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TWO FINDSPOTS OF THE HAMBURGIAN TRADITION IN THE NETHERLANDS DATING FROM THE EARLY DRYAS STADIAL: STRATIGRAPHY

by

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The stratigraphy of two sites of the Hamburgian tradition in The Netherlands (Oldeholtwolde, Luttenberg) is discussed. In both cases the finds occur in Younger Cover Sand I, and therefore most probably date from the Early Dryas Stadial (the short stadial between the Allerød and Bølling Interstadials). A difference in lithology between the Younger Cover Sand I in resp. the northern and the eastern Netherlands is described and provisionally explained by assuming that the southern border of a (probably discontinuous) permafrost was located approximately in the valley of the river Vecht during the deposition of Younger Cover Sand I.

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Contents:

SAMENVATTING

Twee vindplaatsen van de Hamburg traditie in Nederland, daterend uit het Vroege Dryas Stadiaal: stratigrafie.

De stratigrafie van twee vindplaatsen van de Hamburg traditie in Nederland (Oldeholtwolde en Luttenberg, resp. in Friesland en Overijssel) wordt besproken. In beide gevallen werden de vondsten aangetroffen in het Jong Dekzand I en zeer waarschijnlijk dateren zij daarom uit het Vroege Dryas Stadiaal (het korte stadiaal tussen de Allerød en Bølling Interstadialen). Een verschil in lithologie van het Jong Dekzand I in resp. het noordelijk en oostelijk deel van Nederland wordt beschreven en voorlopig verklaard door aan te nemen dat de zuidgrens van een (waarschijnlijk discontinue) permafrost tijdens de afzetting van het Jong Dekzand I ongeveer in de vallei van de Vecht was gelegen.

INTRODUCTION

Since 1975 the Biological-Archaeological Institute, Groningen, has excavated several new sites of the Hamburgian tradition in the northern half of The Netherlands.

Two of them, Oldeholtwolde, in the province of Friesland, and Luttenberg, in the province of Overijssel (fig. 1), occurred in an undisturbed situation, so the stratigraphical position of the finds could be studied in detail. At the Oldeholtwolde site, moreover, a large constructed hearth was discovered, from which a ^{14}C dating is available (Stapert, 1982).

Fig. 1. Map of The Netherlands, showing the locations of the Hamburgian sites at Oldeholtwolde (1) and Luttenberg (2).

The collected stratigraphic evidence strongly suggests a dating of both findspots in the Early Dryas Stadial (the short stadial between the Bølling and Allerød Interstadials). The finds occur in both cases in Younger Cover Sand I. Sections at the sites reveal, however, a difference in lithology of the contemporaneous cover sand layers between the two sites.

The text was read critically by G.H.J. Ruegg and J. de Jong (State Geological Survey, Haarlem), and by Dr. A.J. van Loon (KEMA, Arnhem), for which I would like to thank them here. The english text was improved by Dr. J.J. Butler.

THE LATE GLACIAL

In this section a few summarizing remarks are made about what is currently known concerning the climatic development and stratigraphy of the Late Glacial in The Netherlands, as a background for the description of the Hamburgian sites.

Climatic development

The current biostratigraphical zonation of the Late Glacial is still based on the palynological work by Iversen (*i.a.* 1954) at Bøllingsø (see fig. 2). He divided the Late Glacial into a series of stadials and interstadials. During the stadials trees were for the greatest part absent, and this was caused according to Iversen by too low temperatures. At the same time, however, it was clear that the environment was rather dry, in view of the presence of steppe plants like *Artemisia* and *Helianthemum*, at least during the first part of the Late Glacial.

The Allerød Interstadial could be ascertained at many sites in Europe since Iversen's work, but his Bølling Interstadial was more difficult to establish in other regions (see the discussion by Watts, 1980). The Bølling Interstadial was demonstrated by van der Hammen (1952) at the classic site of Usselo in The Netherlands. Here the "Usselo Layer" was defined by van der Hammen. This fossil soil merged into a layer of detritus-gyttja dating from the Allerød Interstadial.

As a result of the work by Coope (*i.a.* 1975, 1977a & b) on Late Glacial Coleoptera, and recent pollen diagrams from northwestern Europe (*e.g.* Cleveringa *et al.*, 1977; Van Geel *et al.*, 1980/1981; Kolstrup, 1982; Usinger, 1975, Verbruggen, 1975) it has become more and more obvious that trees did not decline during the stadials because of too low temperatures, but rather because of drought (see also Van Geel & Kolstrup, 1978).

Coope demonstrated the presence of only one Late Glacial interstadial, the Windermere Interstadial (roughly equivalent to Bølling *s.l.* + Early Dryas + Allerød). Relatively high temperatures prevailed during the first part of the Bølling Interstadial *s.l.*, after which temperatures gradually became lower. Thus, during the second half of the Allerød pollen zone it was relatively cool according to Coope (in conventional pollen analyses this phase was seen as the warmest part of the Late Glacial!).

Kolstrup & Buchardt (1982) reported on the investigation of Late Glacial lake deposits at Graenge in Denmark. The $^{16}O/^{18}O$ analysis showed that here the Early Dryas Stadial was warmer than the Allerød Interstadial, whereas temperatures dropped gradually during the Allerød Interstadial, thus supporting the conclusions of Coope. Kolstrup (1982) stressed the possibility of conditions of drought during the Early Dryas Stadial as the main decisive factor for the declining *Betula* curves

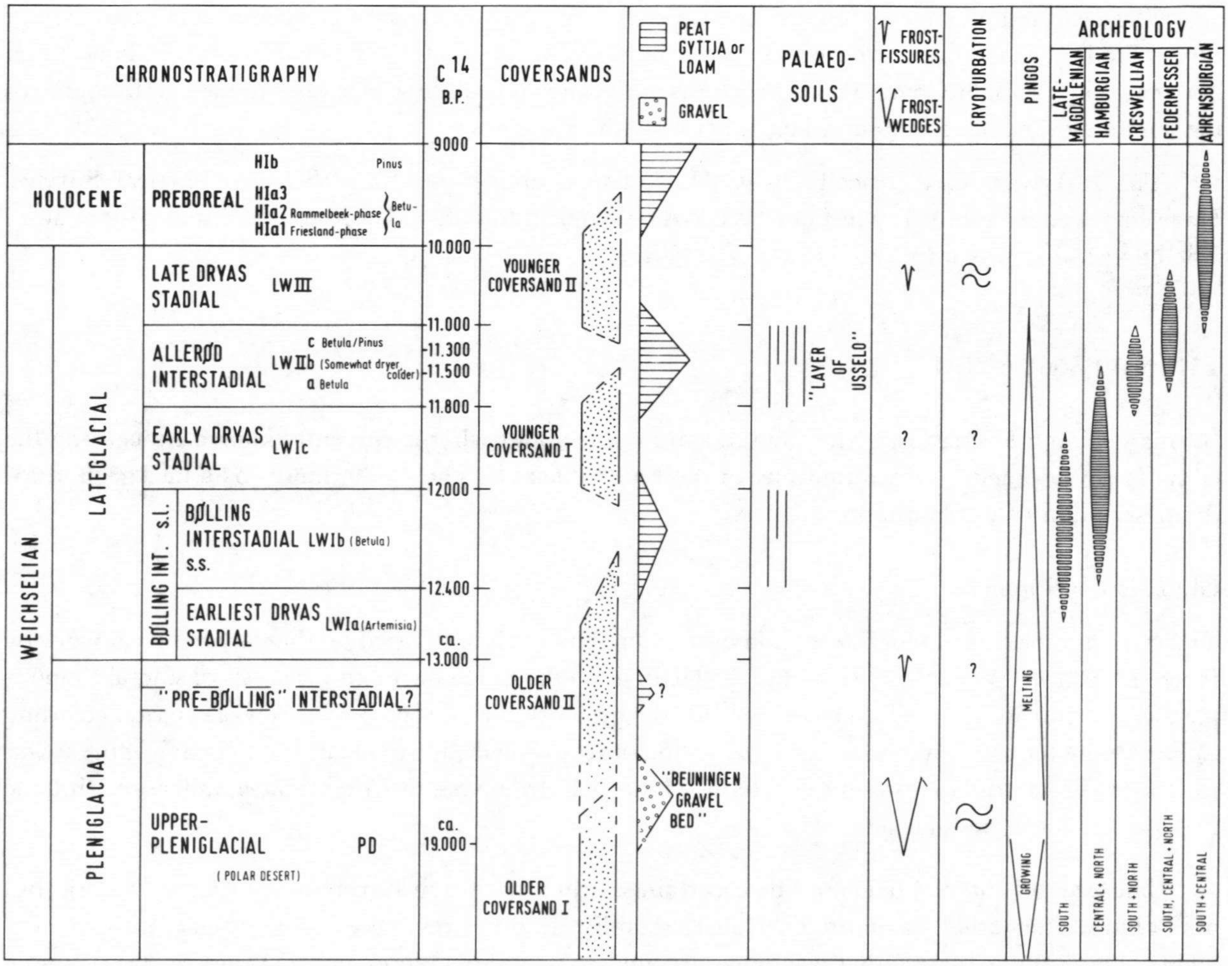

Fig. 2. Schematic stratigraphical table for the Late Glacial in The Netherlands. At the right the possible distribution in time is indicated of the Late Palaeolithic traditions that are known in The Netherlands.

during this zone. The trees could under these circumstances probably not survive winters with little snow cover, and perhaps winds were stronger than nowadays (Kolstrup, 1982). Nevertheless, *Betula pubescens* Ehrh. seems to have been present in northern Europe during the Early Dryas Stadial.

Riezebos & Slotboom (1984) reported that in pollen diagrams the Allerød Interstadial often shows a tripartition. This phenomenon is also visible in the curve of Camp Century (Dansgaard *et al.*, 1971). It seems that in the middle of the Allerød Interstadial, approximately between 11,500 and 11,300 B.P., there was a cooler and/or dryer phase.

That the Late Dryas Stadial was relatively cold is not contested by Coope. Still, summer temperatures cannot have been very low. Casparie & van Zeist (1960) reported the presence of *Typha latifolia* L. during the Late Dryas Stadial at Waskemeer in the Northern Netherlands. Wijmstra & de Vin (1971) also mentioned *Typha latifolia* from the Late Dryas Stadial (Dinkel Valley, Eastern Netherlands). Therefore, Kolstrup (1982) suggested mean July temperatures of 12-13° C for the Late Dryas Stadial in Denmark.

It has often been proposed, furthermore, that the Late Dryas Stadial was relatively "oceanic", compared with the more "continental" conditions during earlier phases of the Late Glacial, on the basis of the presence of *Empetrum* in pollen diagrams for this zone (*e.g.* van der Hammen, 1952). See for a comparison of an older temperature curve based on pollenanalysis, with the curve of Coope and a recent curve of Kolstrup: fig. 3.

Thus a complicated picture has now been arrived at, in which the different Late Glacial environments are considered to be not only the result of fluctuations in temperature, but also of fluctuations in precipitation or atmospheric moisture content. Several other factors are known to have been operative, too.

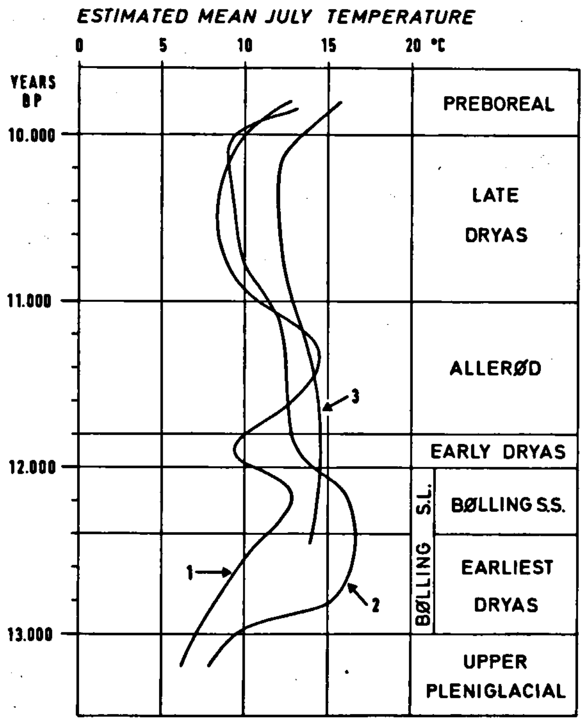

Fig. 3. Some selected mean summer temperature curves for the Late Glacial. 1. After Zagwijn, 1975; 2. after Coope, 1975; 3. after Kolstrup, 1982.

It seems clear, for example, that the local topography can be of vital importance for understanding the type of vegetation that will prevail under specific circumstances. Thus, pingo remnants provided without doubt much better conditions for tree growth than extensive flat areas, because of their relatively higher moistness, and also because more snow was perhaps accumulating there during the winters, protecting local birch stands (see Kolstrup & Heyse, 1980). In this respect it seems significant that the provisional pollen diagram of an Allerød peat layer at Oldeholtwolde (see under Oldeholtwolde, stratigraphy), situated in a flat valley plain, partly more closely resembles "pleniglacial" diagrams than Allerød diagrams obtained from samples from the fillings of pingo remnants (S. Bottema, pers. comm.; see also Van Leeuwaarden, n.d.). Van der Hammen & Bakker (1971) presented a palaeovegetation map of a part of the Dinkel Valley for the late Allerød Interstadial. In brook valleys *Betula* would have been dominating, with higher numbers of Cyperaceae (and low percentages for *Pinus*), while on sand ridges pine forests were present.

Van Geel & Kolstrup (1978) are of the opinion that changes in atmospheric circulation patterns caused the different climatic conditions during various stages of the Late Glacial (see also Lamb, 1977). Campo (1984) stresses the important influence of the temperature of the surface waters in the eastern Atlantic on the vegetations in Western Europe during the Pleniglacial and the Late Glacial.

Large frost wedges are known from the Beuningen Gravel Bed, dating from the Upper Pleniglacial (approximately 19,000 B.P.), during which time a conspicious permafrost must have been present (Dylik & Maarleveld, 1967; van der Hammen *et al.*, 1967; Maarleveld, 1964, 1976; Kolstrup, 1980). The Older Cover Sand I underneath this level is usually strongly affected by cryoturbation. The Older Cover Sand II, however, only rarely seems to contain frost cracks, and also cryoturbatic involutions mostly seem to be absent. From the Younger Cover Sand I a few small frost fissures are known from the region to the south of the River Rhine (Maarleveld, 1976); from the northern half of The Netherlands frost fissures are not yet known to occur in the Younger Cover Sand I, however. Frost fissures and small cryoturbatic disturbances have been documented in relatively great numbers for the Late Dryas Stadial (Dylik & Maarleveld, 1967; Maarleveld, 1964, 1976; van der Tak-Schneider, 1968). They also occur at Oldeholtwolde (see under "Oldeholtwolde; stratigraphy").

The smaller frost fissures, dating from the Late Dryas Stadial, do not necessarily indicate the presence of a continuous or discontinuous permafrost during that zone (Maarleveld, 1976). Even with relatively warm summers they could develop in a seasonal frost layer during severe winters with little or no snow cover. Larger frost wedges seem to be largely absent during the Late Dryas Stadial, although Maarleveld (1964) mentions one from Amersfoort.

Zoller (1981), however, described a wedge cast from Giesselhorst (Ldkr. Ammerland) in Western Germany. This frost wedge was 40-50 cm wide at the top and extended for about 1 m downwards. The top of the wedge occurred just above the "Usselo Layer", so the structure dates from the Late Dryas Stadial. In the "Usselo Layer", and immediately on top of it, artefacts were found that can probably be ascribed to the Creswellian tradition, in view of the presence of Creswell and Cheddar points and long blade endscrapers. In the filling of the frost wedge artefacts were also present, down to approximately 40 cm underneath its top. Consequently, these finds could date from the Allerød Interstadial. Perhaps this frost wedge could indicate the local presence of a (discontinuous) permafrost during the time of its formation, *i.e.* the Late Dryas Stadial?

As mentioned above, frost fissures are hardly known from the Older Cover Sand II. This could give the wrong impression, that the permafrost had then already disappeared entirely from this region. However, as Wijmstra & van der Hammen (1971) noted: "... an extremely dry climate, with a very low tjäle in sandy soil, may account for the absence of frost phenomena. Such problems make one realize how much of the history of the Last Glacial is still unknown". Perhaps the same explanation could be valid for the absence in the northern Netherlands of frost fissures in the Younger Cover Sand I? (see under Discussion).

Many pingos formed during a period with continuous permafrost, somewhere between 25-19,000 B.P. (de Gans, 1981). Between 18-13,000 B.P. the ice cores in most of them melted, so that pingo remnants were formed; some of these, however, are younger and originated during the Bølling Interstadial, or even during the Early Dryas Stadial (see *e.g.* Casparie & van Zeist, 1960; Paris *et al.*, 1979; de Gans, 1981). It is known that during the Late Glacial most pingo remnants held water (gyttjas were deposited), and this is probably the reason why Late Paleolithic findspots are located on their ramparts (for example Oosterhesselen in the province of Drente: Stapert, 1984). Most pingo remnants have depths between 2 and 17 m (de Gans, 1981).

A "Pre-Bølling Interstadial" has not yet been definitely demonstrated in The Netherlands. There are a few indications, however, that point to the possible existence of a short interstadial at c. 14,000 B.P. Kolstrup (1980) investigated a thin layer of loam (gyttja-like) at the base of a layer of Older Cover Sand II at Epe (province of Gelderland). A ^{14}C date of 14,000 ± 150 B.P. (GrN-8509) was obtained for the loam layer. On the basis of pollenanalysis Kolstrup comes to the conclusion that the mean January temperature was -8° C or higher, and the mean July temperature approximately 12° C during the deposition of the loam layer. At Usselo, approximately 0.5 m below the Bølling level, a thin organic band was found to be present (Stapert & Veenstra, in press). This layer has not yet been dated; the pollenanalysis is being carried out by B. van Geel (Amsterdam). Finally it can be mentioned here, that the Camp Century curve shows a somewhat warmer peak underneath the Bølling Interstadial, that can be dated approximately 1000 years before the Bølling Interstadial (Dansgaard et al., 1971).

Cover sands

During the Pleniglacial and the Late Glacial cover sands were deposited in The Netherlands, and also elsewhere in northern Europe. The wide geographical distribution of these mainly aeolian sediments in itself points to rather dry conditions. The stratigraphy of the cover sands, especially in the eastern Netherlands, has been established by van der Hammen (see *i.a.* van der Hammen, 1952; van der Hammen *et al.*, 1967; van der Hammen & Wijmstra, 1971). Older Cover Sands date from before the Bølling Interstadial, Younger Cover Sands from after this interstadial (see fig. 2).

Older Cover Sand I occurs stratigraphically beneath the Beuningen Gravel Bed (van der Hammen, 1952; van der Hammen *et al.*, 1967). Mostly this sediment is markedly distorted by cryoturbation, and it can be coarser than the Older Cover Sand II. The Beuningen Gravel Bed, with its large frost wedges (see *e.g.* Kolstrup, 1980), has been mentioned already. It is overlain by the Older Cover Sand II. In the eastern Netherlands this unit is clearly parallel bedded, and characterized by the presence of thin layers of loam and/or fine sand that can sometimes be traced over considerable distances. Wijmstra & Schalke (1971) mention the fact, however, that in a few cases the Older Cover Sand II does not possess these "loamy bands" in the Dinkel Valley. As mentioned above, the Older Cover Sand II rarely shows frost fissures or cryoturbation.

The Bølling Interstadial is often represented in the eastern Netherlands by the "Lower Loamy Bed" (*i.a.* Van der Hammen & Wijmstra, 1971), that perhaps partly represents a fossil soil. Elsewhere the Bølling Interstadial seems to be locally represented by a bleached band in the cover sand (Bohmers & Houtsma, 1961; see under Discussion). In many places, however, *e.g.* at the classic site of Usselo, the Bølling Interstadial is not represented by a soil of any kind, not even by a bleached band in the cover sand (Stapert & Veenstra, in press).

Above the "Lower Loamy Bed" Younger Cover Sand is present, that is divided into Younger Cover Sand I and II. In many cases between these two layers one encounters the "Usselo Layer", a fossil soil, mostly visible as a bleached band in the cover sand with charcoal particles, dating from the Allerød Interstadial (van der Hammen, 1952). The charcoal most probably derives from natural forest fires. Generally, Younger Cover Sands are coarser than Older Cover Sands and, in the eastern

Netherlands, do not normally possess "loamy bands". But Younger Cover Sand "... of normal habit may pass laterally into loamy cover sand" (van der Hammen *et al.*, 1967). Also Wijmstra & Schreve-Brinkman (1971) remark that "... locally the Younger Cover Sand I may be represented by a cover sand of the loamy Older Cover Sand type. This is the case in depressions". Younger Cover Sand I is often present in the form of ridges, the directions of which in general seem to be related to the local stream pattern (van der Hammen, 1971). Sometimes the dunes can be connected with former wind directions (Maarleveld, 1960; Maarleveld & van der Schans, 1961; Verbraeck, 1984). According to Verbraeck (1984), some cover sand dunes in the Gelderse Vallei probably consist of Older Cover Sand II, however.

As far as is known, the Younger Cover Sand II (dating from the Late Dryas Stadial) never shows "loamy bands". Also the Younger Cover Sand II locally occurs in the form of dunes.

Ter Wee (1979) distinguished three types of cover sands in the Emmen region in the province of Drente (in the northern Netherlands, *i.e.* to the North of the river Vecht, see fig. 1):

- Very loamy sand with thin loam layers. Occurs very locally (probably Older Cover Sand II).
- Yellow-greyish sands, clearly parallel bedded, with thin and somewhat darker layers consisting of loamy or fine sand. These "loamy bands" are characteristic for the Younger Cover Sand I in the northern Netherlands.
- Brownish to yellow-greyish sands, without clear layering. Younger Cover Sand II.

The last mentioned two types of cover sand are often separated by the "Usselo Layer". The first mentioned type of cover sand occurs especially in depressions. According to ter Wee cover sand with "loamy bands" is therefore especially characteristic for the Younger Cover Sand I in the northern Netherlands, in contrast to the eastern Netherlands, where this type of sediment is represented by the Older Cover Sand II.

Thus one gets the impression that the cover sands in the region to the South of the river Vecht are coarser than the contemporary deposits in the northern Netherlands. Veenstra & Winkelmolen (1971) have already pointed out such a conspicuous rise in coarseness in the region of the great rivers in the central Netherlands, going from N to S. The broad and flat valleys were probably a source for coarser cover sand when NW winds prevailed (see Maarleveld, 1960), that at a greater distance from these sources gradually became finer.

According to van der Hammen (1952), the type of cover sand with thin "loamy bands" can best be explained as having been deposited by snow storms. This view is shared by Wijmstra *et al.* (1971; see also: Edelman, 1951).

Ruegg (1983) discussed such laminated cover sands, and has a different opinion on the matter. He distinguished two types of aeolian sands:

- Type A. "Predominantly unimodal well-sorted uniform sands".
- Type B. "... intercalated yellowish and greyish evenly laminated sands ("layer cake" effect); greyish laminae are more or less silty; minor grain-size peaks occur in the coarse silt and/or in the 75-88 µm fractions".

The origin of the sand with loamy bands is, according to Ruegg, connected with the occurrence of alternating wet and dry depositional surfaces during the sedimentation. Dry (*i.c.* frozen) depositional surfaces may be present during winters, allowing the transport of coarser particles and the winnowing of fines. Thus the alternation of coarser and finer bands would be a seasonal phenomenon

(Ruegg, pers. comm.). Besides by permafrost, a wet surface during summers may locally be caused by the presence of an impermeable layer, till for instance, or a situation in a depression.

In the central Netherlands the Younger Cover Sands in general have a dry aeolian, and the Older Cover Sands a wet aeolian genesis, while in addition for the Older Coversand I locally a fluviatile origin can be assumed (Ruegg, 1983). See for a recent discussion of cover sands in the Gelderse Vallei: Verbraeck, 1984.

OLDEHOLTWOLDE

General remarks

Near Oldeholtwolde, in the valley of the river Tjonger, a site of the Hamburgian tradition was excavated in 1980 and 1981. The site lies at the foot of a slope of a relatively low cover sand ridge, along the rim of a Late Glacial/Holocene stream channel. In the part of the valley plain where the site is located, boulder clay is absent as a result of earlier erosion, so the Late Paleolithic hunters must have brought the flints and other stones that are present at the site from elsewhere, probably over a distance of approximately 0.5 km (Stapert, 1982).

Apart from hundreds of small pieces of charcoal and a few pieces of ochre, the finds consist of some 10,400 flint artefacts and 1,126 stones. The total weight of all the stones is about 46 kg, and that of all the flints about 4 kg, together somewhat more than 50 kg. Since a part of the material originally present is missing, that can be estimated as max. 1/6, there must have been brought to the site a total weight of at the most 60 kg of flints and other stones.

Many stones and flint artefacts were broken secondarily by frost splitting, undoubtedly during the Late Dryas Stadial. According to the first count (before the refitting work), there are of the total of approximately 10,400 flint artefacts only 1,668 larger than 1.5 cm, of which 339 were classified as "tools". Among the remaining 8,745 "splinters" of flint, more than 3,550 are smaller than 0.5 cm ("micro-splinters"), that probably originated largely as a result of tool-retouching (see Stapert & Krist, in press; Stapert *et al.*, in press). The circumstance that so many tiny chips are still present at the site, and also the fact that they are found in compact concentrations, makes it evident that no conspicious disturbance of the finds has taken place secondarily, even not by the wind.

Among the tools, which are in general characteristic for the Hamburgian tradition, there are a number that deserve special interest. These include tanged points and Tjonger/Gravette points (fig. 4). Tanged points are known for example from the site of Havelte-Holtingerzand, that, according to Bohmers (1947), is a late Hamburgian site. Tjonger/Gravette points are especially characteristic for the Tjongerian (Federmesser) tradition, that can for the most part be dated in the Allerød Interstadial. These types therefore point to a possible late phase of the Hamburgian tradition at Oldeholtwolde.

In the middle of the find concentration (that has a diameter of approximately 6 m) a large constructed hearth was found. This consisted of a heart-shaped configuration, with a diameter of about 1.5 m, made of flat stones that have an average thickness of some 2 cm, in a shallow depression (see for a description Stapert, 1982). In the centre of the hearth a hollowed-out pit (diameter 35 × 50 cm, depth about 10 cm) was present, of which the bottom and sides were paved with closely set flat stones (fig. 5). Charcoal from burnt brushwood (*Salix*; W.A. Casparie, pers. comm.) was present *under* the stones. A ^{14}C sample of the charcoal from the central pit gave the dating: 11,540 ± 270 B.P. (GrN-10,274).

A multidisciplinary team of researchers is occupied with the study of this site. The team includes J.S. Krist (refitting of flint artefacts), A.L. Zandbergen (stones), J.L. Smit (spatial patterns), M.W.

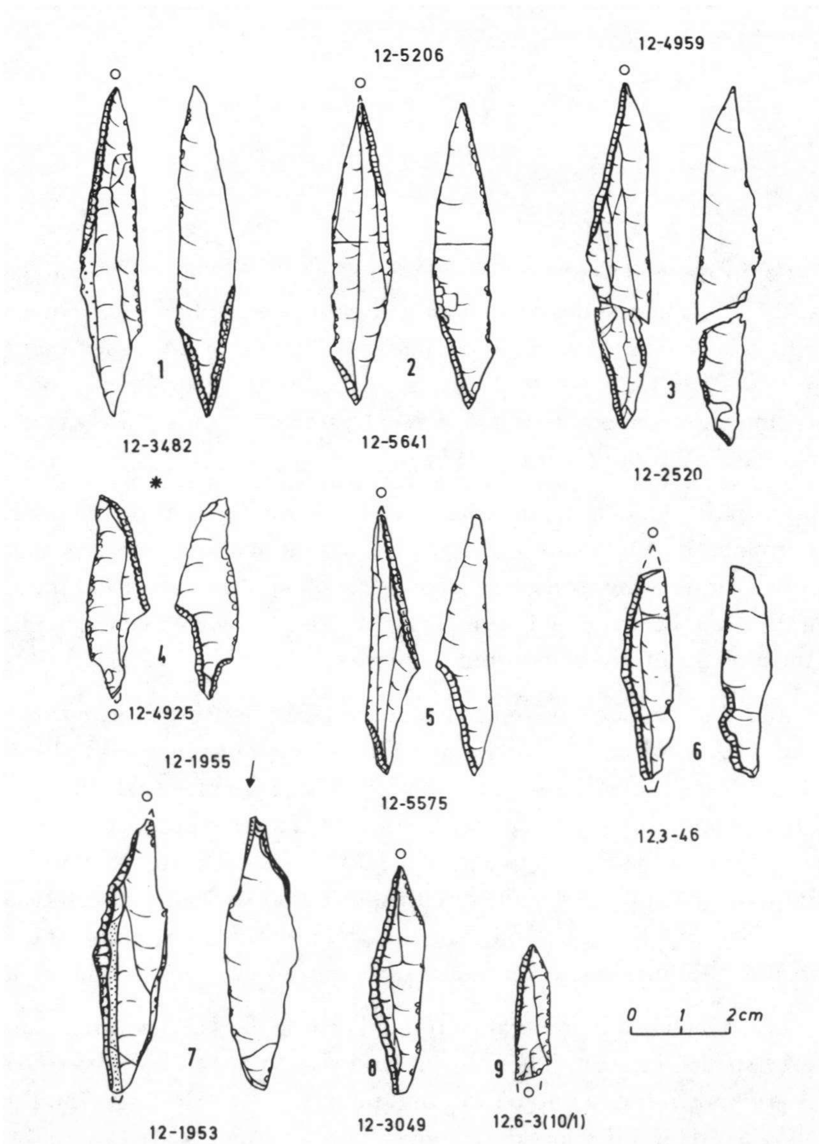

Fig. 4. A selection of some flint points from Oldeholtwolde (apart from these, there are several more points present, that for the most part belong to the category of "normal" shouldered points). Retouching is indicated by a slightly thicker outline. A closed circle indicates the position of the point 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 (most probably frost-splitting dating from the Late Dryas Stadial). No. 3 may have been broken already at the time when it was being worked; the basal part of this point was partly retouched again after the fracture occurred. 1-5. tanged points; 6. backed point with a slight nick about 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 tip (probably caused by its being used as a projectile); 8, 9. Gravette/Tjonger points.

Fig. 5. Central part of the hearth (with the small pit) at Oldeholtwolde. Just underneath the topsoil some remnants of the "Usselo Layer" are preserved.

ter Wee (State Geological Survey — geology), W.G. Mook (^{14}C dating), W.A. Casparie (B.A.I. — charcoal identification), S. Bottema (B.A.I. — palynology), I.L.M. Stuyts (wood identification), G.J. Boekschoten and A.P. Schuddebeurs (petrology) and E.H. Moss (London — use wear traces).

Stratigraphy

From information provided by M.W. ter Wee (State Geological Survey) it can be deduced that the site lies within the boundaries of a main stream channel that was about 18 m deep. Within this stream channel the boulder clay was eroded almost completely; from bottom to top it is filled up with brook deposits of the Twente Formation, containing coarse material at the bottom (Pleniglacial), Late Glacial cover sands (also belonging to the Twente Formation), and peat dating from the Late Glacial and the Holocene.

In many places at the site the "Usselo Layer" was found, a few decimetres below the topsoil (fig. 6). Above this soil, locally a thin layer of relatively coarse and not distinctly parallel layered cover sand was present. Below the "Usselo Layer" finer cover sand was found, distinctly parallel layered and in addition characterized by the presence of thin "loamy bands" that could sometimes be traced over distances of more than 5 m. These "loamy bands" increased in number and thickness downwards. This cover sand layer was approximately 2 m thick.

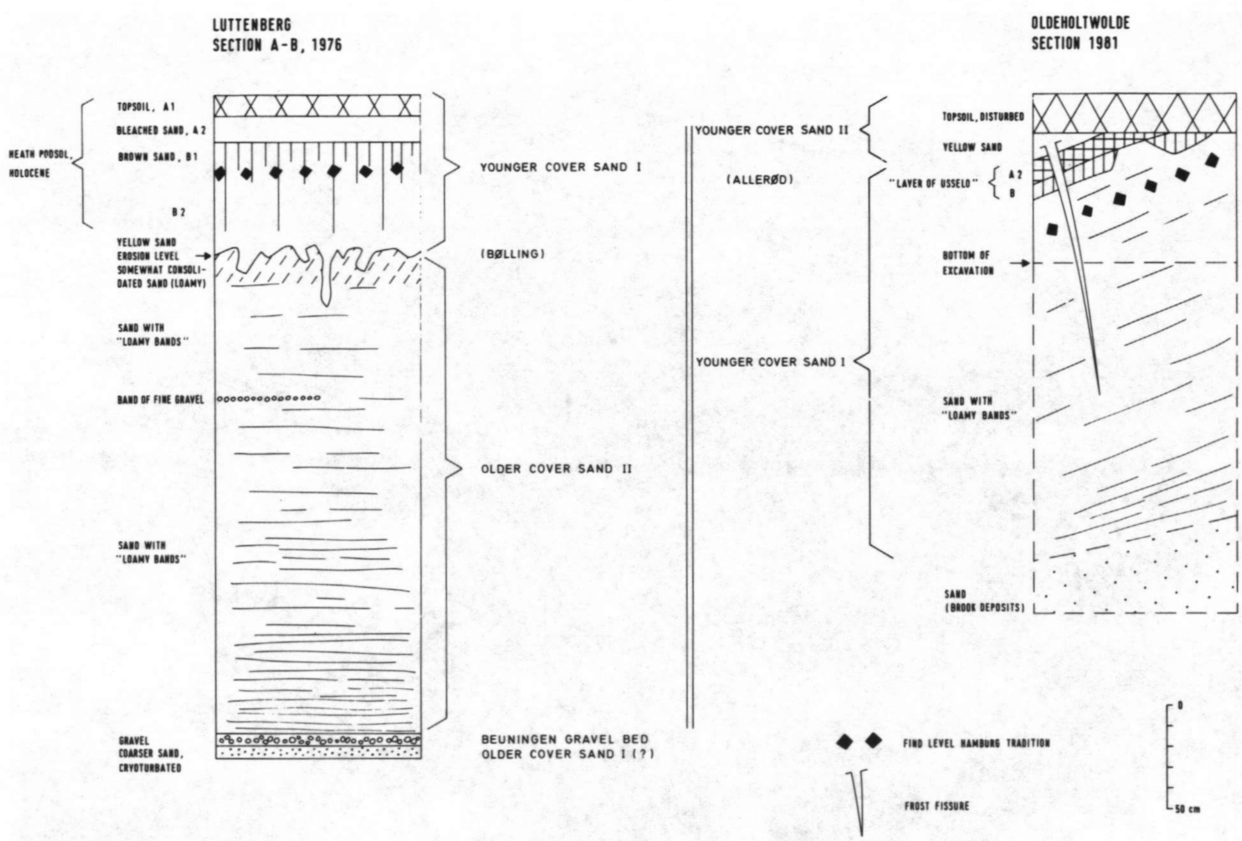

Fig. 6. Schematic drawing of the sections at the sites of Oldeholtwolde and Luttenberg.

According to ter Wee (pers. comm.) the upper cover sand is Younger Cover Sand II, deposited during the Late Dryas Stadial. At the site this layer is mostly only a few decimetres thick and locally absent altogether. The cover sand beneath the "Usselo Layer" is, according to ter Wee, Younger Cover Sand I, dating from the Early Dryas Stadial.

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 and roots (bioturbation). However, it was usually very well possible to establish the position of the original find layer with the help of many large flat stones that could not have been moved very far out of position. The find level was present on average some 30 cm below the top of the "Usselo Layer". This means that the people of the Hamburgian tradition lived here while the Younger Cover Sand I was still being deposited. In view of the total thickness of the Younger Cover Sand I (approximately 2 m) it can be deduced that the archeological material may be dated as slightly older than the end of the Early Dryas Stadial, almost at the beginning of the Allerød Interstadial. Of course, it is here assumed that the deposition of Younger Cover Sand I stopped at the beginning of the Allerød Interstadial, which is not certain (see Discussion).

Inside the stream channel immediately South of the site the following stratigraphy is present (from bottom to top): yellow sand, brown peat, yellow sand, black peat, topsoil. The brown peat layer between the two sand layer dates from the Allerød Interstadial: a ^{14}C dating from the lowermost 1 cm of this layer gave the following result: 11,340 ± 100 B.P. (GrN-11,264). The site lies within 10 m from the fringe of the distribution area of this peat layer. In the peripheral zone this peat layer con-

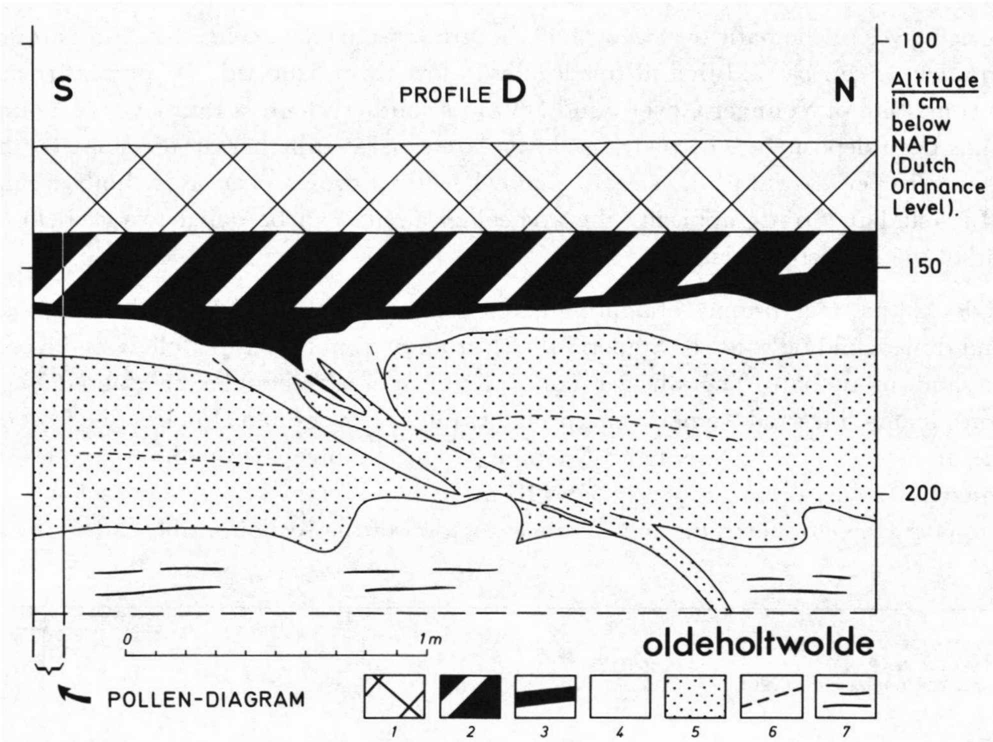

Fig. 7. Drawing of one of the frost fissures present in the stream channel immediately South of the site at Oldeholtwolde. Since the fissure has been exposed in an oblique ditch wall, and does not run perpendicularly with respect to the ditch wall, its dimensions are exaggerated on the drawing. At the top the fissure is about 20 cm wide. 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.

tains wood remains (trunk fragments) of *Salix* and *Betula* (I.L.M. Stuyts, pers. comm.), while further away from the bank abundant remains of monocotyls are present (pers. comm. by S. Bottema). In several places it could be observed that the "Usselo Layer" merges into this peat layer.

Above the peat layer and the "Usselo Layer", a thin layer of Younger Cover Sand II is present. It becomes increasingly thinner towards the central part of the stream channel, until it is only one grain thick, while the peat layer becomes increasingly thicker.

In the uppermost sand layer frost fissures start, up to some 20 cm in width, that penetrate the brown peat layer underneath (fig. 7); they must date from the Late Dryas Stadial. The peat layer also appears to be locally deformed by cryoturbation. As is evident from the drawing, the lowermost part of the black peat at the top, that dates from the Preboreal according to S. Bottema (pers. comm.), has been subjected to folding in the filling of this frost fissure. This could mean that the fissure was still active during the beginning of the Holocene. Higher up the slope, at the site, several thin frost cracks are present, that are up to only 1 cm wide. This difference in width is probably connected with a difference in moisture between the stream channel and the cover sand ridge. As indicated in the chapter "The Late Glacial. Climatic development", these relatively small frost fissures and cracks are also known elsewhere from the Late Dryas Stadial; they are not necessarily indicative of the presence of a permafrost during that zone.

Figure 8 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 (near a stream channel) 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 "Usselo Layer", and deeper — within the stream channel — by a brown peat layer, both dating from the Allerød Interstadial. Stratigraphically the archeological site can be dated to just before or in the beginning of the Allerød Interstadial.

At Oldeholtpa, at a distance of approximately 3 km SE of the Oldeholtwolde site, a section in a cover sand dune could be studied (Stapert, 1982); from bottom to top the following layers were present: fine sand (more than 10 cm thick, Eindhoven Formation ?); boulder clay (about 50 cm, Drente Formation); loamy fine sand (some 75 cm, probably Older Cover Sand II; a few fine frost cracks were observed); fine sand with "loamy bands" (some 20 cm, Younger Cover Sand I); "Usselo Layer" (approximately 12 cm); Younger Cover Sand II (more than 3 m thick, with a podsol at the top). This section supports the chronostratigraphical interpretation of the section at the Oldeholtwolde site.

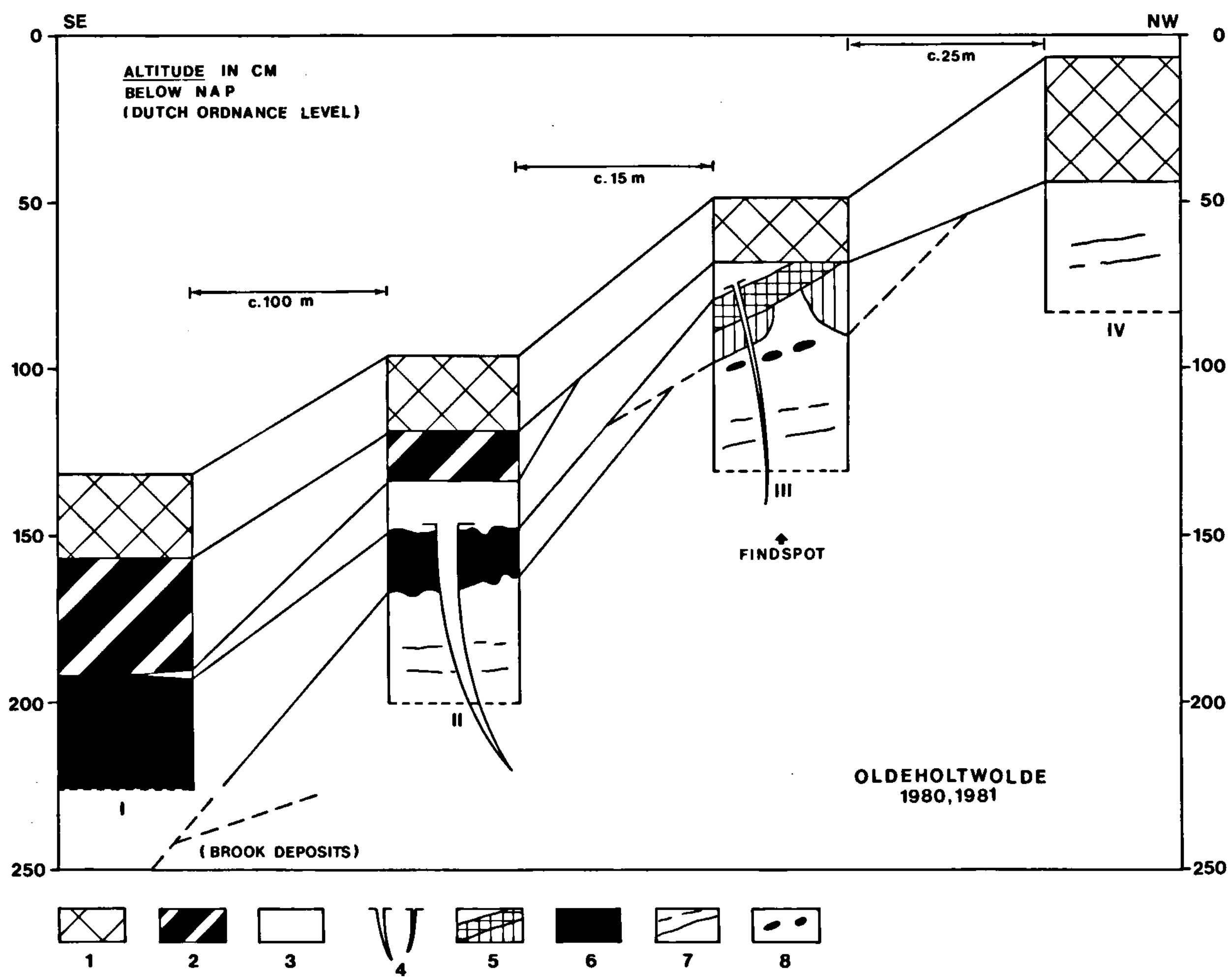

Fig. 8. Schematic overall profile (SE-NW) of the site at Oldeholtwolde and its surroundings. Legend: 1. topsoil; 2. Holocene peat; 3. Younger Cover Sand II; 4. frost fissures and frost cracks; 5. A2- and B-horizons of the "Usselo Layer"; 6. Allerød peat; 7. Younger Cover Sand I; 8. flat stones in the hearth at the site.

LUTTENBERG

General remarks

In 1972/1973 a site of the Hamburgian tradition was discovered near Luttenberg by the late Mr. R. ter Borg; he collected 663 artefacts from the centre of the find concentration. The finds were embedded in cover sand. As the remaining part of the site was undisturbed for the most part, it was decided to carry out an excavation. Excavation campaigns took place in 1976, 1982, and 1983, and about 3/4 of the site has been investigated now.

So far 9,839 flint artefacts have been collected during the excavations; in addition several hundreds of stones were found. Also two fragments of coarse sandstone with grooves were present (so-called "Pfeilschaftglätter"), with grooves that are a little over 1 cm wide. A hearth was not found, but the site has not yet been completely investigated and there are a number of burnt flints.

Most of the finds come from a large filled-in pit with a diameter of 2-3 m and a depth of about 1 m. This pit is provisionally interpreted as the result of an ancient treefall. The finds have not yet been studied in detail, so only preliminary remarks can be made here. There are a little over 40 points present. Of these 28 are fragmentary, among which there are several broken-off tangs. The more or less complete points comprise "normal" shouldered points, but also several tanged points that resemble the ones from Oldeholtwolde. There are a few shouldered points with two notches opposite the shoulder. It is interesting to note that there are also a few Creswell points.

The site is situated at the foot of an ice-pushed ridge. In the immediate surroundings no stream channels are known to exist, but more geological fieldwork has yet to be done.

A description of the profile at the site was given by van der Hammen (in: Verlinde, 1975). Van der Hammen and Wijmstra visited the site during the excavation of 1976, and their interpretation of the stratigraphy forms the basis of the following considerations.

Stratigraphy

Outside the above-mentioned pit, the artefacts occur on average at 30-40 cm beneath the surface, in a heath podsol soil (fig. 6). This podsol soil was undoubtedly formed during the Holocene. In general the finds are located in the B-horizon of this podsol, at the transition from B1 to B2, *i.e.* at the level where the brown colour is becoming somewhat lighter. Higher (*i.e.* in the A2 horizon) and lower (in the C horizon), however, also some finds were found — this vertical scattering is presumably the result of bioturbation. The sand in which this podsol soil developed is relatively coarse cover sand, without clear layering.

At 70-80 cm beneath the surface there is an irregular erosion level present in the sand. Below this level somewhat more loamy cover sand occurs, that is clearly parallel layered, and characterized by the presence of thin "loamy bands". However, locally thin strings of fine gravel also occur in this sand, *e.g.* at a depth of approximately 150 cm beneath the surface. The number and thickness of the "loamy bands" is gradually increasing, going downwards. In both cover sand layers no frost fissures or deformations caused by cryoturbation were observed. At some 310 cm below the surface a thin layer (thickness about 5 cm) of fine gravel is present. This layer could be observed only in a very small trench, so it is not known if there are any frost fissures present at that depth. Below the gravel layer relatively coarse sand occurs, that is clearly deformed by cryoturbation.

The gravel layer at about 310 cm depth is, according to van der Hammen, the Beuningen Gravel Bed, dating from the Upper Pleniglacial (see fig. 2). The cryoturbated sand underneath the gravel could therefore very well represent Older Cover Sand I, but this is not certain. The sand with "loamy bands", between 70-80 and 310 cm beneath the surface must, according to van der Hammen, represent Older Cover Sand II, and the uppermost sand layer is Younger Cover Sand I.

Between the two cover sand layers an irregular erosion level is present. Immediately below this level there is a zone of some 20 cm, sometimes thicker, that is somewhat more loamy than the sand occurring deeper in the profile, and that is "consolidated" to some extent. According to van der Hammen (in: Verlinde, 1975) this zone represents (a remnant of) the Bølling soil. One can hardly speak, however, of a bleached band; moreover this is also not a real loam layer.

Vink & Sevink (1971) mention the existence of fragipans in cover sand sections in the Dinkel Valley. Fragipans are described by them as "loamy subsurface horizons, often underlying a B horizon", that are "seemingly cemented when dry, having a hard or very hard consistence". "Most fragipans have abrupt or clear upper boundaries at depths of 15 to 40 inches below the original surface. They vary between a few inches and several feet in thickness". As these characteristics also apply to the uppermost 20 cm of the Older Cover Sand II at Luttenberg, we suppose for the meantime that we are dealing here too with (the remnants of) a fragipan, or with a Bølling soil with fragipan characteristics.

For the Lutterzand area in the Dinkel Valley, Vink & Sevink (1971) described fragipans for the following stratigraphical levels: top of Older Cover Sand I (just underneath the Beuningen Gravel Bed), top of the Older Cover Sand II (this is the same level where the "Lower Loamy Bed" of Bølling age occurs), top of Younger Cover Sand I (immediately above and below the "Usselo Layer"), and in the Younger Cover Sand II (in the B3 horizon of the Holocene podsol).

Fragipans have been noticed also elsewhere in Europe, and they are known to occur in loess too, according to Vink & Sevink (1971). The genesis of fragipans is not known exactly, but according to Vink & Sevink a pedogenetic process is most probably responsible. Perhaps periglacial conditions played a role, *i.e.* frost action, or alternate desiccation and wetting. Vink & Sevink are of the opinion that fragipans formed during stand-still phases in the cover sand deposition. They also described another type of soil structure, known as "vertical-platy", that seems to occur especially in fragipans. This phenomenon could have been produced by frost action (according to G.C. Maarleveld, after Vink & Sevink, 1971).

Following van der Hammen, the archaeological finds are present here about in the middle of a layer of Younger Cover Sand I that is 70-80 cm thick, and therefore must date from the Early Dryas Stadial. A "Usselo Layer" could originally have been present at the top of this layer, but was in that case later destroyed by the much stronger podsolisation during the Holocene. Since the "Usselo Layer" is not present, an alternative dating for the upper cover sand layer in the Late Dryas Stadial can be considered, but this seems to be excluded on the basis of the Hamburgian finds in this layer. On the basis of all available datings for the Hamburgian tradition it can be concluded that this tradition is nowhere younger than the beginning of the Allerød Interstadial (Lanting & Mook, 1977), after which the people of the Federmesser tradition were present in this region. This last tradition can be dated mainly in the Allerød Interstadial, but also in the beginning of the Late Dryas Stadial.

DISCUSSION

At Oldeholtwolde and Luttenberg finds belonging to the Hamburgian tradition were recovered from Younger Cover Sand I. This means that they can be dated stratigraphically as Early Dryas Stadial. However, we cannot be certain that the deposition of the Younger Cover Sand I stopped at the beginning of the Allerød Interstadial. Especially in extensive flat areas, as at Oldeholtwolde, it is quite possible that during the first part of the Allerød Interstadial no covering vegetation was present (see *e.g.* Kolstrup & Heyse, 1980), so that cover sand deposition could perhaps continue for some time. Taking this into account, it is even conceivable, that the Hamburgian occupation at Oldeholtwolde took place during the first part of the Allerød Interstadial, as the ^{14}C dating seems to suggest. Anyhow, the presence of the Hamburgian tradition during the Early Dryas Stadial now seems to be well established in The Netherlands. There are several other sites of this tradition in the northern Netherlands, where it also seems clear that the finds derive from Younger Cover Sand I, *e.g.* Sassenhein in the province of Groningen (B.A.I.-excavation 1982/1983), and Texel in the province of Noord-Holland (Stapert, 1981).

Bohmers & Houtsma (1961) described several Late Paleolithic sites near Duurswoude in the province of Friesland. Duurswoude I ("Oud Leger") is perhaps a findspot of the Tjongerian (Federmesser) tradition. Only a very limited number of tools were present (6 burins, 3 short scrapers, 1 partially retouched *cf.* Tjonger point). These finds occurred about 20 cm underneath the "Usselo Layer" that was present here, and could therefore perhaps date from the Early Dryas Stadial. However, it is difficult to be certain of the cultural identification in this case, because of the limited quantity of material. It is known, for example, that Tjonger points also occur at some sites of the Hamburgian tradition (*e.g.* Oldewoltholde), while moreover two of the scrapers could be broken blade end scrapers.

At this site the "Usselo Layer" is developed at the top of a layer of cover sand with "loamy bands", that is some 65 cm thick. At the base of this sand, that is presumably Younger Cover Sand I, there is a "vegetation horizon" present, *i.e.* a bleached band in the sand, with a few charcoal particles. This band is about 5 cm thick. Below this bleached band there is still some 12 cm of sand with "loamy bands", and underneath that approximately 1.5 m of sand with cross-bedding. Bohmers & Houtsma (1961) suggest that the bleached band could represent a soil dating from the Bølling Interstadial.

Duurswoude II is a site of the Hamburgian tradition. Among the small number of finds especially "Zinken" are well represented; furthermore there is one clear example of a tanged point that resembles the tanged points from Oldeholtwolde. These finds were present 0-40 cm above a bleached band that just outside the site passed into a loamy layer. The bleached band at Duurswoude II can probably be correlated with the one at Duurswoude I, so that the Hamburgian finds here could date from after the Bølling Interstadial.

A second findspot of Hamburgian artefacts is Duurswoude IV, at a distance of some 600 m West of Duurswoude II. Here again a bleached band was observed in the cover sand, that was very similar to the ones at Duurswoude I and II. At Duurswoude IV the Hamburgian finds were present *in* this bleached band. Assuming that the bleached band is a soil of Bølling age, the Hamburgian artefacts could date from the last part of the Earliest Dryas Stadial, from the Bølling Interstadial *s.s.*, or from the beginning of the Early Dryas Stadial. Again the finds were only present in small numbers, but in this case points were especially well represented. According to Bohmers & Houtsma (1961) they all belong to the category of tanged points of Havelte type. Some of them do not possess a real tang, but have one or two small notches opposite the shoulder-notch.

Taking all evidence together, the Hamburgian finds from the sites near Duurswoude seem to some degree to support the above-stated conclusion, *i.e.* that the Hamburgian tradition in this region was still present during the Early Dryas Stadial — this is true especially for Duurswoude II. However, as Bohmers & Houtsma remarked, it is difficult to be sure that a weakly developed bleached band in cover sand represents a soil. In my opinion, the site at Oldeholtwolde is the best evidence we have so far, because here the Hamburgian finds were present only 30 cm below the top of a layer of Younger Cover Sand I of some 2 m thick, just underneath the "Usselo Layer". The evidence presented in this paper does not necessarily imply, in my opinion, that the Hamburgian and Tjongerian traditions overlapped in time.

If one compares the stratigraphy at the findspots of Oldeholtwolde and Luttenberg with each other (fig. 9), without knowledge of the work done by ter Wee North of the river Vecht and by van der

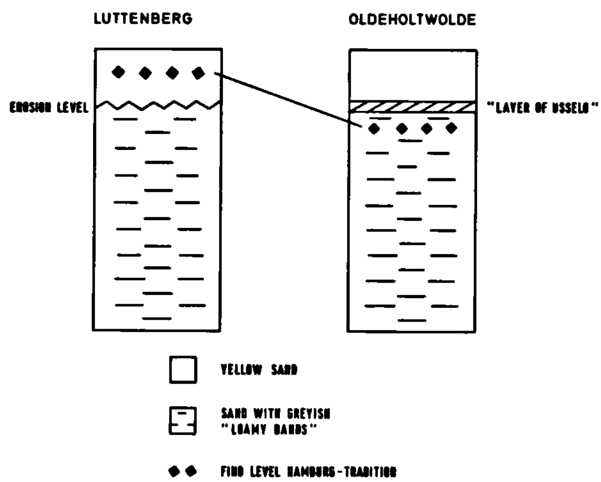

Fig. 9. Comparison of simplified sections at Oldeholtwolde and Luttenberg. The Hamburgian finds, that are comparable at both sites, occur at Oldeholtwolde in sand with "loamy bands" but at Luttenberg in not clearly layered sand above a layer of sand with "loamy bands". See text under "Discussion".

Hammen in the eastern Netherlands, one could easily become very confused. At both sites there is a sequence of sand with "loamy bands" below sand without "loamy bands". In fact the stratigraphical occurrence at both sites of similar Hamburgian finds independently supports the conclusions of ter Wee and van der Hammen, *i.c.* that in the North the facies with loamy bands continued up to Allerød time, whereas South of the river Vecht this facies already ended at Bølling time.

It is of course a task for geologists to explain this situation. The following remarks are therefore speculative. As mentioned above (chapter "The Late Glacial", paragraph "Cover Sands"), according to Ruegg (1983) the "loamy bands" are the result of wet "depositional surfaces" during the summers. This could be a consequence of the presence of a permafrost or another impermeable layer underneath the surface (*e.g.* a layer of till), or of sedimentation in a low depression. In the eastern Netherlands the Younger Cover Sand I is known to possess "loamy bands" only in depressions (Wijmstra & Schreve-Brinkman, 1971). Therefore it may be concluded that South of the river Vecht probably no permafrost existed during the Early Dryas Stadial.

However, at Oldeholtwolde the cover sand with "loamy bands" is present in the form of a dune, without boulder clay beneath the surface. Therefore it appears to be possible that during the time when this sand was deposited, *i.e.* the Early Dryas Stadial, there was still a permafrost present. Yet no frost fissures are known up till now in the northern Netherlands in the Younger Cover Sand I (they seem to occur however South of the river Rhine: Maarleveld, 1976). The provisional conclusion is therefore, that during the Early Dryas Stadial the southern border of the (probably discontinuous) permafrost was located approximately in the valley of the river Vecht.

From the Late Dryas Stadial no cover sands with "loamy bands" are known in The Netherlands. Therefore, if Ruegg is right, we can conclude that the permafrost disappeared completely from this region during the Allerød Interstadial, and did not return during the Late Dryas Stadial, despite the presence of frost fissures dating from that last zone. Thus, even if summer temperatures gradually declined since the Bølling Interstadial, as Coope suggested, the mean annual temperature must have risen nevertheless. If all this is correct, we are left with the question, why frost fissures are relatively abundant during the Late Dryas Stadial, while they seem to be largely missing during earlier zones of the Late Glacial.

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