A NOTE ON THE ALLERØD VEGETATION OF SOUTHEASTERN FRIESLAND (WITH EMPHASIS ON THE OUDEHASKE AREA)

SYTZE BOTTEMA & BETTY MOOK-KAMPS
Groninger Instituut voor Archeologie, Groningen, Netherlands

ABSTRACT: Pollen assemblages dated to the Allerød oscillation in a peat sediment from Oudehaske are compared with those from other Allerød deposits in southeastern Friesland. Palynological information obtained from sediments collected from pingo scars turned out to be very identical. The information of this group of pollen sites differs from the results obtained from shallow bogs, which points to fundamental differences in Allerød vegetation around the two types of catchment sites.

Measuring of birch pollen in the Allerød of Oudehaske, to separate dwarf birch from tree birch, points to a dominance of dwarf birch. Crowberry is claimed to be an indicative pollen type for the Younger Dryas, but shallow peat bogs in eastern Friesland contain important pollen percentages of this plant, suggesting that it occurred locally already in the Allerød, but not in connection with pingo scars.

KEYWORDS: Allerød, Oudehaske, Friesland, dwarf birch, crowberry.

1. INTRODUCTION

The pollen zone known as Allerød is formally characterized by the presence of substantial *Betula* percentages with increasing values of *Pinus*. This characterization is based mainly upon definitions of Allerød formulated outside the northern Netherlands. However, examination of the various pollen diagrams with special consideration of the location whence they originate, reveals considerable differences in pollen values. Diagrams from the Drenthe Plateau, mainly from pingo scars but also small and large peat bogs, do not vary so much in pollen types as they do in the values of those types. This phenomenon is especially stressed by Mook-Kamps (1995) in a study of the Younger Dryas on the Drenthe Plateau. The pollen evidence points to a highly diverse landscape in terms of vegetation. The landscape of the northern Netherlands in the Allerød as in other periods did not have the diversity of a mountain landscape but the distribution of the plant and tree species was very patchy and related to small differences in elevation and available moisture. The quality of the soil, ranging from coversand with almost no organics to peat, and the depth of the sand overlying the boulderclay, dictated the dominance of sedge marsh, dwarf-birch scrub, scattered pines and tree birches, occasional blankets of crowberry on leached sands, 'ruderal' plants such as wormwood and goosefoot, or light-demanding species such as sea buckthorn.

The Allerød pollen-precipitation patterns lead to one conclusion: there is no single typical Allerød pollen assemblage. There are different Allerød pollen assemblages that can be obtained from various kinds of sediment that developed under a variety of conditions during the same period. The authors are of the opinion that changes in the pollen assemblages and palynological differences between locations are fairly local phenomena, although they are subordinated to a general climatic pattern.

According to radiocarbon dates the Allerød period lasted from c. 11,800 to c. 10,800 BP (Lanting & Van der Plicht, 1995/1996). The age of the organic deposits in the coversands of southeastern Friesland was established by this method. The pollen zones which have been dated to the Allerød are compared on the basis of these dates. The conclusion is that we have a highly variable Allerød pollen pattern in southeastern Friesland and quite probably all over the Drenthe plateau.

In his excavation of the Ahrensburg site of Oudehaske (Friesland), Stapert found a 30 cm thick peat layer in coversand. The location and stratigraphy of this layer are given in this volume by Stapert, fig. 8. Stapert's peat layer was radiocarbon-dated between 11,120±70 BP (the uppermost cm) and 11,390±65 BP (the lowermost cm). He believes the peat layer to have been formed in an oxbow lake of a small rivulet that was a tributary of the Boorne.

In the northern Netherlands, Allerød deposits that are suitable for palynological study and informative about contemporary vegetation and other environmental conditions mostly originate from pingo scars. These depressions formed a special habitat that offered water and sheltered conditions where plants and low trees could grow in situations not found on the open, flat land. In comparison to peat sediments, small pingo lakes receive a relatively broad regional pollen precipitation (Kolstrup, 1997).

The dating of Late-Glacial sediment formed in pingo scars is problematic because of seepage water moving

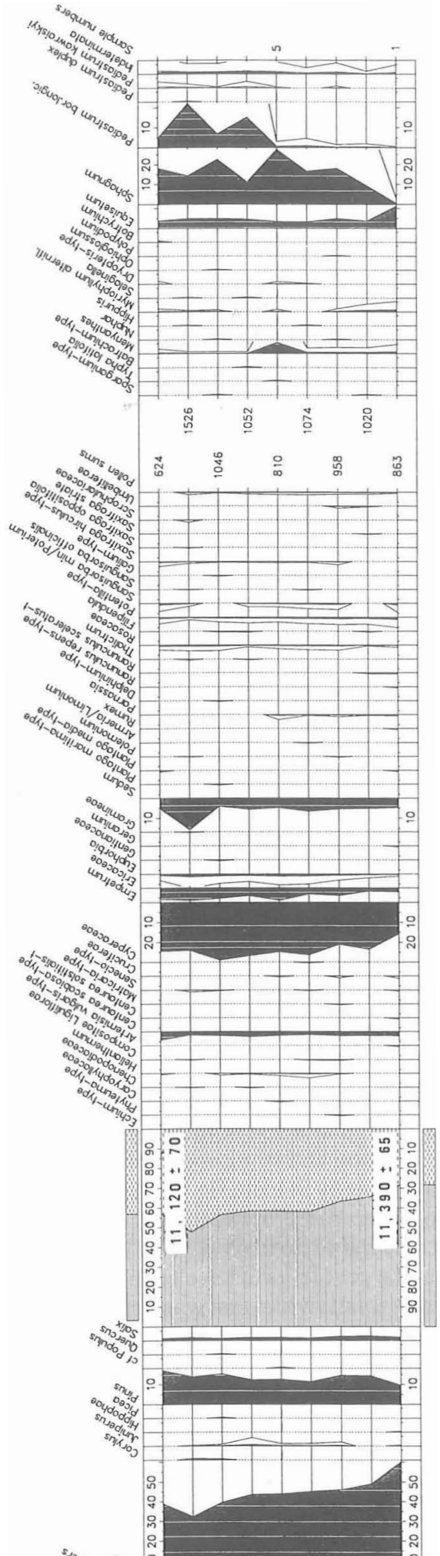

Fig. 1a. Pollen diagram of Oudehaske based on the traditional Iversen sum.

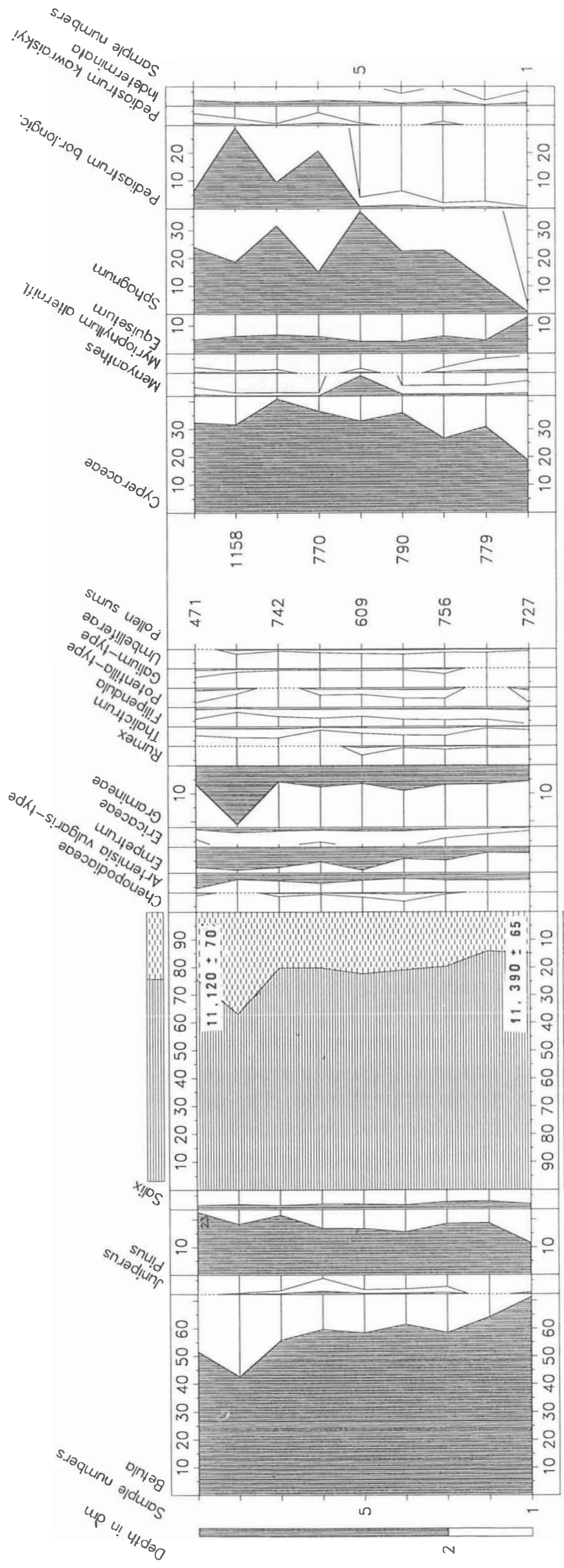

Fig. 1b. Pollen diagram of Oudehaske based on a sum from which the Cyperaceae have been excluded.

upward through the Saale-Glacial boulder clay. This seepage water is depleted in ^{14}C, due to exchange processes between atmospheric CO_2 dissolved in percolating precipitation and fossil carbonate of marine origin in the subsoil. (This is often, but erroneously called hard water effect.) The pingo mounds most probably were formed by water pressed through a layer of permafrost and boulder clay. After the collapse of a pingo frostmound, the depression continued to receive ^{14}C-depleted water for some time. Thus Late-Glacial sediments may yield a date that is too old and consequently the pollen contents may be dated too far back.

The purpose of this study is to reconstruct the Allerød vegetation and environment on the basis of pollen evidence. The part of Friesland where Oudehaske is situated has been studied quite intensively as far as the Late-Glacial is concerned from samples of shallow peat layers and pingo sediments from several locations.

2. MATERIAL AND METHODS

The sediment of Oudehaske consists of horizontally layered, compressed peat and was sampled at 3 cm intervals. The compression was caused by the 1.5 m of coversand that overlay the peat. The peat contains fine silt and sand that must be of aeolian origin. The amount of sand increases upwards. At a depth of 17 cm the peat contains about 5% of sand. The amount of sand or silt in the peat samples is also an indicator of the scantiness of vegetation during the Allerød; at Oudehaske the vegetation no longer consolidated the soil after 11,120 BP, when coversand started to accumulate on the bog.

The preservation of the pollen varies. Some is well-preserved, but others are corroded, suggesting that the basin did not always contain much water. Pollen concentration is high, probably owing to the compression of the peat. Pieces of peat 0.5 cm thick and with a volume of one half to three quarters of a cm^3 were sufficient for preparing samples according to the traditional methods.

The pollen sum used for calculating the diagram is the so-called 'Iversen sum', which while excluding wetland plants, does include sedge pollen. This is primarily because the glacial conditions offered a habitat in which trees could not thrive, in contrast with the subsequent Holocene. For this reason, the pollen of those herbs that are of non-local origin are also included in the pollen sum. In this case the sedges are as usual included in the pollen sum. Iversen believed sedges to have been an important component of the upland vegetation, but this assumption is debatable. However, one has to be careful in attributing the Cyperaceae to a non-local vegetation. There is circular reasoning in drawing conclusions on the basis of pollen evidence, and subsequently using these conclusions to establish a pollen sum that is in turn used to reconstruct the vegetation. Clumps of 40 to 50 pollen grains in some of the Oudehaske samples suggest a very local origin of the Cyperaceae, since clumps of pollen do not travel well. The reason for nonetheless using an Iversen pollen sum is that otherwise not much pollen is left.

The origin of regional sedge vegetations (Cyperaceae) can be studied in modern examples, for instance in the Arctic. Cotton-grass (*Eriophorum*) can be a dominant species in parts of Spitsbergen in moist surroundings where water stagnates on permafrost. Allerød conditions in Oudehaske may in some respects resemble modern Arctic glacial conditions, but there are also fundamental differences between the two, for instance day length and continental versus Atlantic climate, while permafrost is said to have been absent during the Allerød. It is quite possible that Late-Glacial sedges (Cyperaceae) only occurred in local marshy situations in the northern Netherlands, because the coversands were too dry for them. If sedges did grow in important numbers on the sandy plains one must consider whether permafrost was indeed absent during the Allerød, given the case nowadays of for instance the Spitsbergen Boheman Flua where sedges grow in the wet soil of melting top layers.

Since the GRAPPA computer programme allows the rapid calculation and drawing of diagrams based on any pollen sum, various sums have been used and their visual effect studied. In this paper a traditional diagram is given (fig. 1a) and a simplified version that shows a selection of curves calculated on a sum from which the Cyperaceae have been excluded (fig. 1b).

3. DISCUSSION OF THE OUDEHASKE POLLEN DIAGRAM, AND NOTES ON THE ENVIRONMENT

The pollen diagram of Oudehaske is discussed as a single coherent zone. The spectrum numbers will be referred to, wherever necessary. The assemblages contain a series of pollen taxa which are normally present in Late-Glacial deposits of the northern Netherlands. As usual, some represent genera, for instance birch (*Betula*), others represent families, e.g. grasses (Gramineae). Some types can be attributed to species, for instance crowberry (*Empetrum nigrum*). The indicative value of the various taxa varies; abundant types with continuous curves may be less diagnostic than single occurrences with a high ecologically indicative value.

Tree pollen in Oudehaske is dominated by birch (*Betula*) attaining about 40-50%. It is an open question whether this is tree birch (*Betula pubescens/verrucosa*) or dwarf birch (*Betula nana*). Both birches can be proved by macrofossils but are very difficult to identify by pollen analysis except by pollen size. However, size is not always a reliable indicator since size may change due to conditions of preservation of the pollen in the sediment. To demonstrate the presence of tree or dwarf birch pollen in one pollen sample, one has to measure

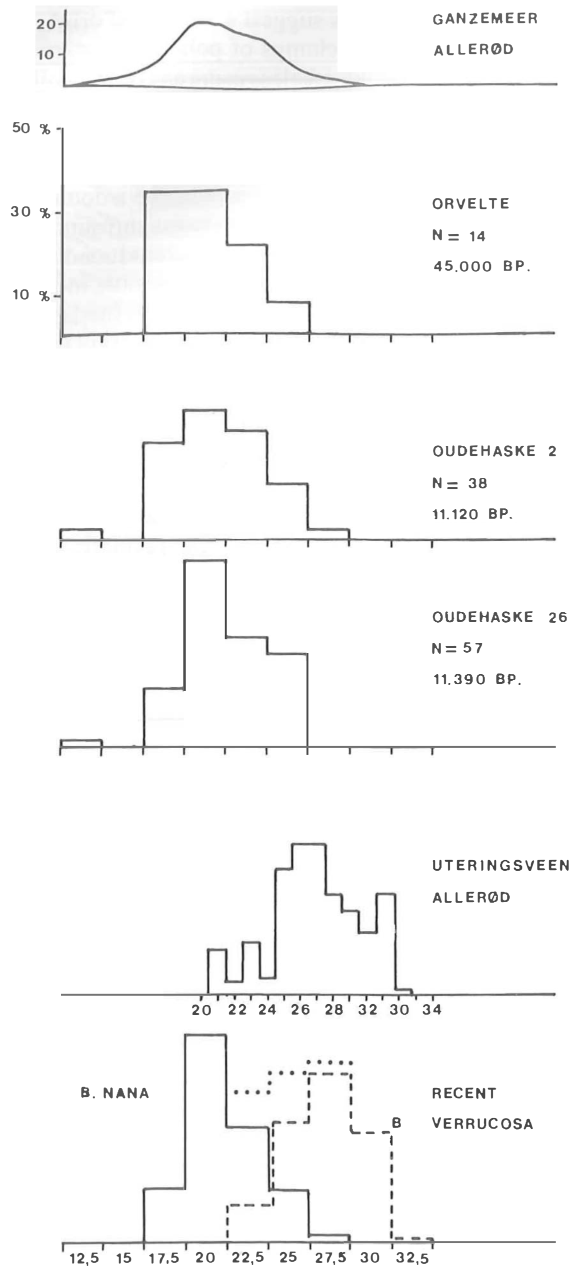

Fig. 2. Measurements (μ) of birch pollen from various periods. The lowest curves show measurements of modern birch pollen. The composite curve for both tree and dwarf birch is indicated by a dotted line.

the pollen grains (Usinger, 1978; Kolstrup, 1982). It is assumed that a normal Gauss distribution of size will appear if only one taxon grew in an area. If both tree and dwarf birch were present, a double-peaked graph should appear. The relative abundance of both tree and dwarf birch might even be concluded from the height of the two peaks.

Birch pollen grains in the lowermost spectrum 1 and in the uppermost spectrum 9 were measured (fig. 2). In both samples a single-peaked curve of the same shape was found, suggesting that only one species of birch grew in the Oudehaske area. Birch pollen in the gyttja sediment, dated 45,000 BP, in which mammoth bones were found near Orvelte were also measured. Dwarf birch was demonstrated there by the presence of its seeds (Cappers et al., 1993). Although the number of pollen grains is small, their measurements closely resemble those of Oudehaske. The shape of the curve of birch-pollen sizes in an Allerød sample from the pingo of Ganzemeer (fig. 3) produced by Bakema (1983) is somewhat different (fig. 2) and points to two different size classes. Compared with the curves presented by Usinger (1978: fig. 1) for Schleswig-Holstein or by Cleveringa et al. (1977: fig. 3) for the Uteringsveen (the Netherlands), the Oudehaske measurements all match the lower values (left part) of those curves. The measured birch pollen in the Uteringsveen samples were preserved in glycerine. This medium generally enlarges pollen somewhat in contrast to pollen kept in silicone oil, the embedding material used at the Groningen Institute.

Modern pollen, *Betula nana* from Flatruet (Sweden) and *Betula verrucosa* (collected by Woldring in Lettelbert, Groningen) was measured by the first author (fig. 2). The left part of the curve shows the dimensions of dwarf-birch pollen, which closely match those of the subfossil material. The right-hand part of the curve represents the tree-birch pollen which is consistently larger. It can be seen in fig. 2 that the curve of the modern pollen grains is double-peaked. The shape of the measurement curves and the size of the pollen strongly point to the presence of dwarf birch during the Allerød in southeastern Friesland, whereas tree birches do not seem to have been present in this area. Dwarf birches quite probably fringed the wetter places: marshes, bogs or small pingo lakes. Tree birches must have grown in many parts of northwestern Europe during the Allerød, as has been demonstrated by Usinger (1978) for Schleswig-Holstein. For the northwestern part of that area, Usinger could even show that tree birches were present during the Bølling period. He also states that it was dwarf birch that grew on Bornholm during the older Allerød.

Scots pine (*Pinus sylvestris*) produces pollen that can travel over considerable distances. The relative pine percentages become more pronounced when the local pollen production of other types becomes insignificant, as for instance in steppe or desert. A sample of the modern pollen precipitation of the salt steppe near Bouara on the border of Syria and Iraq shows 12% pine pollen (Gremmen & Bottema, 1991) although the nearest pine trees grow at a distance of about 500 km. The main reason for this important share of pine in the modern pollen precipitation in this part of the Near East is the travelling capacity of pine pollen and the very scarce vegetation of the local salt flats. This observation also stresses the problem of relative values as opposed to absolute values. To calculate the absolute pollen precipitation is a very difficult task that requires conclusive and accurate dating to reveal the exact number of years represented in a pollen sample. The number of years in a given sediment is only very rarely measurable.

The value of pollen, and in this case pine pollen, is measured in relative percentages of a chosen sum. Thus the level of these values only allows us to assess whether pine grew locally or not. Fortunately, we have evidence of the present-day pollen rain and the modern vegetation (e.g. Van Zeist et al., 1975). Hence, the behaviour of many taxa with regard to pollen production, distribution and representation, also in relative calculations, is fairly well-known. Small numbers of pollen of particular wind-pollinating types can be explained as either a rare local occurrence of a plant or tree, or as a larger number of such plants or trees growing further away. Even in the flat plains of northwestern Germany, conditions are not so homogeneous that one may speak of a closed front of pine trees moving northward at the end of the Pleistocene when conditions became suitable during the Late Glacial. Pictorial information on the northern European pine limit in Finland and Norway, kindly made available by Professor Matti Eronen (Helsinki), shows how pine fills local patches where its requirements are met. Of course Late-Allerød conditions near Oudehaske differ from the modern situation near the Scandinavian tree limit, for instance in soil conditions.

At Oudehaske, the differences in elevation, although slight, will have been responsible for the variations in pine-growth opportunities during the Allerød. Moisture regime and soil properties in drift-sand regions are today factors defining the growth of Scots pine. Since this tree can withstand very low temperatures, this will not have been the limiting factor during the Allerød. As with many plant and tree species, the conditions for germination are decisive for the occurrence of pine. In this respect, moisture in the dry coversands must have played an important role. Evidence for the effect of fire in pine forest is often brought to bear in connection with the 'Layer of Usselo', and can be obtained from present-day circumstances in the Veluwe region (central Netherlands). There the destruction by fire of (planted) pine forest led immediately to the development of birch forest. Even twenty years after a catastrophical fire, the burnt pine area near 't Harde is covered by birch only. During the Allerød, extensive forest fires are thought to have occurred, as demonstrated by charcoal finds in the 'Layer of Usselo'. Even so, such forest fires must have been fairly local for several reasons, one of these being that otherwise a widespread dip in the pine-pollen curve of the Allerød would have been the result. Natural fire, caused by lightning, occurs fairly frequently. It is almost impossible to prove human activity during this period, but such a factor cannot be excluded.

Willow (*Salix*) is present in reasonable numbers if the insect-pollinating nature of this genus is taken into account. Several willow species, for instance creeping willow (*Salix repens*), may have occurred in the Oudehaske area during the period concerned. Juniper (*Juniperus communis*) is present in insignificant pollen numbers and it is concluded that this species was not very common in the area. Only one pollen grain of sea buckthorn (*Hippophaë rhamnoides*) is found at Oudehaske. Today this species inhabits sandy sea coasts in the Netherlands, but is also known from steppic areas or high mountains, for instance Sechzuan, China. The pollen production and dispersal of sea buckthorn are not very efficient, according to studies on the modern pollen precipitation of this shrub. On the other hand, the type is common in daily counts of airborne pollen for hayfever sufferers in the western part of the Netherlands. In the Oudehaske area sea buckthorn will not have played an important role.

An interesting feature are the fairly high values (2-6%) of crowberry pollen (*Empetrum nigrum*). The crowberry is considered a typical plant of the Younger Dryas period, where its pollen is found in fair amounts. The modern habitat of this heather-like plant is found in large open areas, heaths, open pine/birch stands in heaths, dune valleys poor in lime and on the fringe of drift-sand areas. Crowberry thrives in places where a slow accumulation of drift-sand occurs. It collects sand and in this way can form low hillocks. The evergreen blanket of crowberry is able to grow over tree-stumps. In modern times its vulnerability to low winter temperatures has been obvious. Severe frost turns the modern crowberry vegetation in the province of Drenthe (the Netherlands) into a brown carpet. The plants generally are not completely killed but will sprout again from the base. Because flowering crowberries are present throughout the younger part of the Allerød in Oudehaske, as is evident from the pollen finds, one may assume that such vegetation was protected during the winter by sufficient snow cover. The absence or near-absence of crowberry pollen in pingo sediments during the Allerød makes their growing there doubtful, while the presence of a vegetation filter around the depression may have prevented influx of pollen from further away. The pingo habitat supported a vegetation with trees providing enough shade to prevent the growth of crowberry. During the Younger Dryas this vertical vegetation screen may have disappeared, allowing increasing numbers of crowberry pollen to reach the lake deposit.

Crowberry pollen is severely under-represented in the modern pollen rain. Pollen values of this species in the Hijkerveld (province of Drenthe), where crowberry is dominant in certain parts, have been studied by R. Bakker (Groningen Institute of Archaeology). Bakker demonstrates that *Empetrum* is generally not represented in the pollen precipitation at 100 m from its growing stands. In a small oak stand on the heath, crowberry had a value of 4.2% in the soil. It is likely that in this case crowberry pollen originated from stands that were there before the oaks were planted. The presence of 2-6%

crowberry pollen in the Oudehaske diagram points to local abundance. The low percentages in other diagrams from the area may indicate the occurrence of *Empetrum* at a distance.

The vegetation cover of the upland areas must have been rather scanty. The openness of the landscape is deduced from certain pollen types that represent light-demanding plants. A reasonably common species is wormwood (*Artemisia*). Various wormwood species are common in the Near Eastern steppe and desert-steppe nowadays, and even more so during the Glacial. The species included in this genus are palynologically classified into two groups: *Artemisia herba-alba* type and *Artemisia vulgaris* type. The pollen found at Oudehaske is mainly of the latter type, which includes mug-wort (*A. vulgaris*), Breckland wormwood (*A. campestris*) and sea wormwood (*A. maritima*). The wormwood species present in the Netherlands at present flower from late summer to early autumn and are deeprooting perennials, resistant to drought. They need plenty of light, which is the reason why their habitat is the open seacoast or the new agricultural steppe, a man-made habitat devoid of trees.

A species not occurring in the Netherlands nowadays but still found in countries to the north is Jacob's ladder (*Polemonium caeruleum*). The typical pollen of this plant is very rarely encountered in Glacial periods. Today Jacob's ladder is a garden plant up to one metre high, but in the Arctic, for instance where the first author found it at Gypsbukta in Spitsbergen, it is represented by a low creeping form that avoids catching the cold wind. The presence of Jacob's ladder at Oudehaske indicates that the area was not only open but still had minerals in the soil.

The Oudehaske deposit contains a series of types that must be considered to be local marsh plants growing where there is perennial moisture and often these plants contribute to the peat formation. These pollen types are also present in other sediments of this period. These plants produced the organic material which, in various stages of decay, remains today as evidence of the period. The spores of *Sphagnum*, peat-building mosses, are present in high percentages, apart from spectrum 1. The mosses must have grown along the edge of the Oudehaske depression. Bogbean (*Menyanthes trifoliata*) was a common plant in these wet surroundings. We do not know which species of meadow rue (*Thalictrum*) occurred, but it is likely to have been the large marsh species (*Thalictrum flavum*). Rosaceae are represented by members of the genus cinquefoil (*Potentilla*), very probably of local origin. A lower plant whose spores are common is horsetail (*Equisetum*). This species thrives in locations with seepage water rich in certain minerals. The coversand itself is, at least to-day, poor in lime. In the water of the Oudehaske depression, however, seepage water percolating through the Saale boulder clay may have come up, stimulating the growth of horsetail. Horsetail is most numerous in the oldest part of the sediment, formed at a time when seepage was likely. Sealed off by the growing sediment, the seepage later stagnated. The rare find of pollen of mare's tail (*Hippuris vulgaris*) also points to a relatively high mineral content.

Part of the Oudehaske depression, be it an oxbow lake or a depression filled with seepage water, still contained open water during the peat formation. This is deduced from the presence of pollen of alternate-flowered water milfoil (*Myriophyllum alterniflorum*), a plant that can survive the near drying-up of a body of water but that demands open water for its normal growth. At the same time green algae (*Pediastrum*) are found, which also indicate the presence of open water. One is *Pediastrum boryanum* var. *longicorne*, whereas *Pediastrum kawrayskii* is less common. Both algae are rare or absent during the Holocene of the northern Netherlands.

4. COMPARISON OF THE OUDEHASKE DIAGRAM WITH PALYNOLOGICAL EVIDENCE FROM OTHER ALLERØD DEPOSITS IN SOUTHEASTERN FRIESLAND

A pollen diagram by Cnossen & Zandstra (1965), from a peat layer of the Haskerveen polder north of the Jousterweg (fig. 3), shows a section dated to the Allerød (GrN-2136: 11,600±70 BP) in the lower part. The Haskerveen polder originally was a basin filled with fluvial material from the Boorne, as can be deduced from the secondary pollen present in the pre-Allerød deposit. The Allerød deposit in the Haskerveen polder is part of a large marsh and the upland vegetation must have been at quite a distance from its centre compared with the relatively small peat deposit that Stapert found

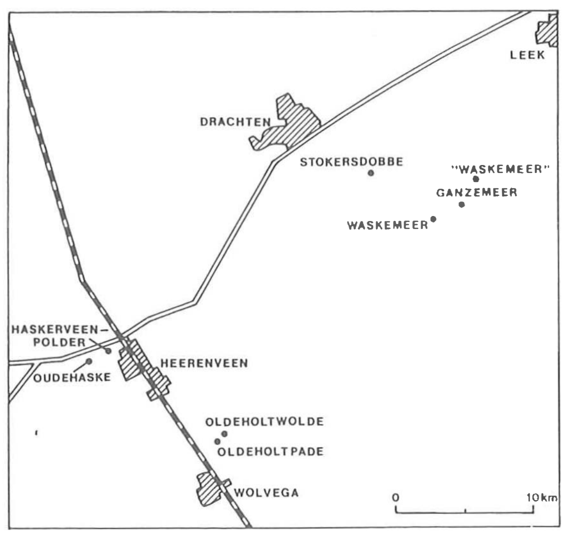

Fig. 3. Map of the area with the location of the coring sites.

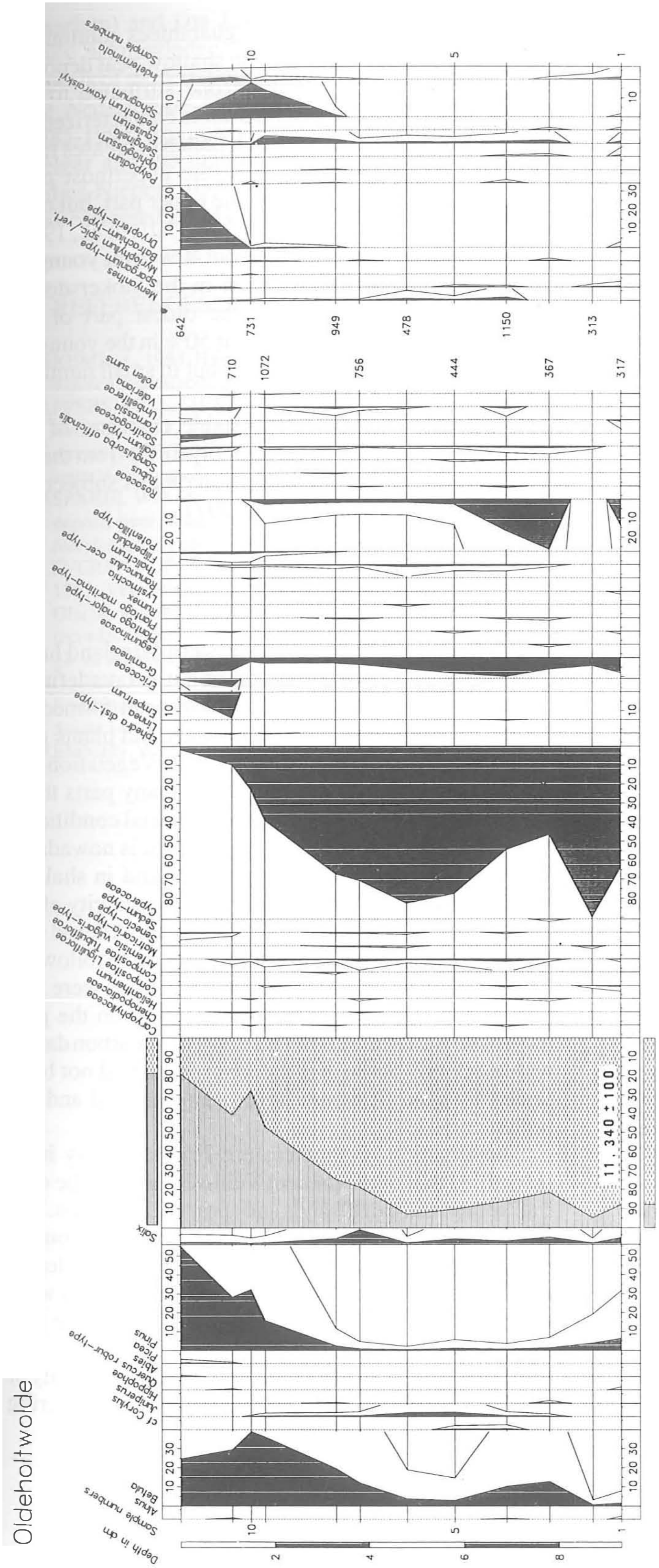

Fig. 4. Pollen diagram of Oldeholtwolde calculated as in Fig. 1a.

in Oudehaske. Compared with the pollen diagram from the Haskerveen polder, representatives of upland vegetation are more common in the Oudehaske sequence. The values of crowberry at Oudehaske point to its common occurrence there at least during the latter part of the Allerød.

Allerød deposits have been demonstrated at Oldeholtwolde, about 10 km from Oudehaske (fig. 3). The base of a peat layer near the Palaeolithic site of Oldeholtwolde, excavated by Stapert (1982) is dated 11,340±100 BP (GrN-11264). A pollen diagram of the Oldeholtwolde peat was prepared by the first author (fig. 4). Throughout the Late Glacial, from about 11,400 BP onward, we see very low tree-pollen percentages. Pine pollen remains under 5% and is often not more than 1%. Birch pollen fluctuates between 3 and 10%. The pollen precipitation on the Oldeholtwolde marsh is dominated by Cyperaceae and *Potentilla*-type (cinquefoil). The absence of crowberry pollen and of other Ericaceae is striking, whereas nearby Oldeholtpade reveals values of 2-5%.

Two Allerød deposits have been identified 2 km southwest of Oldeholtwolde (De Jong, 1992). These sites have been recorded as Oldeholtpade I and III. Location I has radiocarbon dates of 11,960±80 (GrN-14449) and 10,860±60 (GrN-14448). The pollen diagram of Oldeholtpade I is characterized by very low pine pollen values of about 2%. Birch values gradually increase from about 10 to 30%. Ericaceae are present with a few percent. De Jong divides the Allerød into two subzones: a and b. Because of the low tree-pollen values, De Jong believes subzone a, the lower part of the Allerød, to be present in Oldeholtpade I. Oldeholtpade III is not radiocarbon-dated and pollen assemblages have been ascribed to various biozones according to their characteristics. Pine-pollen values are somewhat higher (10%) than in the nearby core Oldeholtpade I and De Jong (1992) attributes them to subzone b of the Allerød. Birch percentages are 60% in the deepest sample only, which is ascribed to subzone a. The four spectra that represent subzone b, have birch values of 10 to 30%. De Jong is of the opinion that subzone b is missing in the Allerød of Oldeholtpade I. Late-Glacial sediments of the northern Netherlands often show abrupt changes or gaps in the sequence. This is mainly caused by sand drifts in bogs.

Sites separated by one kilometre only show large differences in local upland cover, whereas the pollen production of the local peat basins is remarkably similar.

The tremendous differences in pollen assemblages in Allerød deposits are illustrated by the evidence from three pingo scars located 25 km to the northeast of Oudehaske. Evidence has been obtained on the Late Glacial and the beginning of the Holocene from two pingo scars near the hamlet of Waskemeer, called Waskemeer (Casparie & Van Zeist, 1960) and Ganzemeer (Bakema, 1983), and from the Stokersdobbe between Drachten and Waskemeer. Sedimentation in such small but relatively deep holes guarantees continuous deposits, which is not the case in shallow peat deposits in sand-drift areas. The palynozone attributed to the Allerød in the Ganzemeer diagram is characterized by pine-pollen values of 50%. Birch pollen decreases from an initial 70% to about 30% in the uppermost part. Crowberry pollen is present in the upper part, but only attains about 1%. The Stokersdobbe (Paris et al., 1979) produces pine pollen values of about 40% in the youngest part of the Allerød. Birch pollen in the Stokersdobbe diagram amounts to 80% in the oldest part of the Allerød, which decreases to about 50% in the youngest part. Crowberry pollen is present but in small numbers only.

The highly dynamic and instable character of the Allerød landscape did not essentially differ from that of the Dryas periods. For a discussion on this subject the reader is referred to Kolstrup (1997).

5. CONCLUSION

The Allerød landscape in southeastern Friesland had a diverse character. The chronology is not always definite, the peat in Oudehaske seems to have been formed by plants growing above the water mainly, but plants growing under water cannot be excluded. Vegetation developed only in favourable spots. In many parts there was not much difference from more Glacial conditions. Microrelief was more pronounced than it is nowadays. Water was present in the pingo scars and in shallow marshes, but it was rare, as shown by the scarcity of organic deposits. Aeolian activity during the Allerød was less than in the preceding Older Dryas or in the following Younger Dryas, but sand and finer fractions were still transported. The deposition of coversand on the peat must have started around 11,120 BP (radiocarbon dated) without delay, because if the loamy peat had not been sealed by sand, it would have been oxidized and the pollen corroded.

The situation in southeastern Friesland may have resembled that of the present Veluwe region in the central Netherlands: driftsands and sporadic pine trees. The tree birch, present on the Veluwe nowadays, is conspicuously absent in Friesland and Drenthe in the Allerød. Pollen measurements suggest that dwarf birches were the only birch in and around bogs on the Drenthe plateau.

Contrasting with the Younger Dryas is the scarcity of crowberry, but this plant was certainly present during the Allerød; be it far more locally.

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