A SITE OF THE HAMBURG TRADITION WITH A CONSTRUCTED HEARTH NEAR OLDEHOLTWOLDE (PROVINCE OF FRIESLAND, THE NETHERLANDS); FIRST REPORT

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CONTENTS

1 INTRODUCTION

Near Oldeholtwolde in the valley of the river Tjonger a site of the Hamburg tradition was excavated in 1980 and 1981 by the B.A.I. The excavation provided important data, notably concerning the dating. From a stratigraphical point of view the site can be dated to just before the beginning of the Allerød interstadial (see under 4.1.). Moreover a large constructed hearth was found, in which (relatively little) charcoal was present. This provided the opportunity of establishing a C14-dating, the first in the Netherlands for a site of the Hamburg tradition (see under 5. and 6.).

This first report will concentrate mainly on the situation in the landscape, the stratigraphy, the hearth, and the C14-datings. With regard to the flint material that was found, in this report only a few points are illustrated as they appear to support the proposed dating.

Many persons and institutions have been of assistance at various stages, both with the work at the site, and later with the analysis of the data in the institute. It is impracticable to name them all here, but several of them must not remain unmentioned. In the first place J. Boschker (Frisian Museum), who not only discovered the site and prevented its destruction, but also did a lot of work during the excavations; also the Government Service for Land and Water Use, that gave all necessary cooperation for the project (especially in the person of E.J. Winter), and that provided it, moreover, with a substantial subsidy. I hereby wish to offer my grateful thanks to all those people (several dozen) who are not mentioned here by name who helped in one way or another to make the excavation a success.

For their help in the preparation of this article I am furthermore indebted to the following persons: G. Delger, H.R. Roelink, J.M. Smit and W.J. Dijkema (B.A.I.) for the drawings; F.W.E. Colly (B.A.I.) and D. Visser (Frisian Museum) for the photos; G.J. Boekschoten (Geological Institute, Groningen), B. van Geel (Hugo de Vries Laboratory, Amsterdam), J.N. Lanting (B.A.I.), J.L. Smit (B.A.I.) and M.W. ter Wee (R.G.D.: Geological Survey of the Netherlands, northern district) for critically reading the text; Hillie Klaassens (B.A.I.) for typing the manuscript; Sheila M. van Gelder-Ottway for the translation into English.

Fig. 1. Map of the Netherlands showing the location of the site at Oldeholtwolde. (Drawing J.M. Smit, B.A.I.).

2. THE INVESTIGATION

Within the framework of the Midden-Tjonger land reallocation project work was commenced on a parcel of land at Oldeholtwolde (municipality of Weststellingwerf), where shortly before an old farmhouse had been demolished, to make it suitable for agricultural use. Foundations and tree trunks were dug out and the terrain was levelled to a certain degree. In the course of this work, that was done by machine, in the first week of April 1980 flint artefacts appeared, that were noticed by J. Boschker, the field assistant of the Frisian Museum in Leeuwarden. He recognized the material as belonging to the Hamburg tradition, temporarily put a stop to the work in concert with the Government Service for Land and Water Use and warned the B.A.I. During a reconnaissance it appeared that the finds (insofar as they had not already been removed by the machine) were present in an undisturbed position under t

carry out an excavation. This commenced on April 21st 1980, and continued in the first

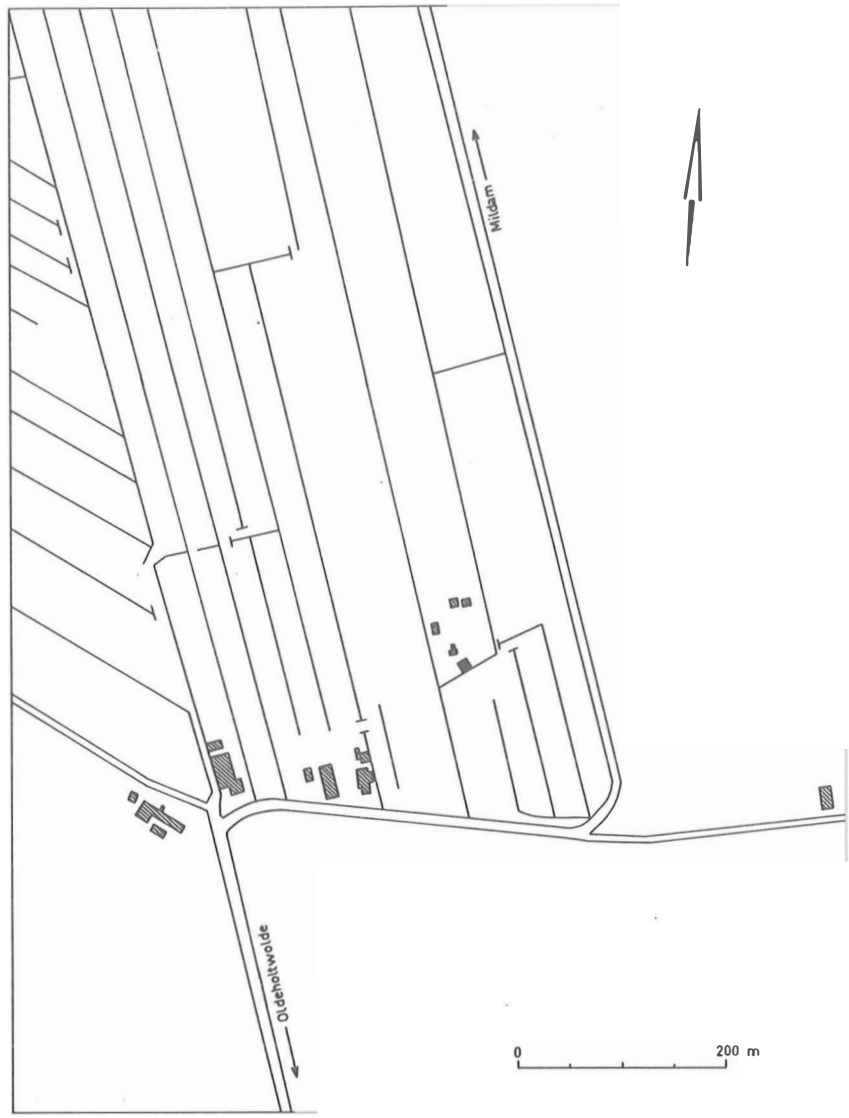


Fig. 2. Sketch-map of the cadastral situation around the site at Oldeholtwolde as it was before the land reallocation project was effected. Black rectangle: excavation site. Based on the Topographical Map of the Netherlands, sheet 16B. (Drawing G. Delger,

instance until May 14th, 1980.

During this initial campaign mainly that part of the terrain that had been disturbed by the machine was dug out, while a long profile was created in which the stratigraphy could be studied. The hearth described below was found, but only a small part of it was excavated. The excavation was stopped because of the problems caused by wind-blown sand, notably the deterioration in the quality of the observations. It was decided to continue excavating in the autumn under a tent. Meanwhile the terrain was covered over with chicken-wire and sand. The second excavation campaign (under a tent) lasted from September 1st until December 16th, 1980. During this campaign the central part of the site, with the hearth, was excavated for the most part. The third and last campaign took place from April 21st until May 21st, 1981. During this period the remaining part of the site was excavated. In addition, to the east of the site a search was made for other concentrations, by means of a series of trial pits (see fig. 13), but without any success. To the north of the site the terrain was deeply disturbed in connection with the demolition of the farmhouse, and from the meadow to the west of the site a layer of sand had already been dug away previously, so the chances of

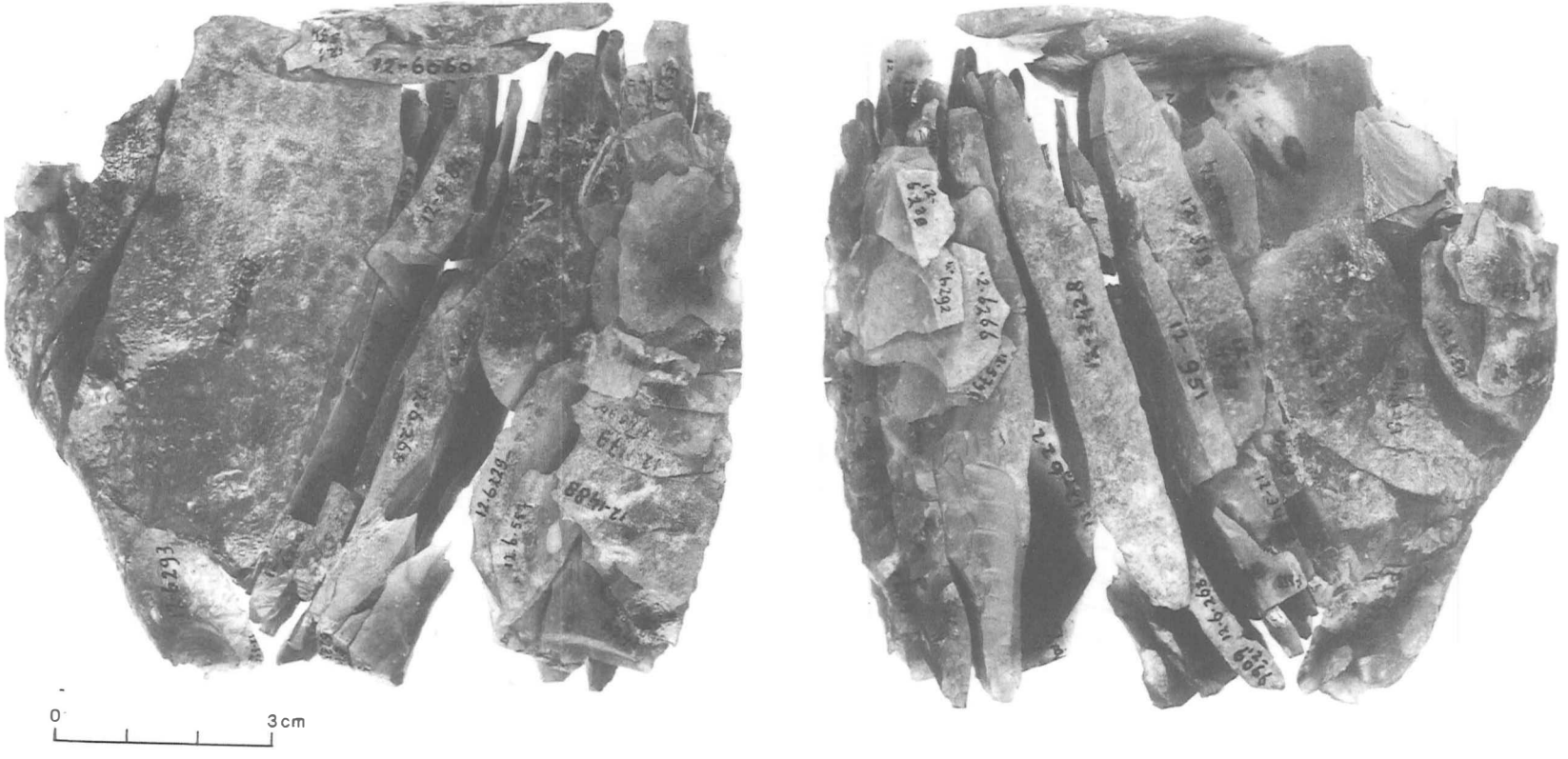


Fig. 3. A reconstructed core from Oldeholtwolde. This piece has 108 components. The core has been fashioned out of a slab-like piece of flint; core preparation is clearly demonstrated in the composition. (Refitting by J.S. Krist; photo F.W.E. Colly, B.A.I.).

preservation there of Upper Paleolithic finds are fairly small.

A total area of 133 m² (apart from the trial pits in the meadow to the east of the site and several profile trenches outside the concentration) was systematically excavated over a period of about 23 weeks (see fig. 28). The disturbance in the eastern corner of the excavated terrain was caused by an earth-moving machine; this disturbance caused the destruction of part of the central area of the concentration. From the loose soil of this spot a number of flints were obtained by means of sieving, but probably not everything was found that had been shifted by the machine. Along the southern rim of the excavation terrain there runs an old filled-in ditch that is also indicated on the cadastral map (fig. 2). In addition, in the western half of the terrain a major disturbance is indicated. This is where a tree was present, but fortunately only a small part of the peripheral zone of the concentration has been disturbed on account of this. The other disturbances indicated in fig. 28 are mostly shallow and are located outside the central part of the concentration.

Excavation was done in the usual way per square metre, each square metre being named according to the coordinates of its north point. The X-line of the measuring system runs from the 0/0 point to the SW, the Y-line to the SE. As a general rule the work was done using trowels. All finds made (including flint splinters, and fragments of charcoal larger than c. 3 mm) were individually numbered and stored in small plastic bags. A total number of c. 6700 finds were recorded. In the field the following data were noted on punch-card forms for each recorded find: X-coordinate, Y-coordinate, height (all in cm), whether or not disturbed (roots, mole tunnels), layer or soil horizon, horizontal, vertical or sloping position (in the latter case it was noted in which compass direction the object was sloping, divided into 4 sectors), date.

All excavated soil was sieved per square metre (mesh width 4 mm), topsoil and soil of undisturbed origin being treated separately. A number of profiles were drawn and photographed (see fig. 10). As a general rule the prepared sufaces were drawn and photographed at several levels. Within the central part of the site, with the hearth, drawings and photos were made at c. 10 levels on average, while in addition stereo-photos were taken of the stone constructions. All stones larger than c. 2 cm were indicated in the drawings. After the excavation all the finds (except for the splinters, charcoal particles, and such like) were numbered with ink, and the following data were recorded: sort of material, whether or not burnt, whether or not broken (in the case of the flints it was noted whether distal, medial or proximal fragments were concerned), technological and typological classification of the flint tools, length, breadth and thickness (for the flints length and breadth were measured as the sides of a circumscribing rectangle that are respectively parallel to and at right angels to the striking direction; for the stones the max. length of the specimen is used as longitudinal axis of the circumscribing rectangle), whether or not the 'working edges' are damaged, the presence of cortex and/or old frost-split surfaces on the dorsal faces of the flints (categories of 25%).

All data collected were subsequently read into a computer file by means of the terminal present at the B.A.I. The analysis of these data, notably the investigation of spatial patterns within the excavated material, is being carried out by J.L. Smit as part of his advanced studies in prehistory.

Two other students of prehistory in Groningen, J.S. Krist and A.L. Zandbergen, are occupied, respectively, with fitting together the flint artefacts (for an example of a reconstructed core see fig. 3), and with fitting together the broken stones (for an example see fig. 4). The geology of the region around the site is being studied by M.W. ter Wee, who in this connection has made a series of borings transversely through the Tjonger valley in the vicinity of the site. The C14-determinations were made in the C14-laboratory in Groningen under the supervision of W.G. Mook. The charcoal fragments that were collected will be identified, as far as possible, by W.A. Casparie (B.A.I.). A pollen analysis of a Late Glacial peat layer found close to the site (see under 4.1.) was carried out by S. Bottema (B.A.I.). Ingelise L.M. Stuijts (B.A.I.) identified a number of wood fragments that were collected from the same peat layer (see under 4.1.). The petrological identification of the stones found will be made by G.J. Boekschoten. It is also intended that the traces of use on

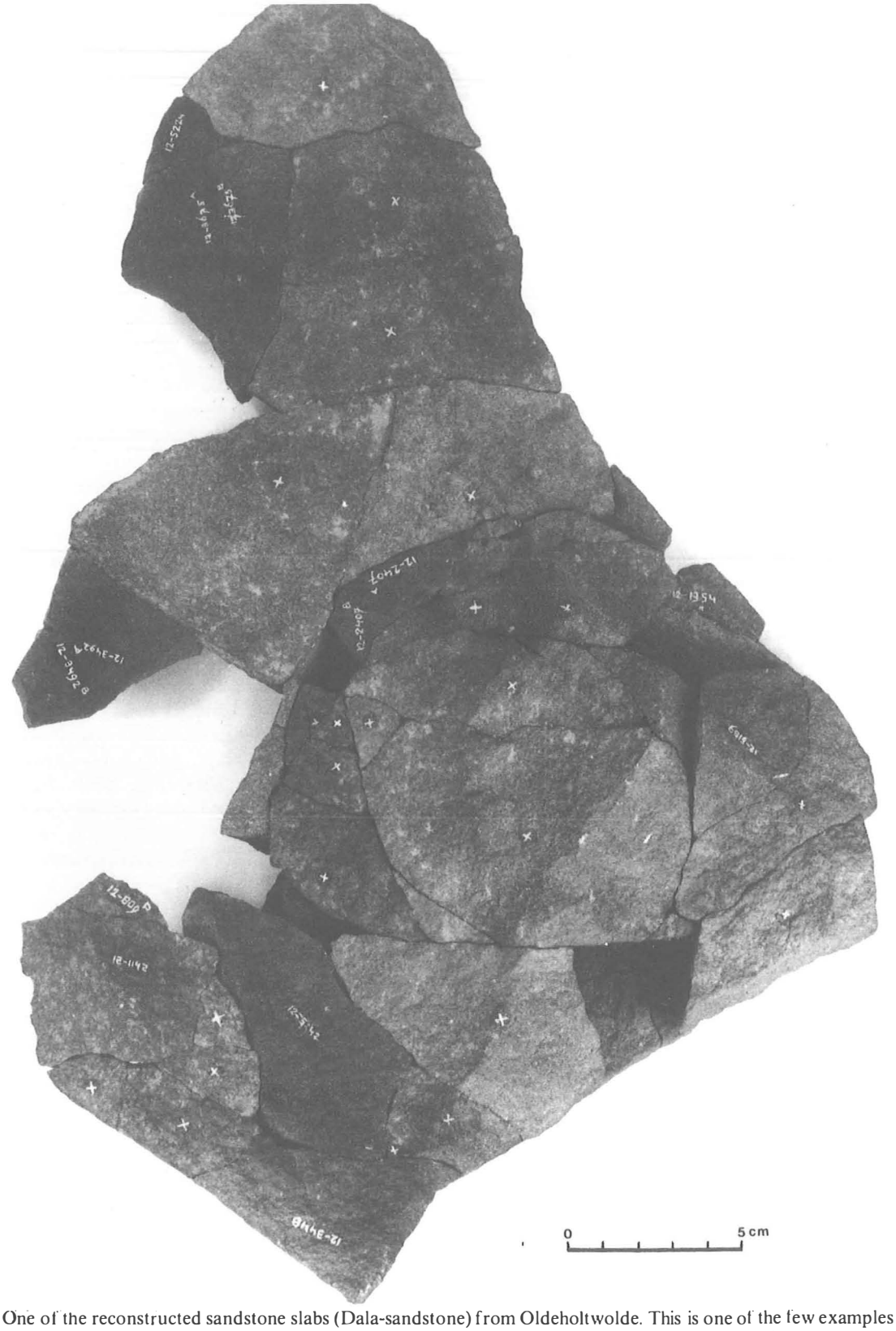


Fig. 4. One of the reconstructed sandstone slabs (Dala-sandstone) from Oldeholtwolde. This is one of the few examples of 2 slabs (splitted along a natural bedding plane) fitting on top of each other. The composition has 41 components, and weights c. 2564 grams. (Refitting by A.L. Zandbergen; photo F.W.E. Colly, B.A.I.). Scale in cm.

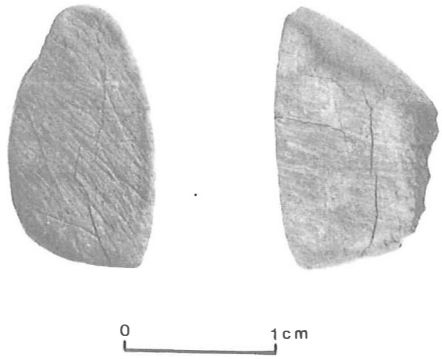


Fig. 5. A piece (two views) of red ochre from Oldeholtwolde. There are several rubbed surfaces present with subparallel scratches. (Photo F.W.E. Colly, B.A.I.).

the flint artefacts will be the object of study, by E.H. Moss (London).

Apart from hundreds of small pieces of charcoal and a few pieces of ochre (fig. 5), the finds consist of 10,413 flint artefacts and 1,126 stones.

The total weight of all the stones is 46,320 gr, and that of all the flints c. 4,052 gr, together somewhat more than 50 kilos. Since we are missing a part of the material originally present, that can be estimated as max. 1/6, there must have been brought to the site a total weight of c. 60 kilos of stones and flints.

According to the first count (before the refitting work), there are of the total of 10,413

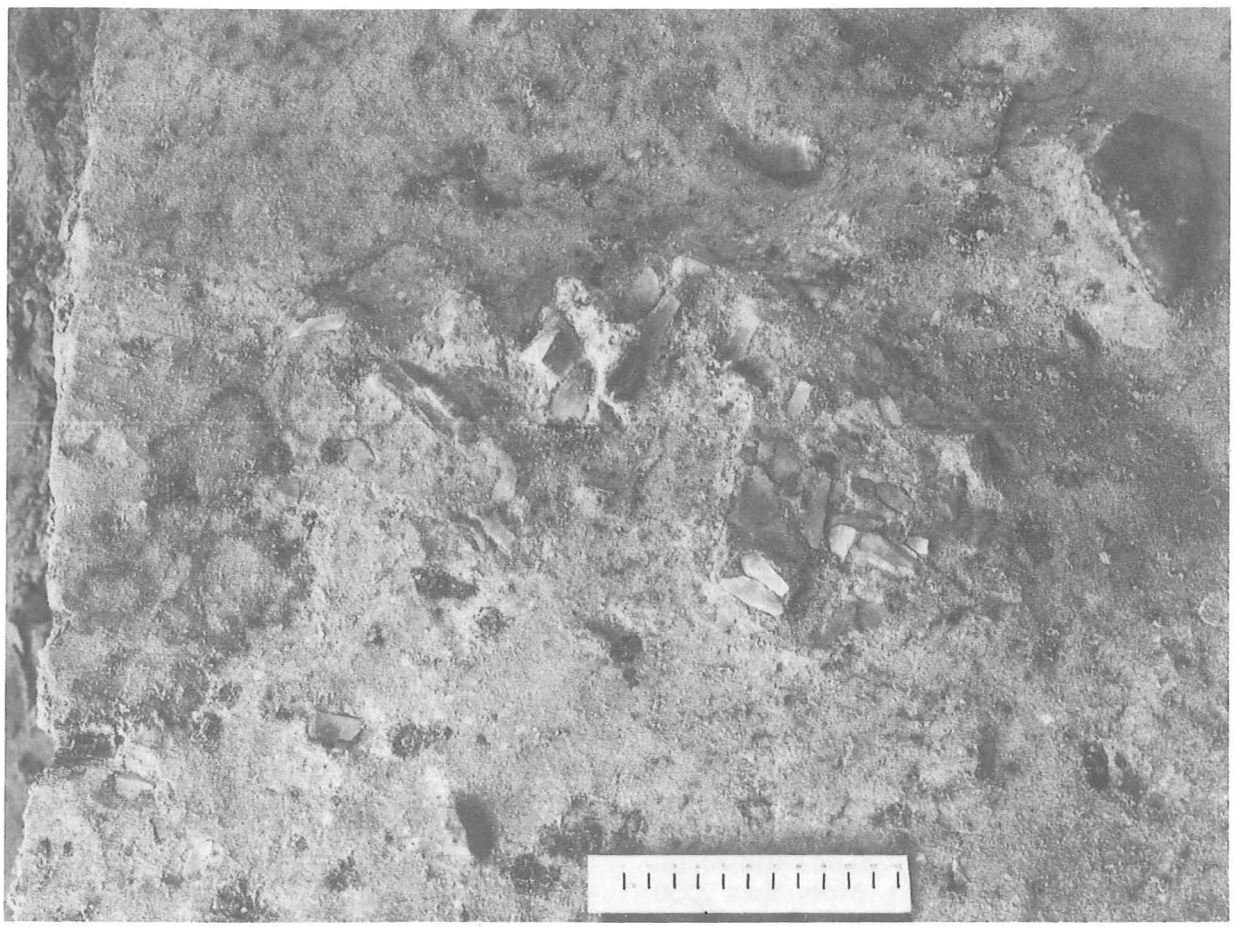


Fig. 6 One of the dense accumulations of small flint artefacts. This concentration (with a diameter of c. 22 cm) was present about 1 m southwest of the hearth–there were several more in a wide circle around the hearth. In the middle of this concentration there is an empty space; here there probably once lay an object of organic material, that eventually decayed altogether. (Photo F.W.E. Colly, B.A.I.). Scale in cm.

Fig. 7. Sand-depth map of the region around the site at Oldeholtwolde, composed within the framework of the land reallocation project Midden-Tjonger. Based on data of Makken & Rutten (1971). (Drawing W.J. Dijkema, B.A.I.). Legend: 1. sand at the surface; 2. depth of mineral subsoil (usually sand, sometimes boulder clay) at 15–40 cm below the surface (at the top there is peat); 3. depth of the mineral subsoil at 40–80 cm below the surface; 4. depth of the mineral subsoil at 80–120 cm below the surface; 5. depth of the mineral subsoil at 120–200 cm below the surface; 6. depth of the mineral subsoil at more than 200 cm below the surface; 7. not mapped; 8. the site.

flint artefacts only 1,668 larger than 1.5 cm, of which 339 were classified as 'tools'. Among the remaining c. 8745 'splinters' of flint (smaller than 1.5 cm), there are 136 fragments of tools (broken-off borer-tips or burin-edges, fragments of points, etc.). More than 3550 pieces present are smaller than 0.5 cm. These 'micro-splinters' presumably have originated largely as a product of tool-retouching. Many splinters and other waste products of flintworking were found lying close together, in several small 'concentrations', mostly 20 a 30 cm in diameter (fig. 6), that are interpreted as dumps of seated flintworkers.

Since the refitting will result in many broken tools being fitted, it is not yet possible to give a type-list with frequencies. This will be presented in a future article by Krist, Smit, Zandbergen and myself.

It is interesting to note as a preliminary result of the refitting work, that a number of tools do not fit together with any other piece.

Fig. 8 Contour map, constructed on the basis of the *Hoogtepuntenkaart van Nederland* (Relief Map) 1 : 10,000, sheet 16B north. Areas lower than 1 m –N.A.P. (Dutch Datum Level) are stippled. An asterisk indicates the site. (Drawing D. Stapert/J.M. Smit, B.A.I.).

This applies for instance to *all* of the points, which therefore must have been carried to the site from elsewhere (see for other examples of the same phenomenon: Leroi-Gourhan & Brézillon, 1972).

3. THE GEOGRAPHICAL SITUATION

The site lies on the western fringe of the Fries/Drents plateau, in the valley of the Tjonger that is about 3 km wide here. The site lies along the Ottersweg between Mildam and Oldeholtwolde (figs. 1, 2); the coordinates on the Topographical Map of the Netherlands (sheet 16B) are: 547.70/196.84. The valley of the Tjonger was originally covered over with peat here. Thus the area around the site is called 'Veenpolder onder Ter Idzard en Oldeholtwolde' (Peat polder below Ter Idzard and Oldeholtwolde), and from maps of the first half of the nineteenth century (*e.g.* Eekhof, 1840) it appears that at this spot peat-digging was carried out in the past.

From a sand-depth map (fig. 7) made within the framework of the land reallocation project by the Soil Survey Institute of Wageningen (Makken & Rutten, 1971) it is evident that within the valley of the Tjonger two main stream channels are present here. The southern one must be regarded as the original (Late Glacial) course of the Tjonger, while the northern one is a side-channel of the former, that meets up with the main channel about 3 km to the west of the site. Immediately to the east of the site a smaller

Fig. 9. The occurrence of boulder-clay in the region around the site at Oldeholtwolde. Based on data of Makken & Rutten (1971). (Drawing W.J. Dijkema, B.A.I.). Legend: 1. boulder-clay practically at the surface; 2. depth of boulder-clay at 40–80 cm below the surface; 3. depth of boulder-clay at 80–120 cm below the surface (in a few cases boring sites are concerned where boulder-clay was found at depths between 120–150 cm below the surface); 4. the site.

side-channel is also present, so it can be said that the site is located on a 'peninsula'. This pattern is also clearly visible on a contour map of the region (fig. 8), made after the *Hoogtepuntenkaart* (Relief Map) of the Netherlands (1 : 10,000, sheet 16B-N).

From the borings made by the R.G.D. it can also be deduced that the southern channel is the principal one, being about 18 m deep, while the northern one is only c. 5 m deep. Within these stream channels the boulder clay (Drente Formation, second half of the Saalian) has been almost completely eroded away; they are filled up with (from bottom to top) brook deposits of the Twente Formation (containing coarse material towards the bottom), Late Glacial cover-sands (also of the Twente Formation) and peat (dating from the Late Glacial and the Holocene) (Ter Wee, pers. comm.). Furthermore it is evident from the borings that the channel pattern as shown in figs. 7 and 8 dates mainly from the Late Glacial. The southern main channel, for instance, was almost twice as wide earlier in the Weichselian, but during the Late Glacial, mainly during the Early Dryas, it became partly filled up with cover-sand, with the result that the Holocene stream channel is conspicuously narrower. The site lies at the foot of a slope of a relatively low cover-sand ridge, along the rim of the Late Glacial/Holocene stream channel, but well within the originally wider channel in which the boulder clay has been eroded away. Here the cover-sand lies on top of Pleistocene brook deposits.

On a map (based on data of Makken & Rutten, 1971) the boring-points are indicated where boulder clay was found within 1.2–1.5 m below the surface (fig. 9). Outside these areas the boulder clay will have been largely or completely eroded away. As there is no boulder clay present at the location of the site, the Upper Paleolithic hunters must have brought the flint and stones that are present at the site from elsewhere, probably over a distance of 0.5 km, but certainly over a distance of several hundred metres.

In view of this situation the spot appears to be a somewhat disadvantageous one, so it is important to indicate the specific features of the location in the landscape that may have induced the people of the Hamburg tradition to choose this spot.

From the sand-depth map (fig. 7) it is evident that the valley floor of the Tjonger, outside the main stream channels, consists of smaller channels, low cover-sand ridges and pingo' remnants. As a general rule the transition from a cover-sand ridge to one of the main stream channels is gradual. Only in a few places is the slope relatively steep and the

transition more abrupt, so that what we see on the map is a border between units 1 and 5, without any intermediate units. The site is located in precisely such a situation, along the edge of a Late Glacial/Holocene stream channel, at the foot of the slope of a cover-sand ridge. In my opinion this is the essentially important fact with regard to the environmental situation. A possible reason for this location could be that the people of the Hamburg tradition were occupied here with fishing, among other things. Seeing that organic material has not been preserved at the site, this could perhaps only be ascertained archeologically by making an analysis of the traces of use on flint artefacts.

Other explanations are also possible, however, such as the availability of (drinking) water and/or brushwood (for fuel), or the hunting of reindeer at a crossing place, or a combination of these. Whatever the explanation may be, it is in any case interesting to note that this site is located along the bank of a stream channel, at a point where there is a relatively abrupt transition to a cover-sand ridge. A comparable situation is also known for other sites of the Hamburg tradition, for example Sassenhein in the province of Groningen (B.A.I. excavation, 1982).

4. THE STRATIGRAPHY

4.1. Oldeholtwolde

In many places at the site the so-called 'Layer of Usselo' was found in the cover-sand, just (max. a few decimetres) below the topsoil. Usually only the A2-horizon was clearly visible, over a thickness of c. 10 cm. This fossil podsol soil with particles of charcoal dates from the Allerød interstadial (Van der Hammen, 1951). C14-datings of the charcoal in this soil usually give figures of around 11,000-10,800 B.P. (Lanting & Mook, 1977). Above this soil, where present, there was a thin layer of relatively coarse and not distinctly layered cover-sand. Below the 'Layer of Usselo' finer cover-sand was found to be present, that was distinctly layered (with parallel layers), and in addition characterized by the presence of thin loamy bands, that could sometimes be traced over a distance of more than 5 m. These loamy bands increased in number and thickness with increasing depth.

According to Ter Wee (pers. comm.) the upper cover-sand is Younger Cover-sand II, deposited during the Late Dryas (the last 1000 years of the Weichselian). At the site this layer is generally only a few decimetres thick, and is sometimes absent altogether. According to Ter Wee the cover-sand under the 'Layer of Usselo' is Younger Cover-sand I, deposited during the Early Dryas–the short stadial between the Bølling and Allerød interstadials (see also Van der Hammen, 1951; Van der Hammen *et al.*, 1967; Ter Wee, 1966; 1979).

The excavated finds have a vertical distribution of several decimetres, up to about 0.5 m, as a result of the activities of various burrowing animals (moles etc.) and roots (bioturbation). However, it was usually quite well possible to establish the position of the original find layer, for example from the presence of large flat stones (see under 5.) that could not have been moved very far out of position. The find level was present on average c. 20 cm below the 'Layer of Usselo'. This means that the people of the Hamburg tradition lived here while the Younger Cover-sand I was still being deposited–for on average c. 30 cm of this sand is present above the find level. In view of the total thickness of the Younger Cover-sand I (c. 2 m) we can say that the archeological material can be dated stratigraphically to shortly before the end of the Early Dryas. According to most authors (*e.g.* Mangerud *et al.*, 1974; Lanting & Mook, 1977) this stadial lasted for only about 200 years (12,000–11,800 B.P.). Assuming that the rate of sedimentation remained approximately constant during this period, it is conceivable that the Hamburg people bivouacked here c. 30 years before the end of this period, *i.e.* almost at the beginning of the Allerød interstadial. This would be assuming that the period of cover-sand deposition corresponds to the duration of the Early Dryas stadial, which is not certain.

Figure 12 shows a profile of the site, that has been obtained by combining the excavation profiles 1 and 6, and profile B in a trench immediately to the south of the excavation area (see the map, fig. 10). In the deepest part of profile B the following stratigraphy is visible (from bottom to top): yellow sand, brown peat, yellow sand, black

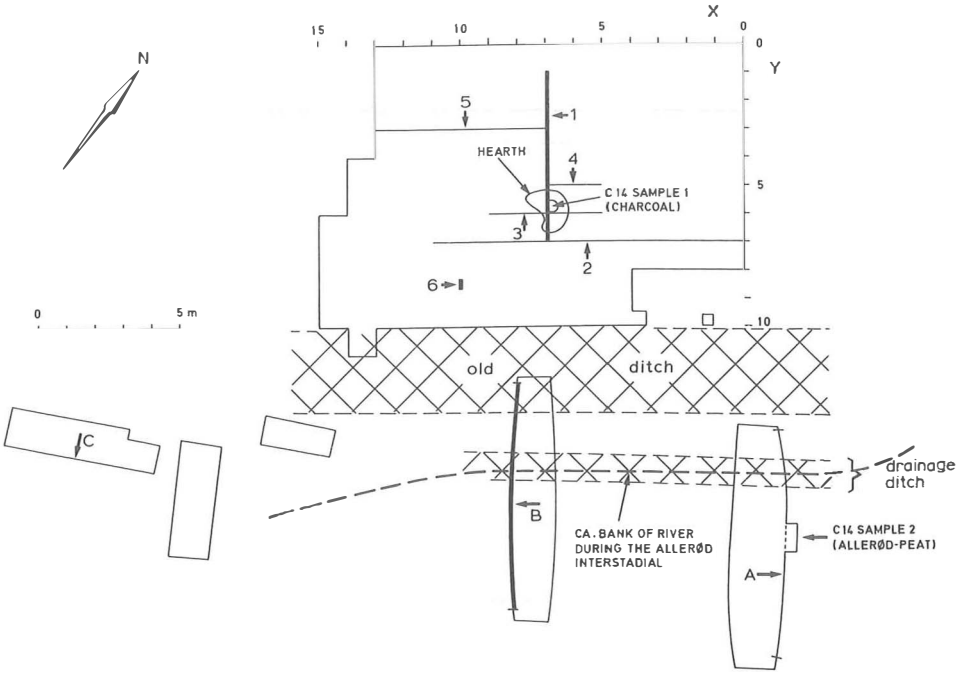


Fig. 10. Sketch-map of the excavation area, showing the profiles that were drawn. (Drawing D. Stapert/J.M. Smit, B.A.I.).

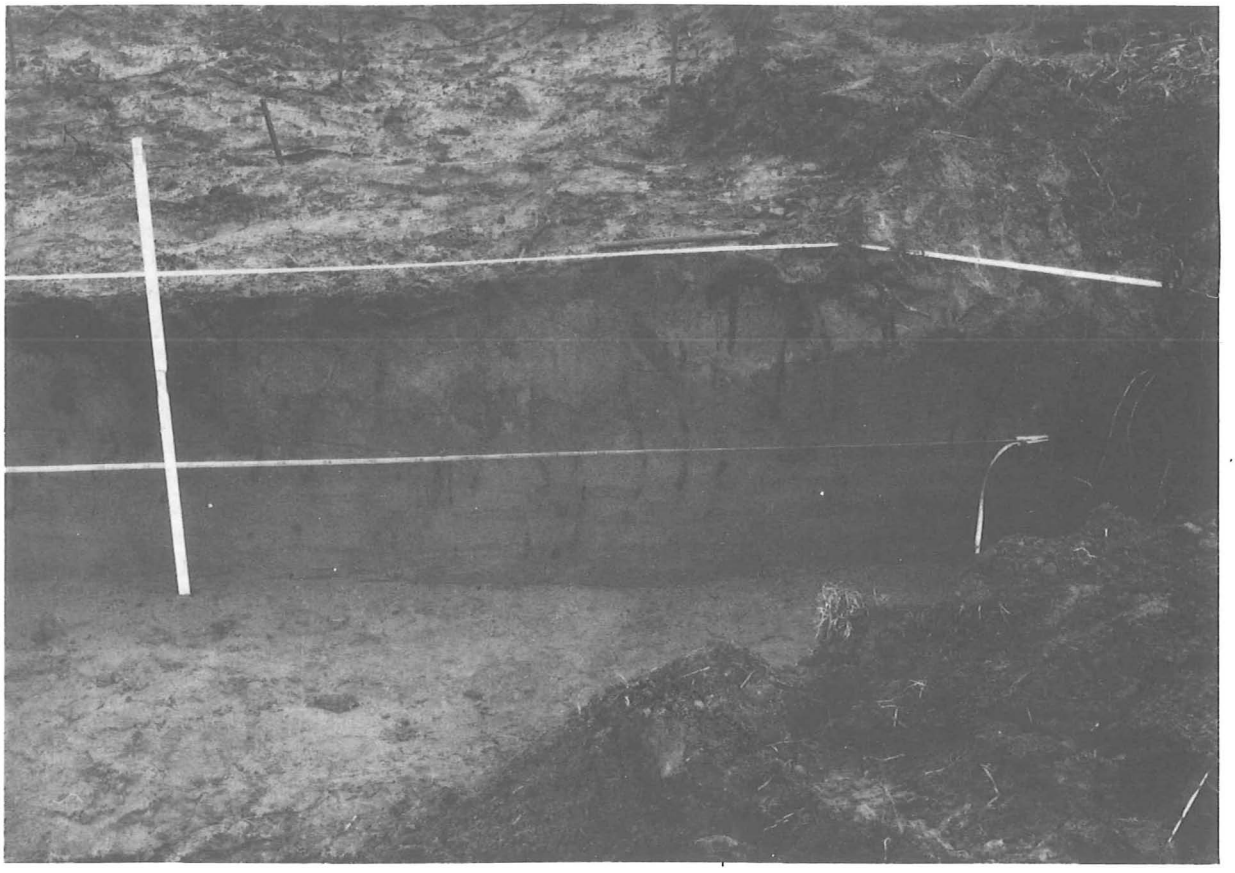


Fig. 11. Photo of the most eastern part of profile 2 (see fig. 10). This profile borders on to that part of the site that was disturbed by a machine in April 1980. Below the thin topsoil the 'Layer of Usselo' is visible as a pale band. Underneath it cover-sand with thin loamy bands is present (Younger Cover-sand I). In this sand, at an average depth of c. 20 cm below the 'Layer of Usselo', the Hamburg artefacts were found. The measuring staff is 1 m long. (Photo D. Stapert, B.A.I.).

peat, topsoil. The brown peat layer between the two sand layers must date from the Late Glacial, and was found not only in profile B but also in profile A, in two ditch profiles to the west and east of the site, and in several trial pits in the meadow to the east of the eastern ditch. In figure 13 all these observations are indicated, and the distribution of the brown peat layer is outlined.

In the two ditch profiles the 'Layer of Usselo' passes more or less distinctly into this brown peat layer. In the profile, however, this transition cannot be seen.

In profile B under the brown peat layer a line has been drawn, that was visible in the profile as a discordant level in the sand; here we are probably concerned (above this line) with sand of fluviatile origin that strongly resembles however the cover-sand under the 'Layer of Usselo' higher up the slope. This indicates that here the bank zone was present already before the deposition of the brown peat.

At this spot also several particles of charcoal were found below the brown peat layer, in profile B. It seems probable that these originated from the hearth at the site (visible in profile 1 in fig. 12), possibly having been transported here by the wind. The profile trenches A and B were otherwise archeologically sterile.

From both profile A and profile B pieces of wood were collected from the brown peat layer in May 1981. These were studied by Ingelise L.M. Stuijts. Out of the total of 24 fragments 17 were found to consist of *Salix* and 7 of *Betula*. Stuijts says in her conclusion: 'The species of wood found and the relatively thick trunk fragments do not exclude a dating in the Allerød. The local vegetation was probably wooded peat-bog. This more or less excludes a dating older than Allerød'.

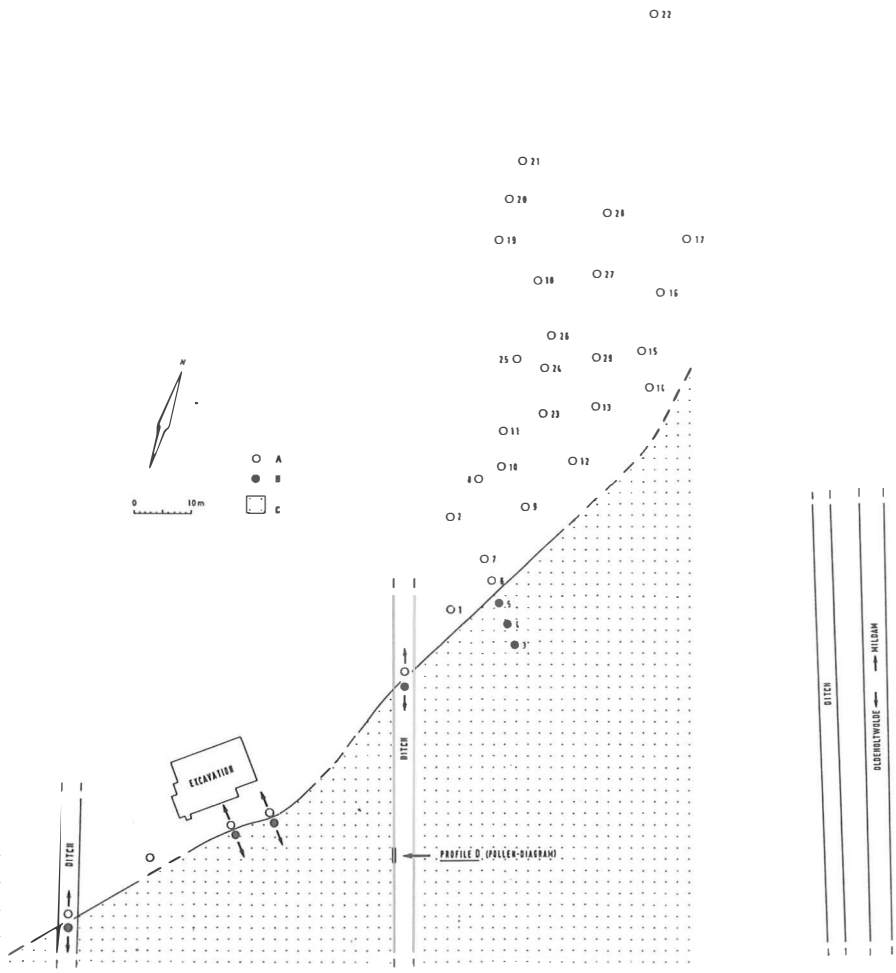


Fig. 13. Sketch-map, showing the distribution area of the brown Allerød peat, and the location of profile D where samples were taken for the pollen analysis (see fig. 16). (Drawing D. Stapert/J.M. Smit, B.A.I.). Legend: A. exposures (profile trenches, ditch profiles and trial pits) without Allerød peat; B. exposures with Allerød peat; C. estimated distribution area of the Allerød peat based on all observations in the field.

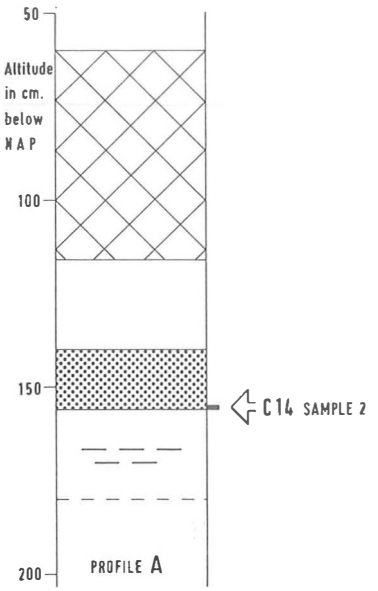


Fig. 14. Drawing of that part of profile A (see fig. 10) where a C 14-sample was taken from the lowermost 1 cm of the brown Allerød peat. Legend as for fig. 16. (Drawing D. Stapert/J.M. Smit, B.A.I.).

In profile A (broadly speaking comparable with profile B) a C14-sample was taken from the lowermost 1 cm of the brown peat layer. For the stratigraphy at this spot see fig. 14. The C14-determination gave the following result: 11,340±100 B.P. (GrN-11.264). This dating confirms the general picture obtained on the basis of the stratigraphical observations, and also the conclusion of Stuijts. The deposition of the peat layer began here during the second half of the Allerød interstadial, at least in places relatively close to the river-bank of that time.

In the ditch east of the site (see fig. 13) frost fissures were observed, coming out of the uppermost sand layer, that penetrate down through the brown peat layer (fig. 15). In profile D (fig. 16) one of these frost fissures is illustrated; at this spot samples for pollen analysis were taken (now being studied by S. Bottema). The brown peat layer is slightly thicker here than in the profiles A and B that are situated closer to the former river-bank, and the topmost sand layer is thinner. Here in the brown peat coarse remains of plants are present (*Carex*: S. Bottema, pers. comm.), while no wood remains were observed here. Apart from the frost fissures the brown peat layer also appears to be locally deformed to some extent by cryoturbation, that undoubtedly also occurred during the Late Dryas. In the middle of the brown peat layer a vague discolouring was observed in profile D that is perhaps a dessication level (indicated in fig. 16).

As is evident from the drawing, the lowermost part of the black Holocene peat has to some extent been subjected to folding in the filling of the frost fissure. This indicates that the frost fissure was still active during the time when this material was being deposited (Preboreal: S. Bottema, pers. comm.). Higher up the slope, at the site, some (thin) frost cracks were present (as visible in *e.g.* fig. 21), but no frost fissures. This probably is connected with a difference in moisture.

The frost fissures and frost cracks from the Late Dryas at Oldeholtwolde are by no means unique. Van der Tak-Schneider (1968) gave a survey of such phenomena from the Late Dryas in the Netherlands. She described several frost fissures with a max. width of c. 20 cm, and several frost cracks with a max. width of 3 mm. Dylik and Maarleveld (1967) gave the following classification: frost cracks–max. width up to 10 cm, uniform width, small polygons (down to smaller than 1 m); frost fissures–max. width more than 10 cm, rapid decrease in width with increasing depth, larger polygons (7 m or more).

At Oldeholtwolde both types occur: frost fissures (max. width c. 20 cm) in the ditch profiles, in those places where the Allerød peat layer is thicker than c. 40 cm, and frost cracks higher up the slope (at the site for example), in the cover-sand.

These relatively small frost fissures and frost cracks are not necessarily indicative of the presence of a continuous permafrost during the Late Dryas (Maarleveld, 1976), as is the case with the (bigger) frost wedges (Dylik & Maarleveld, 1967). Van der Tak-Schneider (1968) is also not certain whether the frost fissures from the Late Dryas could be indicative of the presence of a discontinuous permafrost at that time. Zoller (1982) describes, however, a frost wedge (max. width 40–50 cm) near Giesselhorst (Ammerland, Western Germany), dating from the Late Dryas. In the filling of the frost wedge some Upper Paleolithic artefacts were found, that were also present outside the frost wedge immediately on top of the 'Layer of

Fig. 15. Frost fissure, visible in the ditch profile to the east of the site (profile D, see fig. 13). Samples for pollen analysis were taken approximately where the measuring-staff is placed (see fig. 16). (Photo D. Visser, Frisian Museum).

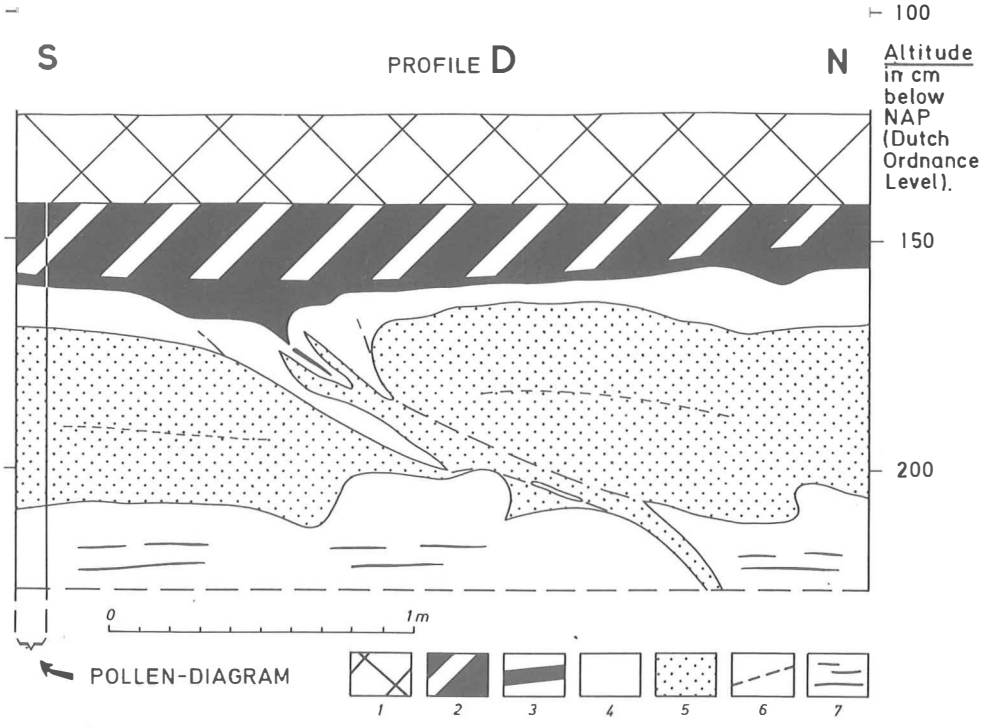


Fig. 16. Drawing of profile D. (Drawing D. Stapert/J.M. Smit, B.A.I.). Legend: 1. topsoil; 2/3. Holocene peat, coloured black; 4. Younger Cover-sand II; 5. Allerød peat, coloured brown; 6. possible desiccation level in the middle of the Allerød peat; 7. Younger Cover-sand I.

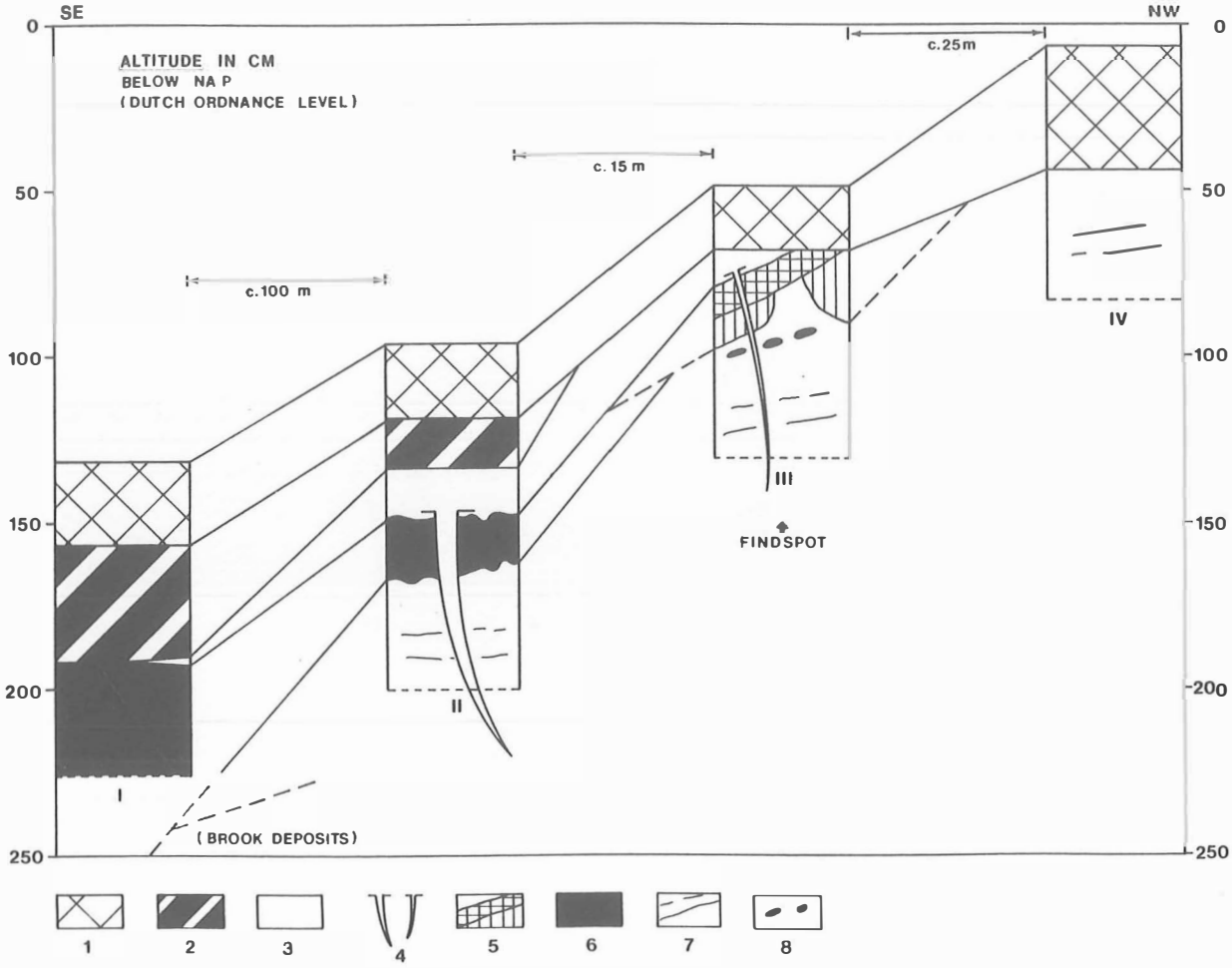


Fig. 17. Schematic overall profile (SE-NW) of the site and its surroundings, in which all stratigraphical observations are included. (Drawing D. Stapert/J.M. Smit, B.A.I.). Legend: 1. topsoil; 2. Holocene peat; 3. Younger Cover-sand II; 4. frost fissures and frost cracks; 5. A2-and B-horizons of the 'Layer of Usselo'; 6. Allerød peat; 7. Younger Cover-sand I; 8. flat stones in the hearth at the site.

Usselo', and which therefore cannot be younger than the end of the Allerød interstadial. They probably belong to the Creswellian tradition.

The frost fissures and frost cracks do in any case appear to be indicative of rapid falls in temperature, and of the absence of snow cover of any significant thickness during the winters (Dylik & Maarleveld, 1967).

Going from the location of profile D deeper into the valley (towards the south) the uppermost sand layer becomes increasingly thinner, until it is only one grain thick. In this direction the brown peat layer becomes increasingly thicker (up to at least 1 m thick), as does the black Holocene peat.

Figure 17 gives a schematic overview of all the stratigraphic data collected at and around the site. To summarize, it can be said that at this locality a low cover-sand ridge is present consisting of Younger Cover-sand I; on its southern flank a thin layer of Younger Cover-sand II has been deposited. The two sand layers are separated higher up the slope by the 'Layer of Usselo', and deeper (within the stream channel) by a brown peat layer dating from the Allerød interstadial. The flint concentration is situated less than 10 m away from the fringe of the area where the brown Allerød peat layer is present (see fig. 13). It can be assumed that at the time of the Upper Paleolithic occupation (*i.e.* several hundred years before the peat formation) the bank of the stream channel was situated

approximately at the same spot. Stratigraphically the site can almost certainly be dated in the last part of the Early Dryas stadial, just before the beginning of the Allerød interstadial.

4.2. Oldeholtpa

At Oldeholtpa, at a distance of c. 3 km to the SE of the site (Topographical Map sheet 16B: 545.5/198.7), an interesting exposure (discovered by J. Boschker) was studied in November 1980. Here we are concerned with a profile in a remnant of a cover-sand ridge, the stratigraphy of which is described briefly here below for the purpose of comparison with the data obtained at Oldeholtwolde. The cleaned part of the profile showed the following succession (from top to bottom, the figures given signify thickness):

100 cm	Topsoil, and disturbed soil (only the lowest part is visible in the photo: fig. 18).
218 cm	Relatively coarse yellow sand. In view of the stratigraphy this layer in its entirety must be Younger Cover-sand II. At the top locally remnants of the B-horizon of the Holocene podsol are visible. At 78 cm from the bottom a thin bleached zone is visible, marked by a brown infiltration band that is connected with the Holocene podsol. This probably signifies a brief static phase in the deposition of this sand. During this static phase some vegetation must have developed at this spot, in view of the presence of traces of roots immediately below this level. The lowermost 16 cm of this layer is dark-brown in colour, as a result of iron infiltration from above; this band marks the transition to the:
12 cm	'Layer of Usselo', light grey level with particles of charcoal. This A_2-horizon of a fossil soil (no B-horizon is visible) is developed in the same fine sand as immediately below:
20 cm	Fine yellowish sand with thin loamy bands. In view of the total succession this must be Younger Cover-sand I. The bottom of this layer is again marked by a brown infiltration band, that is most probably connected with the Holocene podsol at the top of the profile.
25 cm	Loamy fine sand with bands of loam, greenish grey in colour. In this sand and the sand below it thin frost cracks are visible, that extend upwards as far as the above-mentioned brown infiltration band, where they stop. The bottom of this greenish layer is formed by a light grey bleached zone c. 2 cm thick.
50 cm	Loamy fine sand with bands of loam, yellowish-grey in colour. This layer and the one above it must consist of Older Cover-sand; both layers are very loamy compared to the sand layers above them.
50 cm	Boulder-clay, markedly distorted as a result of cryoturbation, bluish-grey in colour (only the topmost part is visible in the photo).
> 10 cm	Fine sand, grey. This is probably sand belonging to the Eindhoven Formation.

The thin sand layer with loamy bands immediately below the "Layer of Usselo" strongly resembles the sand with loamy bands that is present at Oldeholtwolde immediately below the 'Layer of Usselo'. Here it is much more thinly developed, however, while the uppermost (coarser) cover-sand is much thicker. In the profile at Oldeholtpa, below the sand with the loamy bands very loamy sand is present, partly of a greenish colour, that most probably can be regarded as Older Cover-sand, and that does not occur at Oldeholtwolde. This makes it probable that the sand immediately below the 'Layer of Usselo' is indeed Younger Cover-sand I, so the Bølling 'level' must be present where the brown infiltration band occurs at its base. Thus the bleached zone in the middle of the Older Cover-sand presumably has nothing to do with the Bølling interstadial. As a general rule one should therefore be very cautious with the stratigraphical interpretation of bleached zones in cover-sand as 'Bølling level'.

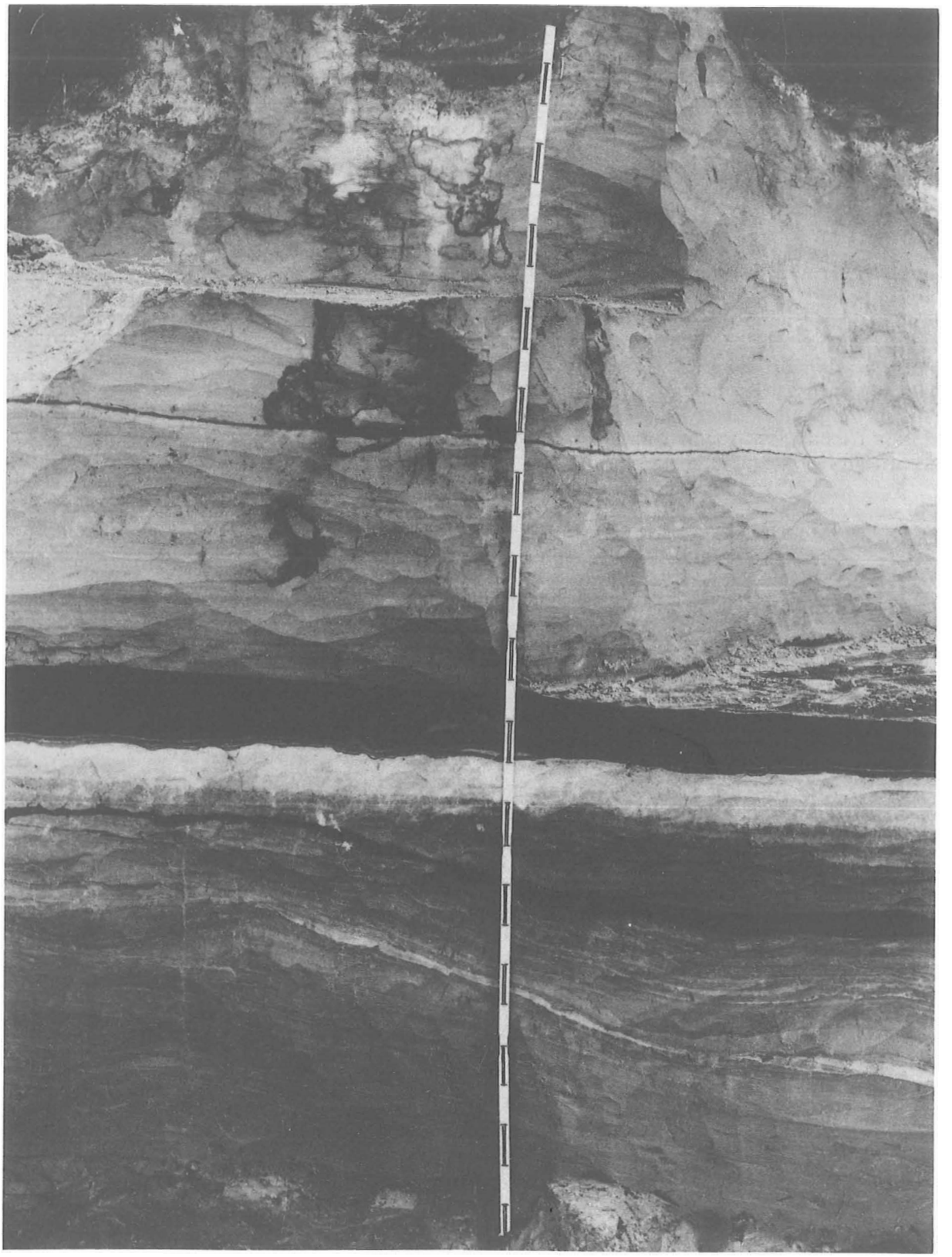


Fig. 18. Photo of the profile at Oldeholtpa. The measuring-staff is subdivided in decimetres. For a description see the text under 4.2. (Photo F.W.E. Colly, B.A.I.).

The profile at Oldeholtpa confirms in my opinion that the sand with thin loamy bands at Oldeholtwolde (in which the artefacts occur) is indeed Younger Cover-sand I. To the south of the river Vecht, for example at the Hamburg site of Luttenberg, and at the classic profile near Usselo (both in the province of Overijssel) the Younger Cover-sand I seems to be relatively coarser. Older Cover-sand II in that region som
Younger Cover-sand I in the north, with thin loamy bands.

4.3. A few summarizing remarks

As stated above the Younger Cover-sand I is placed in the Early Dryas stadial (between the Bølling and Allerød interstadials). This stadial is dated between c. 12,000 and 11,800 B.P. and was thus only of relatively short duration.

The Early Dryas stadial and the Bølling interstadial are as a general rule difficult to ascertain (Watts, 1980). Nevertheless they probably exist as climatological phases. Mangerud (1970; 1980), for example, has been able to determine a small temporary expansion of the ice-sheet in Western Norway, just before c. 12,000 B.P. Also in England and Northern Germany the Early Dryas has been determined with a reasonable degree of certainty (Watts, 1980). But further south in Europe this stadial usually cannot be ascertained unequivocally. Also Coope (Coope & Pennington, 1977; Coope & Joachim, 1980), on the basis of research on Late Glacial beetle remains, sees no occasion for ascertaining the Early Dryas as a colder period. (In 1975 Coope also took samples from the profile at Usselo, where Van der Hammen (1951) demonstrated the Bølling interstadial; however, the results of this investigation are not yet known).

In fact Coope comes to the conclusion that in the first half of the 'Windermere Interstadial' (roughly equivalent to Bølling + Early Dryas+Allerød in the Netherlands), also during the Early Dryas, at St. Bees (N.W. England) for instance, summers were actually warmer than at present. That in some places there was nevertheless no expansion of *Betula* he attributes to the circumstance that the warm summers went together with 'freely draining soils of low organic content', *i.e.* conditions of excessive drought.

His ideas are supported by Van Geel & Kolstrup (1978). In their opinion, in a number of pollen diagrams (*e.g.* Uteringsveen: Cleveringa *et al.*, 1977; De Borchert: Van Geel *et al.*, 1980/1981; Belgium: Verbruggen, 1979) there are indications that suggest that the summers remained relatively warm during (*i.a.*) the Early Dryas, while the proportion of tree-pollen nevertheless declined. In their opinion this is a result of dry summers, and cold winters with little snow cover during this phase, thus rather continental conditions instead of a tundra situation.

Kolstrup (1982) published 2 new Late Glacial pollen diagrams for Denmark (in this important article there is also a discussion of other indications regarding the climate). Her conclusion concerning the Early Dryas is as follows: relatively warm summers, fairly severe winters, and excessive drought. She emphasizes the differences that must have existed at that time between the vegetation in flat regions with little snow-cover in the winter, and places in depressions (such as pingo remnants) where wetter conditions may have prevailed and where there was relatively more snow-cover in the winters (see also Kolstrup & Heyse, 1980).

In this respect it is probably significant that the provisional pollen diagram of the Allerød peat layer at Oldeholtwolde (situated in a flat valley-bottom) partly more closely resembles 'pleniglacial' diagrams than Allerød diagrams obtained from samples from the fillings of pingo remnants (S. Bottema, pers. comm.).

As far as the Northern Netherlands are concerned it seems clear that during the Early Dryas in any case a layer of Younger Cover-sand (I) was deposited, that is sometimes more than 2 m thick. Conditions were nevertheless clearly less extreme than during the Late Dryas, considering, for example, the absence (as far as I am aware) of (larger) frost fissures dating from the Early Dryas.

All in all, in my opinion it can be assumed with a reasonable degree of certainty from a geological viewpoint that the Upper Paleolithic occupation at Oldeholtwolde took place during the final phase of the deposition of Younger Cover-sand I. This means that the finds can be dated geologically, with more or less the same degree of certainty, to just before the beginning of the Allerød interstadial, at least if it can be assumed that the deposition of Younger Cover-sand I ceased at the beginning of the Allerød interstadial (which is not absolutely certain–it is quite possible that

cover-sand was still being deposited during the first part of the Allerød interstadial, especially in this flat region).

5. THE HEARTH AND OTHER CONFIGURATIONS OF STONES

Approximately in the middle of the find concentration a large constructed hearth was found, that was excavated according to the 'quadrant method', so that a cross of profiles through this structure could be studied. During the excavation efforts were made to prepare the surface within the hearth region in such a way that the relief is defined by the lower surfaces of adjacent stones.

In this way one obtains the most accurate reconstruction possible of the topography of the original surface at the time of occupation, and any pits that may have been present are thus revealed.

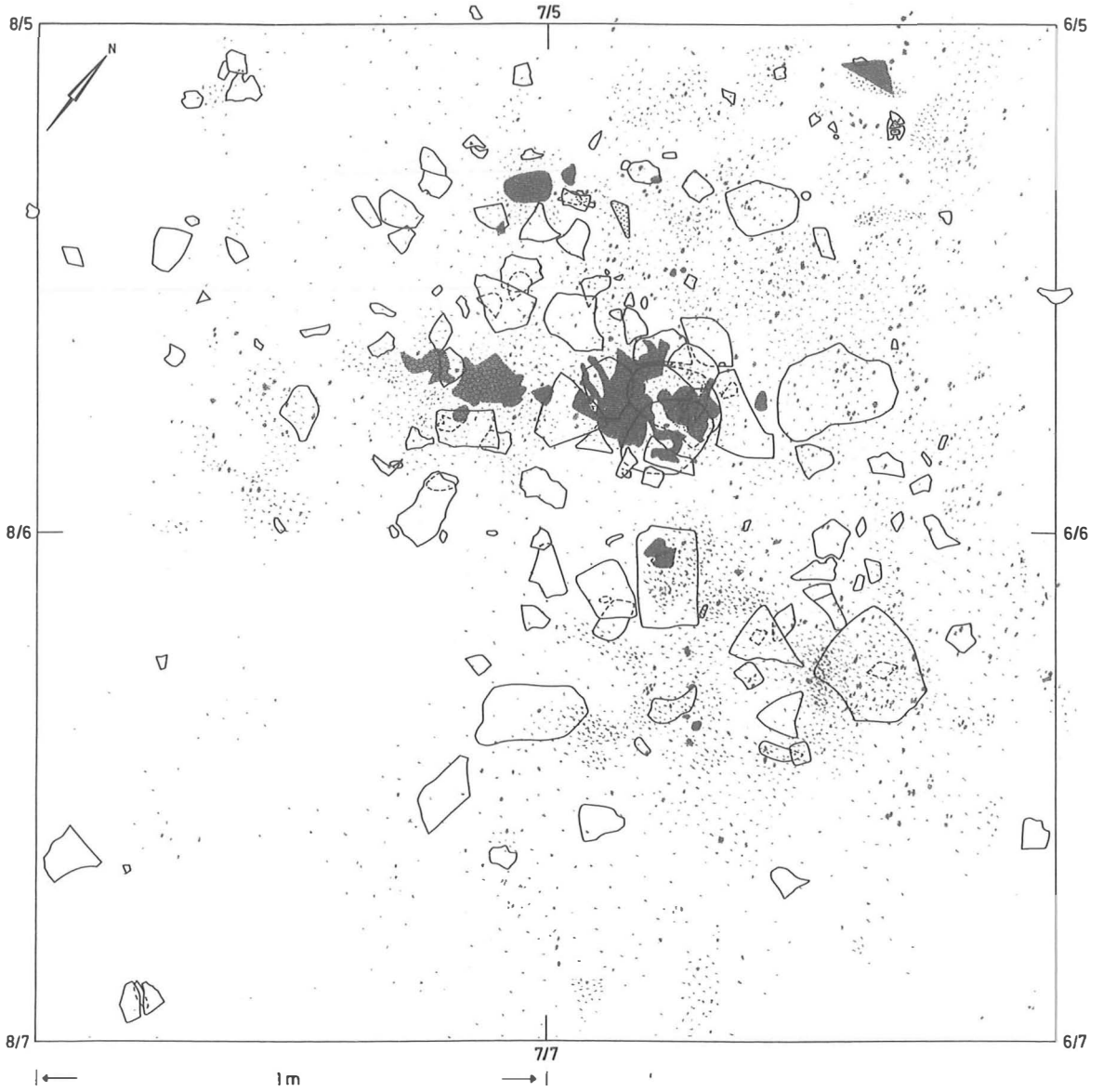


Fig. 19. Drawing of the hearth that was present in the middle of the find concentration. The stones are indicated, as well as (schematically) the charcoal (this was present as a general rule *under* the stones). The stippled object is not a stone, but most probably a partly charred, originally organic object (*e.g.* bone or antler). (Drawing D. Stapert/J.M. Smit B.A.I.).

Fig. 20. Photo showing an overall view of the north quadrant of the hearth after preparation. The east quadrant has already been dug away. In the profile (on the left) a few stones of the south quadrant are visible. Immediately below the topsoil the A^2-horizon of the 'Layer of Usselo' is locally visible. (Photo F.W.E. Colly, B.A.I.).

The hearth consists of a more or less heart-shaped configuration of flat stones in a shallow depression with a diameter of about 1.5 m (fig. 19). The slope of the depression was relatively steep in the western half of the hearth, and more gentle in the remaining part (figs. 24, 27). In the middle of the hearth a small pit was present, max. c. 10 cm deeper than the surround, c. 35 × 50 cm in size, of which the walls and bottom were lined with close-set, flat stones (figs. 20–23). These stone slabs (mean thickness c. 2 cm) include both larger stones (13–24 cm) and smaller fragments of originally larger stones. Many stones, also outside the hearth, show traces of burning that consist of black patches (caused by charring); distinct red colorations were observed hardly or not at all.

As a general rule charcoal was found only *under* the flat stones. Immediately below the stones within the central pit charcoal was present in the form of branch-like streaks (figs. 25, 26). This is most probably indicative of the burning of brushwood. This is in accordance with the geological dating (see under 4.1.), that points to the probable absence of trees in the surroundings at the time of occupation.

Perhaps also bones were used as fuel. In this connection the following find may be of importance. Within the hearth, just outside the central pit an object was found (no. 3508, stippled fig. 19) that is most probably organic. This elongated, triangular object (max. length c. 8 cm) appeared during the excavation as a fairly hard, black surface. Apart from this it had no substance: internally it consisted merely of sand. Probably it was originally a bone or antler fragment, of which the surface became (partly) charred in the fire. It is no longer possible to observe any bone- or antler-structure (A.T. Clason, B.A.I., pers. comm.). It is also possible of course that we are only concerned with food refuse, rather than

Fig. 21. Photo of the north quadrant of the hearth. It can clearly be seen that the hearth lies in a shallow depression. (Photo F.W.E. Colly, B.A.I.).

fuel, that ended up in the hearth by accident. (At Pincevent most bones are found near, but outside, the hearths: Leroi-Gourhan & Brézillon, 1972).

From the branch-like charcoal concentration under the stones in the central pit a C14-sample was taken. This was done in view of the fact that above the hearth the 'Layer of Usselo' was locally present (with natural charcoal particles dating from the end of the Allerød interstadial), and that recent roots and mole tunnels were present everywhere, so both Allerød charcoal and more recent charcoal could have been transported downwards. The charcoal under the pit-lining of stone slabs appeared to have been best protected from contamination of a later date. Unfortunately the charcoal mainly consisted of finely divided material, with only a few small discrete lumps. Moreover a total amount of only 3.5 gram was present, hardly enough for a dating. The C14 dating provided the following result: GrN-10.274: 11,540±270 B.P. This dating falls approximately 260 years after the beginning of the Allerød interstadial, which thus seems to be somewhat too young, in view of the stratigraphical data (see under 4.1.). The standard deviation is rather large, however, as a result of the fact that the sample was rather small (for a further discussion concerning the dating see under 6.).

Outside the central pit of the hearth somewhat larger pieces of charcoal were present, scattered here and there. It is intended that these will first be identified, as far as possible (by W.A. Casparie), after which a second C14-sample will be constituted out of the identified fragments.

Under the 'floor' of flat stones within the central pit a few small fragments of stones were found that were completely charred black, much blacker than the stones that made up the lining of the pit. This indicates that these fragments (undoubtedly split off by

Fig. 22. The north quadrant of the hearth. The light-coloured streak (slightly above the middle of the photo) is a frost crack. (Photo F.W.E. Colly, B.A.I.).

heat) have lain in the hearth for a much longer time than the other stones. In this connection it must be realized that the excavation reveals a situation at one point in time, *i.e.* the hearth as it was used for the last time, just before its users departed. It is even conceivable that on the last day before the site was abandoned the hearth was used (partly) for purposes other than usual during the period of occupation.

It seems clear that the hearth was cleaned out regularly, possibly every day, and in this way the stones used that had been broken up too much by the heat became scattered around the hearth and were not used again. This explains the phenomenon that also stones found several metres away from the hearth show black patches that must have originated at some time in the hearth. Moreover it has become evident, as a result of fitting together stone fragments, that many of them originally belonged to large slabs (max. 38 cm). In the course of time these slabs must have become increasingly more fragmented. This indicates that the site was certainly not used for a very limited period. The occupation must have lasted for a sufficiently long time for this fragmentation to have gradually taken place (see also: Leroi-Gourhan & Brézillon, 1972). In my opinion we should be thinking of a period of occupation in terms of at least several weeks. It is intended to make an attempt to quantify this process, by means of experiments.

Charcoal concentrations were present not only under the stones in the central pit but also elsewhere within the hearth. Immediately to the west of the central pit there is another relatively low-lying space about 20 cm across that is enclosed by stones. In this space, thus not under any stones, a dark patch of charcoal is present. It seems likely that here at an earlier stage a small pit was present that was lined with flat stones, but that these stones were later used in the adjacent pit already described. Charcoal concentrations also occur elsewhere, but these are much smaller. They

Fig. 23. The central pit in the middle of the hearth. The stones are for the most part still covered with a loamy brown-coloured (iron-containing) layer, associated with the Holocene podsol (that has now disappeared). Near the lower limit of the pit a (flint) blade is visible that is not burnt. (Photo F.W.E. Colly, B.A.I.).

could also partly be the result of the regular cleaning-out of the hearth stones. Also outside the hearth a little charcoal was often found close to stones that must have once lain in the hearth in view of the presence of black patches on them.

Many stones, besides, as well as many flint artefacts, became fragmented at a later date (most probably during the Late Dryas) by frost splitting. These fractures are not indicated in fig. 19.

Fig. 27 shows a schematic E–W section through the hearth. Clearly visible are the central pit and the relatively steep slope outside it on the west side. On the eastern rim of the central pit a low 'bank' appears to be present. This probably consists of sand that was scraped out of the central pit. The presence of a pit can also partly be explained, however, if one assumes that the hearth was frequently cleaned out. No distinct concentrated 'dumps' of charcoal were found, and no ash at all. It must be assumed provisionally that these were present outside the excavated area.

It is most remarkable that within the hearth only slab-shaped stones were present. The few round stones that were found during the excavation (outside the hearth) appear to have been used mainly as hammer stones. The flat stones are on average c. 2 cm thick and mostly consist of Dala-sandstone, although other types of rock, such as granites, also occur. The slabs were often split along natural bedding planes, probably by the inhabitants of the site–in almost all cases not at this spot but presumably at the place where they were collected.

Flat stones such as these do not appear to be suitable for use as 'cooking stones': for this purpose smaller round stones would have been generally used (see *e.g.* Batchelor, 1979;

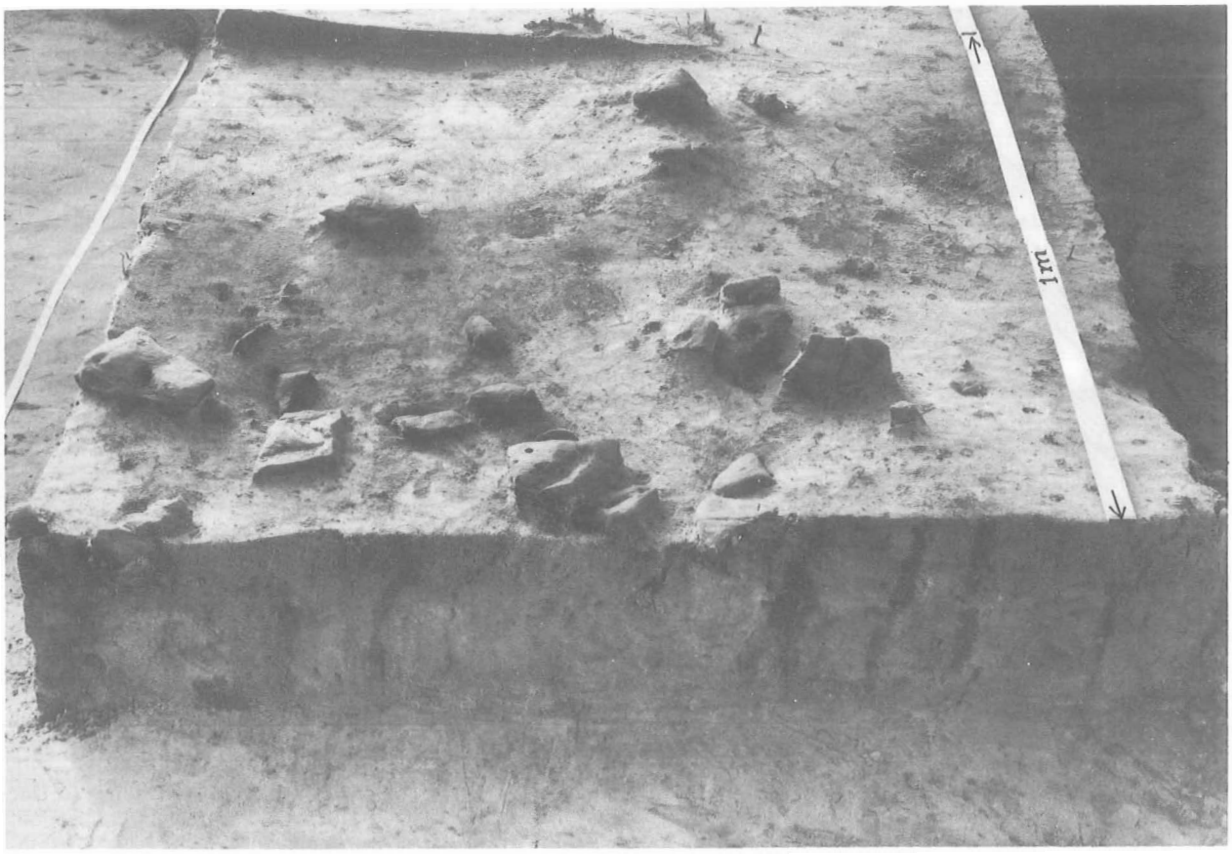


Fig. 24. Photo of the west quadrant of the hearth, taken in the evening, as a result of which the relatively steep slope of the depression in which the hearth lies shows up well. The excavated surface was prepared in such a way that the undersides of adjacent stones were used to define the relief. The measuring staff is 1 m long. (Photo F.W.E. Colly, B.A.I.).

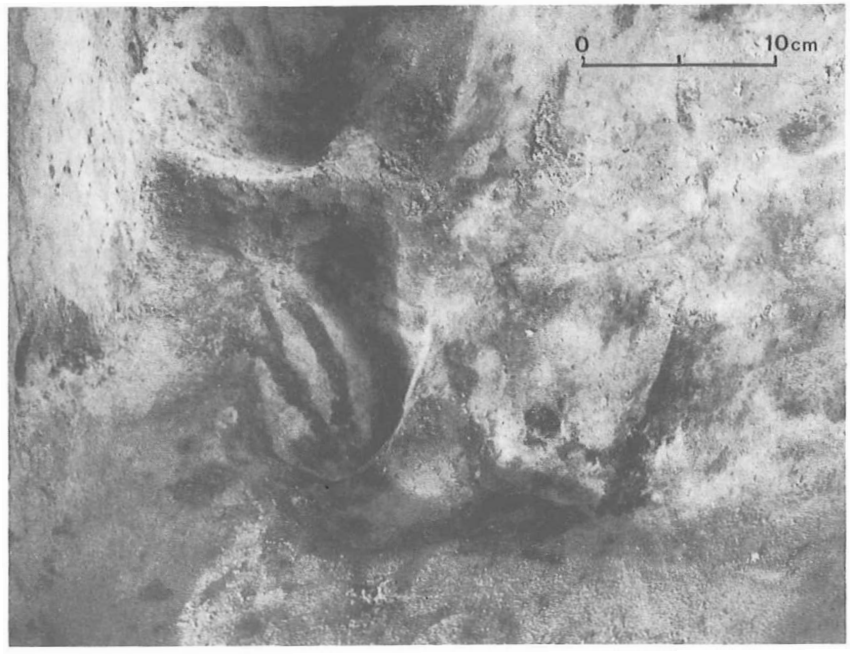


Fig. 25. Photo of the branch-like charcoal streaks immediately below the stones on the bottom of the central pit in the hearth. This charcoal was used for the C14-dating. (Photo F.W.E. Colly, B.A.I.).

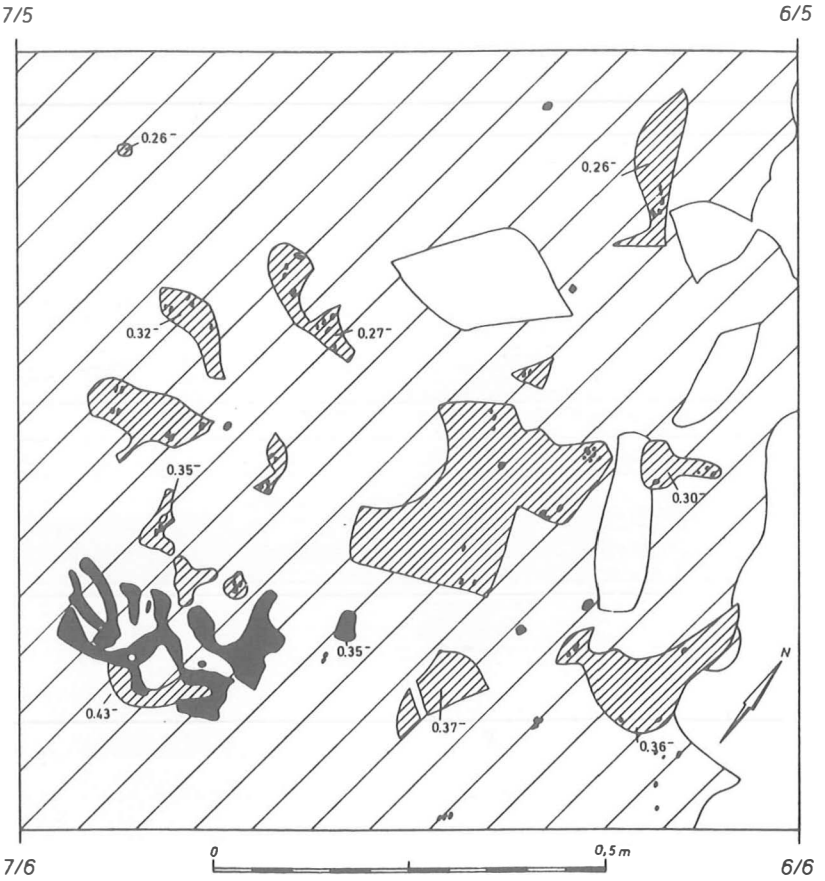


Fig. 26. Drawing of the charcoal immediately below the stones on the bottom of the central pit in the hearth and in the surroundings. The charcoal is indicated with three shades, according to the intensity of the black coloration. (Drawing D. Stapert/J.M. Smit, B.A.I.).

Leroi-Gourhan & Brezillon, 1972). Moreover it seems unlikely that such flat stones were used for 'keeping' the heat (*e.g.* at night)–for this purpose too round stones are more suitable (see Perlès, 1977); flat stones rather lose their heat relatively quickly. In my opinion it is clear that the flat stones were heated intentionally. Charcoal is present only *under* the stones, and not above them, as is evident from a number of drawings and photographs of cleaned surfaces above the stones in the central part of the hearth.

The most obvious function of the hearth in my opinion is that the heated stones were used for roasting meat–perhaps reindeer meat, but possibly also fish. It is intended that experiments will be carried out to ascertain whether the function suggested is in fact possible in practice. In this respect it is interesting to note here that, in his treatise on the material culture of the Iglulik Eskimo, Mathiassen (1928: p. 204) wrote: '.....on rare occasion caribou meat is baked by laying a slice of meat with a lump of fat or blubber between two flat stones, under which a fire is lighted'.

This type of hearth is fairly rare (see Bordes, 1972; Perlès, 1977). Hearths with a central pit and stones are in themselves quite common, but usually the stones form a more or less distinct ring around the central pit in which the charcoal is present (see *e.g.* the hearths of Pincevent: Leroi-Gourhan & Brézillon, 1972).

It is known that the Eskimos in the central part of North Alaska (notably the Nunamiut) also have hearths with stones. As a general rule these are situated in the middle of the winter dwellings. Here too the stones usually form a distinct ring around the central part of the hearth.

Unfortunately there are not very many detailed descriptions of Nunamiut hearths. Corbin (1975; 1976) describes the central hearths in the winter houses (*ivrulit*: moss house) of the Nunamiut as follows: 'First a small round pavement of small, flat stones (c.

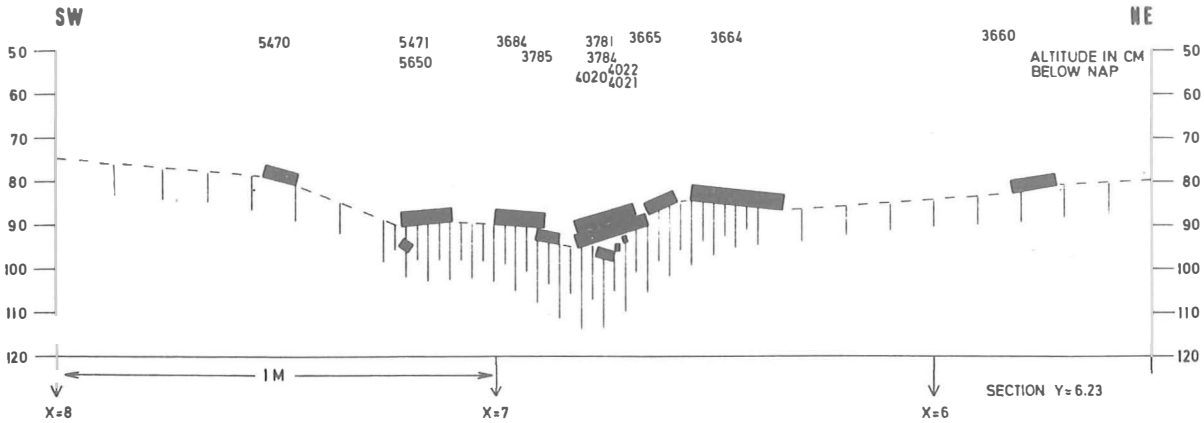


Fig. 27. Schematic cross-section (W-E) through the hearth. The flat stones and the charcoal under them are indicated. The inclination of the large stone immediately to the east of the central pit suggests the presence of a low 'bank' at this spot. (Drawing D. Stapert/J.M. Smit, B.A.I.).

6–8″ in dia) was constructed in the center of the house. The willow flooring was laid down, and then five to seven very large rocks are set into place, partially overlapping the pavement and the flooring. These large rocks tend to have one broad, flat surface which is faced inwards, acting as a reflector'. Hall (1971; 1976) also describes pavements under a few hearths, although he has nothing to say about their function. Perhaps they served to isolate the fire from melt-water. In that case the absence of such a pavement (as at Oldeholtwolde) could indicate that occupation did not take place during the winter.

In the case of hearths outside the dwelling structures (*e.g.* next to summer tents) no stone ring is present as a general rule. The primary function of the stone ring is apparently to contain the fire, in other words to ensure that the fire cannot spread beyond the hearth, where a floor-covering may be present of reeds, willow twigs or such like, that could catch fire (besides the stones sometimes appear to function as heat reflectors). If this were a general situation, then one could postulate the theory that hearths with a stone ring usually lay within dwelling structures (notably in winter houses), while hearths without a stone ring usually lay outside (notably in summer settlements). Nevertheless at Pincevent, for example, there are no distinct, archeologically visible dwellings present, and occupation there probably did not take place during winter (Leroi-Gourhan & Brézillon, 1972).

Seeing that with the hearth at Oldeholtwolde there is no distinct stone ring present, in my opinion the presence of a dwelling structure around it need not be postulated. On the other hand it is not impossible that when the fire was being stoked the stones did indeed lie in a ring around it, and that they were only later laid on top of the hot embers.

As far as other sites of the Hamburg tradition are concerned, reference can be made to a large (double) hearth in a pit, with stones, at Querenstede (provisionally published by Zoller, 1963; 1981). The charcoal from this hearth turned out to be unsuitable for a C14-dating (J.N. Lanting, pers. comm.). At the site of Olbrachcice 8 in Poland too a hearth was found. The charcoal from this hearth (about 8 gram) did provide a good C14-dating: Lod-111 12,685±235 B.P. (Burdukiewicz, 1981a). For a number of other published Hamburg sites in Germany hearths are known, but these are usually small hearths without any distinct structure consisting of stones. Seeing that at various Hamburg sites in the Netherlands similar hearths have also been found, that on the basis of C14-datings evidently date from the Mesolithic (*e.g.* Luttenberg: see Lanting & Mook, 1977), in my opinion one must be very cautious in simply attributing any such hearths to the Hamburg tradition. Identification of the charcoal and carrying out C14-dating of such hearths are to be recommended.

At the Oldeholtwolde site almost 1 m N of the hearth a small ring of stones was found

(see fig. 28). This had a diameter of c. 30 cm, while the enclosed space (diameter c. 10 cm) was empty. Initially we thought that this was possibly a 'post-hole', *i.e.* for a tent-post that was placed on the ground and supported all around at the base by stones. 'Post-holes' of this kind are known for example at Gönnersdorf (Bosinski, 1979). From the reconstructions of the original stone slabs and from the presence of black patches, however, it appears that all of the stones from this ring lay at some time in the hearth. Therefore this cannot be a primary structure, unless one assumes that a tent was set up only some time after the construction of the hearth, which seems unlikely. For the meantime it is therefore assumed that the ring was a structure of *hot* stones. Its function remains essentially unknown, but may well involve activities connected with the preparation of food.

As mentioned previously, outside the hearth many scattered stones are also present, of varying size, up to about 4.5 m away from the hearth. In my opinion the spatial distribution of these stones (see fig. 28) gives no reason for speculations concerning possible tent structures. The distribution seems to be essentially random. At the most one can point out a number of spots that have remained relatively empty; one of the most conspicuous of these empty spots is situated immediately south of the hearth. It seems likely that for some reason or other these spots were avoided when refuse was being dumped. They may have been sleeping-places, for example, or places where other activities occurred and where the presence of (large) stones would have been a nuisance.

Apart from the random distribution there are two other reasons why the stones are probably not 'structural elements'. The first is the fact that most of the stones show burn-marks, and are fragments of originally larger slabs that lay in the hearth. This does not apply to all the stones, however, for a few of the larger ones are neither burnt not fragmented. The second reason is that under a number of the stones, also under a few larger stones without black patches, flint tools were present, so the stones could not have been lying in a primary position. However, this is no absolute argument either, as the stones could have been moved when a tent, if such was indeed present, was being dismantled. Another possibility is that the Hamburg people had the habit of keeping tools under stones, as do some Eskimos (pers. comm. J.L. Smit).

To recap, in my opinion there is no good reason for postulating a tent structure or something similar on the basis of the distribution of the stones. In my view such hypotheses in the literature have been put forward too hastily in a number of cases. The occurrence of empty spots is interesting, however, and must be further investigated, for example by the analysis of the spatial distribution of various categories of flint artefacts (currently being undertaken by J.L. Smit).

Finally it must also be mentioned here that c. 5 m to the NE of the hearth described above a small circular concentration of charcoal (diameter c. 35 cm) was found, clearly outside the find concentration. This probably represents a Mesolithic hearth, in view of the presence of larger lumps of charcoal (this charcoal is to be identified and dated).

6. DISCUSSION OF THE TWO C14-DATINGS

At the moment two C14-datings for Oldeholtwolde are available:

Sample 1 (charcoal from the hearth): GrN-10.274 11,540±270 B.P.
Sample 2 (lowermost 1 cm brown peat): GrN-11.264 11,340±100 B.P.

In fig. 29 both C14-datings are indicated with 1 and 2 standard deviations. The Late Glacial chronozones and their limits are taken from Mangerud *et al.* (1974); essentially they correspond to the data for Usselo (summarized in: Lanting & Mook, 1977). The Bølling chronozone (Bølling *s.l*) comprises the biostratigraphical (pollen-) zones Ia (Earliest Dryas) and Ib (Bølling *s.s.*). Pollen-zone Ib can be dated from 12,300/12,400 to 12,000 B.P.

One of the problems in determining the chronology of the Late Glacial is the relatively short duration of some zones, notably the Early Dryas, for which reason C14-datings with a relatively big standard deviation are often difficult to interpret. They have too little power of resolution (see Lowe & Gray, 1980).

The C14-dating of sample 1 (from the

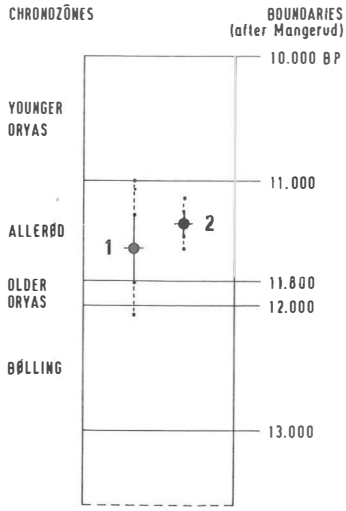


Fig. 29. The C14-datings for Oldeholtwolde. 1. Charcoal from the hearth; 2. Lowermost 1 cm of the Allerød peat in profile A. Both 1 and 2 standard deviations are indicated. (Drawing D. Stapert/J.M. Smit, B.A.I.).

hearth) is a good example of this. There is a 68% probability that the real C14-age lies between 11,810 and 11,270 B.P. This time range spans the last part of the Early Dryas and two-thirds of the Allerød interstadial. If 2 standard deviations are taken into consideration then the situation becomes even more problematical: even the last part of the Bølling interstadial then becomes possible.

With sample 2 this problem is of much less importance, because the standard deviation is much smaller. It seems certain that this sample dates from the second half of the Allerød interstadial, also when 2 standard deviations are taken into consideration.

Sample 1 must be older than sample 2, in view of the stratigraphical position of the two samples with respect to each other. In that respect we are presented with a consistent picture, and thus it can at least be concluded that the hearth cannot be younger than c. the middle of the Allerød interstadial.

Apart from the big standard deviation the dating for sample 1 is less reliable than that for sample 2 also for another reason. Sample 1 consisted of charcoal collected from a spot with a diameter of about 10 cm over a depth of 5 to 10 cm under the stones on the bottom of the central pit in the middle of the hearth. Although the position under the stones appeared to offer reasonable protection against contamination with more recent charcoal from higher up, this still cannot be guaranteed with absolute certainty. Over the entire excavation area many mole tunnels were observed, while many roots were present as well, also around the hearth. These roots have penetrated between and under the stones, presumably because moisture is retained there longer. Therefore the possibility cannot be excluded that some more recent charcoal has nevertheless ended up under the stones.

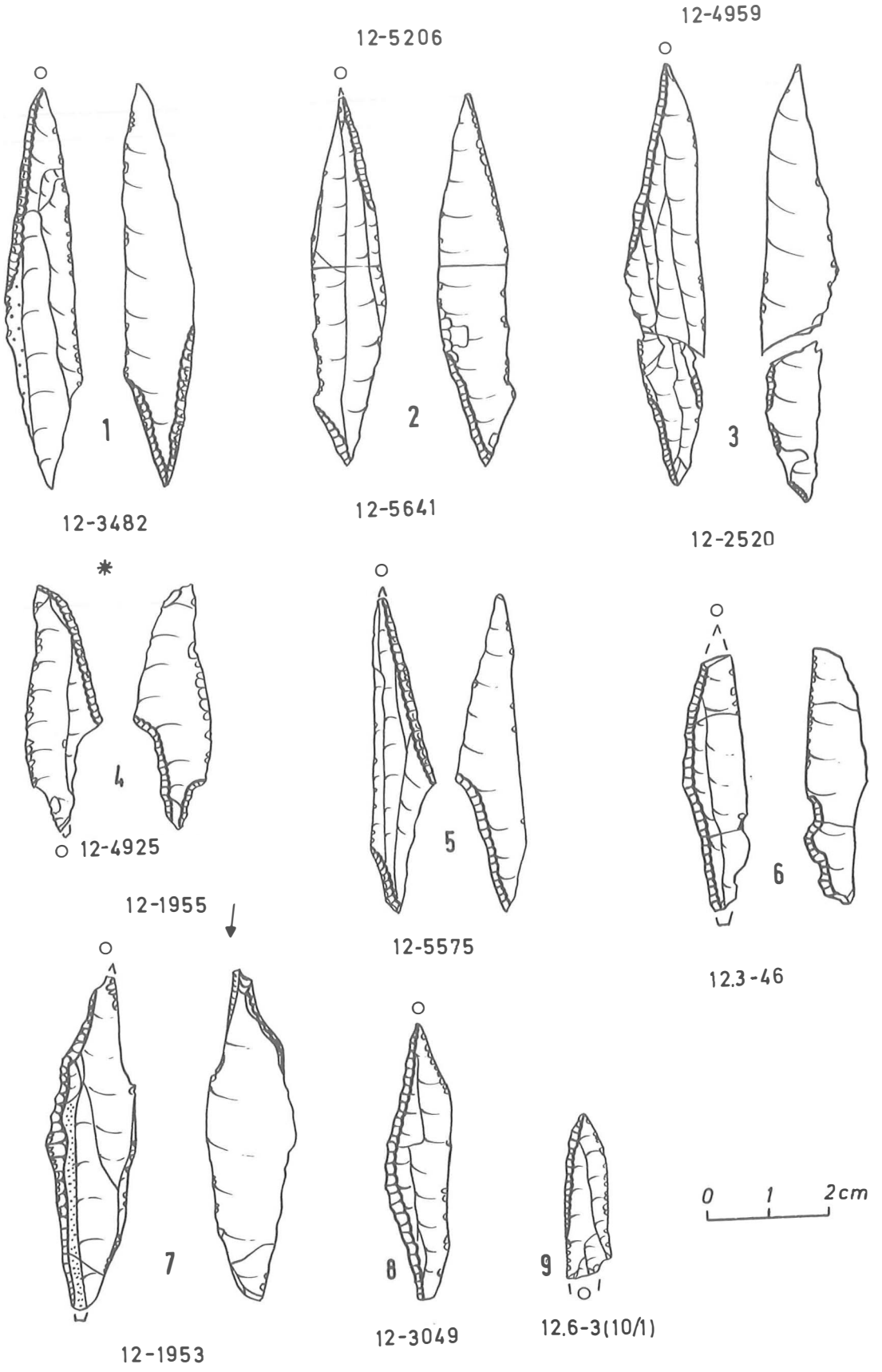
This could not have amounted to very much, however; for instance, a relatively small quantity of charcoal from the 'Layer of Usselo' (Late Allerød)–this was present at c. 30 cm above the hearth–would result in only a minor deviation. To explain away a date of this age apparently 250 years too young because of contamination with Late Allerød charcoal, one would need c. 25% charcoal from the 'Layer of Usselo' in the sample (J.N. Lanting, pers. comm.)!

As already explained above under 4.1., on the basis of the stratigraphical data it is most probable that the Hamburg site dates from just before the beginning of the Allerød interstadial. If we accept this dating then it is not strictly necessary to assume contamination of sample 1 with more recent material, in view of the wide standard deviation: the dating is not in contradiction with the stratigraphical data.

For the meantime it seems therefore most advisable in my opinion to attach most importance to the stratigraphical data. The following reasons can be given for this:

1. The big standard deviation of the C14-dating;
2. The improbability of cover-sand deposition until almost halfway through the Allerød interstadial (however, if the landscape remained fairly treeless during the first part of the Allerød–see under 4.3.–this is less improbable);
3. The improbability of the assumption that the Hamburg site is contemporaneous with and even younger than a number of *Federmesser* sites.

Another reason that can be mentioned here is the good quality of the flint used. As a general rule this is characteristic of Hamburg sites, in contrast to the material from many *Federmesser* sites. A reasonable explanation for this difference could be that it is easier to


12-5206
12-4959
1
2
3
12-3482
12-5641
12-2520
*
4
5
6
12-4925
12-1955
12-5575
12.3-46
7
8
9
0 1 2cm
12-1953
12-3049
12.6-3(10/1)

collect good flint if the landscape is not completely covered with vegetation. This thus seems to indicate a dating for the Hamburg site before the landscape became covered by vegetation during the Allerød interstadial.

To recap, in all probability the site can be dated to relatively soon (perhaps several decennia) before the beginning of the Allerød interstadial, or–less probable–in the beginning of the same. This site is then one of the first Hamburg sites that can be dated with reasonable certainty in the Early Dryas. The Hamburg sites in Germany and Poland are currently dated in the Bølling interstadial *s.l.* (Bokelmann, 1979; Burdukiewicz, 1981b; see also Lanting & Mook, 1977).

There are various other sites in the northern half of the Netherlands that on the basis of stratigraphical data must also probably be dated in the Early Dryas. Such sites include Texel (Stapert, 1981) and Luttenberg (see Lanting & Mook, 1977).

It therefore seems almost certain to me that there exists no 'gap' in time between the appearance of the Hamburg tradition and that of the *Federmesser* tradition. This is possibly supported by arguments of a typological nature, that are presented here below. Besides, in my opinion there are no sound indications at present to suggest that the two traditions overlapped in time.

7. TYPOLOGY OF THE POINTS

Within the confines of this first report it is not possible to give a detailed account of the flint material excavated; this will be done in a later article. The basic intention here is to briefly discuss a number of points. Typologically these can perhaps shed some interesting light on the above-mentioned dating of the site. In this connection also some relevant ideas from the literature will be briefly discussed (under 8.).

The 9 points that are illustrated in fig. 30 are not all the points from the site, but a selection. The points and point fragments that are not illustrated mostly belong to the category of 'normal' shouldered points.

A microlithic point was also found (in the loose topsoil), moreover, that most probably dates from the Mesolithic.

The points illustrated show a few special features. Numbers 1, 2 and 5 could be described as relatively long (and elegant) tanged points, which are not completely typical, however, as the tangs taper to a point and are not concavely backed. (The fracture of no. 2 has been caused by secondary frost-splitting). No. 4 (burnt), however, is a more typical example of a tanged point, but is relatively short compared with the other specimens. No. 3 was broken in ancient times, possibly when it was being made. It is remarkable that the basal fragment was partly retouched (ventrally) once again close to the fracture; the intention of this is not clear (an analysis of the traces of use on the artefacts from Oldeholtwolde has not yet taken place). Otherwise this specimen can be described as a long atypical tanged point (of the same type as nos. 1, 2 and 5).

Especially noteworthy are points 6 to 9 inclusive, as these are neither shouldered points nor tanged points, but types of points that are well known in the Netherlands from the *Federmesser* tradition (the fractures of nos. 6 and 7 have been caused by secondary frost-splitting). No. 6 is a point of which the left edge has been retouched completely; about halfway along this edge a slight nick is visible, on account of which the point is somewhat reminiscent of a shouldered point. At the base (of which a small part is missing, as well as from the top) two small notches have been made along the opposite edge (ventrally), that presumably were intended to facilitate shafting.

No. 7 can be described as a fairly typical

Fig. 30. A few points from Oldeholtwolde. Retouching is indicated by a slightly thicker outline. A closed circle indicates the position of the point of percussion, an open circle the direction of the point of percussion that is no longer present. An asterisk above the tool indicates that it is burnt. An arrow indicates the striking direction of a 'burin spall'. Nos. 2, 6 and 7 show secondary fractures (frost-splitting most probably dating from the Late Dryas). No. 3 may have broken already at the time when it was being worked; the basal part of this point was partly retouched again after the fracture occurrred. 1, 2, 3, 5. atypical tanged points; 4. tanged point; 6. backed point with a slight nick c. halfway along the retouched edge; opposite the retouched edge 2 small notches have been made near the base; 7. Gravette point with the negative of a 'burin spall' near the top (probably caused by its being used as a projectile); 8, 9. Gravette/Tjonger points. (Drawing D. Stapert/J.M. Smit, B.A.I.).

Gravette point. It appears that a burin spall has been struck off the top. This is possibly connected with the point being used as a projectile; 'burin facets' of this kind on points occur frequently (see *e.g.* Odell, 1978; Barton & Bergman, 1982). Only an analysis of any traces of use that may be present could provide an answer to the question whether this is a (used) point, or a burin, made out of a (possibly previously used) point. No. 8 is a finely finished off and complete Gravette point. Finally, no. 9 is fragmentary but can nevertheless be described with reasonable certainty as a small Tjonger point.

Typologically the points numbered 6–9 belong to the group of backed points, and as such are more characteristic of the *Federmesser* tradition than of the Hamburg tradition.

8. DISCUSSION

The Hamburg tradition is subdivided by various authors into groups, that are assumed to have chronological significance (Schwabedissen, 1937; 1951; Bohmers, 1947; Rust, 1951; 1958; 1962; Tromnau, 1975; Burdukiewicz, 1981b).

Schwabedissen has distinguished an older and a younger group, with the younger group being characterized above all by the occurrence of tanged points and blade endscrapers without retouched edges.

Also Bohmers has divided the Hamburg tradition into two groups, Hamburg I and II, of which the group that he regards as the younger (II) is also called the 'Havelte group' after a site near Havelte (Holtingerzand), where fine specimens of relatively long and typical tanged points occur. The older group of Bohmers (I) supposedly shows a quantitative predominance of *Zinken*, and the younger group one of blade endscrapers.

Rust has also distinguished an older and a younger group, the *Komplexe von Meiendorf* and *Poggenwisch* respectively. The group that is the younger in his opinion (Poggenwisch) is supposedly characterized mainly by the occurrence of shouldered points with extra small notches near the base opposite the shoulder; another supposedly characteristic feature of this group is that the blade endscrapers usually have no retouched edges, in contrast to the older group.

Tromnau sees in addition to the three previously postulated groups (Meiendorf, Poggenwisch, Havelte) yet a fourth group, that he calls the *Teltwisch-Gruppe*, on account of material excavated by him at the site of Teltwisch I. The occurrence of so-called *Gravettetypen* are supposed to be characteristic of this group, while tanged points are absent.

According to Tromnau the four groups that he distinguishes can be put in chronological order as follows: Meiendorf, Poggenwisch, Teltwisch, Havelte. He admits, however, that there are hardly any scientifically established datings available to support this hypothesis (the hearths that he found at the site of Teltwisch I are in his opinion younger than the Hamburg tradition; however, no C14-determinations were done). The chronological order of the 4 groups is therefore speculative, and based mainly on an 'intuitive' assessment of the typology. In Tromnau's working area (the *Ahrensburger Tunneltal*) the *Teltwisch-Gruppe* is supposedly the youngest (see his table 4), on the basis of the occurrence of the *Gravettetypen*; in his opinion it is possible that this group dates (partly) from the Early Dryas.

Burdukiewicz sees great similarities between the Hamburg tradition and the (English) Creswellian; he includes both groups together in the 'Shouldered Point Technocomplex'. With 25 sites of the two groups he carried out a taxonomic analysis, that resulted in a cluster-diagram, in which the degree of mutual relatedness of the sites is presented (obtained by means of a factor analysis?). The data used were frequencies of tools per type-class, although no details are mentioned of the procedure followed. The English Creswellian sites were found to cluster together in one group. The Hamburg sites clustered in three groups. These groups differ quite considerably from the other subdivisions described above. Moreover Burdukiewicz's ideas concerning the chronology are rather different from the views of for example Tromnau. His group III, which includes the sites of Havelte-Holtingerzand, Teltwisch I and Deimern 42, is in his opinion the oldest. According to Tromnau these sites belong precisely to his youngest groups. The youngest group of Burdukiewicz(I) includes the sites of Meiendorf, Stellmoor, and Olbrachcice 8, while according to Tromnau Meiendorf and

Stellmoor belong precisely to the oldest group. Moreover the C14-dating for Olbrachcice 8 falls in the first half of the Bølling interstadial *s.l.*, so there would seem to be good reason rather for regarding the group in which this site occurs as one of the older ones. The tools found at the site of Olbrachcice 8 included backed points (*Federmesser*) and short scrapers, that are both more typical of the *Federmesser* tradition that can be dated for the greater part in the Allerød interstadial. Thus it is rather curious that the site of Teltwisch I, that is also characterized by the occurrence of backed points (but not or hardly of short scrapers) becomes included in the group that according to Burdukiewicz is the oldest.

In my opinion the main problem with Burdukiewicz's subdivision is that it is based on quantitative data, namely proportions of tool classes (although from his article it is not completely clear how the subdivision originated), which is something completely different from a classification of sites on the basis of typological characteristics. To my mind a cluster analysis on the basis of quantitative data can hardly lead to a theory concerning the chronological succession of various sites; it is more probable that such data contain information about any functional differences that may exist between the sites.

To return to the results of the excavation at Oldeholtwolde, at least the following remarks can be made:

1. Both tanged points (albeit to some extent of an atypical form) and backed points (Gravette points, Tjonger points) are present.
2. There are no short scrapers present, but mainly blade endscrapers with one or two retouched edges.

We can thus establish the fact that tanged points and backed points can in any case occur at late Hamburg sites. In my opinion this does not necessarily mean that they could not also occur at the older sites. This applies notably in the case of backed points, as seems to be clear from the C14-dating for Olbrachcice 8. In this connection it must be pointed out that backed points are not only characteristic of the *Federmesser* tradition, but that they also can occur in the Magdalenian. In this respect it is rather more difficult to understand the presence of short scrapers at Olbrachcice 8.

An interesting point is that at Oldeholtwolde blade endscrapers with retouched edges are present, contrary to expectations in this respect of Schwabedissen, Rust and Tromnau for young sites.

To summarize, the following points can be established:

– Tanged points occur at late sites;
– Backed points too occur at late sites, but probably also at older ones (in view of the site Olbrachcice 8);
– Short scrapers are not necessarily present at late sites;
– Blade scrapers with retouched edges occur not only at possibly older sites;
– Tanged points and backed points are not mutually exclusive.

All things considered, in my opinion there is good reason to conclude that the above-described subdivisions of the Hamburg tradition are not very useful. Especially the different ideas that have been published about the possible chronological order of various sites are based hardly at all on facts, but mainly on speculative typological evaluations. Purely typological arguments easily lead to hypotheses about a possible "evolution", but in fact for the meantime we know too little about the causative processes to be able to interpret exactly which developments are reflected in the typological information available. Moreover, for the most part these theories have not been tested scientifically. Chronological interpretations of differences in proportions of various types of tools between various sites seem to be based on even weaker grounds theoretically, and in my opinion can best be avoided altogether.

As for possible connections between the Hamburg tradition and other Upper Paleolithic traditions in Europe, I completely agree with Burdukiewicz (1981b) that these must be looked for in the Late Magdalenian (IV–VI). In Northern France a number of Late Magdalenian sites are known with "Hamburg elements" such as shouldered points and *Zinken* (La Pierre-aux Fées: Allain, 1974; Marsangy: Schmider, 1979; 1981; see also: Schmider, 1971; Bosinski, 1978). The most conspicuous difference between most of the Late Magdalenian sites and those of the Hamburg tradition is the presence of relatively large numbers of *lamelles à dos* at the Magdalenian sites (*e.g.* Pincevent section 36 about 60%: Leroi-

Gourhan & Brézillon, 1972); these are virtually absent (so far) with the Hamburg tradition (for the typological differences between the Magdalenian and the Hamburg tradition see also: Bohmers, 1960).

Bokelmann (1979) gives an overview of what is currently known about the Hamburg tradition. As far as the chronological position is concerned it seems most probable to him that the Hamburg tradition can be dated in the Bølling interstadial *s.l.* (that lasted for c. 1000 years). In my opinion it can now be established that people of the Hamburg tradition lived on the Northwest European plain also during the Early Dryas, so there is no longer a "gap" between the appearance of the Hamburg and *Federmesser* traditions. This means, besides, that we must consider the possibility that the way of life of the Hamburg hunters was different during these two zones of the Late Glacial, namely an interstadial and a stadial (during which cover-sand was deposited). This could have consequences for speculations concerning the seasons in which the Hamburg occupation took place in this region.

The model outlined by Bokelmann seems to me to be somewhat premature, for a number of reasons. With reference to the conclusions of Sturdy (1975) regarding the seasonal interpretation of reindeer antlers from the Ahrensburg-level of Stellmoor (assuming that they are correct), I am not convinced that it can simply be assumed that these are also applicable to the Hamburg tradition. To my mind it would be advisable to first of all make a similar analysis of the reindeer antlers from the Hamburg levels.

Another point is the reliability of interpreting seasonality on the basis of the investigation of antlers. For example, Spiess (1979: p. 101) comes to the conclusion that '...antlers are almost useless as indicators of seasonality of hunting...'. To determine the season in which a reindeer died he recommends microscopic investigation of thin sections of teeth.

As for Bokelmann's model: occupation during autumn, winter and spring in Schleswig-Holstein, and during summer in the Netherlands, this seems to me to be too simple. However, there are some indications to suggest that in any case in the Netherlands occupation occurred at least during the summer season.

a) As far as sites that can be dated in the Early Dryas are concerned, it can be assumed that occupation during the winter season is rather improbable. The cover-sand deposition during (*i.a.*) this period is regarded by some geologists as the result of snow-storms, that probably occurred mainly during the winter (this applies especially to cover-sands with loamy bands; see *e.g.* Edelman, 1951; Wiggers, 1973; in the Arctic region storms occur mainly in the winter, see *e.g.* French, 1976: chapter 10).

b) In the Netherlands at least two types of Hamburg settlements occur, namely larger ones (with several thousands of flint artefacts) and smaller ones (with several hundreds of flint artefacts) – two unpublished sites of the second type have been excavated by the B.A.I. at Diever and Norg, that will eventually be published in *Palaeohistoria*. The occurrence of such small sites seems to be indicative of summer occupation, considering what is known of Eskimos (see *e.g.* Mauss, 1979).

For the meantime, however, on the basis of the scarce data that are available it seems premature to me to develop any detailed models of the *mode de vie* of the Hamburg hunters.

9. SUMMARY

In this article a few provisional results are given of the investigation of the Hamburg findspot at Oldeholtwolde. This site was excavated in 1980 and 1981 (over a total period of about 23 weeks). The findspot lies in the valley of the river Tjonger, at the foot of the slope of a fairly low cover-sand ridge along the bank of the main stream channel in the valley, at a spot where the transition from sand ridge to stream channel is relatively abrupt. This last-mentioned fact is possibly one of the most important characteristics of the site as regards the localisation in the landscape, and could indicate the possibility that the Hamburg people were here occupied, among other things, with catching fish. Furthermore the site lies on a kind of "peninsula" in the valley plain of the Tjonger (see figs. 7, 8); the area is surrounded by stream channels on the south, west, north and partly also on the east.

At the site location there is no boulder-clay present. The Hamburg people must have

brought the flint and stones they used over a distance of several hundred metres.

Stratigraphically the finds occur at an average depth of c. 20 cm below the "Layer of Usselo", that was found in parts of the excavation area just below the topsoil. The finds were present near the top of a layer of cover-sand with thin loamy bands that must be regarded as Younger Cover-sand I. This layer (that is locally c. 2 m thick) was deposited during the Early Dryas stadial. On the basis of the stratigraphical situation the finds can be dated to relatively soon (a few decennia?) before the beginning of the Allerød interstadial.

In the stream channel immediately to the south of the site the 'Layer of Usselo' merges into a brown peat layer. In the peripheral zone the peat layer contains wood remains (trunk fragments) of *Salix* and *Betula*, while further away from the bank abundant remains of *Carex* are mainly present. A C14-dating of the lowermost 1 cm of the peat layer (sample taken at a spot c. 3 m south of the fringe of its area of extent: fig. 10) gave the result: 11,340±100 B.P. (GrN-11.264), so it can be said that the peat layer formed during the second half of the Allerød interstadial.

Above the peat layer, and the 'Layer of Usselo', a thin layer of Younger Cover-sand II is locally present, that becomes increasingly thinner towards the south (in the stream channel). Coming out of this sand layer are frost fissures penetrating through the brown peat layer (figs. 15, 16); these must have originated during the Late Dryas.

For the purpose of comparison with the stratigraphical data of Oldeholtwolde, a profile at Oldeholtpa is briefly discussed. Here, under the 'Layer of Usselo', cover-sand with thin loamy bands is also present, and below it extremely loamy cover-sand, that most probably must be regarded as Older Cover-sand. This supports the chronostratigraphical interpretation of the profile at Oldeholtwolde.

In the middle of the find concentration a constructed hearth (diameter c. 1.5 m) was found (figs. 19–27). This consisted of a heart-shaped configuration of flat stones (average thickness c. 2 cm) in a shallow depression. In the centre an hollowed-out pit (diameter c. 35×50 cm, depth c. 10 cm) was present, of which the bottom and sides were paved with closely set, flat stones. Charcoal (probably mostly from burnt brushwood) was present *under* the stones. A C14-sample of the charcoal from the central pit gave the dating: 11,540±270 B.P (GrN-10.274). Outside the hearth, too, many scattered stones were present. In view of the presence of black patches of charring on them most of these must have once lain in the hearth. In my opinion there are no good indications of a 'tent structure' or anything similar to be found in the distribution of the stones.

Among the points, in addition to the shouldered points that are normal for the Hamburg tradition also tanged points and Gravette/Tjonger points are present. These appear to support a late dating of the site: in this region Tjonger points are especially typical for the *Federmesser* tradition that can be dated mainly in the Allerød interstadial.

In my opinion it can be concluded with a reasonable degree of certainty that the site at Oldeholtwolde dates from the final phase of the Early Dryas stadial. There is some reason to assume that this site does not represent a winter camp.

10. REFERENCES

ALLAIN, J., 1974. Circonscription du Centre. *Gallia Préhistoire* 17, pp. 465–485.

BARTON, R.N.E. & C.A. BERGMAN, 1982. Hunters at Hengistbury: some evidence from experimental archaeology. *World Archaeology* 14, pp. 237–248.

BATCHELOR, D., 1979. The use of quartz and quartzite as cooking stones. In: G. Bosinski (ed.), *Die Ausgrabungen in Gönnersdorf 1968-1976 und die Siedlungsbefunde der Grabung 1968* (= Der Magdalénien-Fundplatz Gönnersdorf, Bd. 3). Wiesbaden, pp. 154–165.

BOHMERS, A., 1947. Jong-Paleolithicum en Vroeg-Mesolithicum. In: H.E. van Gelder *et al.*, *Een kwart eeuw oudheidkundig bodemonderzoek in Nederland* (= Gedenkboek A.E. van Giffen). Meppel, pp. 129–201.

BOHMERS, A., 1960. Statistiques et graphiques dans l'étude des industries lithiques préhistoriques. V. Considérations générales au sujet du Hambourgien, du Tjongerien, du Magdalénien et de l'Azilien. *Palaeohistoria* 8, pp. 15–37.

BOKELMANN, K., 1979. Rentierjäger am Gletcherrand in Schleswig-Holstein? Ein Diskussionsbeitrag zur Erforschung der Hamburger Kultur. *Offa* 36, pp. 12–22.

BOSINSKI, G., 1978. Der Poggenwisch-Stab. *Bonner Jahrbücher*. 178, pp. 83–92.

BOSINSKI, G., 1979. *Die Ausgrabungen in Gönnersdorf 1968–1976 und die Siedlungsbefunde der Grabung 1968* (=Der Magdalénien-Fundplatz Gönnersdorf, Bd. 3). Wiesbaden.

BURDUKIEWICZ, J.M., 1981a. The flint technology of the Hamburgian Culture (Olbrachcice, S.A. Poland). *3e Intern. Symposium over Vuursteen-3rd Intern. Symposium on flint* (=Staringia 6). Heerlen, pp. 67–70.

BURDUKIEWICZ, J.M., 1981b. Creswellian and Hamburgian (the Shouldered Point technocomplex). *Archaeologia interregionalis* 1 (=Actes du Colloque International organisé dans le cadre de Xe Congrès U.I.S.P.P. à Mexico), pp. 43–56.

CLEVERINGA, P., W. DE GANS, E. KOLSTRUP & F.P. PARIS, 1977. Vegetational and climatic developments during the Late Glacial and the Early Holocene and aeolian sedimentation as recorded in the Uteringsveen (Drente, The Netherlands). *Geologie en Mijnbouw* 45, pp. 234–242.

COOPE, G.R. & W. PENNINGTON, 1977. The Windermere Interstadial of the Late Devensian. *Philosophical Transactions of the Royal Society of London* B. 280, pp. 337–339.

COOPE G.R. & M.J. JOACHIM, 1980. Lateglacial environmental changes interpreted from fossil Coleoptera from St. Bees, Cumbria, N.W. England. In: J.J. Lowe, *et al.* (eds.) *Studies in the Lateglacial of North-West Europe.* Oxford, pp. 55–68.

CORBIN, J.E., 1975. *Aniganigaruk: a study in Nunamiut Eskimo archeology.* Diss., Washington.

CORBIN, J.E., 1976. Early historic Nunamiut house types. An ethnographic description with archaeological identification, comparison, and validation. In: E.S. Hall Jr. (ed.), *Contributions to Anthropology: the interior peoples of Northern Alaska* (=National Museum of Man, Mercury series, paper 49). Ottawa, pp. 135–176.

DYLIK, J. & G.C. MAARLEVELD, 1967. Frost cracks, frost fissures and related polygons. *Mededelingen van de Geologische Stichting* N.S. 18, pp. 7–21.

EDELMAN, C.H., 1951. Niveo-aeolische afzettingen. *Geologie en Mijnbouw* N.S. 13, pp. 288–289.

FRENCH, H.M., 1976. *The periglacial environment.* London/New York.

GEEL, B. VAN & E. KOLSTRUP, 1978. Tentative explanation of the Late Glacial and Early Holocene climatic changes in North-Western Europe. *Geologie en Mijnbouw* 57, pp. 87–89.

GEEL, B. VAN, S.J.P. BOHNCKE & H. DEE, 1980/1981. A palaeoecological study of an upper Late Glacial and Holocene sequence from "De Borchert", The Netherlands, *Review of Palaeobotany and Palynologie* 31, pp. 367–448.

HALL JR., E.S., 1976. Preliminary analysis of house types at Tukuto Lake, Northern Alaska. In: E.S. Hall Jr. (ed.), *Contributions to Anthropology: the interior peoples of Northern Alaska* (=National Museum of Man, Mercury Series 49). Ottawa, pp. 98–134.

HAMMEN, T. VAN DER, 1951. *Late-glacial flora and periglacial phenomena in the Netherlands* (=Leidse Geologische Mededelingen 17). Diss. Leiden, pp. 71–183.

HAMMEN, T. VAN DER, G.C. MAARLEVELD, J.C. VOGEL & W.H. ZAGWIJN, 1967. Stratigraphy, climatic succession and radiocarbon dating of the Last Glacial in the Netherlands. *Geologie en Mijnbouw* 46, pp. 79–95.

KOLSTRUP, E., 1982. Late-glacial pollen diagrams from Hjelm and Draved Mose (Denmark) with a suggestion of the possibility of drought during the Earlier Dryas. *Review of Palaeobotany and Palynology* 36, pp. 35–63.

KOLSTRUP, E. & I. HEYSE, 1980. A different Late-Glacial vegetation and its environment in Flanders (Belgium). *Pollen et Spores* 22, pp. 469–481.

LANTING, J.N. & W.G. MOOK, 1977. *The pre- and protohistory of the Netherlands in terms of radiocarbon dates.* Groningen.

LEROI-GOURHAN, A. & M. BRÉZILLON, 1972. *Fouilles de Pincevent. Essai d'analyse ethnographique d'un habitat Madalénien (la section 36)* (=VIIe Suppl. Gallia Préhistoire). Paris.

LOWE, J.J. & J.M. GRAY, 1980. The stratigraphic subdivision of the Lateglacial of NW Europe: a discussion. In: J.J. Lowe *et al.* (eds.), *Studies in the Lateglacial of North-West Europe.* Oxford, pp. 157–175.

LOWE, J.J., J.M. GRAY & J.E. ROBINSON (eds.), 1980. *Studies in the Lateglacial of North-West Europe.* Oxford.

MAARLEVELD, G.C., 1976. Periglacial phenomena and the mean annual temperature during the last glacial time in the Netherlands. *Biuletyn Peryglacjalny* 26, pp. 57–78.

MAKKEN, H. & G. RUTTEN, 1971. *De bodemgesteldheid van het ruilverkavelingsgebied Midden-Tjonger.* Wageningen.

MANGERUD, J., 1970. Late Weichselian vegetation and ice-front oscillations in the Bergen district, western Norway. *Norsk Geografisk Tidsskrift* 24, pp. 121–148.

MANGERUD, J., S.T. ANDERSEN, B.E. BERGLUND & J.J. DONNER, 1974. Quaternary stratigraphy of Norden, a proposal for terminology and classification. *Boreas* 3, pp. 109–127.

MANGERUD, J., 1980. Ice-front variations of different parts of the Scandinavian ice sheet, 13,000–10,000 years B.P. In: J.J. Lowe, *et al.* (eds.), *Studies in the Lateglacial of North-West Europe.* Oxford, pp. 23–30.

MAUSS, M. 1979 (1904–5). *Seasonal variations of the Eskimo.* (or. publ.: Essai sur les variations saisonnières des sociétés Eskimos: étude de morphologie sociale; Sociologie et Anthropologie VII). London.

ODELL, G., 1978. Préliminaire d'une analyse fonctionelle des pointes microlithiques de Bergumermeer (Pays-Bas). *Bulletin de la Société Préhistorique Française* 75, pp. 37–49.

PERLÈS, C., 1977. *Préhistoire du feu.* Paris.

RUST, A., 1937. *Das altsteinzeitliche Rentierjägerlager Meiendorf.* Neumünster.

RUST, A., 1943. *Die alt- und mittelsteinzeitlichen Funde von Stellmoor.* Neumünster.

RUST, A., 1951. Uber die kulturentwicklung des endglazialen Jungpaläolithikums in Nordwesteuropa. *Festschrift Gustav Schwantes. Neumünster*, pp. 48–58.

RUST, A., 1958. *Die jungpaläolithischen Zeltanlagen von Ahrensburg* (= Offa Bücher, Bd. 15) Neumünster.

RUST, A., 1962. *Vor 20.000 Jahren; Rentierjäger der Eiszeit.* Neumünster.

SCHMIDER, B., 1971. *Les industries lithiques du Paléolithique Supérieur en Ile-de-France* (=VIe Suppl. Gallia Préhistoire). Paris.

SCHMIDER, B., 1979. Un nouveau faciès du Magdalénien final du Bassin Parisien: L'indústrie du gisement du Pré des Forges à Marsangy. In: D. de Sonneville-Bordes (ed.), *La fin des temps glaciaires en Europe.* Paris, pp. 763–771.

SCHMIDER, B., 1981. Les particularités dans le développement du Magdalénien du Centre du Bassin Parisien et ses rélations avec les cultures de la Plaine de l'Europe due Nord. *Archaeologia interregionalis* 1 (= Actes du Colloque Intern. organisé dans le cadre de Xe Congr. U.I.S.P.P. à Mexico), pp. 117–130.

SCHWABEDISSEN, H., 1937. Die Hamburger Stufe im nordwestlichen Deutschland. *Offa* 2, pp. 1–30.

SCHWABEDISSEN, H., 1951. Zur Besiedlung des Nordseeraumes in der älteren und mittleren Steinzeit. *Festschrift Gustav Schwantes.* Neumünster, pp. 59–77.

SPIESS, A.E., 1979. *Reindeer and Caribou hunters; an archaeological study.* New York.

STAPERT, D., 1981. A site of the Hamburg tradition on the Wadden island of Texel (prov. of North Holland, the Netherlands). *Palaehistoria* 23, pp 1–27.

STURDY, D.A., 1975. Some reindeer economies in prehistoric Europe. In: E.S. Higgs (ed.), *Palaeoeconomy.* Cambridge, pp. 55–95.

TAK-SCHNEIDER, U. VAN DER, 1968. Cracks and fissures of post-Allerød age in the Netherlands. *Biuletyn Peryglacjalny* 17, pp. 221–225.

TROMNAU, G., 1975. *Neue Ausgrabungen im Ahrensburger Tunneltal.* Neumünster.

VERBRUGGEN, C.L.H., 1979. Vegetational and palaeoecological history of the Lateglacial period in Sandy Flanders (Belgium). *Acta Univ. Oul., A 82, Geol. 3,* pp. 133–142.

WATTS, W.A., 1980. Regional variation in the response of vegetation to Lateglacial climatic events. In: J.J. Lowe *et al.* (eds.), *Studies in the Lateglacial of North-West Europe.* Oxford, pp. 1–21.

WEE, M.W. TER, 1966. *Toelichtingen bij de Geologische Kaart van Nederland 1:50.000. Blad Steenwijk Oost.* Haarlem.

WEE, M.W. TER, 1979. *Toelichtingen bij de Geologische Kaart van Nederland 1:50.000. Blad Emmen West & Oost.* Haarlem.

WIGGERS, A.J., 1973. De geologische werking van de wind. In: A.J. Pannekoek (ed.), *Algemene Geologie.* Groningen, pp. 353–366.

ZOLLER, D., 1963. Vorläufiger Bericht über eine Rentierjägerstation der Hamburger Stufe bei Querenstede, Kr. Ammerland. *Die Kunde* N.F. 14, pp. 17–25.

ZOLLER, D., 1981. Neue jungpaläolithische und mesolithische Fundstellen im nordoldenburgischen Geestgebiet. *Archäologische Mitteilungen aus Nordwestdeutschland* 4, pp. 1–12.

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Figs. 12 and 28 are to be found in the fold at the back of this volume.