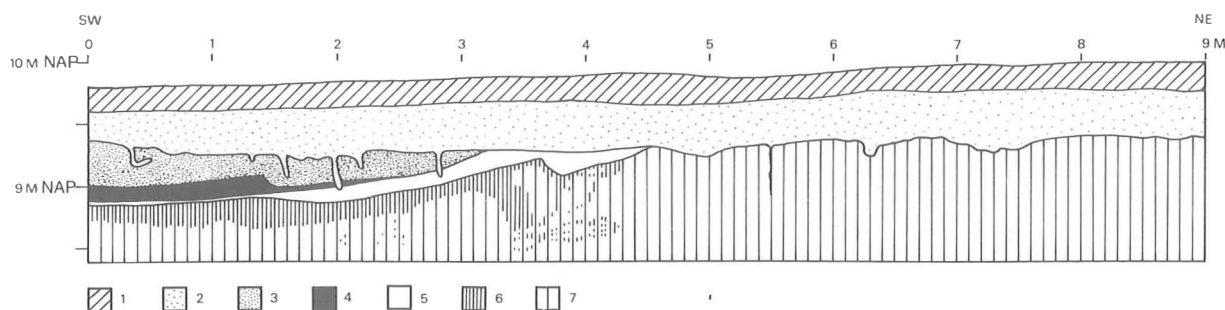


Fig. 46. Gramsbergen I. Section A; for location see fig. 44. Altitude in m NAP (Normal Amsterdam Level). Key: 1. Ploughed topsoil; 2. *Plaggen* soil (*es* layer; medieval); 3. Arable layer of (mainly) Iron Age; 4. Remnants of the dark humic A0 horizon of the podzol; 5. Light-grey A1 horizon of podzol; 6. B1 horizon of podzol; 7. B2 horizon and C horizon. The podzol developed in the top part of a Younger Coversand II layer. Drawing by Dick Stapert/Lykke Johansen.

A complete podzol soil at the top of the coversand was preserved only in the lower parts of the original landscape. Higher parts seem to have been 'truncated', and this was caused at least partly by wind erosion. Within the arable layer, especially at its top, thin bands of driftsand were observed in several places, for example in profile C. Erosion also occurred in parts of the excavated area, implying some movement of artefacts. In general, however, this will have meant that artefacts were displaced downwards; not much horizontal movement will have occurred. It was noted that in the parts with an intact podzol the flints were generally patinated brown, while in the parts where the podzol had been eroded away, white patina could often be seen. The presence of different patinas somewhat hampered the refitting analysis: in many cases white patinated artefacts fitted to brown patinated ones. Finally, it may be mentioned here that in some profiles, for example in profile B, the coversand was deformed by cryoturbation, which must date to Dryas 3. Distinct frost fissures were not observed, however.

4.4. The artefacts of Gramsbergen I, and the refitting analysis

4.4.1. General remarks

The flint artefacts at Gramsbergen were produced from nodules deriving from northern moraine deposits (boulderclay dating from the Saalian). During the period of occupation, flint nodules could not have been collected in the immediate surroundings of the site. Outcrops of boulderclay are present in the region, however (see fig. 42); the nearest sources are 3 to 4 km WSW and N of the site (on the other side of the river Vecht). The quality of the flint is generally quite good at Gramsbergen, but the range from very fine-grained to coarse-grained varieties is much larger than for example at Oudehaske and Sølbjerg I in Denmark (Johansen, in prep.). The flint artefacts of Gramsbergen I and II are mostly patinated, but the degree is variable: from virtually unpatinated to heavily patinated. The degree and kind of patination are connected to very local situations; it was noted above that the stratigraphical position of the flints is variable, owing to wind erosion. Both white and reddish-brown patinas occur, while some flint artefacts in addition show a low gloss. Fitting fragments of single blades are in many cases quite differently patinated. The flints have not been inspected by a use-wear analyst; we believe that most or all artefacts are unsuitable for a micro-wear study because of patination. Below, the various artefact groups are described, including the results of the refitting analysis. Apart from some dozen stray finds or very small artefacts that were unnumbered, a total of 2218 lithic artefacts are included in the Gramsbergen I data file (2195 flint artefacts and 23 stones of other kinds). In creating the data file, we used the square-metre labels written on the artefacts.

The main concentration of artefacts is quite large: some 8-10 m in diameter (fig. 41). The density map in figure 41 (produced by the ANALITHIC program) has no intervals: each frequency has its own diameter. It is a 'peripheral' density map, stressing lower frequencies (see Boekschoten & Stapert, 1996; Czesla, 1990). A linear density map employing six classes (advocated by Czesla, 1990), for the central concentration, is shown in figure 50.

The site was not excavated completely; part of the southeastern periphery of the concentration was disturbed prior to excavation by the digging of the sewer trench. In the extreme southern and eastern corners of the excavated area, additional find scatters are shown on the distribution map, which are evidently incomplete. Moreover, the quality of the spatial data in these scatters is much lower than is the case within the main concentration. The artefacts in the eastern corner were collected at the start of the excavation by the group of amateur archaeologists. The artefacts plotted in square X=1/Y=1 in fact were collected from a larger 'test pit', the precise extent of which is unknown to us. The artefacts in the other squares in the eastern corner, however, were collected by the square metre in the same way as the artefacts in the central concentration. The finds occurring in the eastern corner can be shown by refitting to be contemporaneous with the main concentration. The finds in the area between X=0-3 and Y=0-3 include the following (n=107): 3 B-points, 2 scrapers, 1 burin, 2 burin spalls, 9 complete blades, 28 blade fragments, 35 flakes, 23 chips, 2 cores and 2 blocks. Among these artefacts, 16 are burnt (c. 15%). The composition of this assemblage is not unlike that of Gramsbergen I as a whole. It does not make the impression of being a dump or some other kind of special activity area. Nevertheless, there are some indications that part of the scatter in the eastern corner may be a dump (see under 4.4.2 and 4.4.3). On the other hand, in the eastern corner we may also be dealing with the peripheral zone of another find concentration, similar to the central one at Gramsbergen I. It is also conceivable that both ideas are correct.

None of the finds in the extreme southern corner were systematically collected by the square metre. Most were collected in the sewer trench prior to the systematic excavation, mainly by R. van Beek. He indicated the approximate position of these finds with respect to the excavation grid to the second author during the B.A.I. excavation, but the exact location could not be established (following Van Beek, these artefacts were labelled 'PQ1' or 'PQ1/2'). To check whether there was any additional concentration in that area, a few square metres were excavated beyond the line Y=17, immediately to the south of the location indicated by Van Beek. Since in this area no artefacts at all were encountered during the B.A.I. excavation, we do not feel certain about the existence of a separate find scatter in that location. In fact, we consider it possible

that these artefacts derive from the part of the sewer trench bordering to the main concentration, and thus belong to it. These finds are in any case related to the main concentration by refittings. The finds plotted in this area ($X=0$ to 2 and $Y=15$ to 17) by the group of amateur archaeologists include the following ($n=143$ flints and 1 other stone): 3 points, 1 scraper, 3 burin spalls, 12 complete blades, 34 blade fragments, 39 flakes, 50 chips, 1 block and a fragment of a possible cooking stone. Among the flint artefacts, only 2 are burnt (1.4%).

In this paper, we will be mainly concerned with the central artefact concentration. On subsequent distribution maps in this paper, the area south of $Y=14$ is omitted, because of the uncertainties described above. As already noted, the excavation was done essentially by collecting artefacts by the square metre. In the automated data file, artefacts were therefore assigned coordinates in the centres of the square metres. However, results of refitting cannot be mapped in that way, because all artefacts from the same square metre would then lie on top of each other. To make refitting maps readable, we randomized the artefact locations per square metre. One has to realize this when looking at the refitting maps in this paper. Refitting lines to artefacts mapped by the group of amateur archaeologists in the southern corner are not shown in the maps, because the locations of those artefacts are uncertain (see above). Distributions of various artefact groups, without refitting lines, are systematically shown as density maps, based on the frequencies per square metre.

4.4.2. Burnt flint artefacts

As noted above, an irregularly shaped pit was excavated by the group of amateur archaeologists; it contained charcoal and artefacts, with quite a high proportion of burnt artefacts (see 4.1.2). The charcoal from this pit produced the radiocarbon date discussed earlier. We are now convinced that this pit had a natural genesis, and does not represent the remains of a hearth. The pit was probably created by an ancient tree fall, and the burning of the artefacts could therefore very well date from after the Ahrensburgian occupation at the site. Did the Ahrensburgians have a hearth, and if so, where was it? In order to investigate this, a density map was made of burnt flint artefacts (fig. 47). As can clearly be seen, two cells ($X=2-3$, $Y=6-8$) had high numbers of burnt artefacts and fall in the highest interval (19-22). It seems probable that these artefacts became burnt in a man-made hearth. In these two square metres, no pits or other structures were observed during excavation, however. If there was a hearth here, it either was a simple surface hearth, or, alternatively, any structures and charcoal present here originally were destroyed by subsequent erosion. If the concentration of burnt flints can be taken as a reliable indicator of the position of the hearth, then its position may be reconstructed as being at about $X=2.5/Y=7.0$. This reconstructed location of the hearth is indicated by

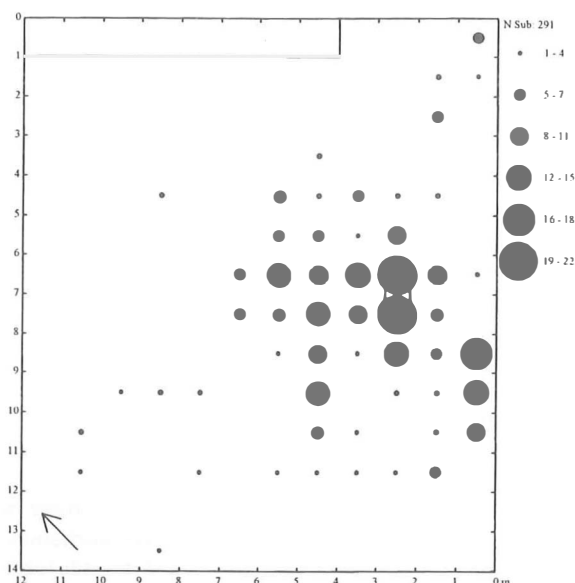


Fig. 47. Gramsbergen I. Burnt flint artefacts. The centre of the reconstructed hearth is set between the two richest cells. Drawing by Dick Stapert/Lykke Johansen.

a circle (or another symbol) in all distribution maps in the remainder of this paper.

An alternative way to investigate the distribution of burnt flints is by a proportion map, in which the percentages of burnt artefacts for all square metres are indicated: fig. 48. In this map, cells with a higher percentage than that of burnt flints over the whole area (14.2%) have an infilled circle, those with a lower percentage an empty circle. In order to avoid spurious pictures, a threshold value can be set by the ANALITHIC program; in this case only cells with at least 5 flint artefacts are represented in the map. It can be seen that higher proportions of burnt artefacts occur in the central part of the concentration, at the reconstructed hearth location. It is interesting that higher proportions also occur in the periphery, possibly as a result of clearing out; the pattern suggests some kind of 'centrifugal effect'. The cells with very high proportions of burnt flints in the extreme eastern corner might represent a dump. Finally, a density map was made of fragments of flint artefacts which were burnt so heavily that they could not be classified as to type (fig. 49). The idea behind this map is that, at least partly, such heavily burnt artefacts would have lain in the hearth for quite a long time. Since they easily crumble, they would also have had a smaller chance of being cleared away. Therefore, these heavily burnt fragments may indicate the position of the hearth more clearly than a map showing all burnt artefacts including those with only weak alterations by heat. It is satisfying to find that these artefacts indeed show a distinct clustering in the centre of the main artefact concentration, at the reconstructed hearth location. A density map of

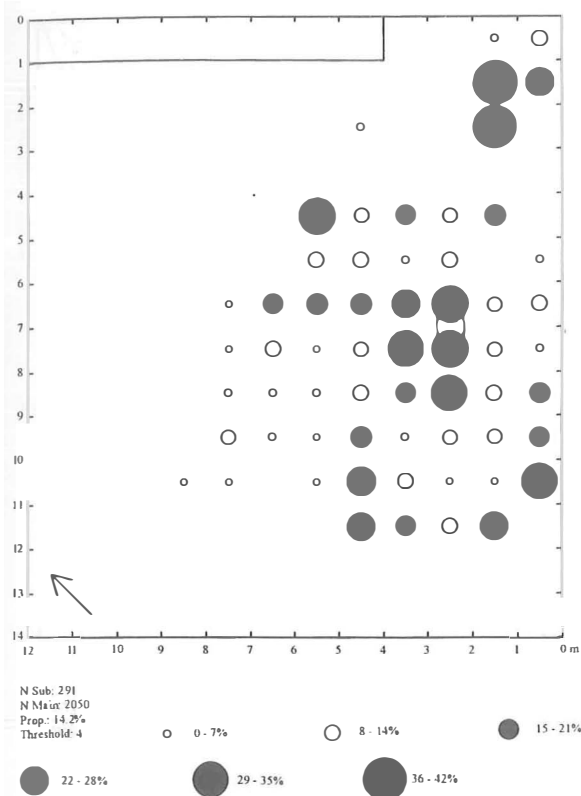


Fig. 48. Gramsbergen I. Burnt flints as a percentage of all flint artefacts per square metre. Only cells with at least 5 flint artefacts are represented. The reconstructed hearth is indicated by a circle. Drawing Dick Stapert/Lykke Johansen.

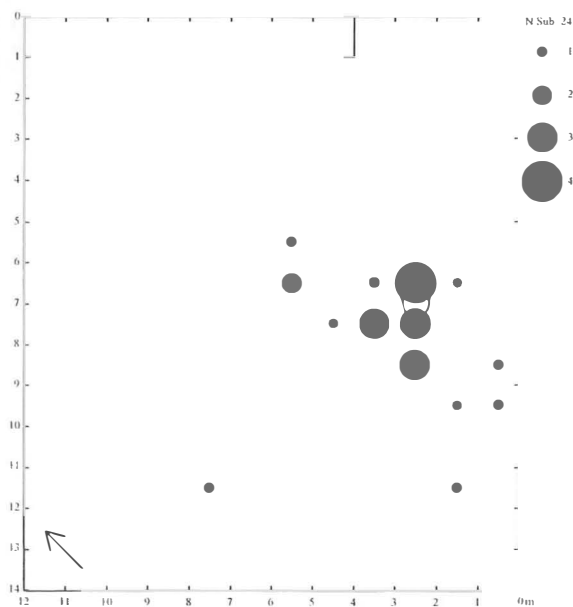


Fig. 49. Gramsbergen I. Density map of unclassifiable burnt fragments of flint artefacts. Drawing by Dick Stapert/Lykke Johansen.

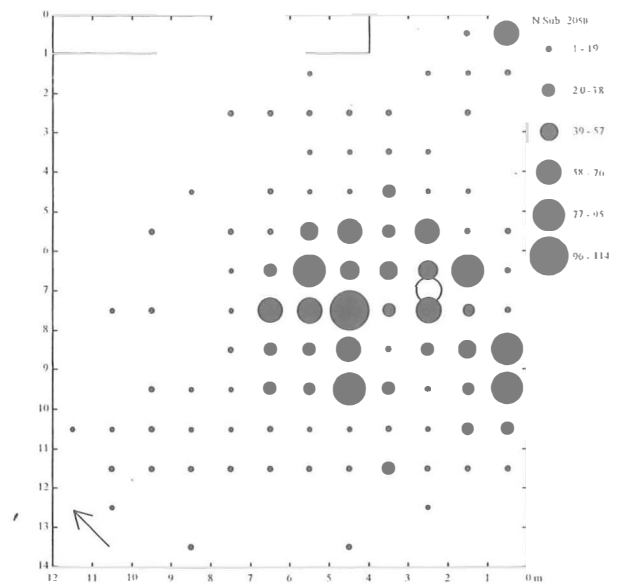


Fig. 50. Gramsbergen I. The part of the excavated area selected for the analysis of spatial patterns in the remainder of this paper. The reconstructed hearth is shown as a circle. All flint artefacts in this area are shown in a density map according to the principles of Czesla (1990): a linear division into six classes. Drawing by Dick Stapert/Lykke Johansen.

all flint artefacts in the area selected for analysis is shown in figure 50; this is a linear density map with 6 intervals: the approach advocated by Czesla (1990; see also Boekschooten & Stapert, 1996). The reconstructed hearth is indicated by a circle. It can be seen that the richest cells occur some 2 m west of the reconstructed hearth. However, several rich cells occur to its south, close to the edge of the excavation; it is obvious that part of the concentration was destroyed.

4.4.3. The refitting analysis: general results

Included in the refitting analysis were all tools and tool fragments, waste products from tool production, cores, all blades and blade fragments larger than 1.5 cm, and flakes larger than 2.5 cm. In total, 1432 artefacts were involved in the refitting analysis, of which 299 could be refitted, resulting in 104 refitted groups; the refitting percentage is 20.9%. Most of the refitted groups only contain a few fitting artefacts; 66 of them consist of two artefacts (63.5% of all refitted groups). One refitted group stands out: it contains 33 artefacts. The numbers of artefacts per refitted group are shown in a diagram (fig. 51). Refitting lines are drawn according to the system of Czesla (1990). In total, 242 refitting lines connect the refitted artefacts in the 104 groups. In the case of Gramsbergen I, these lines can be split up into five different types of refit. There are three primary types of line: sequences, breaks and burins/burin spalls.

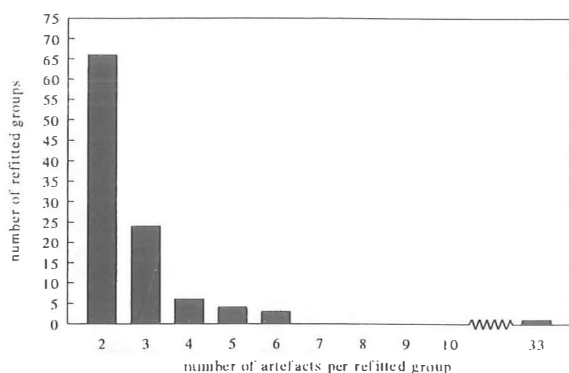


Fig 51. Gramsbergen I. Numbers of artefacts involved in the 104 refitted groups. In total, 299 artefacts are involved in refitted groups. Drawing by Dick Stapert/Lykke Johansen.

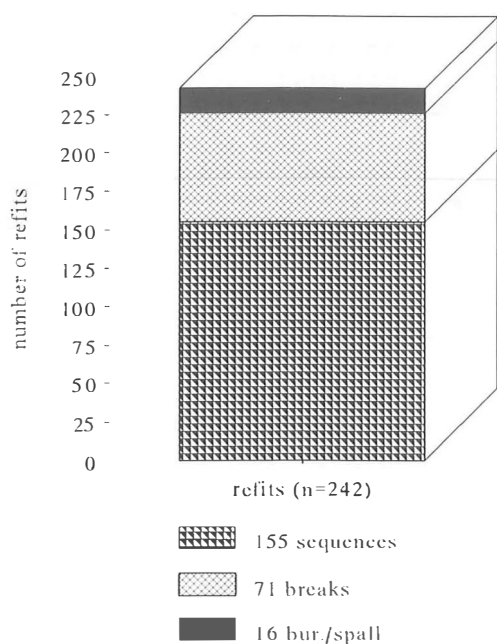


Fig. 52. Gramsbergen I. The total of 242 refits (= refitting lines) are divided into three categories: sequences, breaks and burin/burin spalls. Refitting lines are generated according to the system of Czesla (1990). Drawing by Dick Stapert/Lykke Johansen.

In figure 52, the frequencies of these three types of refit are shown in a diagram. At Gramsbergen I, there are 155 dorsal/ventral refits, 16 lines connecting burin spalls to burins, and 71 refits of breaks. Within the last category, 21 breaks are due to heat, and 3 to frostsplitting; for the remainder of the breakage refits, the process responsible for the break is undetermined.

It was noted above (under 4.4.1) that in the maps showing the results of refitting, lines to artefacts in the area $Y > 14$ m have been omitted. Of the total of 242 recorded refits, 231 connect artefacts within the area

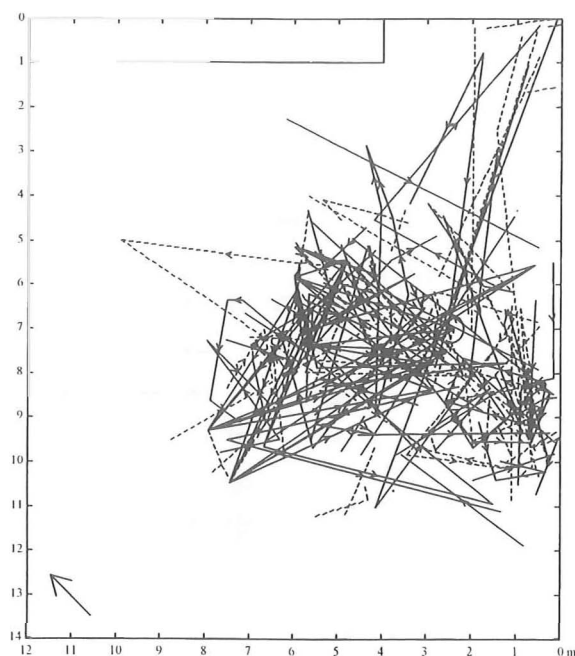


Fig. 53. Gramsbergen I. Within the area shown in fig. 50, a total of 231 refits (= refitting lines) were produced by the refitting analysis, which are all shown here. This and similar figures in this paper are based on the randomized file. The refitting lines are generated according to the system of Czesla. In this and following figures, three types of line are employed: unbroken line with arrow: sequences, the arrow is directed towards the core; broken line with arrow: burin/burin spall, the arrow points towards the burin; broken line without arrow: breaks. Drawing by Lykke Johansen/Dick Stapert.

selected for analysis; all these lines are shown in figure 53. Three line types were employed in this map: normal lines with an arrow: dorsal/ventral sequences (the arrow points towards the core); broken lines with an arrow: burin spall/burin (the arrow points from spall to burin); broken lines without an arrow: breaks. In the map, the reconstructed hearth is indicated by a circle. It can be noted that most refitting lines cluster in two areas, west and south of the hearth. Moreover, it may be noted that quite a lot of refitting lines connect the main concentration to the artefact cluster in the extreme eastern corner of the excavated area.

It is of interest to study the length of refit lines. In the case of Gramsbergen I, however, it has to be remembered that the artefacts were given random locations within the square metres from which they were collected; this means that there is no point in looking at small line lengths. Based on the randomized data file, length classes of 1 m for the refit lines are shown in figure 54. As usual, shorter refit lines predominate. The longest refit line is between 11 and 12 m long. We decided to study the relative frequencies of the different types of refit per length class (see Czesla, 1990). In figure 55, the refit lines are divided into 4 length classes: 0-1.50 m, 1.51-

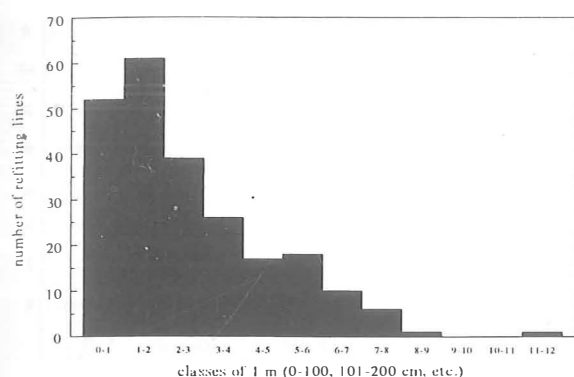


Fig. 54. Gramsbergen I. The lengths of the 231 refitting lines within the area shown in fig. 50, presented in classes of 1 m. Drawing by Lykke Johansen/Dick Stapert.

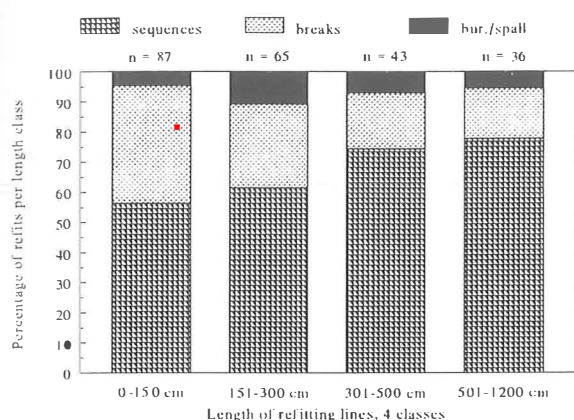


Fig. 55. Gramsbergen I. The 231 refits within the area shown in fig. 50 are split up according to 3 refit types and 4 distance classes. Note that the longer the refitting lines, the higher the proportion of sequences among the refits. Drawing Lykke Johansen/Dick Stapert.

3.00 m, 3.01-5.00 m and 5.01-12.00 m. As can be seen, the proportion of sequences systematically increases with longer refit lines, while that of breaks decreases. This seems to indicate that it is relatively rare for fitting fragments (breaks) to end up very far from each other. On the other hand, it is not infrequent that artefacts fitting in the ventral/dorsal way end up far apart; this may partly reflect the circumstance that blades and tools often were carried from the production spot, where flint knapping was done, to activity areas elsewhere. The highest proportion of burin/burin spall refits occurs in the length class of 1.5-3 m.

In figures 56-59, all refit lines are shown per length class. The short lines (fig. 56) occur especially clustered to the west/northwest and south of the reconstructed hearth. It is probable that the northwestern cluster reflects a flint-knapping location. The refit lines of 1.5-3 m (fig. 57) essentially present the same picture; it is noteworthy,

however, that sequences predominate in the northwestern cluster, while break refits predominate in the southern cluster. This may indicate that in the northwestern cluster a good deal of flint knapping took place, while in the southern cluster tools and blades were intensively used, resulting in breaks. In other words: flint knapping was proportionally much more important in the western cluster than in the southern one. We will later investigate whether or not there are also other differences between these two subareas, for example in terms of tool types. The lines of 3-5 m length show a heavy clustering to the west of the reconstructed hearth (fig. 58). The lines longer than 5 m (fig. 59) show an interesting pattern. A dense bundle of lines connects an area at about 5 m west of the hearth with the immediate surroundings of the hearth. Moreover, this map shows how the scatter in the eastern corner is connected by refit lines to the area around the reconstructed hearth.

Up till now, all refitting maps only showed the refit lines, not the artefacts. In figures 61-65, refit lines of several categories are shown, together with symbols for various artefact groups. The key to the artefact symbols used in distribution maps in the remainder of this paper is shown in figure 60. It has to be noted that artefact classifications were done before the refitting analysis. As a result of refitting, the classification of some artefacts changed; this applies to burin spalls especially. In the refitting maps shown below, burin spalls are in some cases represented by a blade symbol. The change in classification in such cases is evident from the line type: a broken line with an arrow indicates the refitting of a burin spall to a burin. All dorsal/ventral sequences are shown in figure 61. It can again be noted that these cluster heavily in the area west and northwest of the reconstructed hearth. Most of the cores are also present in this area. A smaller cluster of sequence lines is present to the south of the hearth, and a few cores are also present in that area. Refits of burin spalls to burins are shown in figure 62. The two clusters northwest and south of the hearth show up again. It is interesting to note, however, that two burin spalls in the southern cluster fit to burins in the northwestern cluster. These burins were made (or resharpened) next to the hearth in the southern cluster, and then transported to spots at quite a distance west or northwest of the hearth, where they presumably played a functional role. All refits of breaks whose causative process is unknown are shown in figure 63. The two clusters once again show up. Furthermore, it is of interest that a couple of these refit lines connect the area around the hearth with the scatter in the extreme east corner. This seems to support the idea that part of the artefacts in the eastern corner were in a dump context. In figure 64, all breaks resulting from heat are mapped. There is a concentration of refit lines close to the reconstructed hearth, but several fitting fragments occurred at some distance. Several refit lines clustering to the south of the hearth may represent a secondary burning event (connected to the pit with

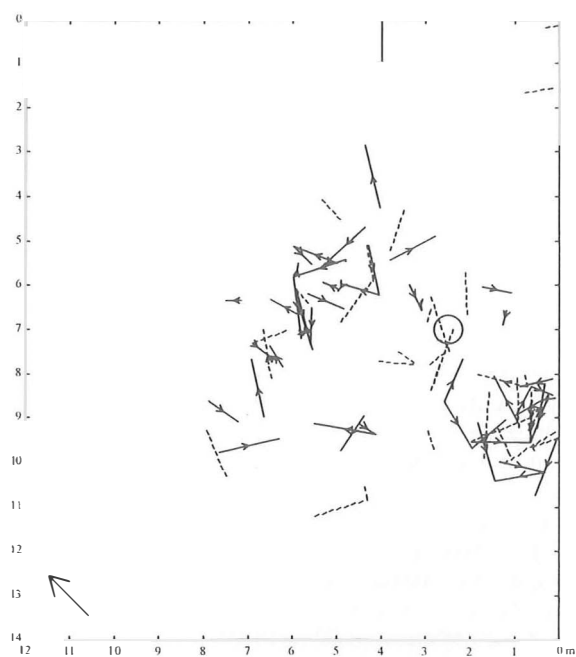


Fig. 56. Gramsbergen I. All refitting lines of 0-150 cm within the area shown in fig. 50, $n=87$. For types of line, see fig. 53. Drawing by Lykke Johansen/Dick Stapert.

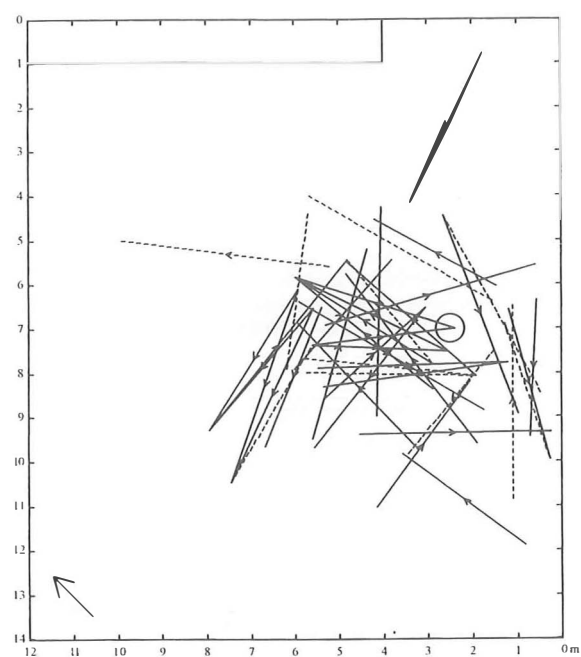


Fig. 58. Gramsbergen I. All refitting lines of 301-500 cm, $n=43$. Drawing by Lykke Johansen/Dick Stapert.

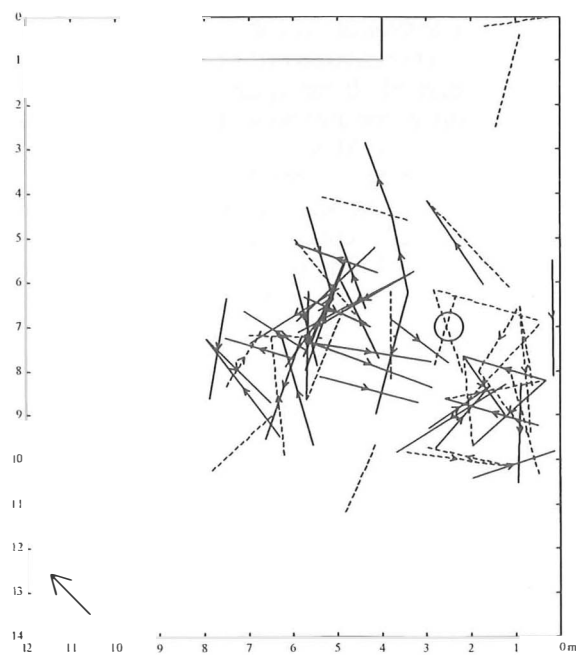


Fig. 57. Gramsbergen I. All refitting lines of 151-300 cm, $n=65$. Drawing by Lykke Johansen/Dick Stapert.

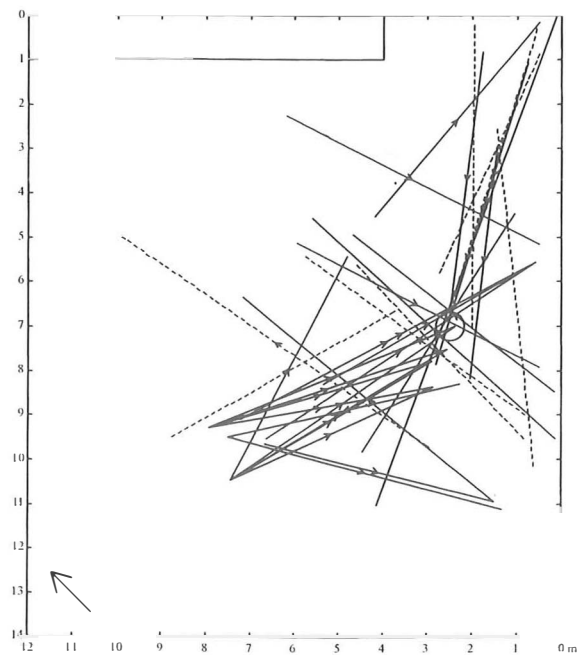


Fig. 59. Gramsbergen I. All refitting lines longer than 500 cm, $n=36$. Drawing by Lykke Johansen/Dick Stapert.

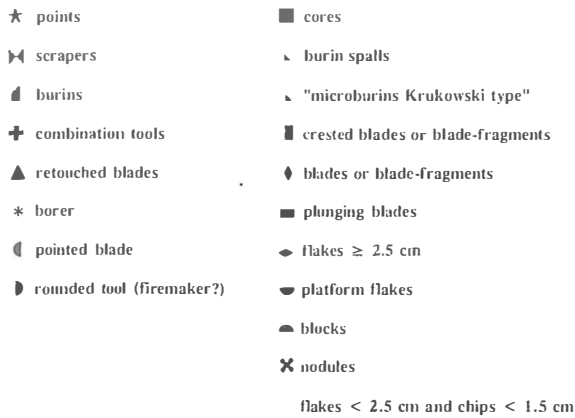


Fig. 60. Gramsbergen I. Key to symbols used in refitting maps. Drawing by Lykke Johansen.

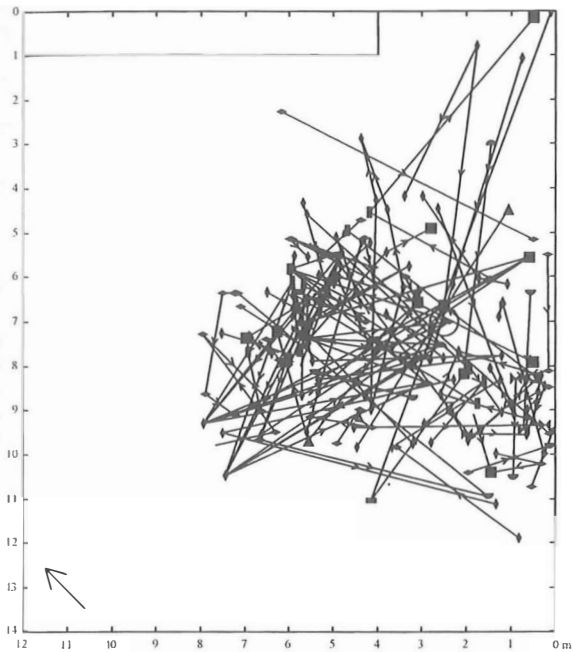


Fig. 61. Gramsbergen I. All refits of sequences, $n=149$. In total, 182 artefacts are involved. Drawing by Lykke Johansen/Dick Stapert.

charcoal in that area: see under 4.1.2). Finally, figure 65 shows the few refit lines that can be ascribed to frost-splitting. Of interest is a core that broke along a hidden frost crack during its exploitation (fig. 101: 3). The fact that half of the broken core turned up in the extreme east seems again to support the idea that at least part of the artefacts in that area occurred in a dump.

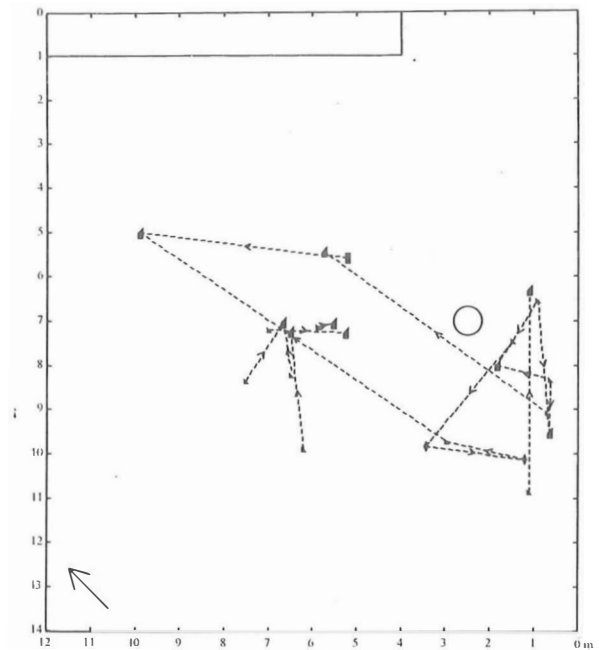


Fig. 62. Gramsbergen I. All refits of burin spalls to burins, $n=16$. In total, 23 artefacts are involved. Note that some artefact classifications changed as a result of the refitting analysis. Drawing by Lykke Johansen/Dick Stapert.

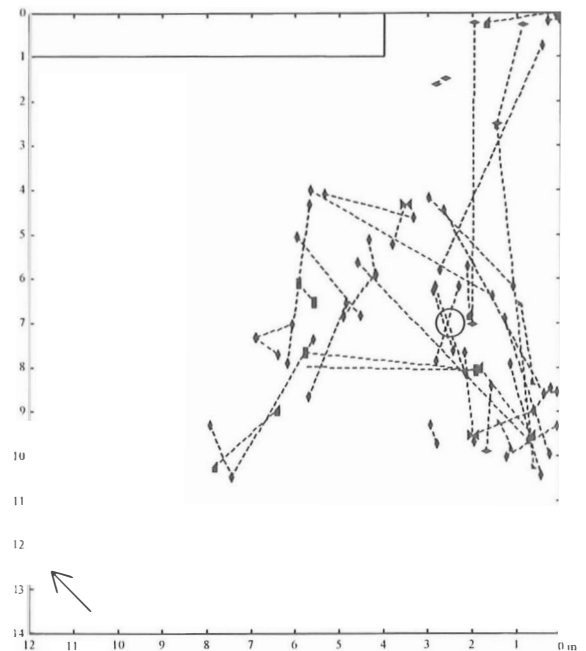


Fig. 63. Gramsbergen I. All refits of breaks due to undetermined causes, $n=42$. In total, 81 artefacts are involved. Drawing by Lykke Johansen/Dick Stapert.

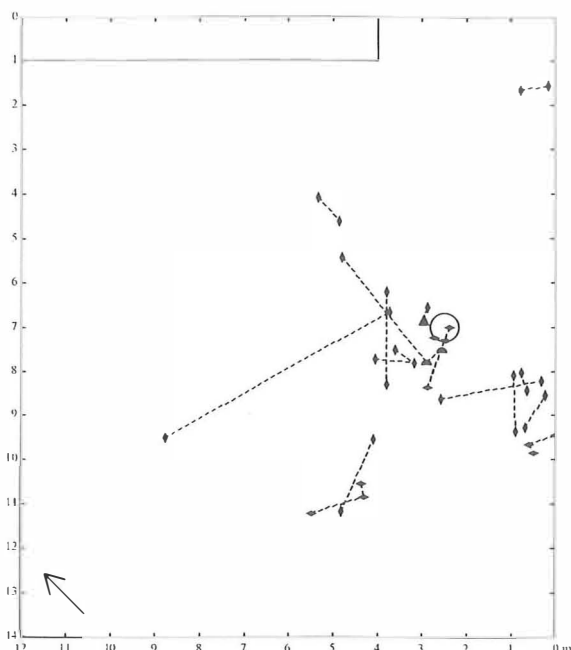


Fig. 64. Gramsbergen I. All refits of breaks caused by burning, $n=21$. In total, 36 artefacts are involved. Drawing by Lykke Johansen/Dick Stapert.

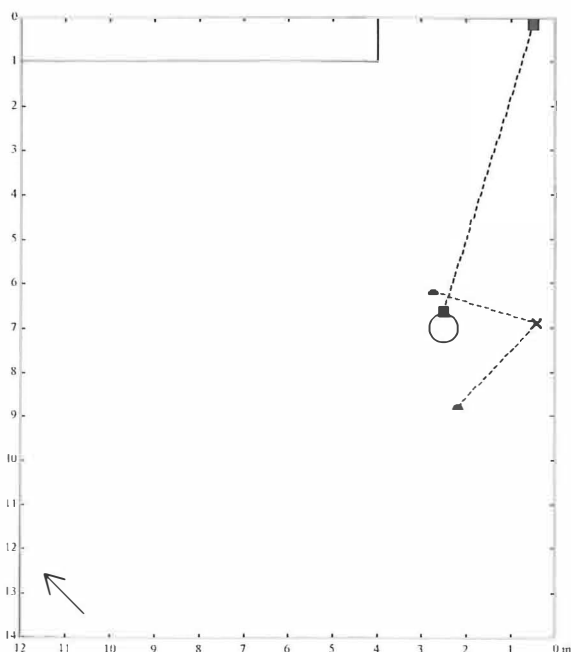


Fig. 65. Gramsbergen I. All refits of breaks caused by frost-splitting, $n=3$. Five artefacts are involved. Drawing by Lykke Johansen/Dick Stapert.

4.4.4. The tools

In total, 164 tools are known from Gramsbergen I; they are listed in table 4. All tools are described and illustrated below.

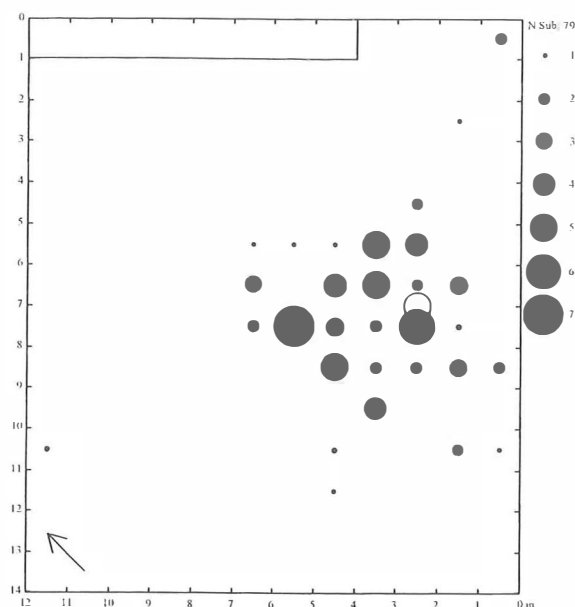


Fig. 66. Gramsbergen I. Density map (linear) of the points ($n=79$). Open circle: reconstructed hearth. Drawing by Lykke Johansen/Dick Stapert.

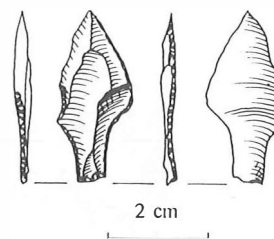


Fig. 67. Stray find of a tanged point, said to have been found near Gramsbergen. After Wouters (1990: p. 50). Drawing by Lykke Johansen.

The points ($n=82$). In total, 82 points of Gramsbergen I have been included in our data file, but according to notes made by the group of amateur archaeologists several more existed that were lost prior to our study. Probably some 85 to 90 points were present originally. No tanged points were found during the excavations at Gramsbergen I (nor at Gramsbergen II). However, a stray find of one tanged point at 'Gramsbergen' is reported by Wouters (1990). This point (fig. 67) is said to have been found by H. Teusink in 1988. No information was given concerning the precise findspot, and we did not succeed in tracing the finder.

Points are clustered especially on one side of the reconstructed hearth: to its north and west (fig. 66). The richest cell, containing 7 points, occurs at a distance of about 3 m northwest of the hearth. However, most of the points are located relatively close to the hearth; for example, a square containing 6 points occurs in its immediate vicinity. Most points were made of blade

Table 4. Gramsbergen I. List of artefacts. Numbers counted before refitting analysis.

A. Flint tools		
	N	Percentage of subtotal
Points	82	50.0
Zonhoven points, (near-)compl.	8	
B-points and point fragments	74	
Scrapers	43	26.2
on blades	9	
on blade fragments	21	
on flakes (including 4 double scrapers)	13	
Burins	29	17.7
on break, A (single: 5, double: 6, triple: 1)	12	
on truncation, RA (single: 7, double: 4)	11	
dihedral, AA (single: 3, combined with A or RA: 3)	6	
Combination tools (scraper/burin)	2	1.2
Borer	1	0.6
Pointed blade	1	0.6
Retouched blades	5	3.0
Tool with rounded end (possible 'strike-a-light'):	1	0.6
Subtotal	164	99.9
	(7.5% of total)	
B. Flint non-tools		
		Percentage of total
Burin spalls	48	2.2
'Microburins of Krukowski type'	10	0.5
Blades or blade fragments	826	37.6
Flakes	621	28.3
Chips (<1.5 cm)	458	20.9
Blocks and nodules	26	1.2
Cores	18	0.8
Unclassifiable burnt fragments	24	1.1
Total	2195	100.1
C. Other artefacts		
Ochre?	1	
Probable and possible cooking stones:	16	
Hammerstones:	2	
Iron concretions:	3	
Anvil stone?	1	

fragments, and we believe that most breaks occurring opposite the truncations at the tips of the points were intentional, in order to give the point a desired length. There is hardly or no evidence that the 'microburin technique' was used to divide the blades into parts. Sometimes, however, probably unintentionally, microburin-like artefacts were produced in the manufacture of points. These are so-called 'microburins of Krukowski type'.

In total, 10 of these artefacts are present at Gramsbergen I. Since they are produced in the manufacture or repair of points, their horizontal distribution is discussed here.

The microburins of Krukowski type are nicely concentrated to the west of the reconstructed hearth (fig. 94), and have a much more restricted distribution than the points. The concentration may reflect a spot where damaged points were repaired or new points

made. Though there is a concentration of points in this area (including the richest cell, containing 7 points), most of the other points are located closer to the reconstructed hearth. This can be understood if we envisage two different activities: making or repairing points (flint-working), and repairing the composite projectiles of which points were a part (presumably arrows). The latter activity probably took place near the hearth, because heat was needed for attaching the new points to their hafts with resin. The difference between the two density maps seems to suggest that production or repairing of flint insets was done at some distance from the hearth, while the hafting was done close to the hearth. In many sites, points are close to hearths; in general these must be used ones, removed from the hafts prior to the insertion of newly-made ones. In this connection it is interesting that none of the points of Gramsbergen I can be refitted with any other artefact

(the same goes for the microburins of Krukowski type). This must clearly mean that none of the points was made on the site. They were imported to the site in a hafted state, and left behind as a result of what Keeley (1982) has called 'retooling'. They were taken out of their hafts, and replaced by newly-made ones, which were subsequently taken away from the site.

Eight points can be described as Zonhoven points: points combining a truncation at the tip with basal retouch (fig. 68: 1-8); one of these has a concavely retouched base (No. 4). Only one seems to be complete (No. 3), five lack part of the tip (Nos 2, 4, 6, 7 and 8) and one is damaged both at the tip and at the base (No. 5). Three of these points have the truncation at the right and five at the left (if the tip faces upwards). The tip is located distally in five cases, and proximally on the remaining three points. All the other points can probably be best classified as B-points: simple microliths with an

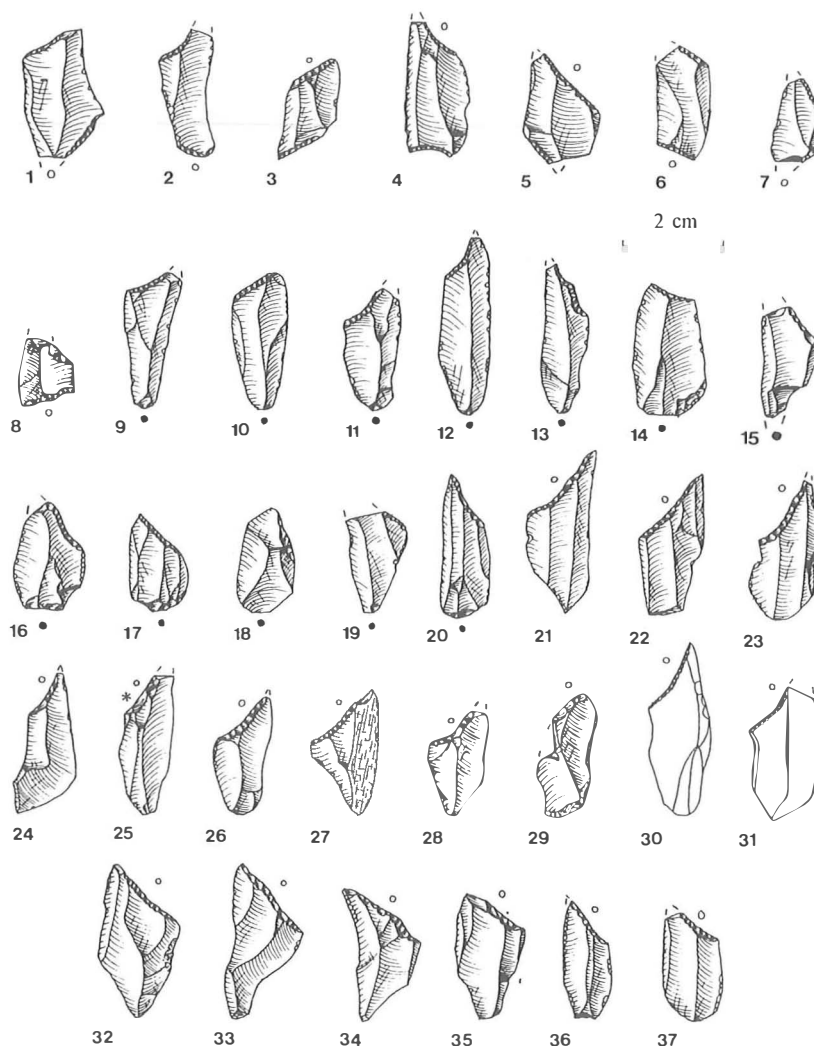


Fig. 68. Gramsbergen I. 1-8. Zonhoven points; 9-37. B-points. An asterisk indicates that the tool is burnt. Nos 30 and 31 were lost. Drawing by Lykke Johansen.

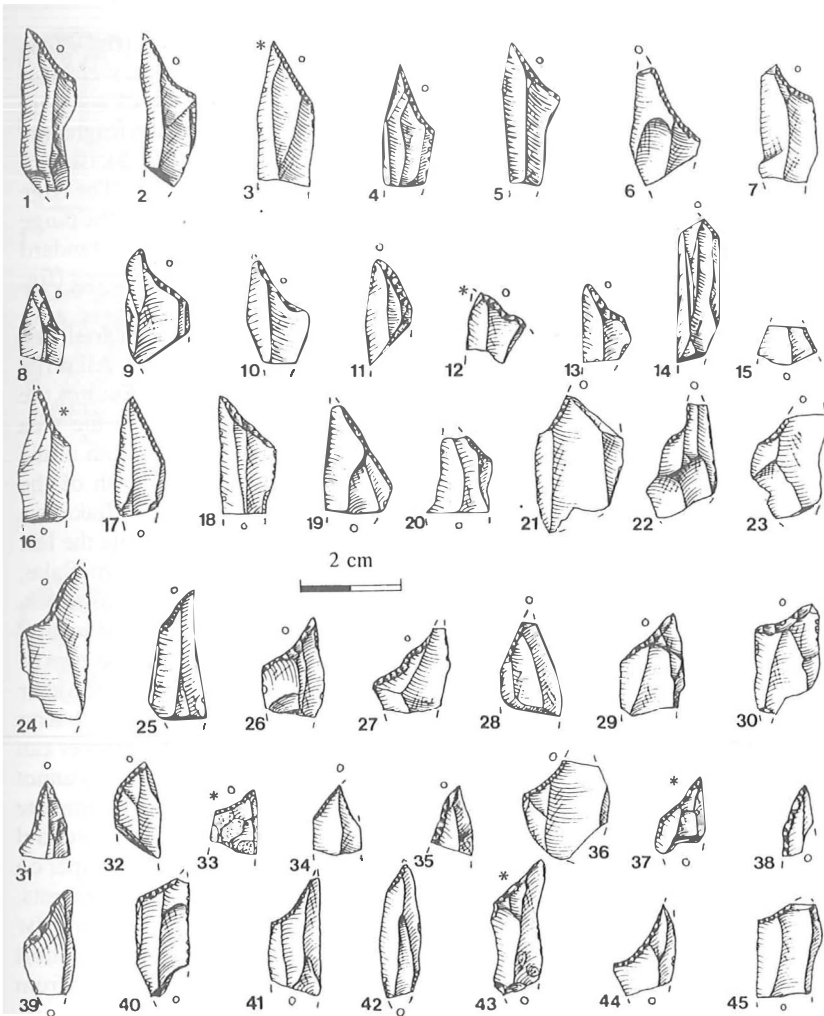


Fig. 69. Gramsbergen I. 1-45. B-points and point fragments. Drawing by Lykke Johansen.

oblique truncation at the tip. Of these, 29 points are 'complete' in the sense that there is no break opposite the tip (fig 68: 9-37). Two of these points were lost during an exhibition, but schematic drawings of them were kept at the B.A.I. (Nos 30 and 31). Of these 29 points, 12 have their tip at the distal end, while the remaining 17 have their tip at the proximal end. Left truncations occur 15 times, right truncations 14 times. Theremaining 45 points combine an oblique truncation at the tip with a break at the opposite end (fig. 69). In principle it is not possible to know whether these are fragments of either B-points or Zonhoven points or complete B-points with an intentional break at the base. Our guess is that most of them have intentional breaks, but some are fragmented as a result of use. Of these points, 16 have their tips at the distal ends, and 29 at the bulbarends. Left truncations occur on 25 of these points, and right truncations on 20.

If we take all 82 points together, the location and the lateralization of the tips can be summarized as follows:

	Right	Left	Total
Distal	18	15	33 (40.2%)
Bulbar	21	28	49 (59.8%)
Total	39 (47.6%)	43 (52.4%)	82

We will return to these attributes in the final chapter of this paper.

The scrapers (n=43). The scrapers are located mainly in two concentrations (fig. 70): a dense one to the south of the reconstructed hearth (close to the excavation's edge), and a less dense scatter northwest of the hearth. Compared to the points (fig. 66), the scrapers occur on average at a much greater distance from the reconstructed hearth. This phenomenon has also been noted at many other Upper or Late Palaeolithic sites (Stapert, 1992), and may be explained by the fact that some types of hide-working require a good deal of working space. Among the scrapers, 22 are complete while 21 are frag-

mented; only one of the fragmented scrapers became complete as a result of refitting. All single scrapers have the working edge opposite the bulbar end; the four double scrapers have one of their working edges proximally. Most of the scrapers show edge-damage along the sides, maybe (partly) as a result of hafting. Nine single scrapers are on complete blades, measuring 3-8 cm in length (fig. 71: 1-6, fig. 72: 1-2, and fig. 76: 1).

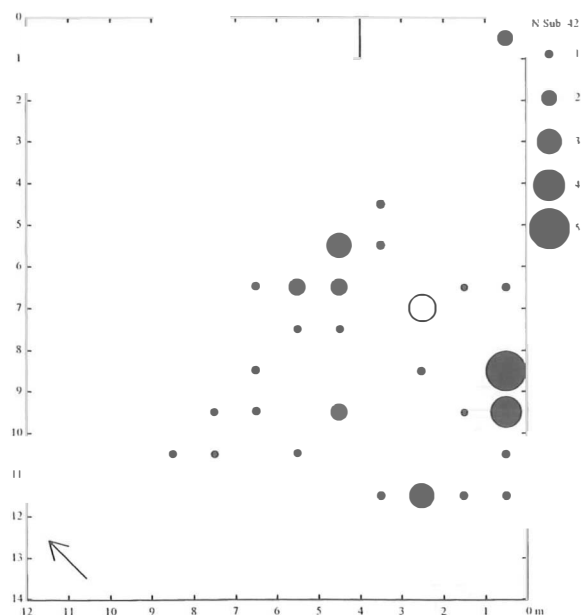


Fig. 70. Gramsbergen I. Density map of the scrapers (n=42). Drawing by Lykke Johansen/Dick Stapert.

Nine complete single scrapers are on flakes (fig. 72: 3-9, and fig. 73: 1-2). The four double scrapers were also made on flakes (fig. 73: 3-6). Most of the 21 scrapers occurring in a fragmented state are on blade fragments (fig. 74: 1-12, 14-15, fig. 75: 1-4, and fig. 76: 3); two are on flake fragments (fig. 74: 13 and fig. 75: 5). The edge angles of the scrapers were measured (n=47). The range is quite large: 32-80 degrees; the mean is 56.6°, standard deviation: 10.1; the modal class is 56-60 degrees (fig. 81).

Five of the scrapers can be refitted with other artefacts; they are part of five different refitted groups; all refits involving scrapers are shown in figure 78. Four of the refitted groups involving scrapers cluster in the area with the largest concentration of scrapers, south of the reconstructed hearth; one occurs to the north of the hearth. One scraper was made on the thickest flake in a sequence of four flakes (fig. 73: 1). At any rate the last flake removed in this sequence is a platform flake; however, there is no core that can be fitted to this series. Another scraper on a flake can be refitted dorsally/ventrally with a platform flake (fig. 73: 2). The core of this production sequence was not found, and no other flakes with the same heavily weathered cortex as that on the scraper were found. One fragment of a scraper can be fitted with a blade fragment (fig. 74: 2), but it cannot be refitted into a dorsal/ventral sequence. One complete scraper on a blade can be refitted in the dorsal/ventral way with another blade (fig. 76: 1). Another scraper on a blade fragment can be fitted with two blade fragments, completing the tool, and this can be refitted dorsally/ventrally to another blade (fig. 76: 3). These two short sequences involving scrapers consist of artefacts from

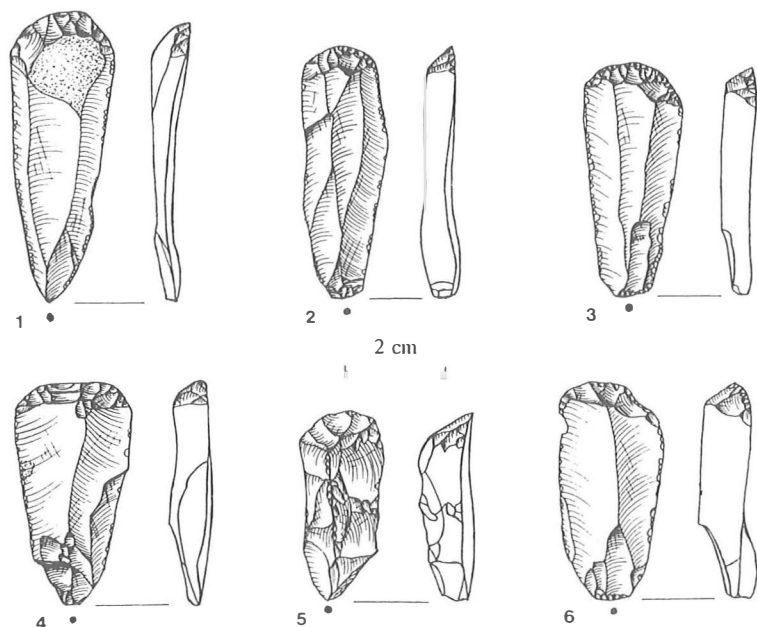


Fig. 71. Gramsbergen I. 1-6. Blade scrapers. Drawing by Lykke Johansen.

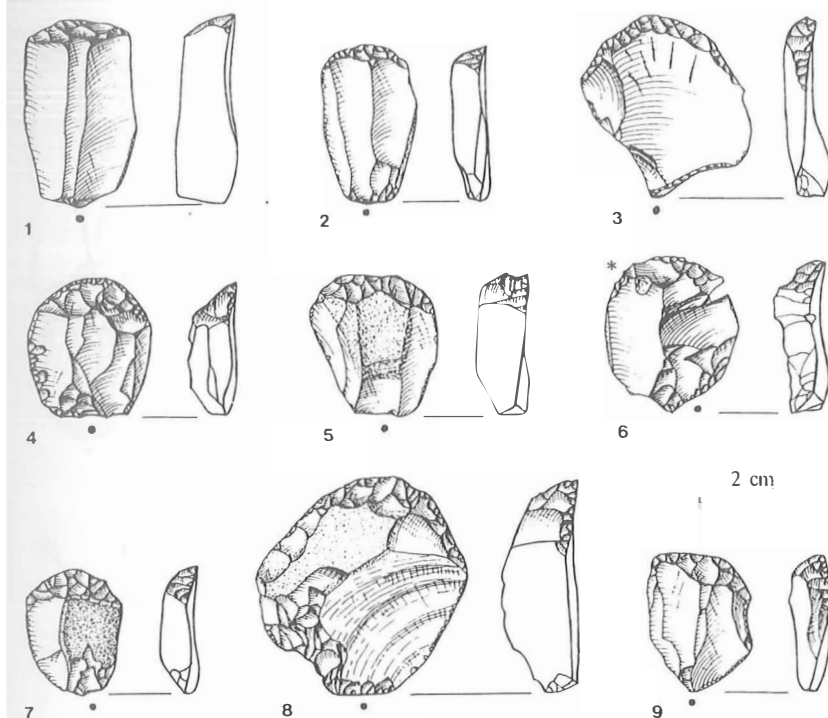


Fig. 72. Gramsbergen I. 1-2. Short blade scrapers; 3-9. Flake scrapers. Drawing by Lykke Johansen.

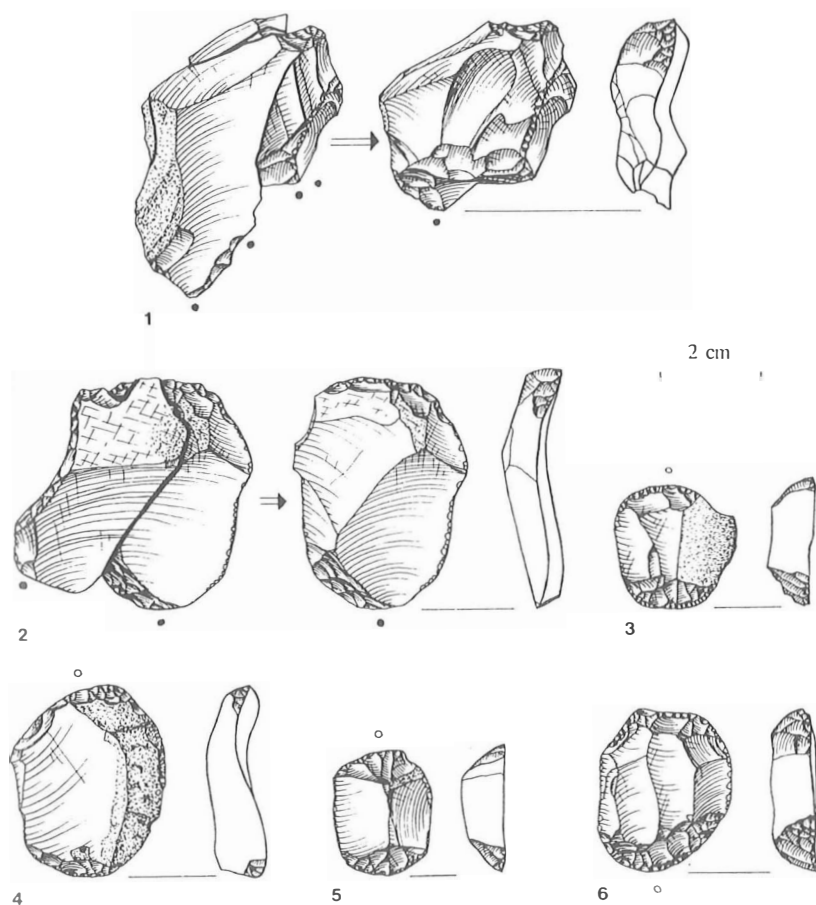


Fig. 73. Gramsbergen I. 1-2. Flake scrapers refitted into short sequences; 3-6. Double scrapers. Drawing by Lykke Johansen.

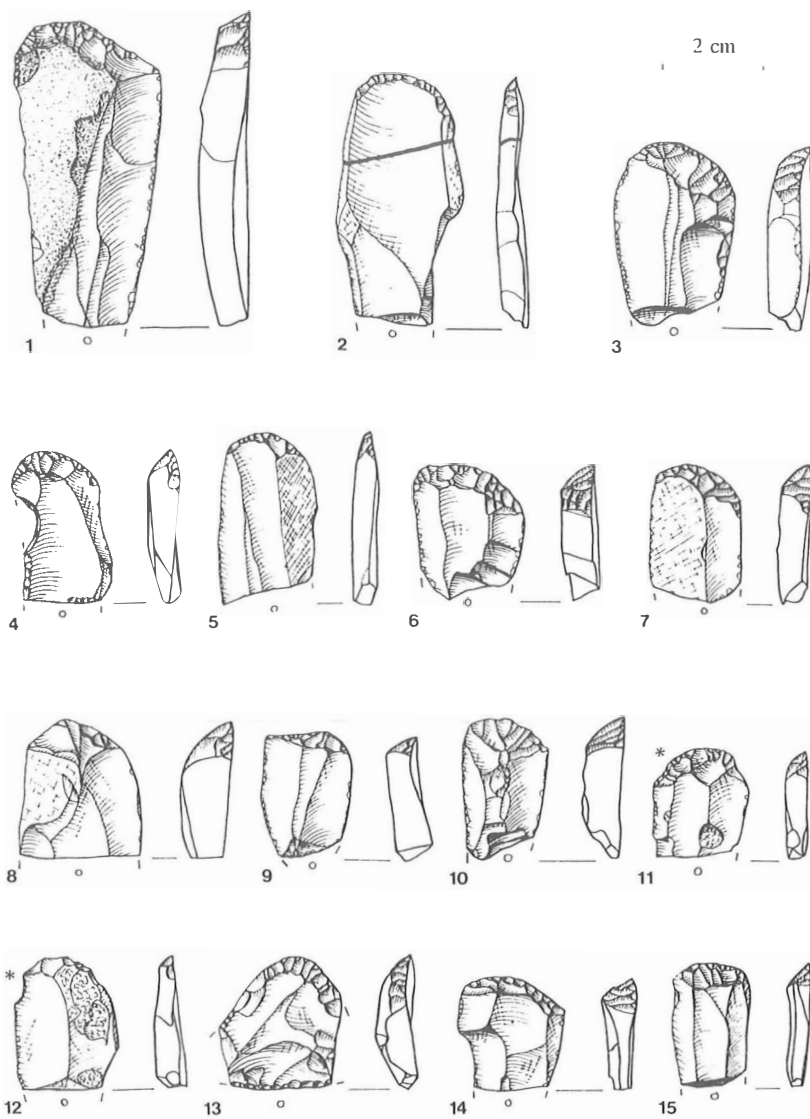


Fig. 74. Gramsbergen I. 1-15. Scrapers on blade fragments. Drawing by Lykke Johansen.

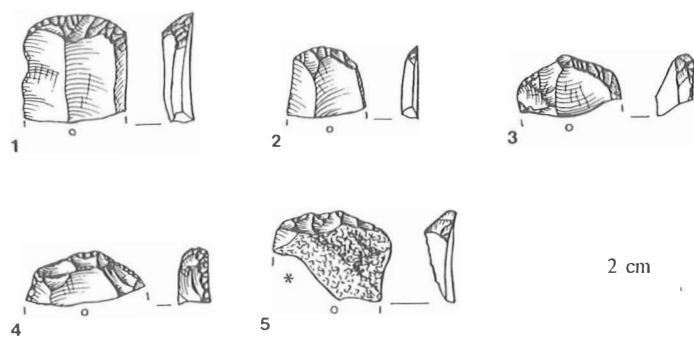


Fig. 75. Gramsbergen I. 1-5. Scrapers on blade fragments. Drawing by Lykke Johansen.

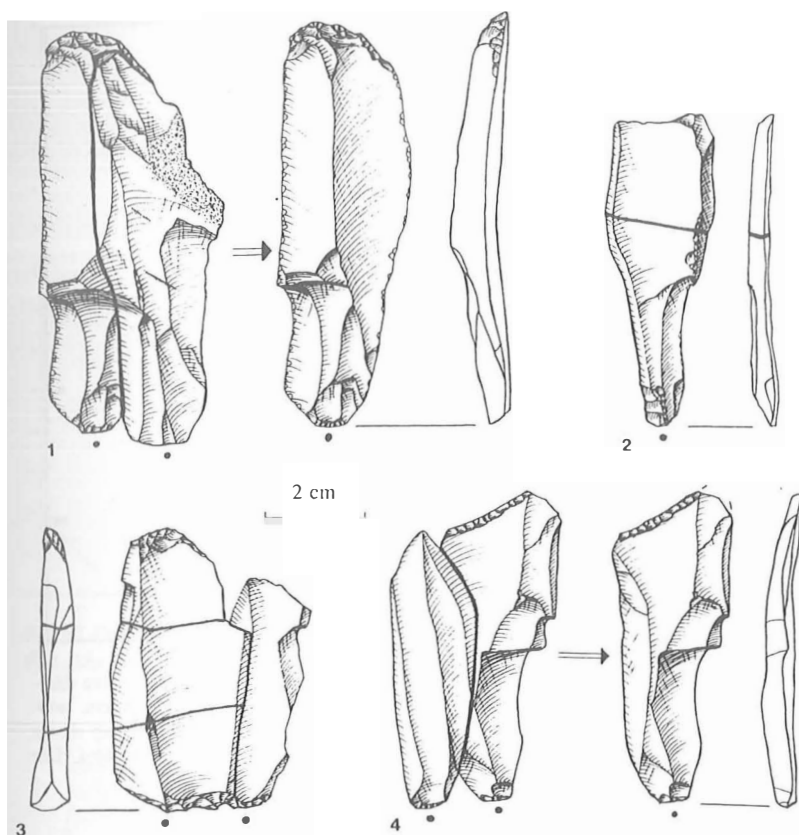


Fig. 76. Gramsbergen I. In figs 76 and 77 all artefacts made of a distinctive type of flamed flint are presented. 1, 3. Blade scrapers fitted ventrally/dorsally to one blade in each case; 2, 4. Other artefacts of flamed flint, including a truncated blade fitted to a blade (4). Drawing by Lykke Johansen.

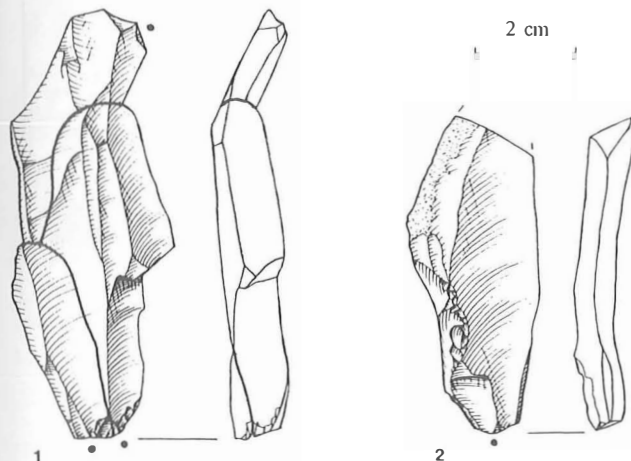


Fig. 77. Gramsbergen I. Artefacts made of flamed flint (see also fig. 76). 1. Three fitting blades; 2. Crested blade. Drawing by Lykke Johansen.

the same flint nodule. It concerns a flamed variety of fine-grained flint, with shades of light or dark brown, depending on the degree of patination. Several other blades of the same type of flint also occur on the site. One of these blades has an oblique truncation, and this tool can be refitted dorsally/ventrally with another blade (fig. 76: 4). Another blade of the same flint consists of two fitting fragments (fig. 76: 2). Three other blades of

the same flint can be fitted in the dorsal/ventral way (fig. 77: 1). Only one blade of this flint is not involved in any refitted group; it is a proximal end of a blade (fig. 77: 2). Apart from this one, all the other blades and tools of this type of flint are complete after refitting. The five refitted groups of this flint and the isolated blade fragment can not be refitted to each other. Furthermore, no flakes or core of this particular type of flint were found on the

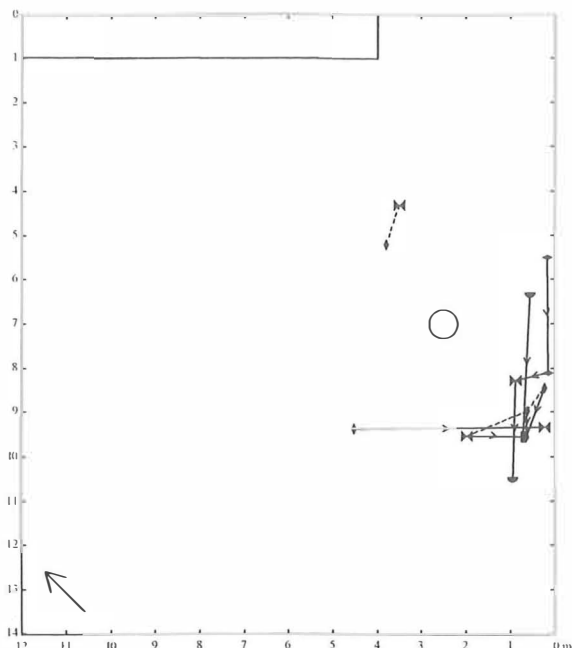


Fig. 78. Gramsbergen I. All refits involving scrapers, $n=11$. Fourteen artefacts are involved. Drawing by Lykke Johansen/Dick Stapert.

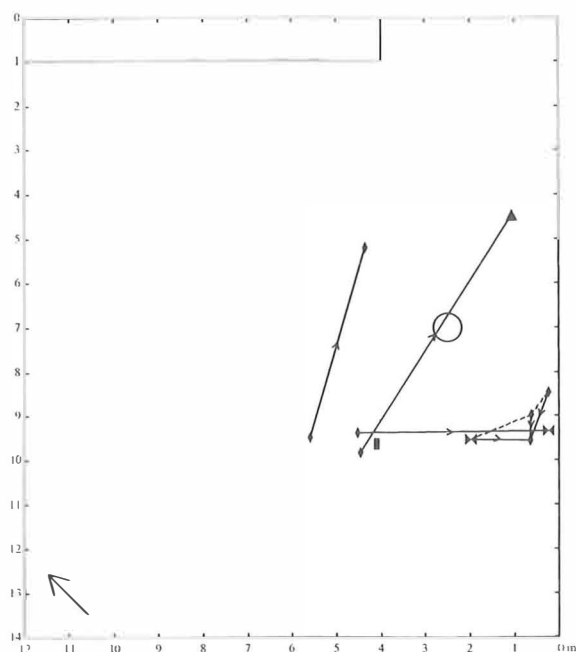


Fig. 79. Gramsbergen I. All artefacts made of flamed flint ($n=11$), and the refits they are involved in ($n=8$). Drawing by Lykke Johansen/Dick Stapert.

site. In total, there are eight blades and three tools on blades of this flint. We believe that these artefacts were imported to the site, and that they represent a selection of good blanks from a single episode of blade-production

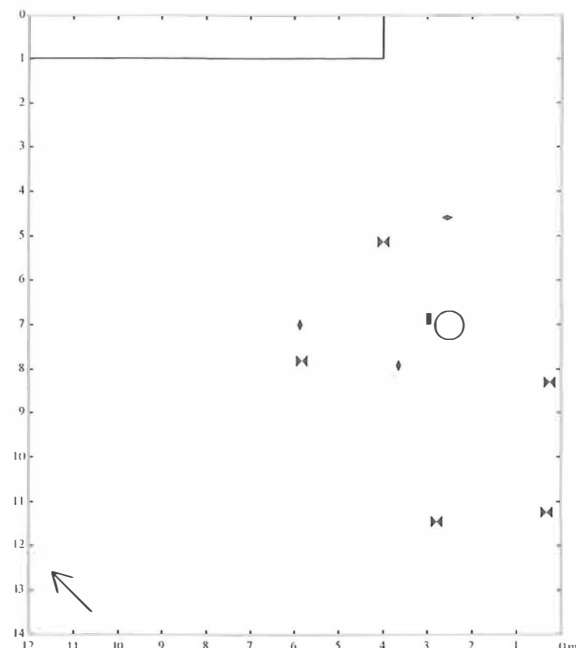


Fig. 80. Gramsbergen I. All artefacts made of a distinctive dark-brown flint with a thick cortex, including five scrapers, $n=9$. These artefacts cannot be refitted to each other. The map shows locations on the basis of the randomized file. Drawing by Lykke Johansen/Dick Stapert.

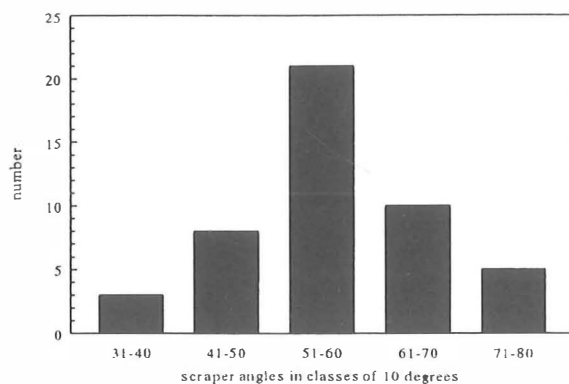


Fig. 81. Gramsbergen I. Scraper angles in classes of 10 degrees. Drawing by Dick Stapert.

done elsewhere. All artefacts of this particular type of flint, and their refitting lines within the area selected for analysis, are shown in figure 79 (3 of the total of 14 artefacts belong in the extreme south corner not shown in this map). If these artefacts were carried to Gramsbergen from a site elsewhere, and used during the first phase of occupation at Gramsbergen, then the refitting lines shown by this group seem to indicate that most of the area around the reconstructed hearth was occupied from the start.

Five scrapers (four of which on flakes) are made of

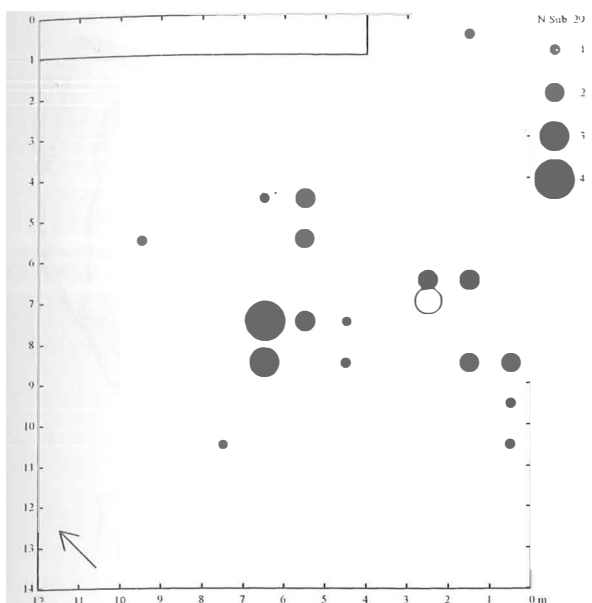


Fig. 82. Gramsbergen I. Density map of the burins, $n=29$. Drawing by Lykke Johansen/Dick Stapert.

a dark-brown flint with a rather thick white cortex (fig. 72: 5, 7 and 8; fig. 73: 4 (double scraper); fig. 74: 1). Four other artefacts from the site consist of the same flint and have the same cortex: three short blades (one is crested) and a flake. The locations of these artefacts are shown in figure 80 (remember that the locations are randomized within each square metre). Some other blades and tools might be of the same flint, but we cannot be sure of that because they are without cortex (these are not shown in fig. 80). Neither other flakes nor a core of this type of flint were found on the site. This could indicate that these artefacts were all imported to the site, either in the form of blades and flakes, or as tools. The horizontal distribution of the artefacts of this flint shows that they are spread all over the main concentration.

In conclusion it can be said that there is no proof, on the basis of the refitting analysis, that any of the scrapers were made of blanks produced on the site. Therefore, most or even all of the scrapers were imported to the site, like the points, or made there on imported blanks.

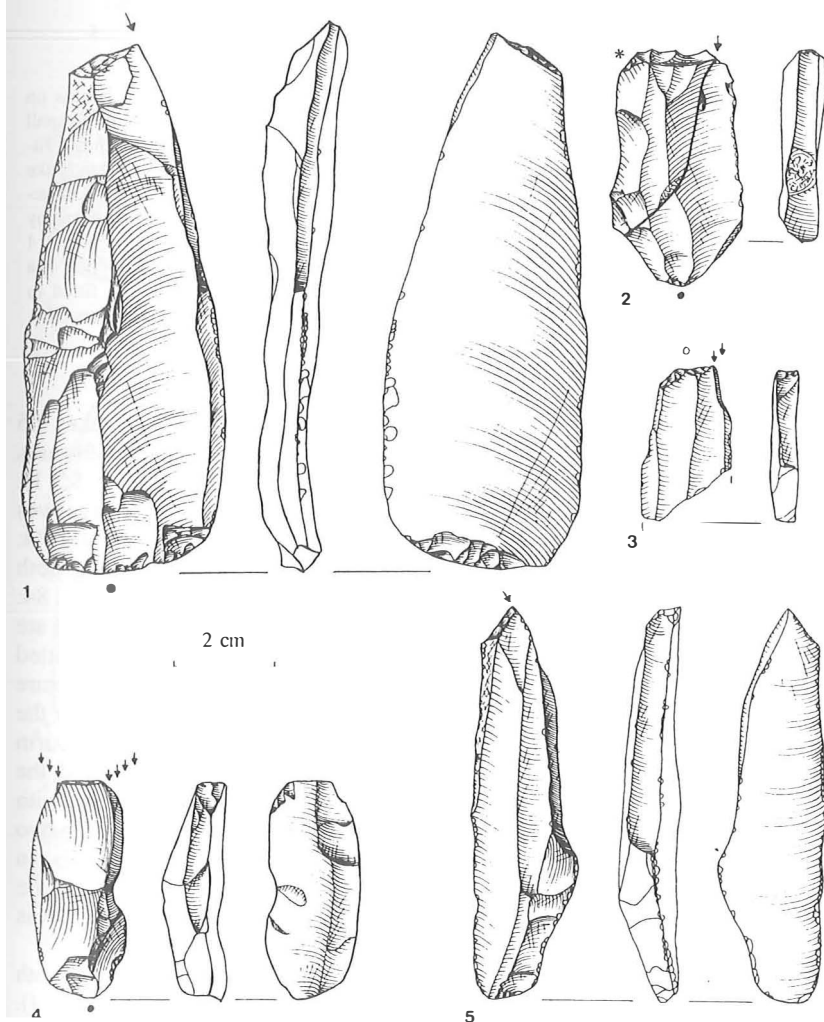


Fig. 83. Gramsbergen I. 1-5. Burins on truncations. No. 4 is a double burin. A plunging burin spall could be fitted to burin No. 2. Drawing by Lykke Johansen.

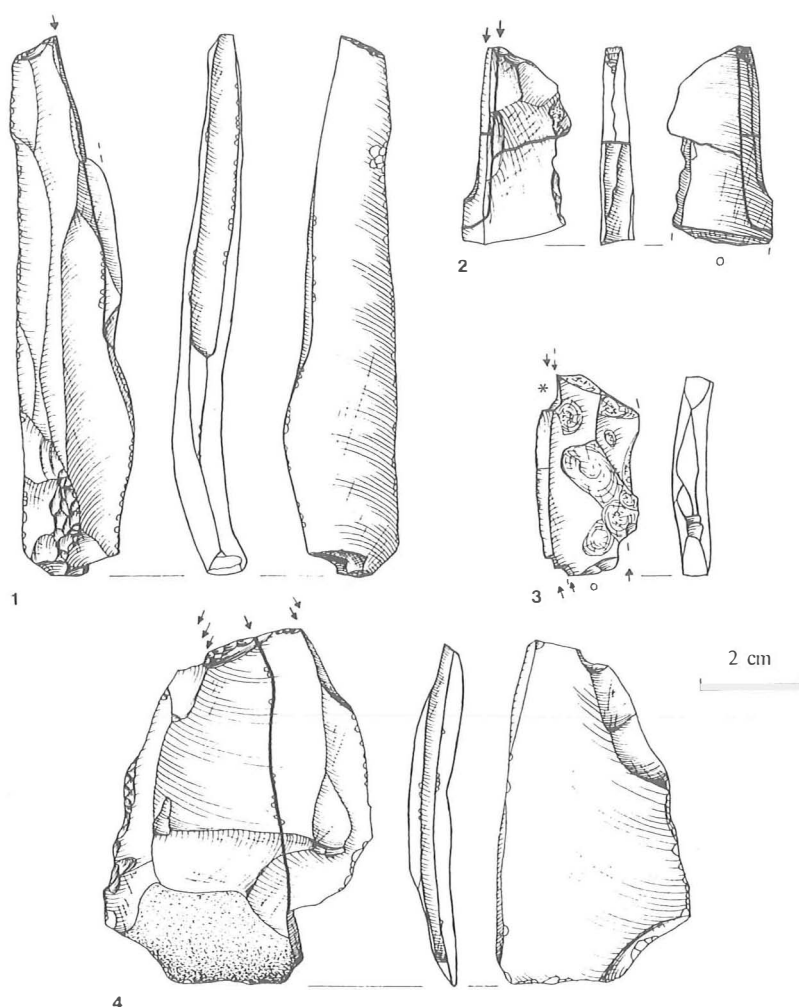


Fig. 84. Gramsbergen I. 1-4. Burins on truncations. A fragment of the burin spall could be fitted to No. 1. No. 2 has a fitting (broken) burin spall; the burin broke and the proximal fragment was subsequently turned into a burin on a break by two spalls (both missing). Nos 3 and 4 are double burins. In the case of No. 4, a secondary burin spall could be fitted to the burin. Drawing by Lykke Johansen.

It is worth noting that at the Hamburgian site of Oldeholtwolde refitting also showed that all the points and most of the scrapers were either imported or made of imported blanks (Stapert & Krist, 1990; Johansen, in press b).

Burins ($n=29$). The horizontal distribution of the burins shows that they occur in several clusters. One lies close to the reconstructed hearth, the others at a few metres' distance from it. The densest concentration of burins occurs to the west of the hearth, at a distance of about 3 m (fig. 82). In the same area the densest clusters of points and microburins of Krukowski type were also present. Therefore, burins seem to have roughly the same horizontal distribution as points, while scrapers show a rather different distribution.

Ten burins are on truncations ('RA-burins' in the classification of Bohmers; fig. 83: 1-5; fig. 84: 1, 2 and 4; fig. 85: 1, 2). Four of these burins were made on very long and/or broad blades or flakes. The two longest are 10.4 and 10.7 cm long and 4.0 and 2.2 cm wide (fig. 83:

1 and fig. 84: 1). Two others were made on flakes 7.5 and 7.0 cm long and 4.3 and 5.0 cm wide; in both cases their thickness is only 0.9 cm (fig. 84: 4 and fig. 85: 1). Seven of the burins on truncations only show negatives of burin spalls along one side (fig. 83: 1-3 and 5; fig. 84: 1-2); three are double, having negatives along both sides, on the same end of the blank (fig. 83: 4; fig. 84: 4; fig. 85: 1). Of the ten burins on truncations, three are fragmented. One of the broken burins can be refitted with a burin that shows a burin blow from the fracture surface (fig. 85: 2); it is impossible to tell whether the burin in its refitted state originally had one or two burin edges. Two other burin fragments can also be fitted; the refit shows that first this was a burin on truncation, with at least two burin spalls removed. Later it broke in two pieces, one of which was then transformed into a burin again by two burin spalls struck off from the fracture surface (fig. 84: 2). One burin on truncation was destroyed by a plunging burin spall (fig. 83: 2).

Eight burins have burin spalls struck off from both ends of the blank (fig. 84: 3; fig. 85: 3-6; fig. 86: 1-4).

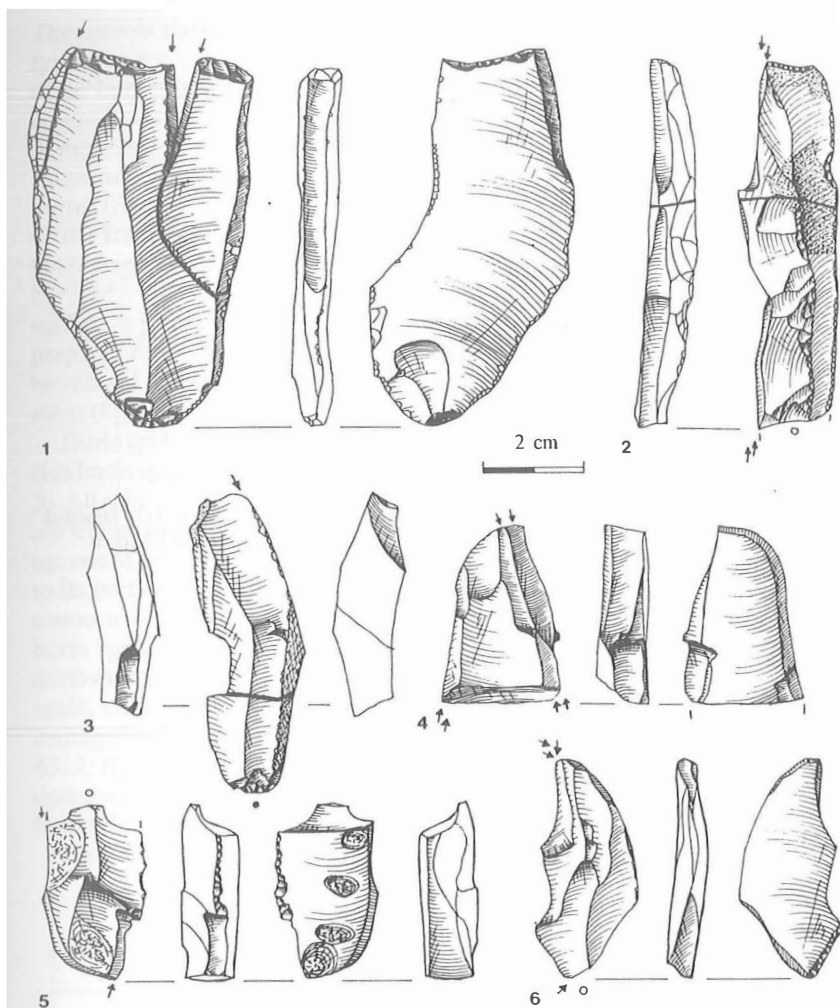


Fig. 85. Gramsbergen I. 1-2. Burins on truncations (No. 2 is combined with a burin on a break); 3. Double burin on a break; 4-6. Dihedral burins, combined with a burin on a break in No. 4 and with a burin on a truncation in No. 6. In the cases of Nos 4 and 5 we are dealing with a special version of the dihedral burin (see text). Drawing by Lykke Johansen.

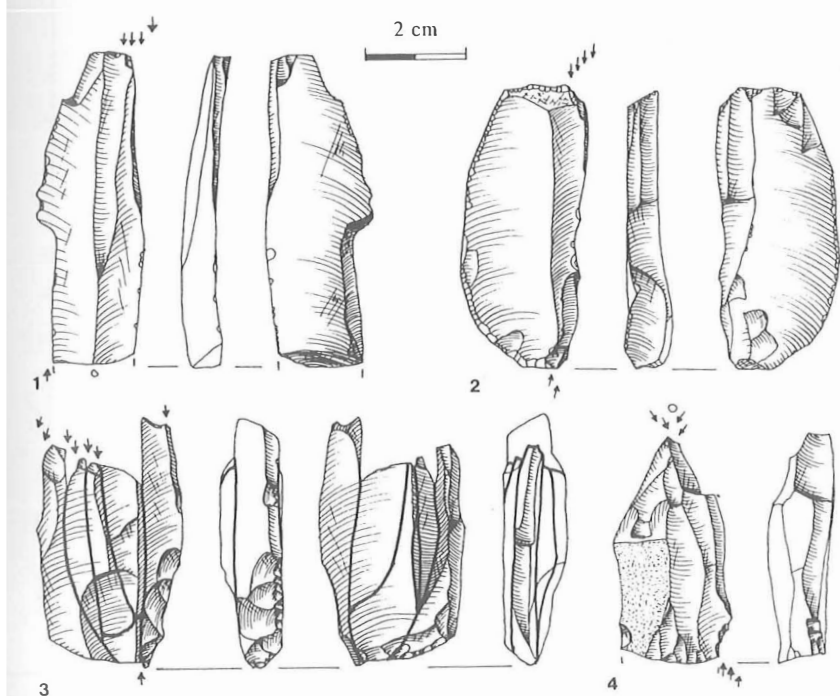


Fig. 86. Gramsbergen I. 1-3. Double burins on breaks; 4. Double burin: dihedral burin and burin on a break. Drawing by Lykke Johansen.

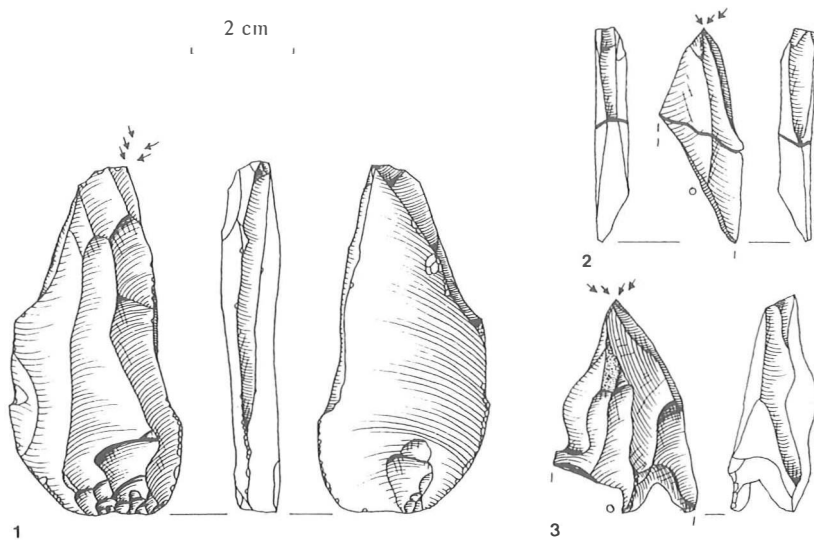


Fig. 87. Gramsbergen I. 1-3. Dihedral burins. Drawing by Lykke Johansen.

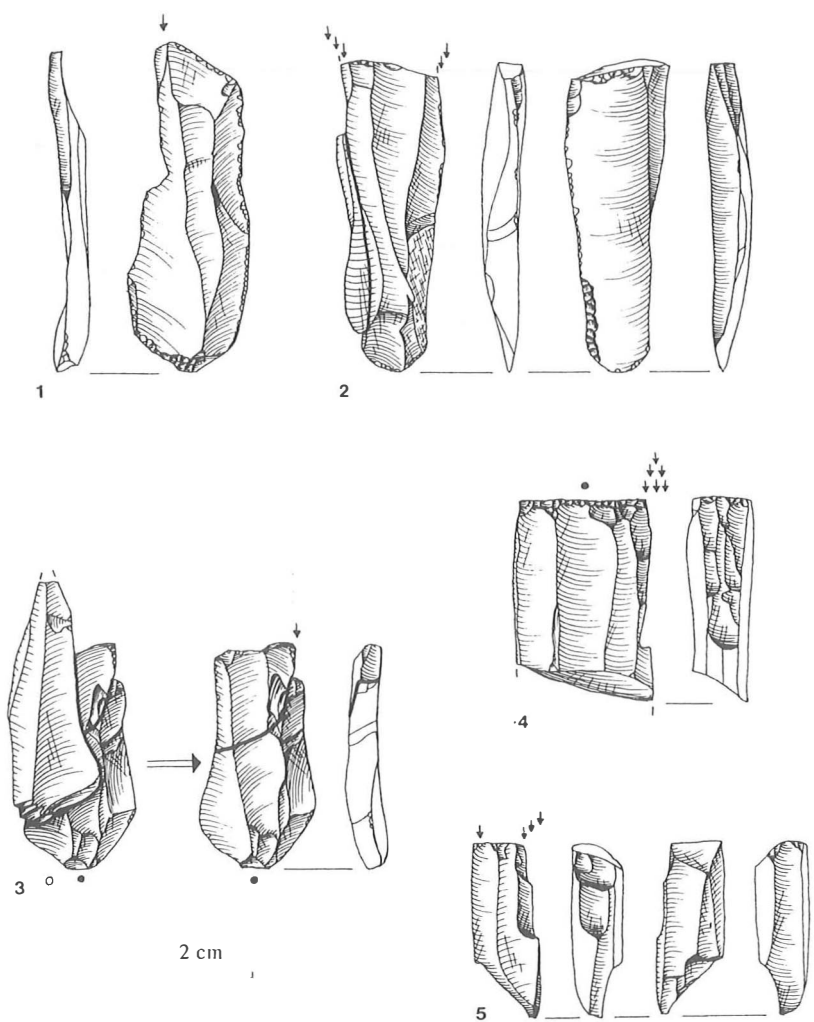


Fig. 88. Gramsbergen I. 1-5. Burins on breaks. Nos 2 and 5 are double burins. No. 3 has a fitting plunging burin spall, and is refitted with a blade. Drawing by Lykke Johansen.

These tools show various combinations of burin-edge types (on truncation, from a break, dihedral). Two of these burins occur in a broken state, the others are complete (at least as burins, not always as blanks). One of these double burins can be fitted to a proximal blade fragment (fig. 85: 3). Three burins are single dihedral burins (fig. 87: 1-3); only one of these is complete. One of the fragmented burins can be fitted with a medial blade fragment (fig. 87: 2). Five burins show one or two burin edges, shaped by burin blows made from a fracture surface, a platform remnant or some other type of unprepared face (fig. 88: 1-5). One of these burins could be refitted in the ventral/dorsal way with a blade fragment (fig. 88: 3).

Burin spalls can be fitted to eight burins. In one case, five burin spalls could be fitted to a single burin (fig. 86: 3). All refitting lines connecting burin spalls with burins are shown in figure 89. Once again, two clusters show up: one to the south of the reconstructed hearth, and one to its northwest. As noted earlier, the two clusters are connected by two refit lines, in both cases involving burin spalls in the southern cluster and burins in the northwestern cluster. In three of the cases where burin spalls could be fitted to burins, the last burin spall damaged or destroyed the burin, because it plunged (fig. 83: 2; fig. 86: 3; fig. 88: 3). Also one other burin was destroyed by a plunging burin spall, which was not found (fig. 88: 5).

Four burins must have been manufactured (as tools,

not necessarily as blanks) on the site (fig. 83: 2; fig. 84: 1; fig. 85: 1; fig. 88: 3), because after refitting burin spalls to them we end up with complete blades or flakes. Several other burins could also have been made on the site; especially if burin spalls were quite thin there is a good chance that they were not found during excavation (no sifting was done). Though it can be proved that several blanks were transformed to burins on the site, the blanks themselves were most probably not produced on the site. Only one burin can be refitted in the ventral/dorsal way: with one blade fragment. It seems that most or even all of the burins were imported to the site from elsewhere, either as blanks or as finished tools.

Scraper/burin combinations (n=2). Combination tools are quite rare in the Ahrensburgian, compared to some of the other Late Palaeolithic traditions; for example, they are quite common in the Hamburgian. In the Mesolithic, combination tools are virtually absent. The two specimens at Gramsbergen I are both scraper/burin combinations (fig. 90). Neither of these tools can be refitted to any other artefact at the site. The locations of these tools are shown in figure 93; both of them do appear to 'belong' to the main 'scraper cluster', rather than to the main 'burin cluster' (compare with figs 70 and 82).

Borer (n=1). Borers and *becs* are very rare in the Ahrensburgian, compared to for example the Hamburgian. At Gramsbergen I there is only one tool that may be classified as a borer, with retouch on both sides of the borer tip, part of which had broken off (fig. 91: 4).

Pointed blade (n=1). One tool must be classified as a 'pointed blade', because it is only retouched on one side at the tip (fig. 91: 2). Edge damage can be observed at the other side, however, so the tool was probably used as a borer.

Blades with retouch (n=5). Five blades show retouch in various locations, either along one of the sides or at the proximal or distal ends. Three of these are illustrated in figure 91 (Nos 3, 5 and 6) and one in figure 100 (No. 4).

Blade with rounded end: possible 'strike-a-light' (n=1). At many Upper or Late Palaeolithic sites in Europe, finds include flint artefacts with rounded ends. To mention just one example, several rounded tools, found at Hengistbury Head, were illustrated with microscope photos by Barton (1992). Similar rounded tools are known from the Mesolithic and Neolithic. For example, both rounded flint tools and pieces of pyrite are known from the Early Mesolithic site at Star Carr (Clark, 1954). In the Netherlands, blades with one or two rounded ends are known from the Hamburgian (Oldeholtwolde: two, Vledder: one, Sassenheim: at least four), the Federmesser Group (Usselo: one), and the Ahrensburgian (Johansen & Stapert, 1995; Stapert, in press). From the Ahrens-

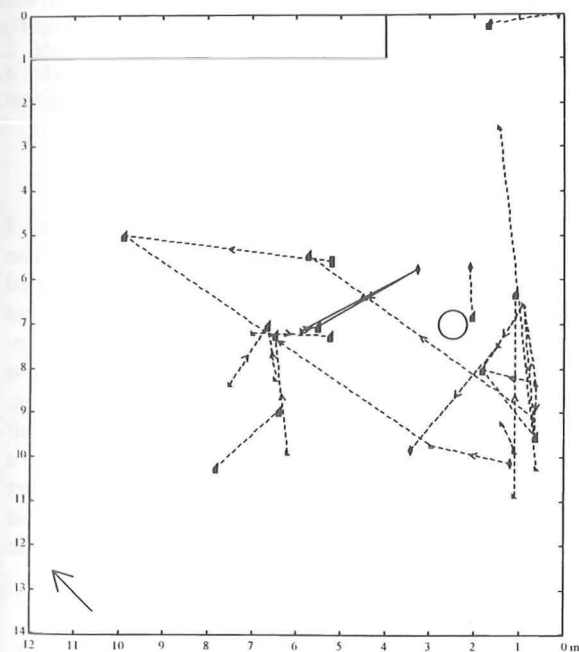


Fig. 89. Gramsbergen I. All burins and burin spalls involved in refits. Note that some artefact classifications changed as a result of the refitting analysis. In total, there are 24 refits, involving 34 artefacts. Drawing by Lykke Johansen/Dick Stapert.

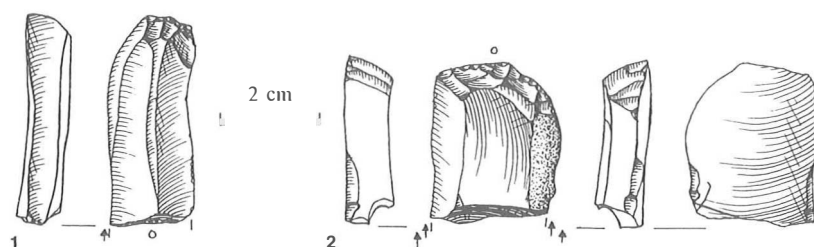


Fig. 90. Gramsbergen I. 1-2. Combination tools: scraper/burin. Drawing by Lykke Johansen.

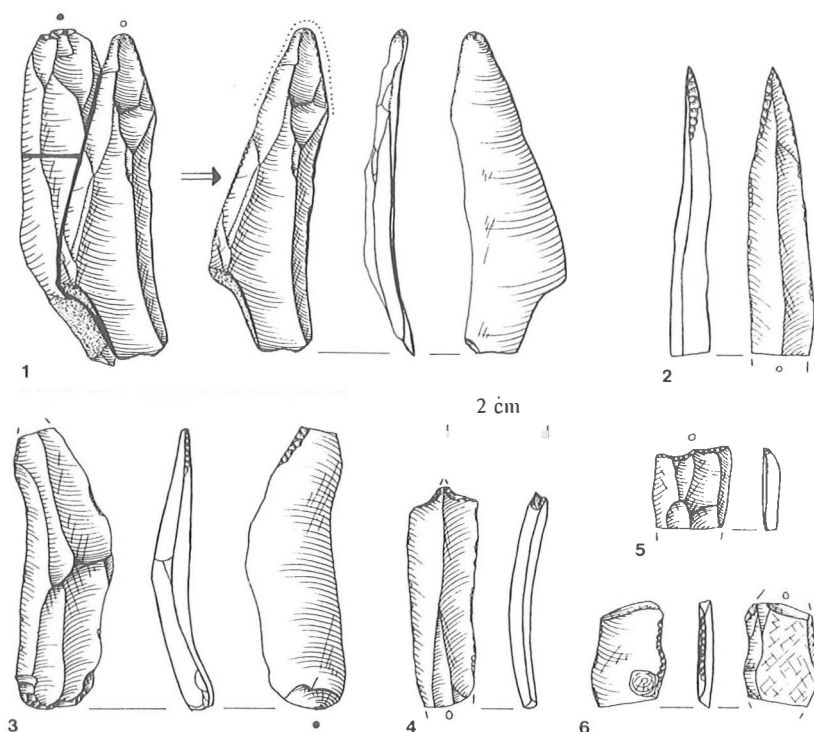


Fig. 91. Gramsbergen I. 1. Tool with heavily rounded end (strike-a-light?), ventrally/dorsally fitting to a blade; 2. Pointed blade; 3, 6. Retouched blades; 4. Borer; 5. Truncated blade fragment. Drawing by Lykke Johansen.

burgian so far two specimens are known to us: one from Gramsbergen I (described below) and one from Gældrop I (Deeben, 1994: p. 40 and fig. 20: 10). Rounded tools are also known from Hamburgian sites in Germany and Denmark (for the Hamburgian site at Sølbjerg in Denmark, see: Johansen, in press c; Stapert & Johansen, in press).

We have carried out experiments concerning this tool type, at the Lejre Experimental Research Centre, Denmark. We are convinced that most implements with rounded ends were used to make fire, in combination with pyrite (Johansen & Stapert, 1996). On the rounded parts, massive parallel scratching can be observed with a stereomicroscope, in addition to gloss. It is of interest to note that in a few cases (Oldeholtwolde and Sølbjerg 3) very small particles containing sulphur and iron have been detected with the help of a scanning electron microscope; these may be pyrite particles, though no mineralogical determination was carried out.

The presumed strike-a-light from Gramsbergen I (fig. 91: 1) shows heavy rounding of the bulbar end. The rounding was clearly created after the blade was knapped (it extends to the ventral face), so the rounding is not due to abrading the platform edge on the core prior to knapping off the blade. A photo made by a scanning electron microscope shows the rounded part very clearly (fig. 92). The strike-a-light can be refitted in the dorsal/ventral way to another blade, though they only have a very small contact area at the distal ends. No other blades from the site can be refitted to them, which most probably implies that both blades were imported to the site.

4.4.5. Waste products from the manufacture of tools

'Microburins of Krukowski type' ($n=10$). For a general discussion about this type of artefact, see 3.4.3. Two specimens are illustrated in figure 95. The spatial distri-



Fig. 92. Gramsbergen I. SEM photo of the rounded end of the tool illustrated in fig. 91: 1. The scale bar is 1 mm. Photo by H.J. Bron (Groningen University).

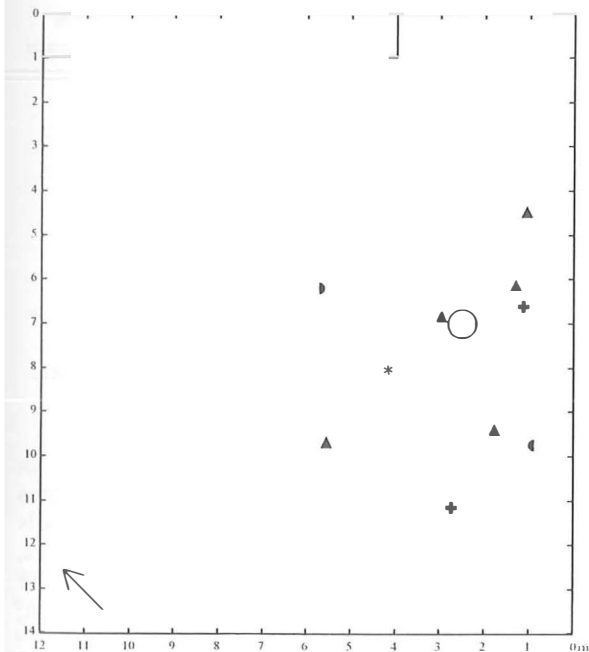


Fig. 93. Gramsbergen I. Locations of combination tools, re-touched blades (including truncation), rounded tool (strike-a-light?), borer and pointed blade. Note: locations are randomized per square metre. Drawing by Lykke Johansen/Dick Stapert.

bution (fig. 94) was already discussed above, under points. The number of 'microburins of Krukowski type' is quite small, compared with the large number of points. This, and the fact that no points can be refitted in the dorsal/ventral way with other artefacts may indicate that very few points if any at all were produced on the site.

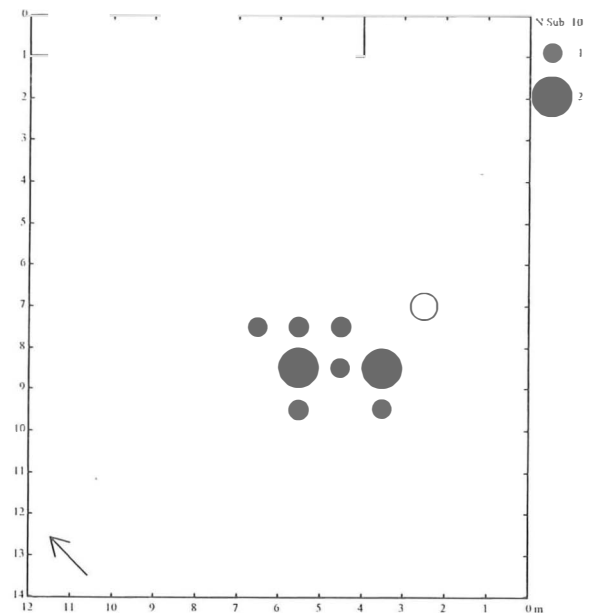


Fig. 94. Gramsbergen I. Density map of 'microburins of Krukowski type', n=10. Drawing by Lykke Johansen/Dick Stapert.

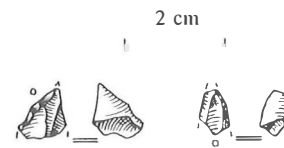


Fig. 95. Gramsbergen I. Two specimens of 'microburins of Krukowski type'. Drawing by Lykke Johansen.

Burin spalls (n=48). As noted above, the soil was not sieved at Gramsbergen I, so quite a few small or fragmented burin spalls will have escaped notice. Therefore, large, thick or plunging burin spalls will be over-represented. In three cases two burin-spall fragments can be fitted together (resulting in two complete burin spalls and a still incomplete one). After the refitting of breaks this leaves 45 burin spalls. Burin spalls were found especially in the peripheral zones of the main concentration around the hearth, and do not show much clustering (fig. 96). Many burin spalls are quite long, showing that a considerable number of long burins were produced or resharpened on the site; most of these must have been subsequently taken elsewhere. The longest spall is 7.1 cm in length and ends in a hinge, so the burin must have been even longer. Of the 45 burin spalls (after refitting breaks), 30 are primary and 15 secondary burin spalls. Seven burin spalls are plunging. In total, 13 burin spalls can be fitted to burins; these have been discussed and illustrated above (of these, four are plunging).

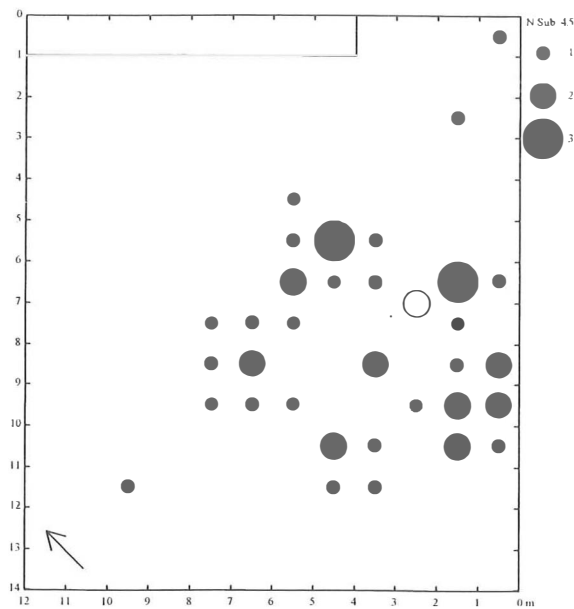


Fig. 96. Gramsbergen I. Density map of burin spalls, $n=45$. Drawing by Lykke Johansen/Dick Stapert.

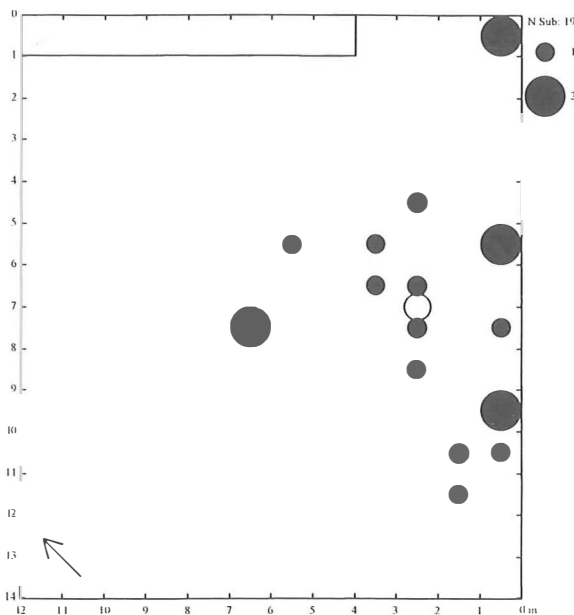


Fig. 97. Gramsbergen I. Density map of the cores, $n=19$. Drawing by Lykke Johansen/Dick Stapert.

4.4.6. The cores and core fragments ($n=19$)

The cores occurred especially in the periphery of the main concentration around the hearth (fig. 97). As at many other Upper or Late Palaeolithic sites, the cores are on average located farther from the hearth than the tools, as a result of the 'centrifugal effect' (e.g. Stapert,

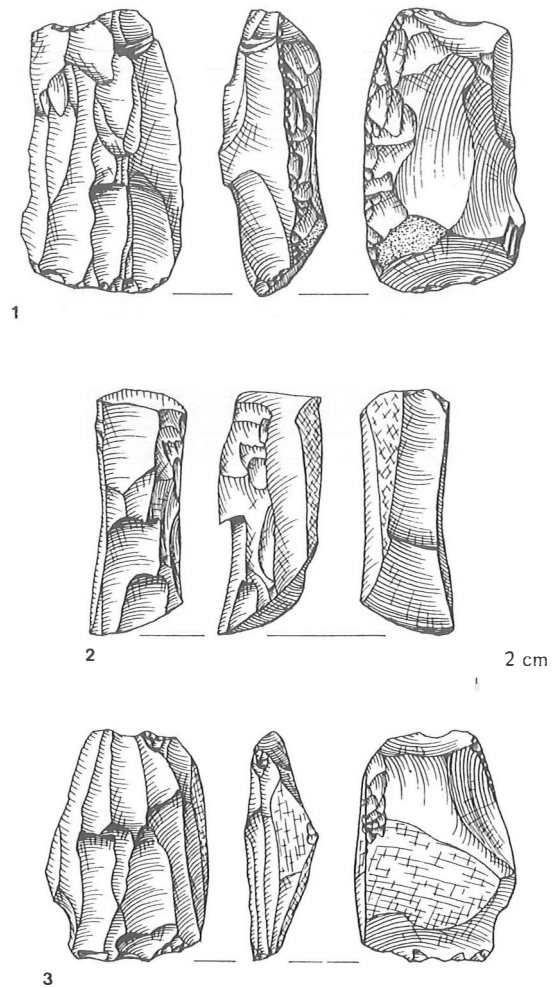


Fig. 98. Gramsbergen I. 1-3. Cores. Drawing by Lykke Johansen.

1992). It may also be noted that quite a few cores occurred to the east of the hearth, while most of the tools lay west of it. After refitting breaks there are 18 cores, 16 of which have two opposite platforms. The cores are 3.1-6.0 cm long in their used-up state; mean: 4.5 cm; stand. dev.: 0.8.

Cores without fitting blades or flakes. It proved impossible to refit any artefacts to nine cores or core fragments; eight of these are illustrated here (fig. 98: 1-3, fig. 99: 1-4, and fig. 100: 1). These are all rather small cores (3.8-5.6 cm) and almost or totally used up. In most cases it does not seem that a hinge or some other accident during flint knapping caused the cores to be discarded, but rather that they had simply become too short to be of any further use. Most of these cores have two opposite platforms. The measurable platform angles of these cores range from 34 to 80 degrees; mean: 59 degrees; stand. dev.: 14.4.

Most of the cores have been worked in a competent

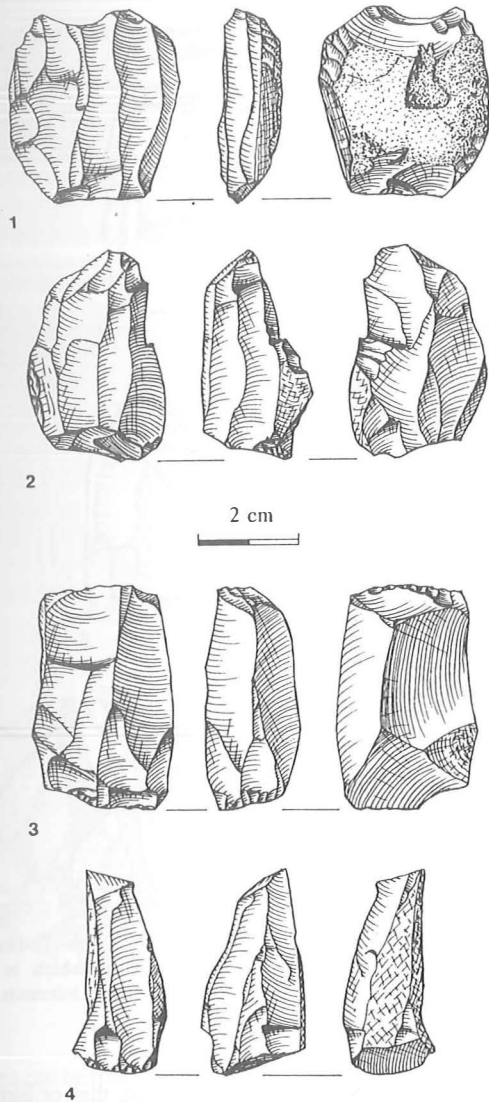


Fig. 99. Gramsbergen I. 1-4. Cores. Drawing by Lykke Johansen.

way, which implies that there was at least one experienced knapper on the site. Cores such as those illustrated in fig. 98: 3 and fig. 99: 1 were exploited to the very limit. Not many negatives of hinged or plunging blades are present, though these will normally occur fairly often when cores become so small and light. The two residual cores mentioned above are only 1.2 and 1.3 cm thick. All these cores must have been imported to the site in a more productive state. The total absence of fitting blades can be explained by assuming that the final sequences of blades knapped from these cores were carried away from the site.

Eight cores with fitting blades and/or flakes. To eight of the cores (one consists of two fitting fragments), 2 to 32 other artefacts could be fitted. These cases are briefly discussed here one by one.

One core (fig. 100: 2) can be refitted with a complete blade and a flake. These are the two last blanks knapped off the core. After the last blade was struck off, many small flakes or chips were knapped off from the same platform as used for the blade. Most of these ended in hinges, however, and the core was then given up. The core had two platforms opposite each other, as was normal in Ahrensburgian flint technology (core angles are 77 and 70 degrees). Although not much can be refitted to the core it nevertheless appears that the core was worked by a fairly experienced knapper. The fact that the last attempts at producing blades failed does not necessarily mean that the knapper was unskilled: it is quite difficult to strike good blades from such a light and small core. It seems that the core entered the site in an already partly used state.

Another core (fig. 100: 3) could be refitted with a retouched blade and two complete blades. The core is the shortest of all the cores from the site (3.1 cm), but it is in a broken state. The refittings show that the core was at least 6.5 cm long at an earlier stage. After the three refitted blades were struck off, the core probably broke into two pieces, one of which was not found. The core was then already very thin (about 1.2 cm). The missing part might still have been a usable blank for a tool, e.g. a burin, which could have been exported. The refittings show that the core originally had two opposite platforms, only one of which is present now (with a core angle of 58 degrees). The core must have been knapped by a fairly experienced knapper, even though he ran into problems created by several hinged blades. After the core broke, a few short blades or flakes were removed prior to its abandonment. This core also seems to have been imported in an already prepared and partly used state.

The third core (fig. 101: 1) can be refitted with a hinged blade and a platform flake. The refittings show that the core was originally at least 5.8 cm long; its length in the residual state is 4.0 cm. The core has two opposite platforms (core angles are 76 and 70 degrees). To one of these, one platform-shaping flake can be refitted. After the platform was renewed, a failed attempt to produce a blade was made. A hinged blade coming from the second platform can be fitted to the core. After this, at least three other hinged blades were knapped off from the same platform. Though the knapper then tried to repair the platform, the core was soon given up. The core had been imported to the site in an already partly used state. The shape of the core must still have been quite good, however. The refittings show that no good-quality products were knapped off this core on the site. The refitted platform-flake was partly successful, but it did not create perfect angles and almost all subsequent strokes resulted in hinges. This might imply that a relatively inexperienced flint-knapper worked this core on the site, but the refitted sequence is too short to be certain of this. It is hard to understand why no more artefacts could be fitted to the core. The core consists of

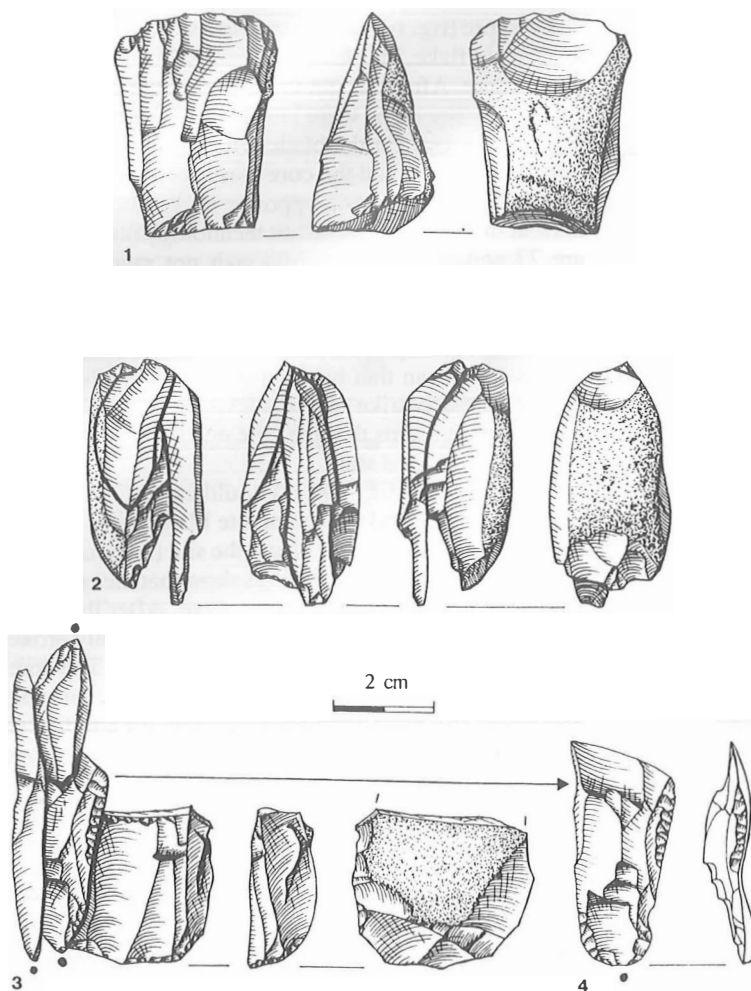


Fig. 100. Gramsbergen I. 1-3. Cores. To No. 3, three blades are fitted, one of which is re-touched: No. 4. Drawing by Lykke Johansen.

a rather distinctive type of flint, so we can be quite sure that no other artefacts of this flint occurred on the site.

The fourth core (fig. 101: 2) can be refitted with three blades or blade fragments. An interesting feature of this core is the heavy abrasion of one of the side-edges near the platform (best seen on the drawing of the back of the core). This was done by forcefully crushing some ridges. This kind of core-preparation is quite well known from sites of the Havelte Group of the Hamburgian (Johansen, in press c), but is rarely seen in the Ahrensburgian. The crushing cannot have resulted from use as a hammer-stone, because that would have produced a much coarser crushing of the flint. The core in its refitted state (fig. 101: 2) seems to be the form in which it was brought to the site. It has two opposite platforms. Two blades were struck from the upward-facing platform, the second of which ended in a hinge. A few more short blades were then knapped off from the other platform; the last of these broke and the proximal fragment can be fitted to the core. The crushing of platform edges or ridges between scars, before striking off a blade, is sometimes done by modern experimental archaeologists to prevent

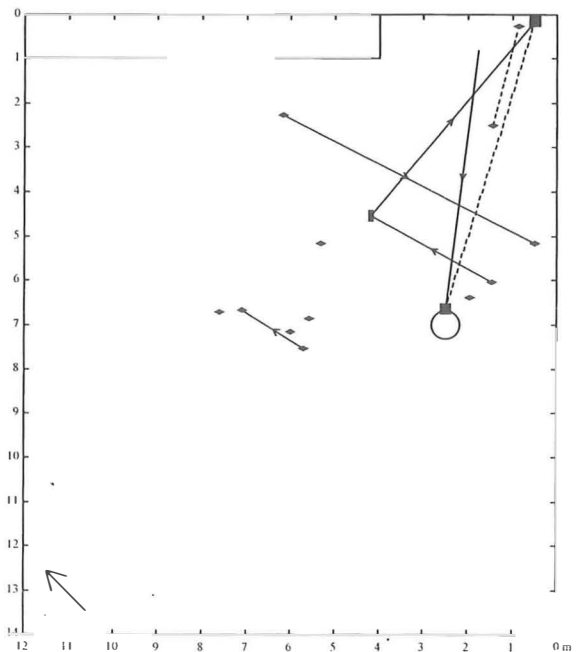
the detachment of an excessively short, thin or hinged blade. But although the crushing is very heavy on this core, the knapper placed the first stroke too deep, so a very thick blade was produced. The next stroke was too soft, and resulted in too thin a blade that moreover hinged. The knapper of this core may have had some experience, but his work was certainly not very successful. It has to be noted, however, that this core was already rather small and light; it is not easy to exploit such a core, even for an experienced knapper.

The fifth case involves two fitting core fragments, refitted with two flakes and one crested blade (fig. 101: 3). The artefacts consist of a characteristic type of flint containing small fossils. This flint is less fine-grained than most other kinds of flint present on the site. It also had some hidden frost cracks, causing problems for the knapper. It is difficult to tell in which state the core entered the site. Some eleven flakes of the same type of flint were found on the site, some of which are partly covered by cortex. Six of these flakes can be refitted in three pairs: two pairs in the dorsal/ventral way and one a refitted broken flake. None of these small refitted



groups can be fitted to the core, however. The distribution map of the core with its refits and the associated eleven flakes shows that most of these artefacts occurred in the eastern part of the excavated area (fig. 102). An additional scatter of flakes occurred in the cluster to the northwest of the hearth. It seems probable that this core was imported at quite an early stage of production, with cortex still covering some of its surface. A series of rather short blades must have been produced, which were most probably exported from the site. Then the first of the flakes refitted to the core was struck off. The shape of the core was not very good, so a crest was made and a crested blade was detached. A little further knapping then was done, but failed to result in any usable blades. The next thing to happen was that the core split into two pieces along a hidden frost crack in the flint. Some

Fig. 102. Gramsbergen I. All artefacts of orange-coloured flint (see fig. 101), and their refits. Note that symbols for small flakes or chips are omitted. In total, there are 16 artefacts, and 7 refits. Drawing by Lykke Johansen.



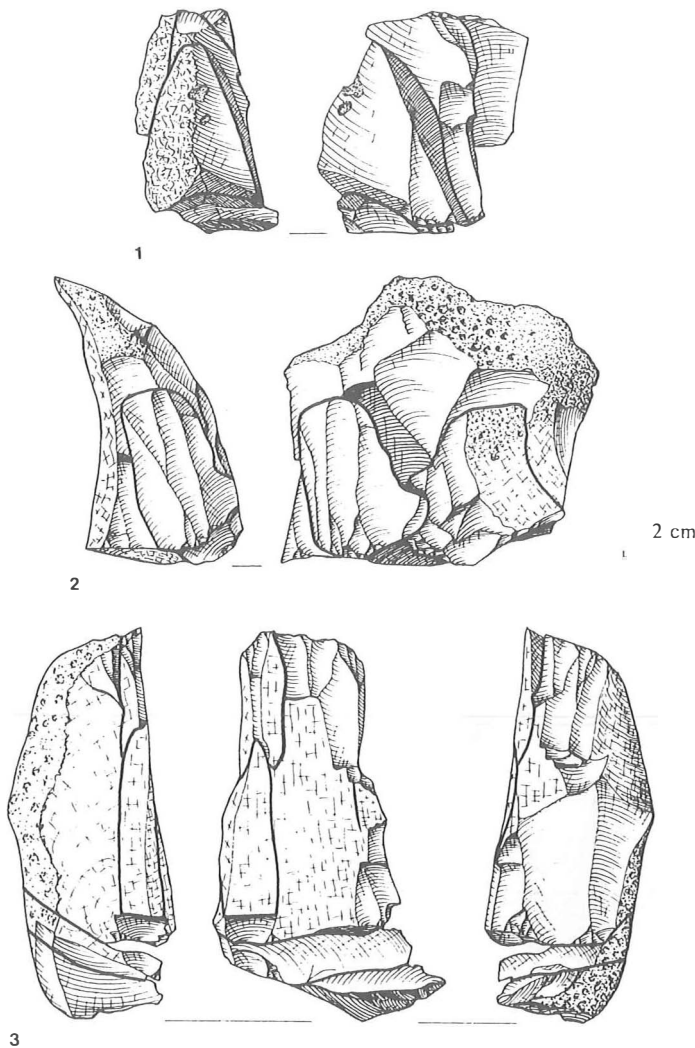


Fig. 103. Gramsbergen I. 1-3. Cores with fitting flakes and blades. Drawing by Lykke Johansen.

knapping was attempted with both cores, without resulting in any blades. These last flakes were not found on the site. It can be noted, however, that several of the refitted artefacts of these cores were found close to the edge of the excavation or in the extreme eastern corner, so part of the flints belonging to these cores may have been missed. The poor standard of knapping in this case indicates that this core was not worked by a very experienced knapper. Admittedly, the hidden frost cracks in the flint presented some problems. But it can be noted that the way the platforms were created was not very skilful, and the knapping was consistently done with overly forceful strokes. Because of all this we believe that this knapper was still a learner of the art of flintworking, probably an older boy.

The sixth core (fig. 103: 1) could be refitted with a medial blade fragment, a plunging blade and a block. The core consists of flint of quite poor quality. The chalky part of the cortex is totally gone and where it was is now a heavily crushed area, with numerous fracture

cones. Associated with the crushed surface are many cracks inside the flint. The core was probably made out of a thick cortex flake. Because of the many cracks, it was difficult to work this core. A block split off at one end of the core along a hidden crack, and the break surface was then used as a platform for blade production. An attempt was also made to create a second platform at the opposite end of the core, but this resulted only in a few chips being struck off. The last of the refitted artefacts is a short plunging blade. After this happened, one other blade was struck off (not found) before the core was finally discarded. Its length was then only 3.3 cm. It is curious why any flint knapper should select such a bad piece of flint for a core. Even at the very start of the work it was very small, with a maximum length of some 4.5 cm. The quality of flint-knapping is rather poor, but maybe not much more could be expected of such a miserable nodule. Our conclusion is that the flint-knapper who worked this core was not very skilled. It might have been the same person as in the previous case.

The seventh core (fig. 103: 2) could be refitted with two flakes. The core was made of good-quality flint, a nodule covered by both cortex and old frost-split faces. The original dimensions of the nodule were 5.8x3.0x6.1 cm. The cortex is very characteristic, and because of that we are pretty sure that no other flakes with the same cortex were found on the site. This must mean that the core was shaped at another place and brought to the site in a prepared state. Only two flakes can be refitted, but two more flakes must have been knapped off later. None of these flakes was of good quality, and two of them ended in hinges. An attempt was made to create a platform, but it was not very successful (platform angle on the refitted core is 80 degrees). Hardly any steps of the Ahrensburgian *chaîne opératoire* were followed in this case, but that would indeed have been difficult with a nodule shaped like this one. A good flint-knapper probably would not have selected such a nodule, so we seem to be once again in the presence of a rather inexperienced knapper.

The eighth core (fig. 103: 3) can be refitted with two flakes, a complete blade and a distal blade fragment. Three sides of the core still show the old, natural surfaces of the nodule. The first knapping of the core was an attempt to create a platform. Then one blade was struck off, but the core angle was bad: about 100 degrees. Subsequently about four flakes were knapped off, two of which can be refitted. From the new platform, still not very good (with a core angle of about 82 degrees) only a few small, hinged flakes and a blade were knapped off. On the opposite end of the core a natural surface was used as a platform. From that platform a series of hinged blades were knapped off, one of which could be refitted. Most of the blades and flakes from this core ended in hinges. The quality of the knapping is rather poor in this case. The prepared platform never possessed a good angle, and the knapper kept on trying to make blades in places where he had previously created hinges, resulting in more hinges. Much better products could have been struck from this core if the normal Ahrensburgian technology had been applied. This knapper was probably a learner, possibly the same as in previous cases.

The distributions of the eight refitted groups involving cores described so far are shown in figure 104. As can be seen, the refits cover a large area. None of these groups is associated with a dense scatter of debitage, which normally indicates a knapping location. In most cases only very few artefacts could be refitted to these cores.

A core for Grossklingen. The last core to be described (No. 293) presents a very different story; it could be refitted with 32 other artefacts (figs 105-108). The raw material probably came to the site in the form of a largely unworked nodule; it was not prepared previously but probably only tested. The rather coarse-grained flint is not of very high quality. On two sides of the refitted group, remnants of the natural outer surface of the

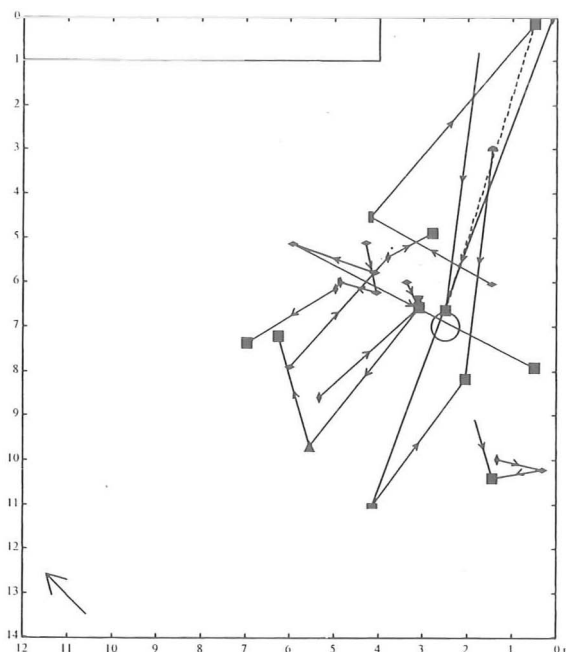


Fig. 104. Gramsbergen I. All refitted groups involving cores, except the large refitted group No. 92. In total there are 23 refits, involving 31 artefacts. Drawing by Lykke Johansen.

nodule can be seen. The original size of the nodule must have been larger than 16x7.5x7 cm. Two opposite platforms were created. Along one of the sides a long crest was made, over the whole length of the core (see fig. 105: a). An attempt was then made to strike off a long crested blade, but without success: it stopped halfway. The remaining part of the crest was then detached from the opposite platform, resulting in a second crested blade. After this preparatory stage, several attempts were made to strike off very long blades, of up to 15 cm long. Only one blade of 12.1 cm came off successfully. It later broke into two pieces, one of which was later fragmented by heat into four pieces (fig. 109). The blade was probably used on the site.

At the other side of the core too a crest was made (fig. 106: c), but the blade that should have removed the crest became too thick and removed too much material of the core; it became a large flake instead, damaging the blade-producing potential of that side of the core. Only much later were several small blades taken from this side.

Seven platform flakes could be refitted to one of the core's platforms. From the first four platforms only a few blades and flakes were struck, because the platform angles were too wide. The three later platforms were more productive, but it is clear that the flint-knapper had some difficulties in making good platforms, especially in creating good angles between the platform and the core-front. In creating the opposite platform, flakes were also removed (see fig. 108: g and h), but these had

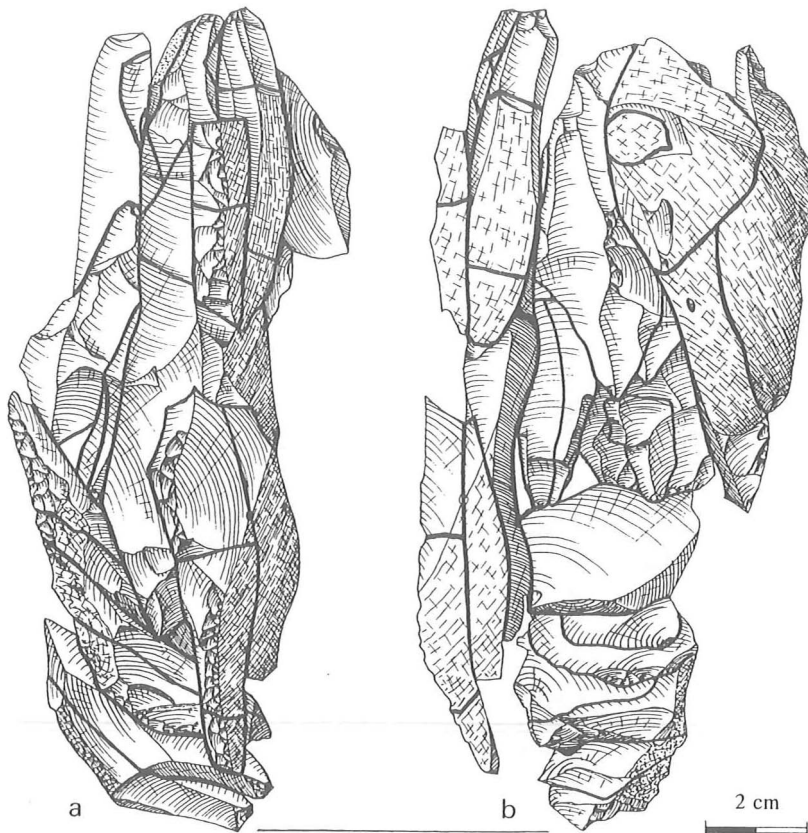


Fig. 105. Gramsbergen I. Refitted group No. 92: two views (see also figs 106-108). This group involves a core, and consists of 33 artefacts in total. Drawing by Lykke Johansen.

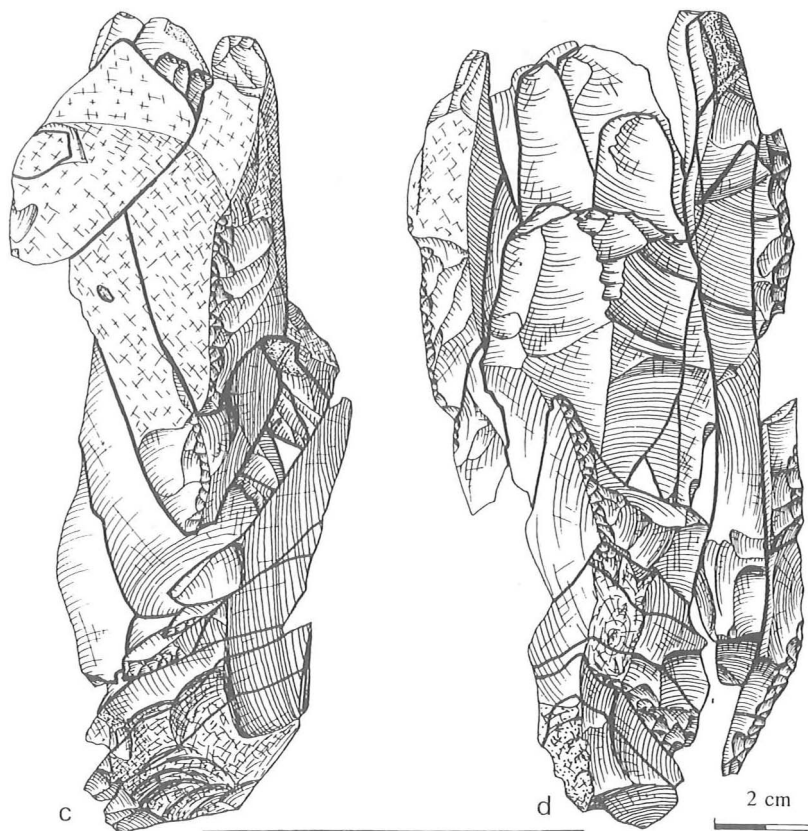


Fig. 106. Gramsbergen I. Refitted group No. 92: two views (see fig. 105). Drawing by Lykke Johansen.

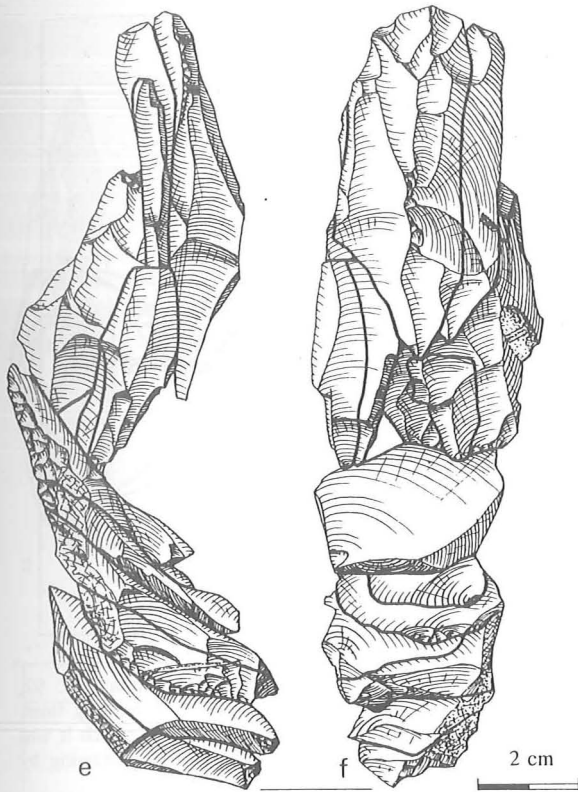


Fig. 107. Gramsbergen I. Refitted group No. 92, without the outer layers of fitting blades and flakes: two views (see also fig. 108). Note the series of platform-reshaping flakes (*tablets*). Drawing by Lykke Johansen.

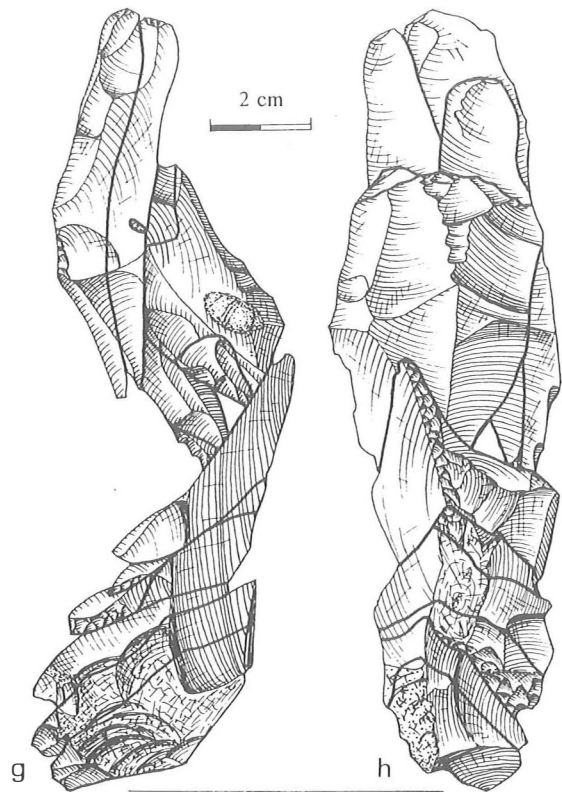


Fig. 108. Gramsbergen I. Refitted group No. 92, without the outer layers of fitting blades and flakes: two views (see fig. 107). Drawing by Lykke Johansen.

the size of chips and it proved impossible to refit them.

Blades were produced from both platforms, but also from both sides of the core. Normally, Ahrensburgian cores have only one blade-producing front, and a non-productive back, but this core had two fronts – at least during parts of its exploitation. At a certain stage, one of the core-fronts developed a bad protrusion in the middle part (the core became too 'pointed'; see fig. 107: e). The flint-knapper tried to remedy this by a little cresting in that area (fig. 107: f). Afterwards, four blades were detached from one platform, and only two blades and some flakes from the opposite platform; the last blank was a hinged flake that could be refitted to the core (fig. 107: f). The used-up core that was finally discarded on the site is less than 6 cm long. The flint-knapper who exploited this core was skilled in all the technological tricks of Ahrensburgian flintworking, such as the use of two opposite platforms, preparing and repairing core-fronts by cresting, and creating the right core angles. Nevertheless, he had to face quite a lot of problems during the knapping of this core. Some of these problems arose from the presence of fossils in the flint, resulting in fractures. From the refitting it is clear that quite a long sequence of blades from this core were taken away, most of which must have been of good quality, and quite

long. The distribution of this refitted group is illustrated in figure 110. Most of the knapping must have been done northwest and west of the reconstructed hearth, though there is no single very dense cluster of flint waste. It seems probable that the core's exploitation took place in several phases, and moreover quite a few of its products were transported over the site; for example, several blades ended up near the hearth. The residual core ended up to the east of the hearth. It was probably thrown away to the side of the hearth where not many daily activities went on; most tools are located to the west and south of the hearth. This pattern is also known from many other Upper or Late Palaeolithic sites.

To conclude: it appears that at least two different flint-knappers were active at Gramsbergen I. One of these was quite experienced, while the second was still in the process of learning the craft. We think it very probable that we are dealing here with a man and a not very young boy. All considered, including the non-specialized tool inventory, it seems that at Gramsbergen I a family with at least one child camped for some time. Similar conclusions were reached for other Late Palaeolithic sites, for example in the case of Oldeholtwolde (Johansen & Stapert, in press).

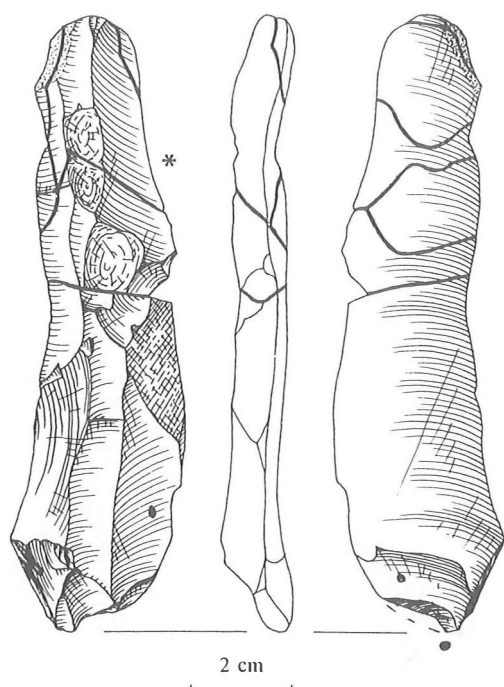


Fig. 109. Gramsbergen I. Large blade, refitted from several fragments. The blade is part of refitted group No. 92 (see figs 105-108). The distal half (4 fragments) is burnt (indicated by an asterisk). Drawing by Lykke Johansen.

4.4.7. The blades

General remarks and spatial patterns. In total, 826 blades or blade fragments larger than 1.5 cm were excavated at Gramsbergen I. Of these, 53 are blades or blade fragments with crestring (6.4%). A few specimens of crested blades are illustrated in figure 111. There are eight plunging blades. Numbers and proportions of complete and fragmented blades (normal and crested) can be found in table 5. Among the 'normal' blades ($n=765$), 197 are complete: almost 26%. More than half of the crested blades are complete (27 out of 53). The overall rate of breakage is lower than in the case of Oudehaske. For example, of all blades and blade

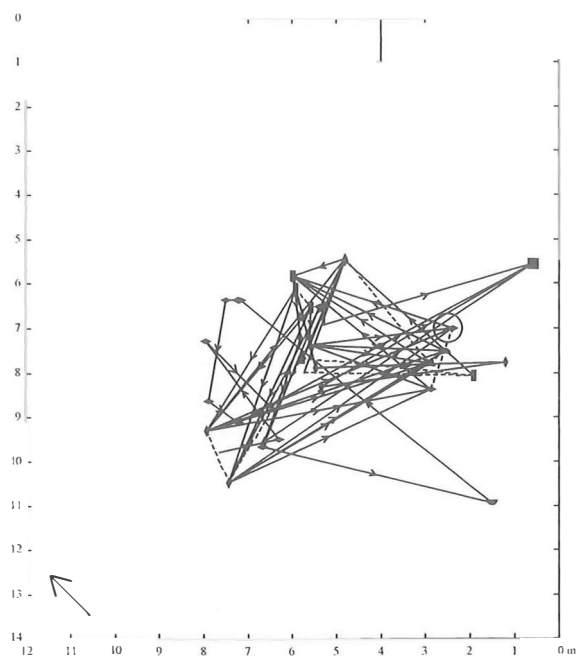


Fig. 110. Gramsbergen I. The large refitted group No. 92, consisting of 33 artefacts. In total, there are 58 refitting lines. Note that the core is located outside the areas in which it was exploited, to the east of the reconstructed hearth. Drawing by Lykke Johansen/Dick Stapert.

fragments, about 16% are medial fragments, whereas this proportion is about 21% in Oudehaske. A linear density map showing the distribution of blades and blade fragments (fig. 112) shows a large concentration northwest and west of the hearth and a second, smaller one to the south of the hearth. If we look at separate maps for complete blades, proximal, medial and distal blade fragments (not illustrated) we would in each case see roughly the same distribution. It may be noted, however, that a slight overrepresentation of blade fragments can be observed in the area immediately around the hearth and to the northwest of it, probably due to trampling.

Some of the blades from Gramsbergen I can be described as *Grossklengen* as defined by Taute (1968).

Table 5. Gramsbergen I. Blades and blade fragments.

	Normal		Crested		Total	
	N	Perc.	N	Perc.	N	Perc.
Complete blades	197	25.8	27	50.9	224	27.4
Proximal fragm.	243	31.8	11	20.8	254	31.1
Medial fragm.	124	16.2	7	13.2	131	16.0
Distal fragm.	201	26.3	8	15.1	209	25.6
Total	765	100.1	53	100.0	818	100.1

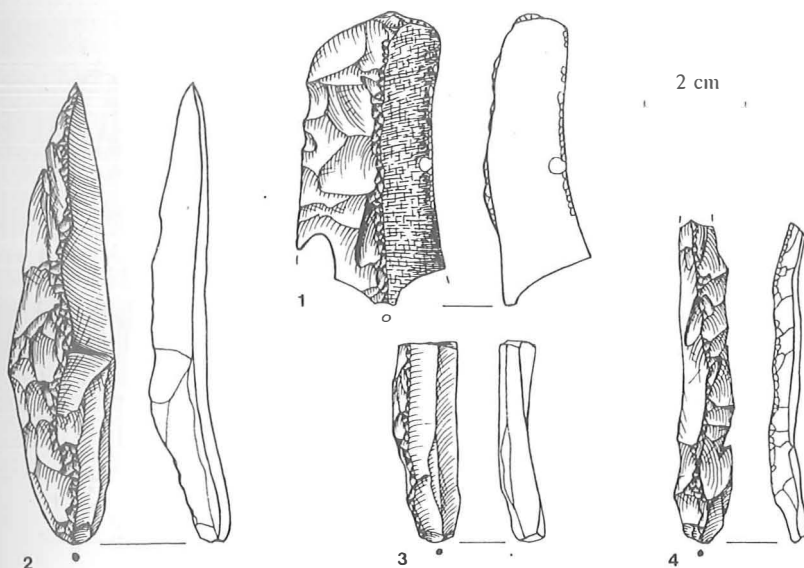


Fig. 111. Gramsbergen I. 1-4. Crested blades or blade fragments. Drawing by Lykke Johansen.

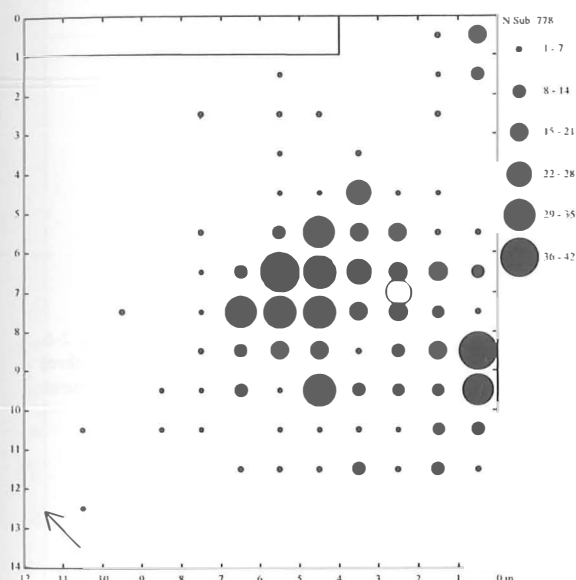


Fig. 112. Gramsbergen I. Density map (linear) of all blades and blade fragments. Drawing by Dick Stapert/Lykke Johansen.

One proximal blade fragment is 12.2 cm long, and appears to have been appreciably longer (fig. 113: 1). Another large blade, already mentioned above, is part of refitted group 92 (see figs 105-108); its length is 12.1 cm (fig. 109). Four other blade fragments are 4.0, 4.0, 3.8 and 3.7 cm wide, and must in their complete state have been quite long (fig. 114: 2, 4-6). Three of these broad blade fragments (fig. 114: 4-6), and a fourth less broad one, consist of the same type of flint and must derive from a single core. They are all made of a beautiful fine-grained, dark-brown to cream-coloured, flamed

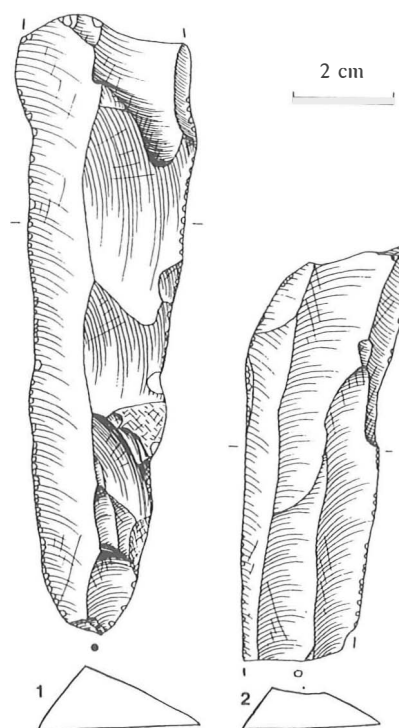


Fig. 113. Gramsbergen I. 1, 2. Fragments of large blades. Drawing by Lykke Johansen.

flint. None of these large blades can have been produced on the site, because nothing else of this type of flint is present.

Ten blades or blade fragments are longer than 8.0 cm but not very broad (fig. 113: 2, fig. 114: 1, fig. 115: 1-4 and fig. 116: 1-4); five of these are crested blades.

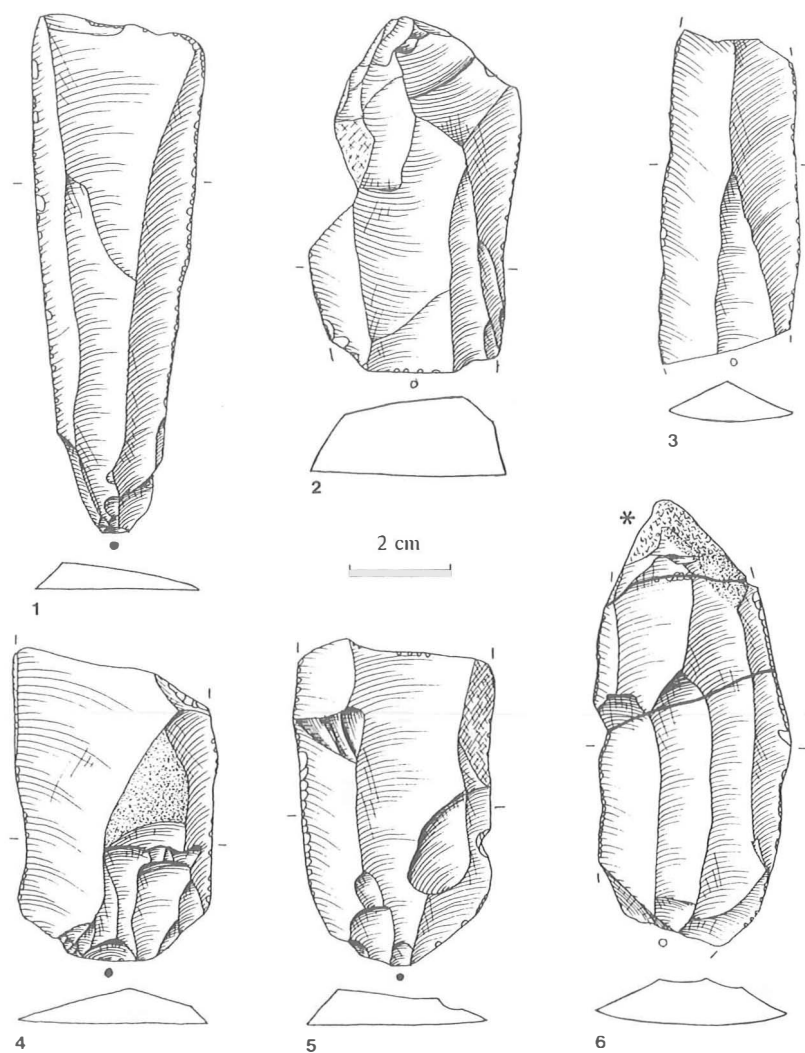


Fig. 114. Gramsbergen I. 1. Blade; 2-6. Blade fragments. No. 6 consists of three fitting fragments of which one is burnt. Drawing by Lykke Johansen.

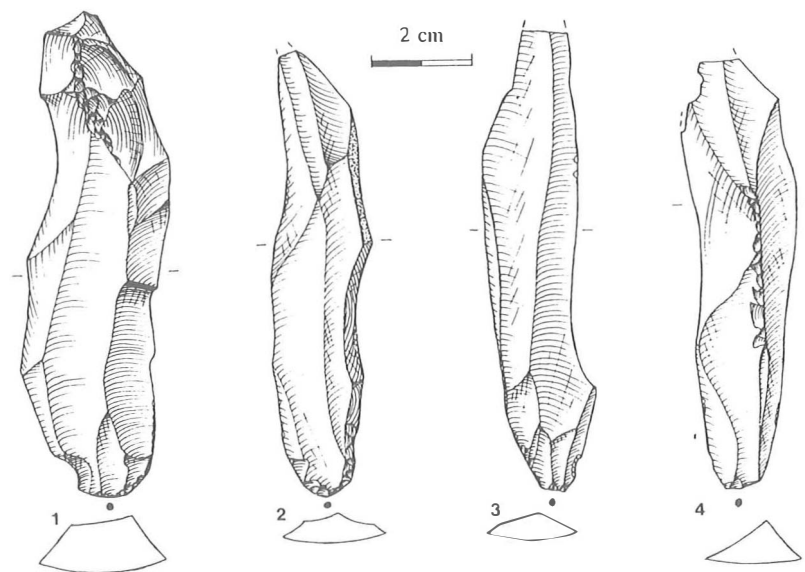


Fig. 115. Gramsbergen I. 1-4. Blades or blade fragments longer than 8 cm. Drawing by Lykke Johansen.

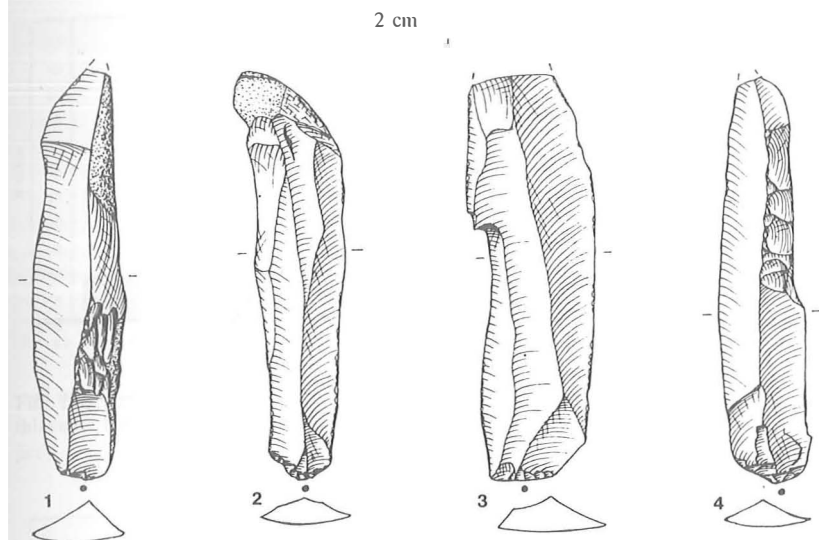


Fig. 116. Gramsbergen I. 1-4. Blades or blade fragments longer than 8 cm. Drawing by Lykke Johansen.

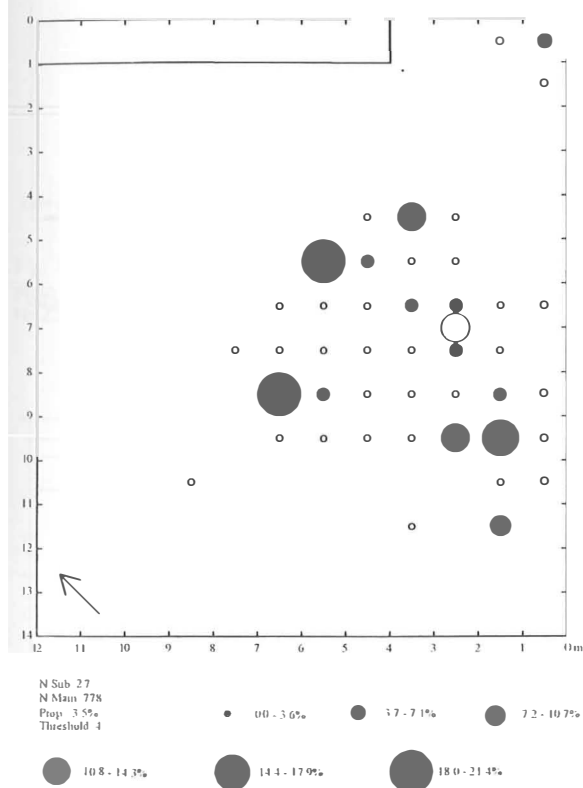


Fig. 117. Gramsbergen I. Proportion map of 'big blades': blades or blade fragments longer than 8 cm and/or wider than 2.5 cm ($n=27$). Expressed as a percentage of all blades and blade fragments per square ($n=778$). Only cells with at least 5 blades or blade fragments. Cells with a percentage higher than that over the whole area (3.5%) have infilled circles. Note the tendency of big blades to occur in higher proportions in the periphery. Drawing by Dick Stapert.

None of these blades longer than 8.0 cm can be refitted in any dorsal/ventral sequence, which indicates that they were imported to the site. In total, there are 27 blades or blade fragments longer than 8 cm and/or broader than 2.5 cm. These are mapped in a so-called proportion map (fig. 117). In this map these 'big blades' are represented as percentages of all blades and blade fragments per cell of 1x1 m; only cells with at least 5 blades and/or blade fragments are shown. It can be clearly seen that large blades are located especially in the periphery of the concentration around the reconstructed hearth. They comprise as much as 21.4% here, while over the whole area their percentage is only 3.5%. This pattern illustrates the 'centrifugal effect' that must have been working on the larger artefacts. Note, however, that a few cells close to the reconstructed hearth also have a slightly higher number of big blades than average. The pattern of figure 117 might partly have been created by the barrier effect of a tent wall. In this case, unfortunately, we cannot confidently state whether or not a dwelling structure was present (see also under 4.6).

Some metrical attributes of the complete blades are summarized in table 6. Frequency distributions of the length, width and thickness of complete blades are presented in figures 118-120. Especially the distribution of the lengths is positively skewed. As in the case of Oudehaske (under 3.4.5), two indices were calculated for Gramsbergen I: the ratio of length to maximum width (fig. 121) and the ratio of length to maximum thickness (fig. 122). When comparing these diagrams with those for Oudehaske, it will be noted that at Gramsbergen higher values of these indices are found occur (see also tables 3 and 6). The highest value for the length/width ratio is 6.8 (at Oudehaske: 6.2), and that for the length/thickness ratio is 20.5 (at Oudehaske: 18).

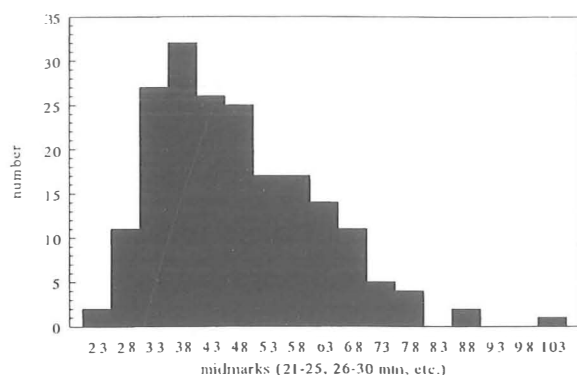


Fig. 118. Gramsbergen I. Lengths of complete blades, in intervals of 5 mm. N=194. Drawing by Dick Stapert.

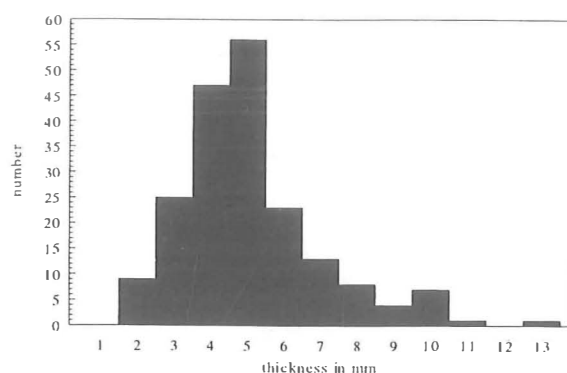


Fig. 120. Gramsbergen I. Thicknesses of complete blades, in intervals of 1 mm. Drawing by Dick Stapert.

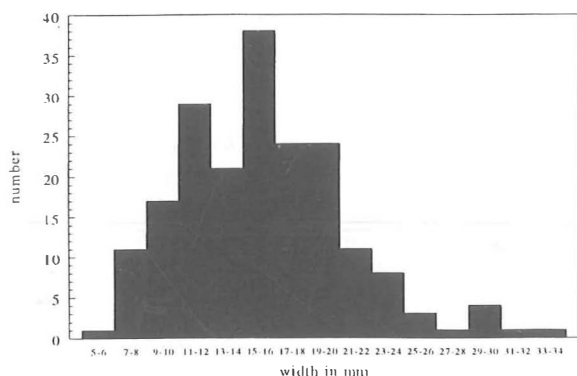


Fig. 119. Gramsbergen I. Widths of complete blades, in intervals of 2 mm. Drawing by Dick Stapert.

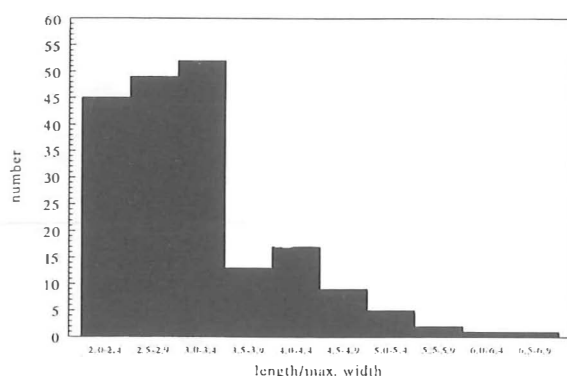


Fig. 121. Gramsbergen I. Frequency distribution of the length/width index, for all complete blades. Drawing by Dick Stapert.

Table 6. Gramsbergen I: metrical attributes of the complete blades. N=194. V: coefficient of variation (100 x standard deviation/mean).

	Length	Width	Thickness	L/W	L/Th
Range	24-102 mm	6-34 mm	2-13 mm	2.0-6.8	4.3-20.5
Modal class	36-40 mm	15-16 mm	5 mm	3.0-3.4	8-9
Median	4.5 cm	1.6 cm	5 mm	3.0	10.0
Mean	4.8 cm	1.6 cm	5.1 mm	3.2	10.0
Stand. dev.	1.41	0.51	1.92	0.88	2.87
V	29.5%	31.9	37.6	27.5	28.7

This difference can be largely explained by the fact that the sample at Gramsbergen is larger. The median values are the same at both sites: 3.0 (length/width) and 10.0 (length/thickness).

From 221 complete blades, the striking direction of dorsal negatives could be recorded. In total, these blades show 681 negatives, of which 531 (78.0%) have the same striking direction as the blades on which they occur (fig. 123). This proportion is remarkably similar to that found at Oudehaske. This seems to be more or

less the normal proportion when cores were predominantly exploited from two opposite platforms.

Refitted groups consisting of blades. Above we already discussed blades refitting with tools or with cores. Here we will consider the 48 refitted groups consisting only of blades (or blades and a few flakes). In total, 156 blades or blade fragments are involved in these refittings, within the area selected for analysis (36 complete blades, 41 proximal blade fragments, 33 medial blade fragments

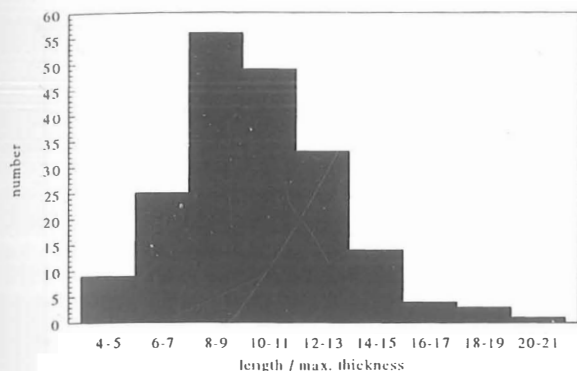


Fig. 122. Gramsbergen I. Frequency distribution of the length/thickness index, for all complete blades. Drawing by Dick Stapert.

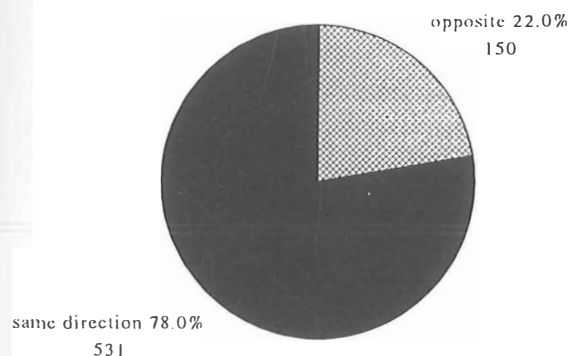


Fig. 123. Gramsbergen I. Direction of dorsal negatives on complete blades: identical or opposite to that of the blades themselves. N=221. Drawing by Dick Stapert.

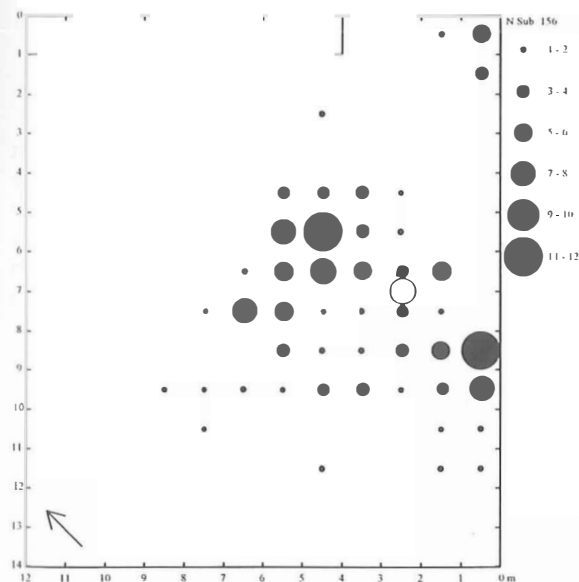


Fig. 124. Gramsbergen I. Density map (linear) of all blades or blade fragments involved in refits (n=156). Drawing by Lykke Johansen/Dick Stapert.

and 46 distal blade fragments). A density map of these blades shows the now familiar pattern of two clusters near the reconstructed hearth, northwest and south of it (fig. 124).

In total, 29 refitted groups of blades are sequences. If we look at the numbers of blades in sequences (counting blades consisting of several fitting fragments as one), it may be noted that most are very short. Of the 29 sequences, 22 consist of only two blades (76%), four of three blades (14%), one of four blades (3%) and two of five blades (7%). Few of these sequences seem to document flint-knapping on the site; most of them consist of imported series of blades produced elsewhere. There are some sequences from a core's early phases of blade production (fig. 125: 3-4 and fig. 126). But the cores belonging to these sequences were not found on the site. A sequence of several flakes and one blade (fig. 125: 1) reflects some of the first steps in shaping a core, which, again, was not found on the site. Among the 19 refitted groups consisting of broken blades, seven cases can be attributed to the effect of heat. After broken blades were fitted, 13 complete blades resulted. Their lengths are: 4.6, 5.4, 6.1, 6.5, 6.5, 7.2, 7.3, 7.5, 7.6, 8.3, 9.0, 9.3 and 10.1 cm. The average length of these blades is 7.3 cm: much more than the average length of the complete blades (4.8 cm); for an example, see figure 125: 2.

The main conclusion of the refitting analysis of the blades and blade fragments from Gramsbergen I is that a large part of the blades were imported to the site. Quite an amount of flint-knapping was done on the site, but most of the produced blades were exported out of the site. The impression we get, as in the case of Oudehaske, is that a considerable number of blades, either in the form of blanks or as tools, were carried during travel. Because few of the blades produced on the site were also discarded there, people must have stayed at these sites for relatively brief periods, and the same goes for Sølbjerg I in Denmark (Johansen, in prep.). Among the three sites (Gramsbergen I, Oudehaske and Sølbjerg I), the Gramsbergen site was probably in use longer than the other two.

4.4.8. The flakes and chips

At Gramsbergen I, a total of 621 flakes were recovered, of which 556 occurred in the area selected for analysis. Of these 621 flakes, 303 are smaller than 2.5 cm. Platform-shaping flakes or flakes renewing platforms (*tablets*) number 27 in total. Flakes occur concentrated in the two clusters northwest and south of the hearth, but also in fairly large numbers near the hearth (fig. 127). Flakes smaller than 1.5 cm are classified as chips: a total of 458, of which 407 were found within the area selected for analysis. Their distribution (fig. 128) shows that they occurred mainly in two concentrations. The largest of these is located to the northwest of the hearth, and a much smaller one to the east of and close to the hearth. It is of interest to note that not many chips are located to

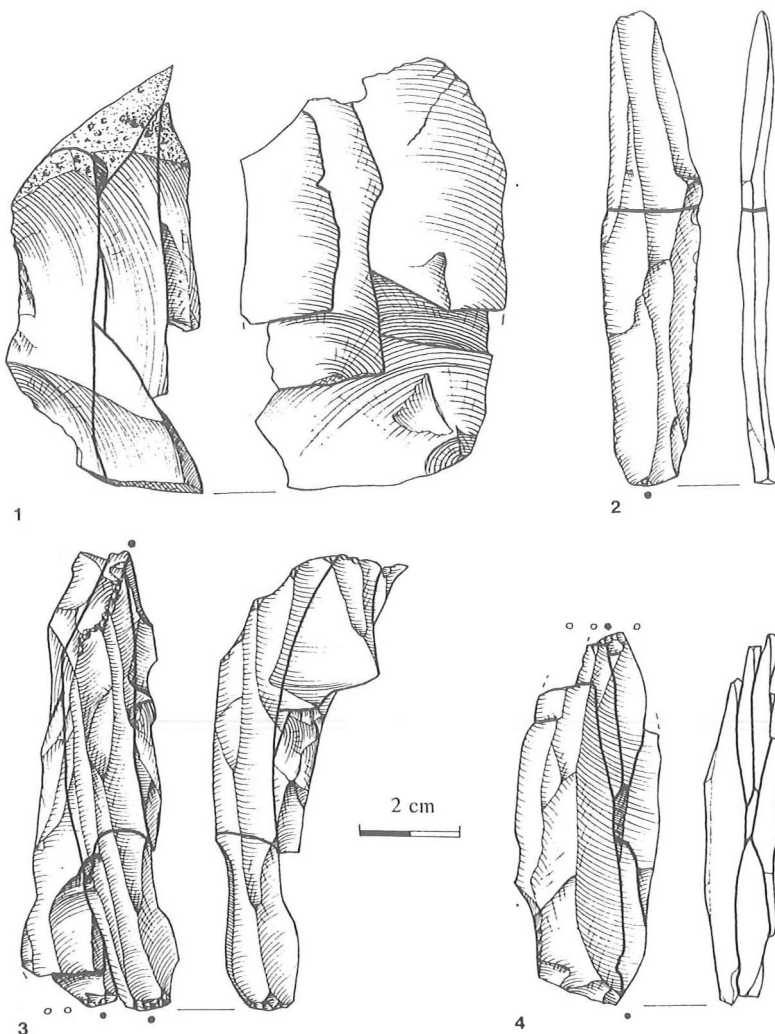


Fig. 125. Gramsbergen I. 1. Sequence involving several flakes and a blade; 2. Blade consisting of two fitting fragments; 3, 4. Short sequences of blades or blade fragments. Drawing by Lykke Johansen.

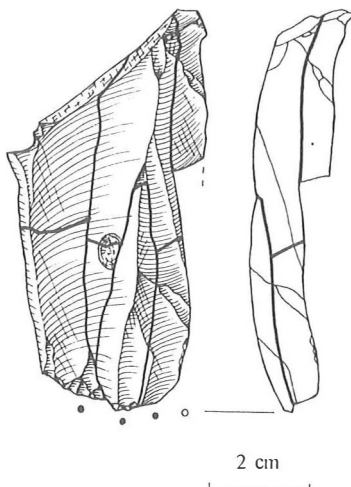


Fig. 126. Gramsbergen I. Sequence involving several blades and blade fragments. Drawing by Lykke Johansen.

the south of the reconstructed hearth. This is in contrast to flakes, the densest cluster of which occurs to the south of the hearth. Dense concentrations of chips may be interpreted as flint-knapping locations or as dumps (Johansen & Stapert, 1998). In the case of Gramsbergen I, most of the flint-knapping seems to have been done to the northwest of the hearth.

4.4.9. Other artefacts

In total, 28 stones of other kinds than flint were excavated (of six the location is unknown). Most of these were determined by the late A.P. Schuddebeurs (a few pieces were too small). Sandstones are the most common type ($n=15$); these sandstones (dating from the Cambrium or older periods, derived from southern Sweden) must have been collected from northern moraines. One sandstone has three rubbed sides, but its exact findspot is unknown and it might date from a much later period.

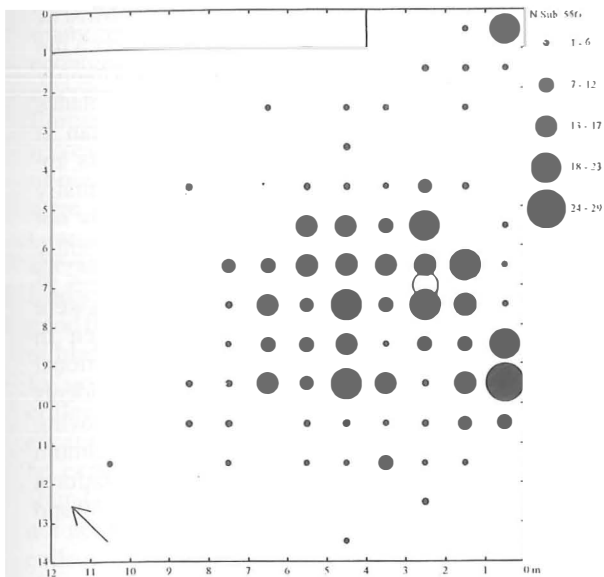


Fig. 127. Gramsbergen I. Density map (linear) of all flakes within the area selected for analysis (n=556). Drawing by Dick Stapert/Lykke Johansen.

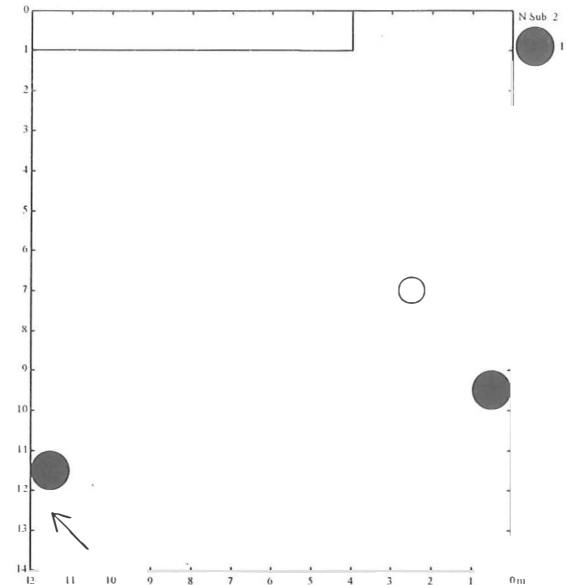


Fig. 129. Gramsbergen I. Locations of two possible hammerstones of sandstone. Drawing by Lykke Johansen/Dick Stapert.

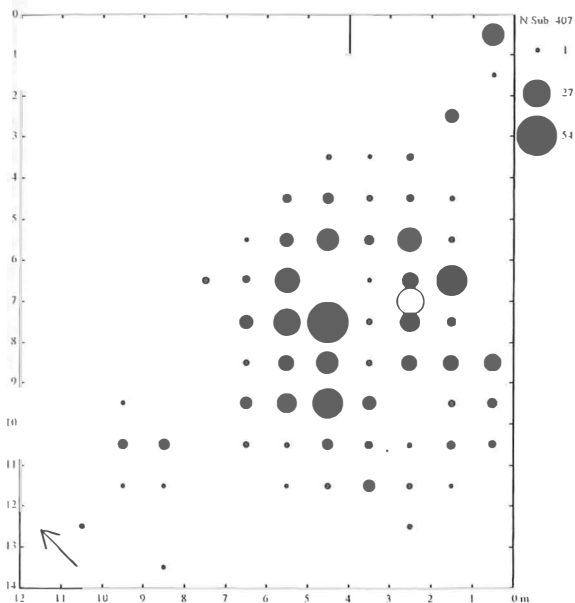


Fig. 128. Gramsbergen I. Density map of all chips (flakes smaller than 1.5 cm; n=407). This is a peripheral density map, stressing the lower frequencies. There are no classes; in the key, extreme values and the middle value are indicated. Drawing by Dick Stapert/Lykke Johansen.

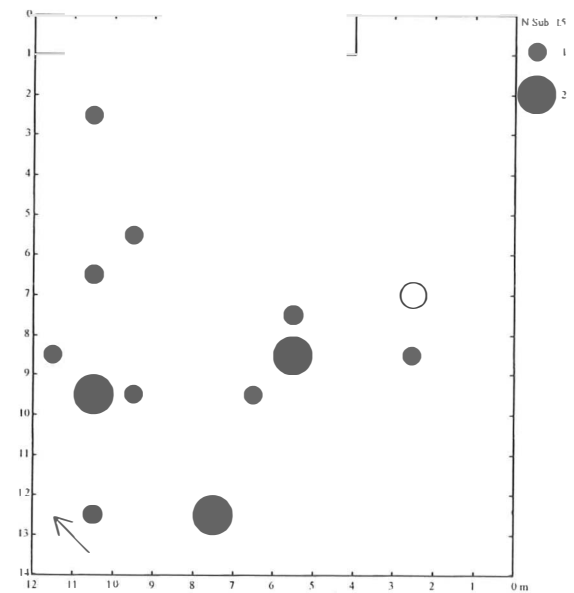


Fig. 130. Gramsbergen I. Locations of possible cooking stones (mostly sandstone). Drawing by Lykke Johansen/Dick Stapert.

Furthermore, four granites, two gneisses, a porphyry, and a quartzite breccia were collected, also derived from moraine deposits. Three pieces of iron concretions are present, which have a local origin. Finally, two small stones covered by a thin layer of red ochre were excavated. Except the porphyry (discussed below), most

of these stones are quite small.

Two possible hammerstones are present (fig. 129). Both consist of sandstone and are fragmented (weights are 50 and 75 gr). About 15 stones are burnt, and may have been used as cooking stones. Most of these are sandstones, but three granites are also burnt, as are the

two gneisses and the breccia. The distribution of the presumed cooking stones is illustrated in figure 130. Many occurred quite far away from the reconstructed hearth, in the westernmost part of the excavated area. This pattern may be explained by clearing-up behaviour; most of the used-up (broken) cooking stones seem to have been flung away from the central activity area around the hearth. The largest stone of Gramsbergen I is a porphyry (find No. 115) with a weight of 1.4 kg (its dimensions are 16.0x9.3x7.4 cm). It has a damaged area on its surface, some 8 cm in diameter. Within the damaged area, with a maximum depth of about 0.5 cm, a red colouration is present suggesting red ochre, but which according to Schuddebeurs does not consist of ochre. The stone was found with the damaged area facing upwards during excavation, about 2 metres north of the reconstructed hearth (fig. 40). It may have been used as an anvil.

It proved impossible to refit any of the stones, though several occur in a fragmented state. However, it is difficult to refit stones with a very damaged or coarse-grained surface and from which most of the original surface has disappeared.

4.4.10. *The chaîne opératoire of blade production*

Most of the flint nodules exploited at Gramsbergen I were brought to the site in an already prepared state ('pre-cores'). Only one nodule was worked at the site from a very early stage (refitted group No. 92, the largest 'composition' described above: see figs 105-108). It also seems that pre-cores were prepared at the site, and then exported from the site; from these only some cortex flakes or blades are present. Nearly all the cores of Gramsbergen I are bipolar ones, with two opposite platforms used in alternation. The platform flakes are normally rather small (chips), and therefore difficult to refit. But some are quite large, for example several included in refitted group 92. The cores were often prepared by cresting the front, and sometimes the sides or the back of the cores were also crested. In total, there are 53 crested blades or blade fragments; these all show a real crest, not just remnants of a crest. This is quite a large number for an Ahrensburgian site. The technique of preparing cores by cresting was very common in the Hamburgian and the Magdalenian but less so in the Ahrensburgian. The knappers at Gramsbergen I seem to have liked this way of shaping their cores. One attempt at making very long blades (*Grossklingen*) was made on the site, but most long blades on the site were imported from elsewhere. It seems clear that Late Ahrensburgian people had a preference for long blades. At Gramsbergen and Sølbjerg I, burins especially were made out of long blades, and at Oudehaske in some cases also scrapers. At all three sites, distinct bruised blades (*pièces mâchurées*), as described by Fagnart (1997) for northwestern France and by Barton (1989) for southeastern England, however, are absent.

Blades were struck off by direct percussion. Most of the blades have a small lip along the edge between the platform remnant and the bulbar face, and this is mainly seen with soft percussion techniques. A number of blades show a 'bulb-flake', but proportionally less than at Oudehaske (see under 3.4.7). Platform remnants are normally very small and crescent-shaped or virtually absent: less than 1 mm thick. Bulbs are normally not prominent. All these features indicate a predominantly soft percussion technique, in which use was made of soft hammerstones and/or antler hammers. Blades were knapped from two opposite platforms, often in alternation. This was done to keep the core in a functional shape for as long as possible, and also because accidents such as hinges may be quite easily repaired by removing the next blade from the opposite platform. For optimum blade production, core angles (between the platform and the core front) would generally be between 50 and 70 degrees.

4.5. 'Refitting clusters' and summarizing remarks about the refitting analysis of Gramsbergen I

4.5.1. *Import and export of flint*

One of the most important results of the refitting analysis of Gramsbergen I relates to the phenomenon of import and export of tools and blanks. Most of the blades cannot be refitted in the dorsal/ventral way, and the relatively few tools and blades that can are mostly part of rather short sequences. Obviously, this means that most tools and blades found at the site were carried to the site from elsewhere. Only one more or less complete blade-production sequence is documented, by refitted group No. 92; the best products from this core were subsequently exported from the site. A consequence of this situation is that the whole *chaîne opératoire* is rarely if ever represented by any one refitted group. In other words, we do not see tools or blades from cores knapped on the site being used and eventually discarded on the site. The same is true for Oudehaske and Sølbjerg I, and this was also noted at Kartstein by Baales (1996) and at Zonhoven-Molenheide (Vermeersch & Creemers, 1994; see also Peleman et al., 1994; Vermeersch et al., 1996). Tools made, used and discarded at a single site are known from many other Upper or Late Palaeolithic sites; for example, at the Hamburgian site of Oldeholtwolde such tools include most of the *Zinken*, burins and notched tools (Stapert & Krist, 1990; Boeschoten et al., 1997).

There may be several reasons for this situation. One obvious explanation is that the period of occupation was very short in the case of the Ahrensburgian sites. Another approach would be that the function of the sites, and the season of occupation, have something to do with it. Gramsbergen and Oudehaske might represent specialized sites, 'extraction camps' dedicated to hunting activities, while sites such as Oldeholtwolde might

represent 'base camps', where apart from hunting also many other activities took place. Differences in 'flint economy' may also have played a role. If we compare a series of sites with refitting data from northwestern Europe, it seems that two different flint economies are represented. One system, in which substantial numbers of blanks and tools, and probably also prepared cores, were carried during travel, may be exemplified by Gramsbergen I and Oudehaske. This system might operate in a situation where over large parts of the landscape it was difficult or even impossible to collect good flint nodules. Therefore, people carried a large bag of blades and finished tools with them, to enable them to 'survive' in areas where hardly or no flint could be collected, and still have enough left for a next encampment. The second system of flint economy would be expected in situations where flint was relatively abundant in large parts of the landscape, so that it was not necessary to carry a great deal of flint, but only a collection of tools for use during travel and the first phase of occupation at the next encampment. This is what we seem to see at some Hamburgian sites, for example Oldeholtwolde. In the Netherlands, it may well have been much more difficult to find good flint nodules during the Late Ahrensburgian than in Hamburgian times, because in the meantime much more wind-blown sand had been deposited. It has to be noted, however, that it is impossible to prove the existence of such differences, because of another variable influencing the picture: the duration of the sites' occupation.

4.5.2. Individual flint-knappers

A refitting analysis brings out the *chaîne opératoire* of blade production, even in cases, such as Gramsbergen and Oudehaske, where mainly short sequences can be documented. An important aspect is that the level of technical skill of the knapper or knappers can be studied to a certain extent. Refitting is therefore one of the few methods allowing us to come quite close to individual Stone Age people, at least those people who did some flint-knapping. At the site of Gramsbergen I at least two flint-knappers seem to have been active: a learner who still made a lot of mistakes without knowing how to repair them, and a second one who had fully mastered the flint technology of Ahrensburgian times. The experienced flint-knapper was probably also responsible for all the imported good blades, and especially for the blades longer than 8 cm.

Three refitted groups can be attributed to the master knapper, among which is the large refitted group No. 92. Four refitted groups can be attributed to the learner with a fair probability. The total numbers of refitted artefacts are 40 for the master and only 17 for the learner. In figures 131 and 132, linear density maps are shown for both groups, together with all refit lines. If we first look at the work of the master knapper (fig. 131), the familiar cluster northwest of the hearth is clearly

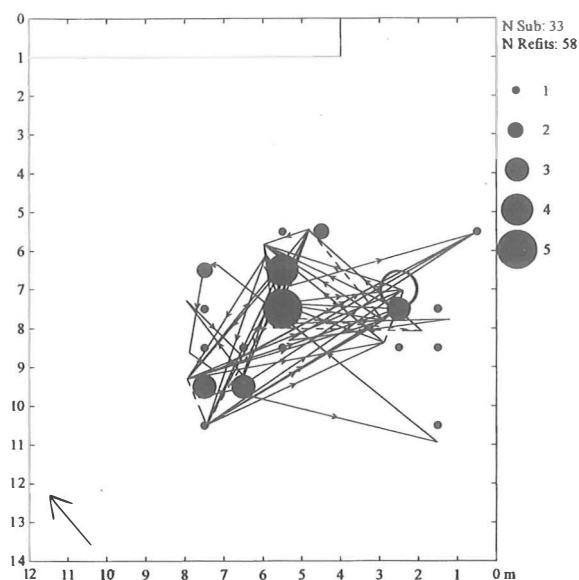


Fig. 131. Gramsbergen I. Density map of all refitted artefacts that can be attributed to the master flint knapper, combined with the refit lines. The picture is dominated by the large refitted group No. 92 (see fig. 110). Drawing by Lykke Johansen/Dick Stapert.

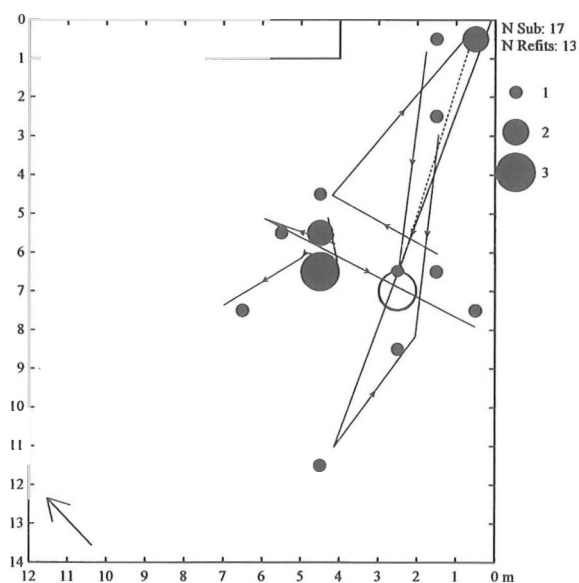


Fig. 132. Gramsbergen I. Density map of all refitted artefacts that can be attributed to an inexperienced flint knapper, combined with the refit lines. Drawing by Lykke Johansen/Dick Stapert.

visible; most of the knapping must have been done there and a compact set of refit lines connects this area with the vicinity of the hearth. The distribution of artefacts associated with the inexperienced knapper shows a very different picture (fig. 132). The densest cluster is located next to the one of the master knapper, but somewhat

closer to the hearth. There is an additional, smaller cluster in the easternmost corner (possibly in a dump context). The refit lines do not show a distinct pattern, and it seems that these artefacts were moved around quite a lot. Two other cores with a few fitting artefacts (not mapped here) were possibly worked by the learner; one group among these artefacts occurs to the west of the hearth, a second in the southern cluster.

On the basis of ethnographical sources concerning subrecent hunter/gatherers (e.g. Murdock & Provost, 1973), it seems probable that both flint-knappers were male: probably a man and a boy. In this case we could be dealing with a father and son. Since there also were quite a few scrapers, supposedly tools predominantly used by women, it is a reasonable hypothesis that Gramsbergen I briefly was the home of a family.

4.5.3. Refitting clusters and spatial patterns

On sites with less import and export of flint artefacts, mapping of refitting lines will generally show quite clearly at which locations flint-knapping took place. At Gramsbergen I this is a problem, because of the severe effect of import and export of flints. Even the largest refitting group (No. 92: 33 artefacts) shows no distinct knapping location if we look at the map of refit lines (fig. 110). In such cases it may be helpful to combine the refit lines with a density map of the included artefacts (as in fig. 131); in this case the densest concentration of artefacts occurs about 2.5 m northwest of the reconstructed hearth, and it is reasonable to assume that this core was worked here. At Gramsbergen I, the problem is partly caused by the circumstance that the

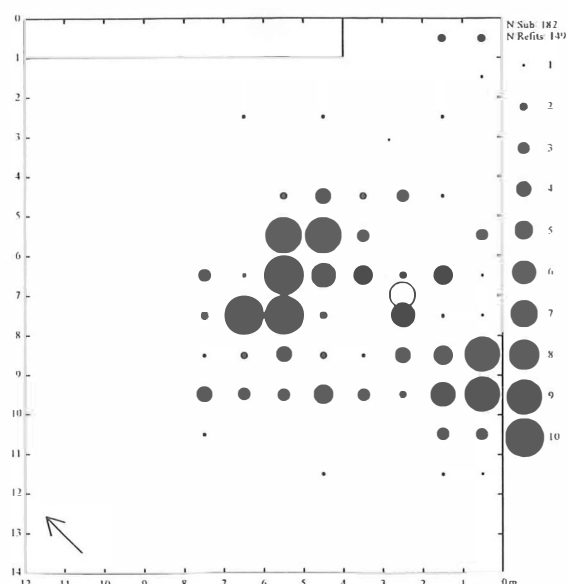


Fig. 133. Gramsbergen I. All artefacts involved in refitted sequences. Drawing by Lykke Johansen/Dick Stapert.

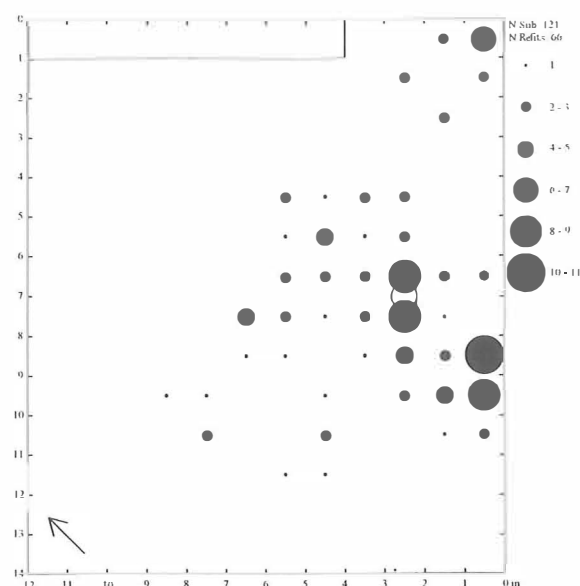


Fig. 134. Gramsbergen I. All artefacts involved in refitted breaks. Drawing by Lykke Johansen/Dick Stapert.

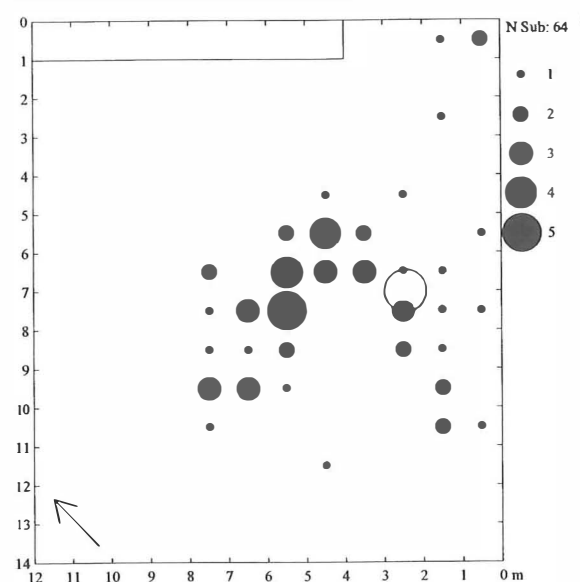


Fig. 135. Gramsbergen I. All artefacts in sequences involving a core. Drawing by Lykke Johansen/Dick Stapert.

soil was not sieved, so most of the chips from knapping were not collected. Normally, knapping locations are visible quite clearly as dense concentrations of small chips (see Johansen & Stapert, 1998, for examples); these locations are often smaller than 0.5 m across.

In this connection it is interesting to study separate density maps of two groups of artefacts that are part of refitted groups: artefacts involved in sequences (fig.

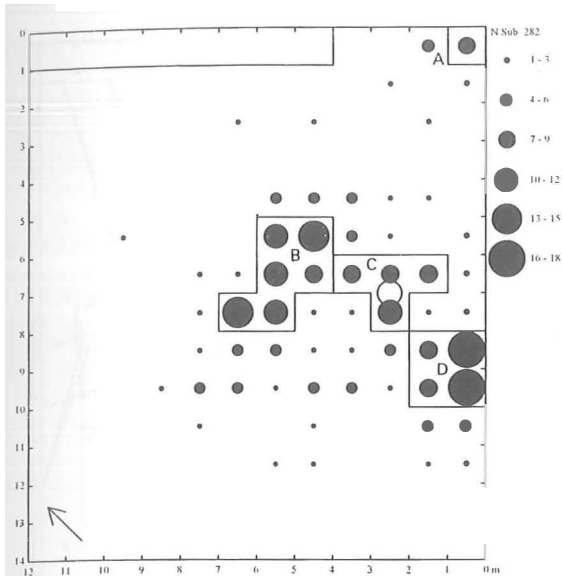


Fig. 136. Gramsbergen I. The areas selected as 'refitting clusters' (labelled A-D), on the basis of a density map of all refitted artefacts. Drawing by Lykke Johansen.

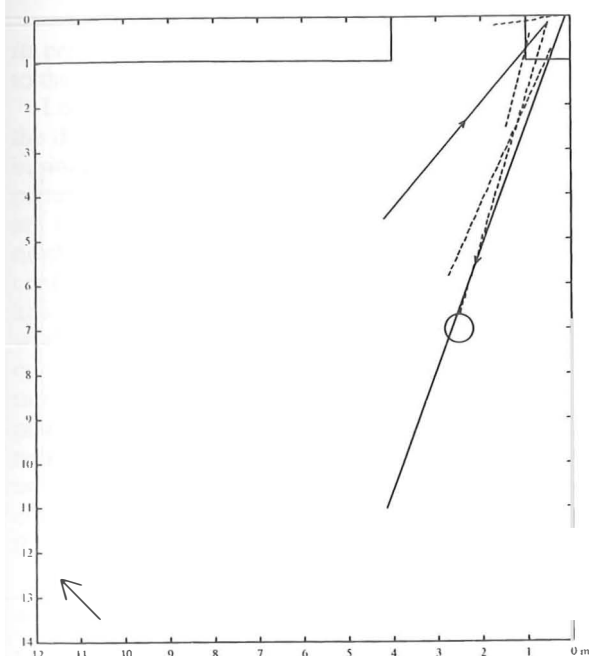


Fig. 137. Gramsbergen I. All refit lines (n=6) crossing the boundaries of refitting cluster A. Drawing by Lykke Johansen.

133) and artefacts involved in refitted breaks (fig. 134). Refitted breaks occur especially in the 'southern cluster' and much less in the 'northwestern cluster'. Artefacts involved in refitted breaks also occur in high numbers close to the reconstructed hearth; these breaks can be attributed to heat. Artefacts involved in sequences,

however, are well represented in both the northwestern and the southern clusters. We have seen that many imported blades and tools can be refitted in short sequences; these are not expected to show refit lines with cores. Therefore it may be interesting to show only artefacts that are in sequences with cores (fig. 135). Now only one dense cluster is visible: northwest of the hearth. This prompts the provisional conclusion that most of the flint-knapping went on in that area. In the area to the south of the hearth, many blades and tools broke, and we assume that in this area a lot of work was done involving both imported tools and tools made on the site. An important group of sequence lines in the southern cluster connect imported tools, especially scrapers. No distinct knapping locations are present in that area.

Mapping the results of refitting may reveal patterns of artefact movements around the site, for example from knapping locations to activity areas, and from there to dumps. To investigate this matter more fully, the first author has introduced the concept of 'refitting clusters' (Johansen, 1993; 1998; in press a). Refitting clusters are subareas with a relatively high number or proportion of refitted artefacts. These clusters are often centres of activity on the site. In using the ANALITHIC computer program, it is possible to show only the refit lines crossing the boundaries of the defined refitting clusters, while omitting the inner lines. In the case of Gramsbergen I four refitting clusters were defined, labelled A-D (fig. 136); these are areas with seven or more refitted artefacts.

Refitting cluster A is in the easternmost corner of the excavated area, cut off by the excavation's edge. The refitting lines from cluster A nearly all go to the main concentration around the hearth, but are few in number (fig. 137). If we expand this cluster to an area of 3x3 m, many more lines appear (fig. 138). Most of these lines connect the easternmost corner with the cluster south of the reconstructed hearth. We believe that the easternmost corner is partly a dump area, connected to the main activity area around the hearth. Cluster B is located to the northwest of the reconstructed hearth. This is the largest cluster; it covers six square metres. Most of the refitting lines crossing its perimeter are sequence lines, connecting this cluster with the area close to and south of the hearth (fig. 139). Cluster B probably saw most of the flint-knapping. Cluster C is the area in the centre, including the reconstructed hearth (fig. 140). The refitting lines crossing its perimeter show connections with cluster B (mostly sequence lines), cluster D to the south of the hearth (mostly refits of breaks) and cluster A (in the easternmost corner). Some of these lines are quite long, up to 6 metres. Cluster D is located south of the reconstructed hearth (fig. 141). This cluster of four square metres includes two square metres with the highest numbers of refitted artefacts on the site, close to the edge of the excavation. The refitting lines crossing

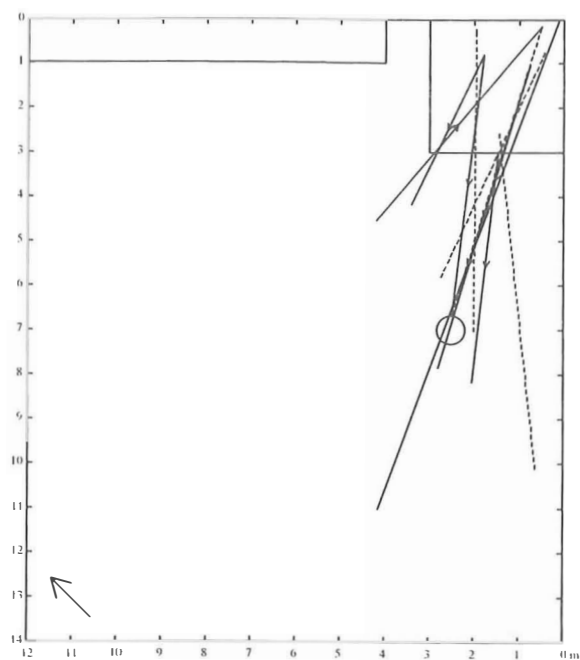


Fig. 138. Gramsbergen I. All refit lines ($n=11$) extending from an area of $3 < \text{maal} > 3$ m in the easternmost corner (compare with fig. 137). Drawing by Lykke Johansen.

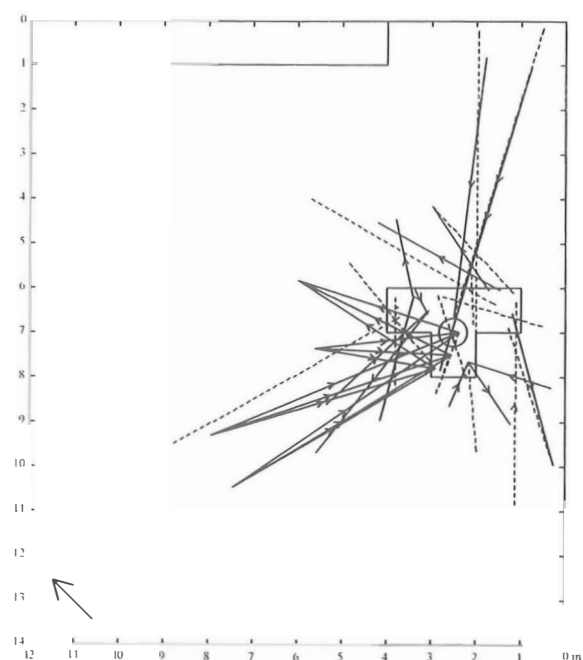


Fig. 140. Gramsbergen I. All refit lines ($n=41$) crossing the boundaries of refitting cluster C. Drawing by Lykke Johansen.

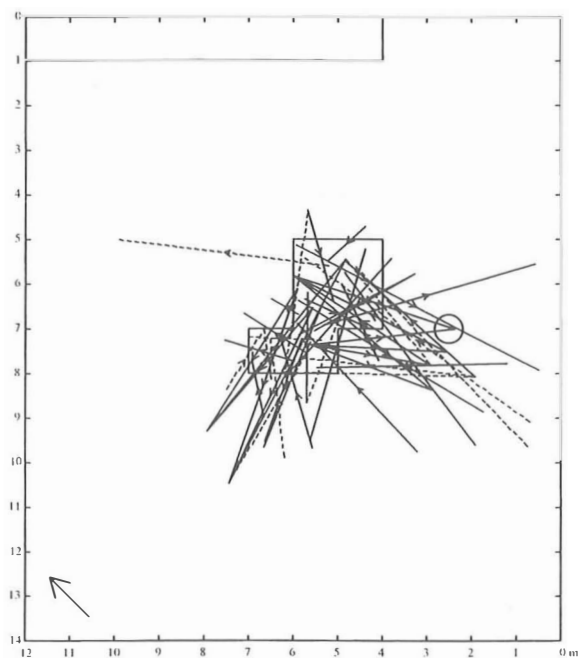


Fig. 139. Gramsbergen I. All refit lines ($n=50$) crossing the boundaries of refitting cluster B. Drawing by Lykke Johansen.

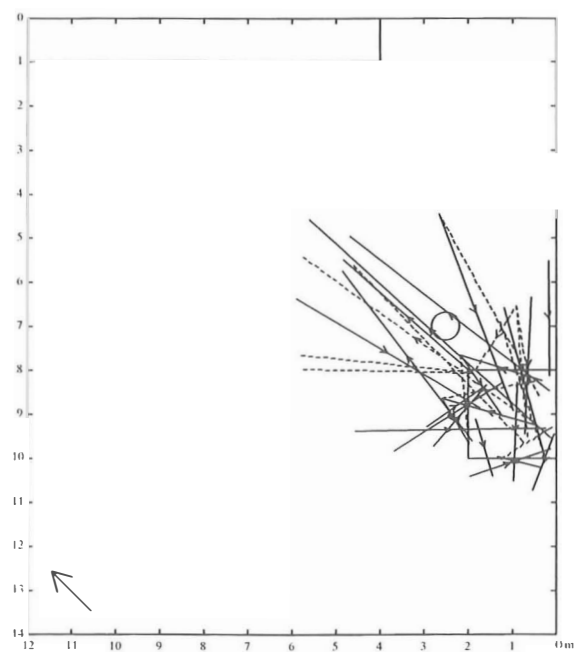


Fig. 141. Gramsbergen I. All refit lines ($n=34$) crossing the boundaries of refitting cluster D. Drawing by Lykke Johansen.

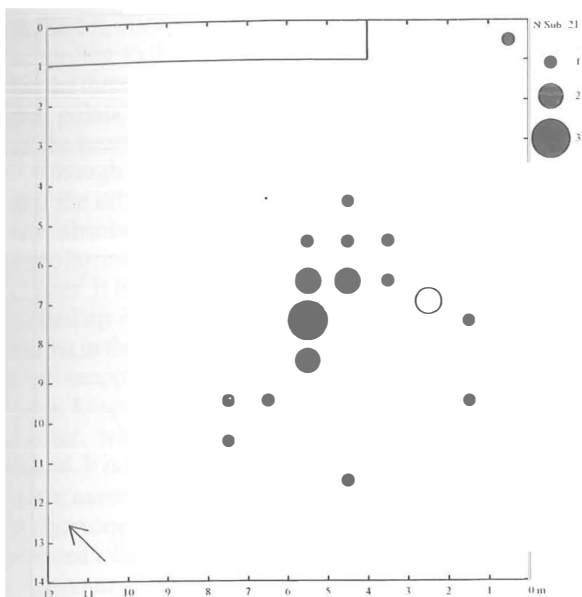


Fig. 142. Gramsbergen I. Blades refitted into sequences involving a core. Drawing by Lykke Johansen/Dick Stapert.

its perimeter mainly show a connection with cluster B to the northwest of the hearth.

Looking at these patterns, and comparing them with the distributions of the three main tool types (points, burins and scrapers), we can begin to build up a spatial picture of the site and its occupants. It seems that there are two main activity areas around the hearth: to its northwest and to its south. Cluster D to the south contained most of the scrapers, and probably no flint-knapping was done there: presumably a woman's working area. Interestingly, most refittings in this area concern breaks. Cluster B to the northwest contained most of the points and burins, and is moreover a knapping area: probably a man's working area. It may be noted that artefacts refitted in sequences involving cores are concentrated in this area, and this applies most clearly to blades (fig. 142). We will discuss some of these patterns more extensively in the next section.

4.6. Gender patterns at Gramsbergen I?

In many of the distribution maps presented so far, two artefact clusters show up: one to north/northwest of the reconstructed hearth and one to its south. The same clusters are evident in a linear density map of all tools within the area selected for analysis (fig. 143). The northwestern cluster is clearly associated with flint-knapping, and contains most of the points and burins. The possible 'strike-a-light' is also located in this area. The southern cluster contains most of the scrapers. Much less flint knapping seems to have been done in the latter area; instead, we see many refits of breaks, pointing to an intensive use of tools and blades. It is not possible

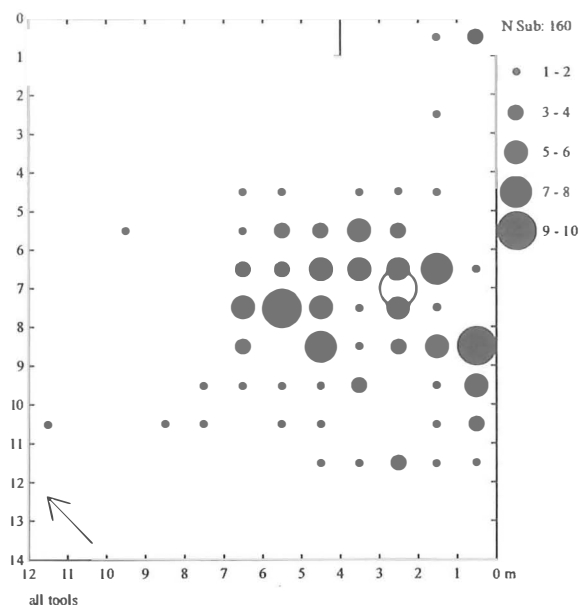


Fig. 143. Gramsbergen I. Linear density map of all tools (n=160). Drawing by Dick Stapert/Lykke Johansen.

to investigate whether the (reconstructed) hearth of Gramsbergen I was in the open air or inside a dwelling. The spatial data, counts per square metre, are in this case not precise enough for a reliable application of the ring and sector method. In applying that method, the use of individual coordinates for all the tools is the best approach; grid-cell data can be used only if the cells are not larger than 50x50 cm (see Stapert & Johansen, 1995/1996).

If we look at the distribution of the tools over 8 sectors, within 6 m from the centre of the reconstructed hearth, it can be observed that the western half is the tool-richest one (fig. 144). This is a sector graph, in which the centre has the value zero, and the circle represents the average number of artefacts per sector. Sectors with a higher number than the average have a bar outwards, sectors with a lower number a bar inwards. This and following sector graphs are based on the randomized data file. Although we do not know whether the hearth of Gramsbergen I was in the open air or inside a dwelling, it may be noted that this type of asymmetry, with most of the tools located on the western side of the hearth, was found to be quite common in Upper or Late Palaeolithic sites with a hearth in the open air (Stapert, 1989 b). It has to be remembered that the sectors are not all complete in this case, owing to the proximity of the eastern excavation boundary; the sector graphs in this paper must therefore be interpreted with caution.

Density maps of the various tool groups have been presented above. One of the results was that points are located on average much closer to the hearth than burins and scrapers. Based on the randomized data file, the average distance between point locations and the hearth

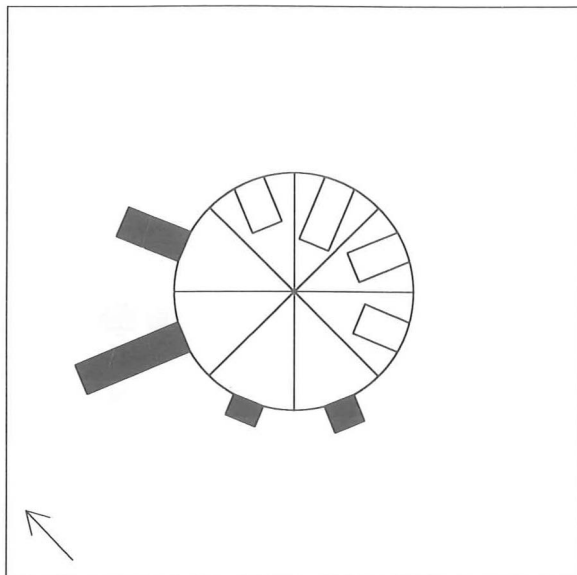


Fig. 144. Gramsbergen I. Sector graph, employing 8 sectors, of all tools within 6 m of the centre of the reconstructed hearth (n=150; see text under 4.6). Note that the tool-richest half is the western half. Drawing by Dick Stapert.

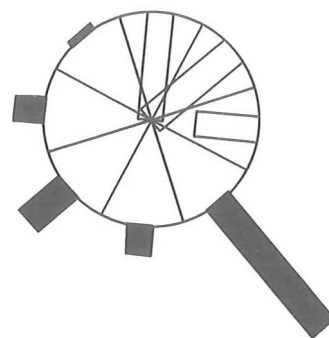


Fig. 146. Gramsbergen I. Sector graph of the scrapers (n=38). Drawing by Dick Stapert.

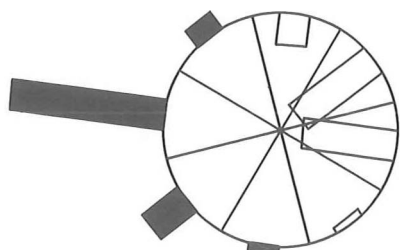


Fig. 145. Gramsbergen I. Sector graph of the points (n=76). In figs 145-147, the 'richest sector option' was used, in order to bring out any tendency to cluster. Drawing by Dick Stapert.

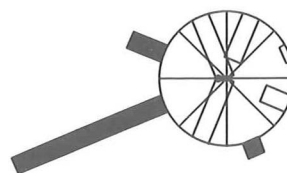


Fig. 147. Gramsbergen I. Sector graph of the burins (n=26). Drawing by Dick Stapert.

centre is 2.2 m, that of burins 3.1 m, and that of scrapers 3.2 m. This is the normal picture, encountered in many sites (Stapert, 1992). Here, we would like to take a closer look at their distributions in the space around the hearth, with the help of sector graphs. The ANALITHIC

program can optimize sector graphs, by rotating the sector wheel to the position in which one or more sectors contain the highest possible number of any selected group of artefacts. Any tendencies towards clustering are brought out very clearly in this way (see e.g. Stapert

& Street, 1997). In figures 145-147, sector graphs according to this 'richest sector option' are illustrated for the three main tool groups. Once again, it can be seen that points and burins occur clustered to the northwest of the hearth, and scrapers to its south.

Though the general pattern is clear, it has to be noted that the differences between the two clusters are in no way absolute. Points also occur in the southern cluster, as do burins, and scrapers occur also in the northwestern cluster. It is also of interest that quite a few burin spalls turned up in the southern cluster, some of which fit to burins in the northwestern cluster. Finally, though most flint-knapping was done in the northwestern cluster, some knapping undoubtedly occurred in the southern cluster, where both *tablets* and crested blades were found. It is of interest that all refitted artefacts assigned to the master knapper occur in the northwestern cluster. At least one core that was possibly worked by the inexperienced knapper was uncovered in the southern cluster.

It is attractive to interpret the differences between the two clusters in terms of gender patterns in space, with a man's working area to the northwest of the hearth (points, burins), and a woman's to its south (scrapers). We tried to investigate this hypothesis by chi-square tests on the basis of counts per quarter (4 sectors). However, because chi-square tests require that not more

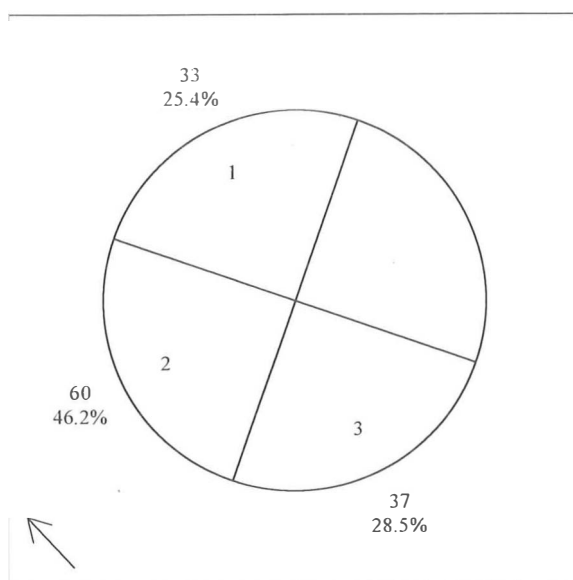


Fig. 148. Gramsbergen I. Sector graph, employing 4 sectors (quarters), of points + scrapers + burins. The sector wheel is located in such a way that the total number of tools in three of the sectors is maximized. The poorest sector, not labelled, contains 10 tools. The numbers of points, scrapers and burins in sectors 1-3 were subjected to chi-square tests (see text under 4.6). Drawing by Dick Stapert.

Table 7. Gramsbergen II. List of artefacts.

A. Flint tools

	N	Percentage of subtotal
Points	6	46.2
Scrapers (including a double scraper on flake)	2	15.4
Burins	1	7.7
Pointed blade	1	7.7
Retouched blades	3	23.1
Subtotal	13	100.1
	(6.2% of total)	

B. Flint non-tools

		Percentage of total
Burin spalls	3	1.4
Blades and blade fragments	84	40.0
Flakes	89	42.4
Chips (<1.5 cm)	7	3.3
Blocks	6	2.9
Cores	6	2.9
Unclassifiable burnt fragments	2	1.0
Total	210	100.1

C. Other artefacts

<i>Retouchoir</i>	1
Small stone, burnt	1

than 20% of the expected values are below 5, numbers are too low for that approach. The ANALITHIC program can calculate the position of the sector wheel in which three adjacent sectors out of four contain the maximum possible number of tools. This position is shown in figure 148; the poorest sector, unlabelled, contains only ten tools and will not be included in the chi-square tests. The numbers of points, scrapers and burins in sectors 1-3 are as follows:

Sectors	Points	Scrapers	Burins	Total
1 (north)	21	7	15	43
2 (west)	38	11	11	60
3 (south)	13	18	6	37
Total	72	36	22	130

Chi-square tests were performed for each pair of tool types. Only the difference between points and scrapers is significant in a statistical sense: two-tailed $p < 0.01$ (the chi-square values are: points/scrapers 12.02; points/burins 0.99; scrapers/burins 3.14). It may be noted that

the numbers of burins and scrapers are much lower than the number of points, a circumstance somewhat hindering the interpretation of the results. It is clear, however, that there is not much difference between points and burins; the difference between burins and scrapers is distinct, but owing to the small numbers significance cannot be achieved. In our opinion, the outcomes support the hypothesis that the two activity areas near the hearth were, at least partly, gender-dominated, though the differences are not absolute. In combination with the results of the refitting analysis (see 4.5.2), this leads to the conclusion that probably a family sojournd here, consisting of at least a man, a woman and a boy.

4.7. Gramsbergen II

At this concentration, 210 flint artefacts and two stones of other kinds were collected. The finds are listed in table 7. In total, only 13 flint tools are present (fig. 149). The six points can be described as B-points, and are similar to those from Gramsbergen I. Furthermore, there

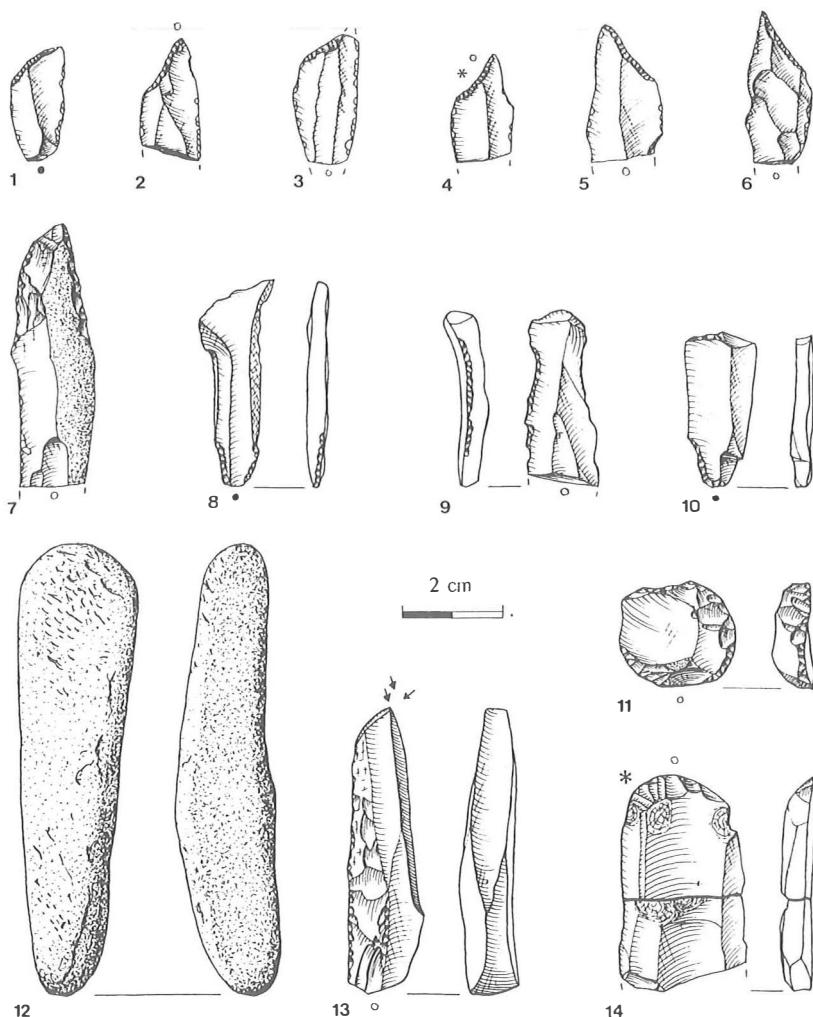


Fig. 149. Gramsbergen II. 1-6. B-points; 7. Pointed blade; 8-10. Retouched blades; 11 and 14. Scrapers; 13. Burin; 12. *Retouchoir* made of quartzite. Drawing by Lykke Johansen.

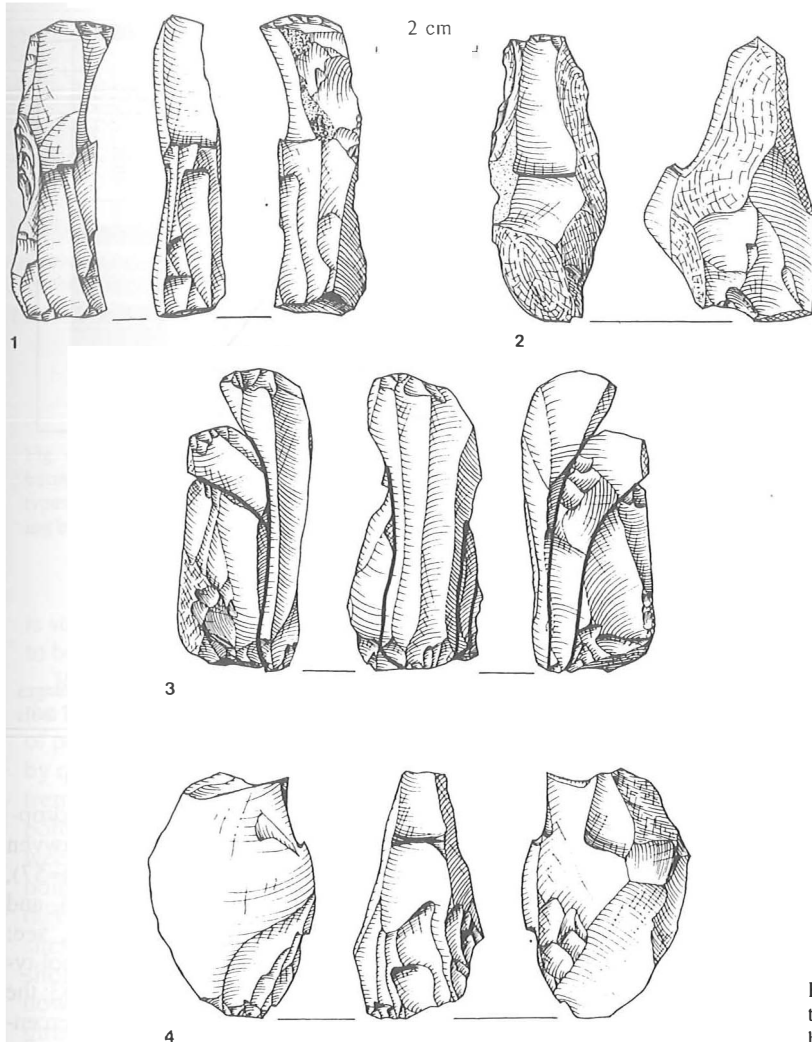


Fig. 150. Gramsbergen II. 1-4. Cores. To No. 3 two plunging blades could be refitted. Drawing by Lykke Johansen.

are two scrapers, one burin and a pointed blade. The pointed blade has sturdy retouch along both sides, and is similar to the *Spitzklinge* from Kartstein (Baales, 1996: pp. 49-51). One of the scrapers is a double one, made of a flake. The second scraper, on a blade, consists of two fitting parts and is still incomplete; one of the fragments is burnt. The single burin is of the dihedral type. In total, six cores were uncovered (figs 150 and 151). These are all rather small and used-up cores. To one of them (fig. 150: 3) we could refit two plunging blades, which totally destroyed the core. In addition to an unclassifiable small, burnt stone, a *retouchoir* was present at Gramsbergen II (fig. 149: 12). It consists of quartzite and has a long narrow shape; its dimensions are 88x22x18 mm. Because of the layered structure of the stone, the impact damage is not very distinct. Stone *retouchoirs* are quite common in both Federmesser and Ahrensburgian contexts (e.g. Taute, 1965), though wider and flatter shapes occur more often than narrow ones. A narrow and long *retouchoir* is also known from Gel-drop-3.1; it consists of lydite (Deeben, 1995).

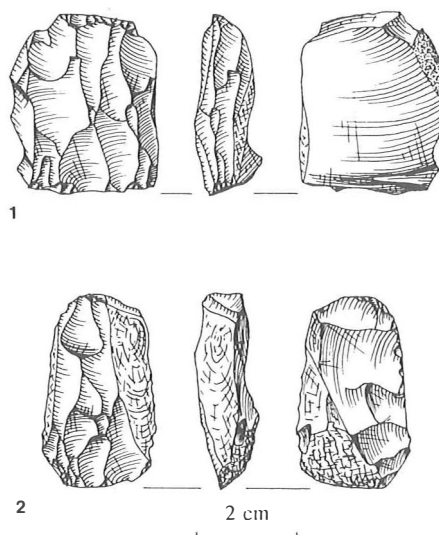


Fig. 151. Gramsbergen II. 1, 2. Cores. Drawing by Lykke Johansen.

4.8. Some conclusions

As at Oudehaske, the period of occupation must have been quite short at Gramsbergen I. Though one core, for *Grossklingen*, could be refitted with 32 other artefacts, most good blades struck from this core were exported from the site. Most tools and larger blades present on the site were probably imported from elsewhere, not made on the site. Once again, therefore, few if any tools were made, used and discarded at the site, and the best explanation for this situation is that the site was occupied only briefly. All tool classes are represented, and the degree of 'specialisation' is less extreme than in the case of Oudehaske. On the basis of the refitting analysis and the analysis of spatial patterns, it seems reasonable to suppose that the site was occupied by a family, comprising at least a man, a woman and a boy.

5. DISCUSSION OF A FEW SELECTED TOPICS

5.1. Proportions of points, burins and scrapers

In this section, we will be concerned only with the three main tool types: points, burins and scrapers. At most Ahrensburgian sites, other tool types are represented only in very small numbers or not at all. In figure 152, the percentages of points, burins and scrapers are given for Oudehaske, Gramsbergen I and Sølbjerg I, based on the total number of tools of the three types ($n=58$, 154 and 46, respectively). Though it may be noted that Oudehaske has a relatively high proportion of points, and Sølbjerg I a fairly low proportion of burins, the differences between the three sites are not extreme in any way. (Although two-tailed $p = 0.05$ when we submit the tool numbers of the three types for all three sites to a chi-square test, none of the p 's for each pair of sites falls below 0.05)

For comparison, we have calculated tool percentages for nine other (Epi-)Ahrensburgian sites: Geldrop-1 ($n=104$; Deeben, 1994), Geldrop-2 ($n=126$; Deeben,

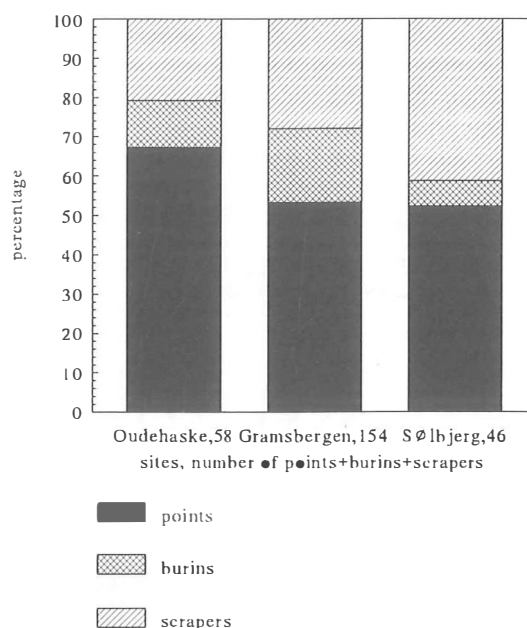


Fig. 152. Oudehaske, Gramsbergen I and Sølbjerg I. Percentages of points, burins and scrapers, based on the total number of tools of these three types. Drawing by Dick Stapert.

1994), Geldrop-3.1 ($n=186$; Deeben, 1995), Geldrop-3.2 East ($n=222$; Deeben, 1996), Vessem-Rouwven ($n=428$; Arts & Deeben, 1981), Teltwisch-West ($n=57$), Teltwisch-Mitte ($n=357$), Teltwisch-Ost ($n=83$), and Teltwisch-2 ($n=298$; for the Teltwisch sites, see: Tromnau, 1975). The proportions of the three tool types, for all twelve sites, are presented in figure 153; the sites are ordered according to decreasing point percentages (the raw data on which this figure is based can be found in table 8). It is quite clear that several types of sites are represented in the sample, though it is difficult to tell to what extent differences in preservation and excavation technique have contributed to the picture (when the whole contingency table of 3 types \times 12 sites

Table 8. Twelve Ahrensburgian sites: numbers of points, burins and scrapers.

Sites	Points	Burins	Scrapers	Total
Oudehaske (OH)	39	7	12	58
Geldrop 1 (G-1)	67	15	22	104
Geldrop 3.2 East (G-3.2)	137	31	54	222
Vessem-Rouwven (V-R)	251	67	110	428
Gramsbergen I (Gr-I)	82	29	43	154
Sølbjerg I (S-I)	24	3	19	46
Geldrop 3.1 (G-3.1)	85	32	69	186
Geldrop 2 (G-2)	54	34	38	126
Teltwisch-Ost (T-O)	14	12	57	83
Teltwisch-2 (T-2)	19	55	224	298
Teltwisch-Mitte (T-M)	22	65	270	357
Teltwisch-West (T-W)	2	16	39	57

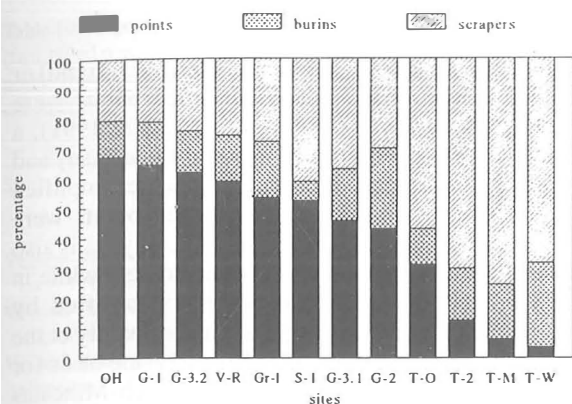


Fig. 153. Twelve Ahrensburgian sites. Percentages of points, burins and scrapers, based on the total number of tools of these types. For key to abbreviations of site names, see Table 8. Drawing by Dick Stapert.

is submitted to a chi-square test, two-tailed p turns out to be essentially zero; the value of chi-square is 599!).

Points show the widest range in proportions. Among the twelve sites, Oudehaske has the highest percentage of points: 67.2%. The Teltwisch sites are characterized by quite low point percentages; Teltwisch-West is extreme in this respect, with its percentage of only 3.5 (2 points). In general, there is a negative correlation between the total number of tools and the proportion of points: the smaller the site, the higher the point percentage. This can be understood by assuming that hunting sites (predominance of points) were occupied for only short periods. There are two notable exceptions, however. Teltwisch-West is a small site (tools of the three main types total 57), but points make up only 3.5%. As at the other Teltwisch sites, scrapers are represented very well (68.4%). Such sites may be special activity areas within a larger site complex. More difficult to understand is the situation at Vessem-Rouwven. It is the largest site (tools of the three types total 428), but the percentage of points is moderately high: 58.8%. One explanation might be that multiple occupations took place.

Scrapers also show quite a wide range in proportions. Oudehaske has the lowest percentage (20.7) and Teltwisch-Mitte the highest (75.6). Burins in most cases occur in moderate proportions; the range is from 6.5% (Sølbjerg 1) to 28.1 (Teltwisch-West). It is of interest to note here that some small sites are without burins; for example, Richter (1981) reports that the German Ahrensburgian site at Gahlen contained 34 points (4 tanged points and 30 microliths) and 7 scrapers, but no burins.

A subdivision of the sites into 'point sites' and 'scraper sites' seems to be suggested by frequency diagrams of the proportions of the three tool types, in which the percentages per tool type are grouped in intervals of 10%. Points (fig. 154) and scrapers (fig. 156) show weak bimodal distributions, while burins (fig. 155)

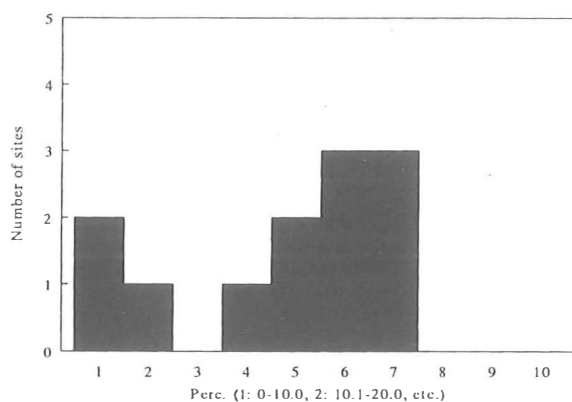


Fig. 154. Twelve Ahrensburgian sites. Percentages of points in intervals of 10 percent. A slight bimodality can be seen. Drawing by Dick Stapert.

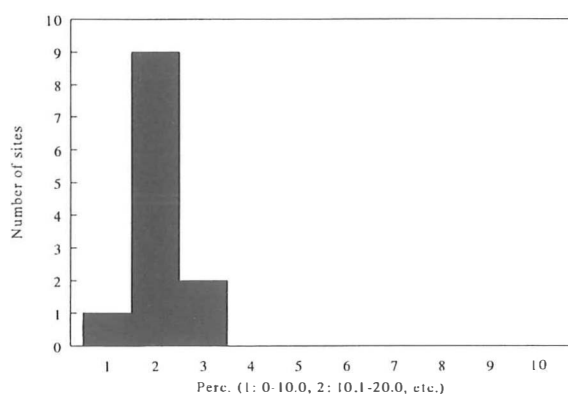


Fig. 155. Twelve Ahrensburgian sites. Percentages of points in intervals of 10 percent. This is a clearly unimodal pattern. Drawing by Dick Stapert.

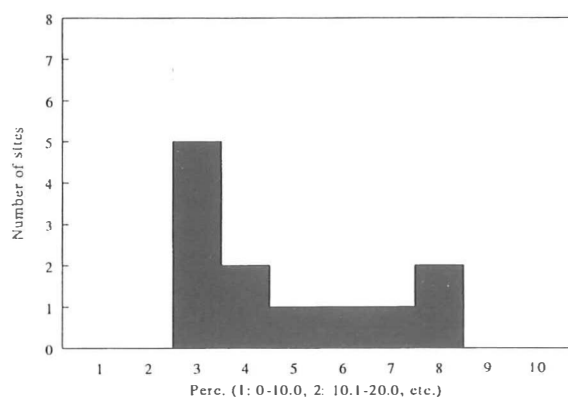


Fig. 156. Twelve Ahrensburgian sites. Percentages of scrapers in intervals of 10 percent. A slight bimodality can be seen. Drawing by Dick Stapert.

display a distinct unimodal pattern. Three sites have point percentages below 20 and scraper percentages above 65 (Teltwisch-2, Teltwisch-Mitte and Teltwisch-West). The remaining nine sites have point percentages above 30 and scraper percentages below 60.

It is necessary to be very cautious in interpreting these patterns. The main reason is that differences in excavation technique may have great consequences for the resulting tool proportions if tool types are markedly different in size. Whether or not sifting of the soil has been done has huge consequences especially for the proportion of microliths. Oudehaske can serve as an illustration. The amateur collection predating the excavation included 5 points (27.8%), 5 burins (27.8%) and 8 scrapers (44.4%). Excavation involved sifting the soil. The final total collection (excavation finds plus amateur collection) includes 39 points (67.2%), 7 burins (12.1%) and 12 scrapers (20.7%): a very different composition. As noted above, the three sites with very low point percentages in our sample are all Teltwisch sites. At these sites, no sifting of the soil was done (for a description of the excavation technique used, see Tromnau, 1975: p. 17). This certainly must have brought down the proportion of the points. It is worth noting, however, that at several sites with relatively high point proportions, such as Geldrop-1, Geldrop-3.2 East and Vessem-Rouwven, sifting was also omitted.

5.2. Right or left lateralization of points

When tips point upwards, the truncations at the tips can be at the left or right. This lateralization is regarded as a possible stylistic attribute by some authors (e.g. Close, 1978; Gendel, 1989). We have calculated percentages of left and right truncations for Oudehaske, Gramsbergen and Sølbjerg 1; for comparison, percentages were also calculated for both tanged points and microlithic points at Vessem-Rouwven (based on Arts & Deeben, 1981). The data can be found in table 9. In this table, the results of chi-square one-sample tests are also presented. It may be noted that none of the four sites are marked by a significant lateralization. Therefore, we consider this attribute as most probably non-stylistic.

5.3. Proximal or distal location of point tips

Point tips can be located proximally (at the bulb end) or distally on the blanks from which the points were manufactured. According to Fischer (1978; 1991), a trend in time can be discerned in northern Germany and Denmark: in the older Ahrensburgian sites (exemplified by Teltwisch-Mitte) the tips of tanged points were thought to be located predominantly distally (as is also the case with the preceding Bromme points), while in the younger Ahrensburgian sites (exemplified by Stellmoor) tips would be located predominantly at the bulbar ends of the blades. Unfortunately, the basis for this supposed trend is rather weak. Teltwisch-Mitte has no radiocarbon dates. Stellmoor produced a series of radiocarbon dates of around 10,000 BP (Fischer & Tauber, 1986; Lanting & Van der Plicht, 1995/1996), but it is possible that the site was occupied over a long period.

We have calculated percentages of the two locations of point tips for Oudehaske, Gramsbergen I and Sølbjerg 1; again, for comparison, percentages were also calculated for Vessem-Rouwven (based on Arts & Deeben, 1981). The data can be found in table 10. In this table, the results of one-sample chi-square tests can also be found. It will be seen that Vessem-Rouwven and Sølbjerg 1 produced significantly more distal point tips than bulbar ones. In figure 157, the four sites are arranged according to increasing percentages of bulbar tips; tanged points and microlithic points were lumped together. If we really were dealing with a chronological trend, Sølbjerg 1 would be the oldest site of the four. This stands in stark contrast to the view of Lanting & Van der Plicht (1995/1996: p. 112), who think it probable that this site dates from the first half of the Preboreal.

Most of the points at Sølbjerg 1 are tanged points (only one certain microlithic point is present). Only about 20% of the points have bulbar tips. At Gramsbergen I, where tanged points are absent, about 60% of the points have bulbar tips. At Oudehaske, with only one tanged point in the point assemblage, the percen-

Table 9. Left or right lateralization of points (tip pointing upwards), at four Ahrensburgian sites. Chi-square one-sample tests.

Sites	N	Right		Left		Chi-squared	p (two-tailed)
		N	%	N	%		
Vessem-Rouwven, tanged points	70	39	55.7	31	44.3	0.91	0.3 < p < 0.5
Vessem-Rouwven, microliths	30	13	43.3	17	56.7	0.53	0.3 < p < 0.5
Vessem-Rouwven, all points	100	52	52.0	48	48.0	0.16	0.5 < p < 0.7
Sølbjerg 1	15	8	53.3	7	46.7	0.07	0.7 < p < 0.8
Gramsbergen I	82	39	47.6	43	52.4	0.20	0.5 < p < 0.7
Oudehaske	13	8	61.5	5	38.5	0.69	0.3 < p < 0.5

Table 10. Proportions of point tips at bulbar (= proximal) and distal ends, at four Ahrensburgian sites. Chi-squared one-sample tests. *: significant (two-tailed p smaller than 0.05). The difference in proportions of point tips at bulbar (= proximal) and distal ends between the two groups of points from Vessem-Rouwven (tanged points and microliths), is significant according to the chi-square test. Using the correction of Yates, chi-squared = 7.75; $0.001 < p$ (two-tailed) < 0.01 .*

Sites	N	Right		Left		Chi-squared	p (two-tailed)
		n	%	n	%		
Vessem-Rouwven, tanged points	186	44	23.7	142	76.3	51.63	$p < 0.001$ *
Vessem-Rouwven, microliths	30	15	50.0	15	50.0	≈ 0	$0.95 < p$
Vessem-Rouwven, all points	216	59	27.3	157	72.7	44.46	$p < 0.001$ *
Sølbjerg I	24	5	20.8	19	79.2	8.17	$0.001 < p < 0.01$ *
Gramsbergen I	82	49	59.8	33	40.2	3.12	$0.05 < p < 0.1$
Oudehaske	13	6	46.2	7	53.8	0.08	$0.7 < p < 0.8$

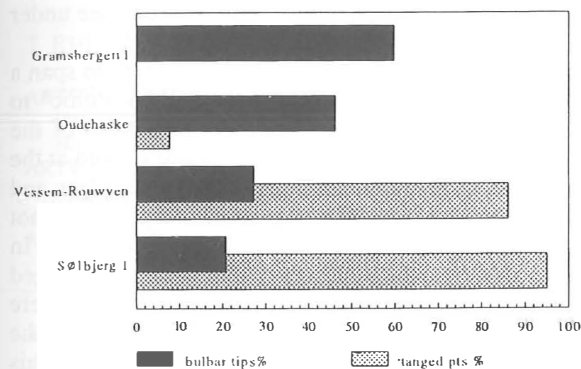


Fig. 157. Four Ahrensburgian sites. Seriesations according to the percentage of tanged points among all the points, and the percentage of bulbar tips of points. Drawing by Dick Stapert.

tage of bulbar tips is about 46. As noted in the introduction, many authors consider sites with a predominance of B-points or Zonhoven points to be relatively late. If we plot the percentage of tanged points of the same four sites (see fig. 157), Sølbjerg I has the highest value (about 95%), and Gramsbergen I the lowest (zero); this suggests once again that Sølbjerg I is the oldest site. Therefore, if Fischer's typological seriation is a reliable chronological one as well, Sølbjerg I should be dated to the end of the Allerød Interstadial, instead of the beginning of the Preboreal (we agree with Lanting & Van der Plicht that occupation during Dryas 3 in Denmark is unlikely).

At Vessem-Rouwven, the numbers of both tanged points and microlithic points are large enough for calculating percentages of bulbar tips for both groups of points (fig. 158). Interestingly, a significant difference exists: bulbar tips occur on only about 24% of the tanged points, but on 50% of the microlithic points (for

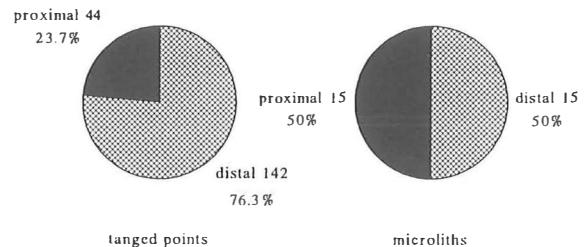


Fig. 158. Vessem-Rouwven. Proportions of bulbar tips on tanged points and microlithic points. Drawing by Dick Stapert.

the data, see table 10). Since tanged points predominate, the percentage of bulbar tips is relatively low when all points are considered together (as in fig. 157). In other words, the proportion of bulbar tips is dependent of the proportion of tanged points: the fewer tanged points, the fewer bulbar tips. The proportion of bulbar tips at Gramsbergen I and Oudehaske, where tanged points are rare or absent, is broadly comparable with that of the microlithic points at Vessem-Rouwven. It seems that in the case of microlithic points, the proportion of bulbar tips falls around 50%; in other words: the location of the tip is a mere matter of chance.

Unfortunately, no radiocarbon dates for the site of Sølbjerg I are available. We do not consider the evidence presented in this paragraph as decisive, but the possibility that the site dates to the transition period from Allerød to Dryas 3, rather than the Preboreal, cannot at present be ruled out.

5.4. Seasonal models and the Epi-Ahrensburgian

Several researchers have developed seasonal models of occupation for the Ahrensburgian. In the Netherlands, the model presented by Arts & Deeben (1981) has been

quite influential. It entailed summer occupation in the plains of the southern Netherlands, and winter occupation in the Ardennes hills.

An overview of previous models and of the present state of the evidence is given by Baales (1996). In his important book, seasonal indications in the faunal assemblages from Kartstein, Hohle Stein (Kallenhardt) and Remouchamps are presented in great detail. In Baales' model, as in several other models, seasonal patterns in the Ahrensburgians' use of the landscape are seen as largely determined by seasonal movements of the reindeer. In his opinion, the main summer grazing areas of the reindeer were in the *Mittelgebirge* area (including the Ardennes) and the uplands of central England, while during the autumn the reindeer migrated to their wintering areas in the northern plains (including the southern part of the North Sea). Sites such as Remouchamps and Kartstein were occupied during the spring, when the reindeer migrated to the south, whereas sites such as Stellmoor were occupied in autumn, during the reindeer's trek to the north. This model then led Baales to suppose that Oudehaske, in the northern Netherlands, was located in the area where the Ahrensburgians "... *die harten Winter verbrachten*". It is of interest to note that Baales' model is more or less the opposite of that of Arts & Deeben, who lacked the seasonal data relating to Remouchamps which became available only later.

Baales' work is impressive and we find his model very attractive. In Denmark too, patterns in the Late Palaeolithic settlement distribution across the landscape have been associated with reindeer migration routes (Vang Petersen & Johansen, 1991; 1994; 1996; Johansen, in press c), and Sølberg is believed to have been located on one of these routes. Unfortunately, in the Netherlands and Denmark seasonal indicators at Ahrensburgian sites are absent. Artefacts made of bone or antler, probably at least partly dating from Ahrensburgian times, have only been found in secondary contexts (see for finds in the Netherlands, e.g. Arts, 1987; 1988; Van Noort & Wouters, 1987; Wouters, 1982; Verhart, 1988), and can neither support nor refute the model, as Baales himself remarks.

A more general problem is posed by the existence of an 'Epi-Ahrensburgian' phase dated to the first half of the Preboreal, as proposed by Gob (e.g. 1988; 1991). We have ascribed Gramsbergen I and Oudehaske to the Epi-Ahrensburgian. This phase may be characterized by the circumstance that tanged points are rare or absent while blade technology still has a 'Late Palaeolithic' character, and many tools such as burins and scrapers are made of relatively large blades (see under 1). Sites such as Gahlen (Richter, 1981), Höfer (Veil, 1987), Duisburg (Tromnau, 1980) and Bedburg (Street, 1989; 1991; 1993) may also be assigned to this phase. At several of these sites, for example at Höfer and Bedburg, no tanged points are present, just as at Gramsbergen. In the title of Veil's paper, this type of assemblage

is characterized as follows: "*Ein Fundplatz der Stielspitzen-Gruppe ohne Stielspitze ...*". Baales' model views the Ahrensburgian (as defined by the presence of tanged points) as essentially a Dryas 3 phenomenon. However, we might be dealing with two very different climatic periods, Dryas 3 and the Preboreal, and there is no compelling reason to assume that seasonal patterns in settlement systems remained unchanged in the two periods over the large area covered by the model. As noted above, new datings of Stellmoor fall around the transition of Dryas 3 to the Preboreal. Two of the three radiocarbon dates of Kartstein fall in the Preboreal too, but are provisionally explained away by the assumption of insufficient treatment to eliminate more recent contamination (Baales, 1996: p. 42); new dates are being made (Baales, pers. comm. 1998). Of course, the presence or absence of tanged points may also be due to functional factors, instead of chronological positions, as both Veil and Baales point out. The situation is furthermore complicated by the brief, colder Rammelsbeek phase in the first half of the Preboreal (see under 1).

Epi-Ahrensburgian and related sites seem to span a gradual transition phase from 'Late Palaeolithic' to 'Mesolithic', during the first 500 years or so of the Holocene. At Bedburg we seem to have arrived at the end of this phase; there no longer were any reindeer, and apart from the presence of relatively large blades not much in terms of 'palaeolithic' traits has endured. In general, we get the (untestable) impression that tanged points were associated with reindeer hunting, and were therefore carried northwards by hunters following the reindeer in the early centuries of the Holocene. In this respect it is of interest that tanged points still occur in 'mesolithic' contexts in Norway (see e.g. Bang-Anderesen, 1990; Bjerck, 1990).

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