III. The Drenthe Plateau: physical environment, vegetation and archaeology

III.1 Topography

The subject of this study is the Gietsenveentje, presumably a pingo scar, situated near the village of Gieten in the province of Drenthe, the Netherlands. The location of the Gietsenveentje in the Netherlands is shown in fig. 14. The Gietsenveentje is situated on the Hondsrug, a ridge that is part of the Drenthe Plateau (fig. 14). The Drenthe Plateau is the visible part of a till complex, formed during the Saalian glaciation (see III.2.1). In the north and west, the till plain disappears under marine and fen-peat deposits formed in the Holocene. In the east and south, the Drenthe Plateau is bounded by two originally deep valleys, which were also formed during the Saalian glaciation and which since have largely filled up: the Hunze valley and the Vecht valley.

Fig. 15 shows a recent topographical map of the Gietsenveentje and near surroundings. This map represents an area of ca. 4.5 x 4.5 km; the Gietsenveentje lies in the centre. The coordinates of the centre of the Gietsenveentje are 246.30/558.90. Possibly, the name of the Gietsenveentje is derived from the Proto-Germanic water name "Gets". This suggests that the Gietsenveentje and also the village of Gieten are named after a stream, called "Giets", which in earlier times ran along the western side of the village (KLAASSENS-PERDOK 1983, 8).

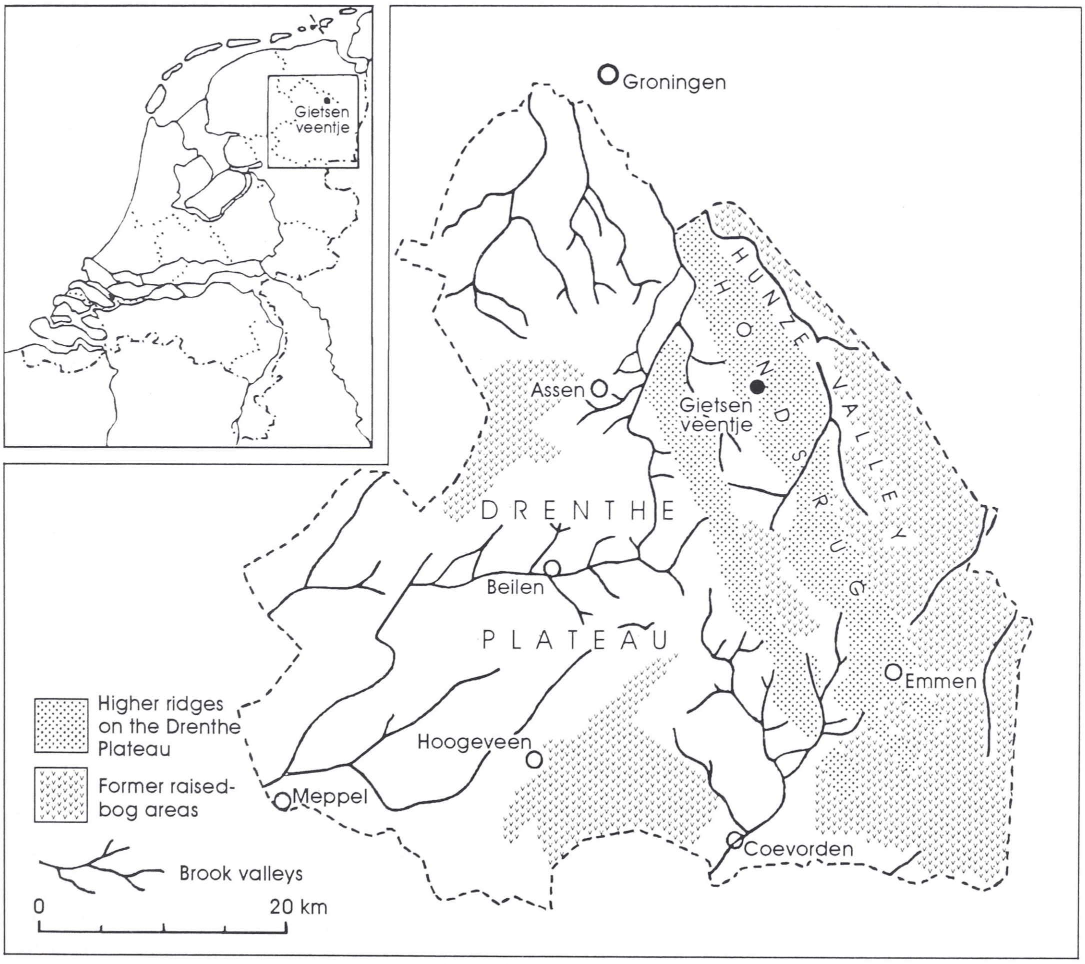


Fig. 14. Location of the Gietsenveentje in the Netherlands and overview of the part of the Drenthe Plateau located in the province of Drenthe (after TER WEE 1984, adapted).

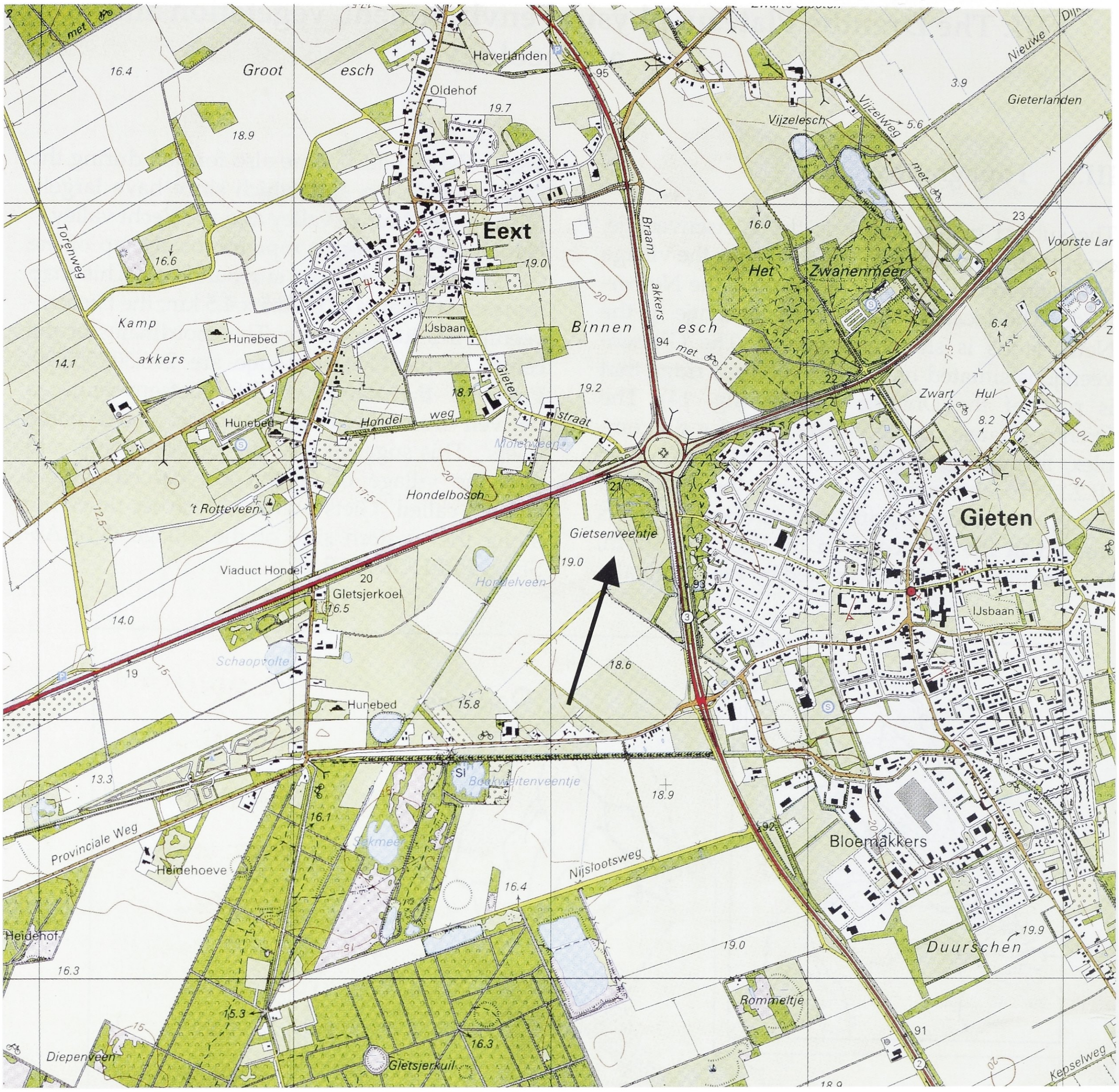


Fig. 15. Topographical map of 2001 of the Gietsenveentje and its surroundings, scale 1:25,000, made by the Dutch Topographical Service. © Topografische Dienst, Emmen.

In fig. 16, a contour map of the same area is shown. The Hondsrug ridge can be easily recognized: it extends from southeast to northwest. The highest parts of the Hondsrug are formed by man-made plaggen soils (*essen*, see III.3.2). The Gietsenveentje lies in the midst of these elevated plaggen soils; within a few hundred metres of the Gietsenveentje, heights of more than 20 metres occur. To the northeast, the Hondsrug dips steeply to the Hunze valley; to the southwest, it slopes far more gently. In the west, the embranchments of an ancient valley system can be recognized. Probably the above-mentioned stream called "Giets" once ran through this valley. Further downstream (outside the map), the Scheebroekerloop nowadays flows through this valley. Fig. 17 shows an aerial photograph of the Gietsenveentje, taken in 1995. It can be seen that it is nowadays completely covered with woodland of various types.

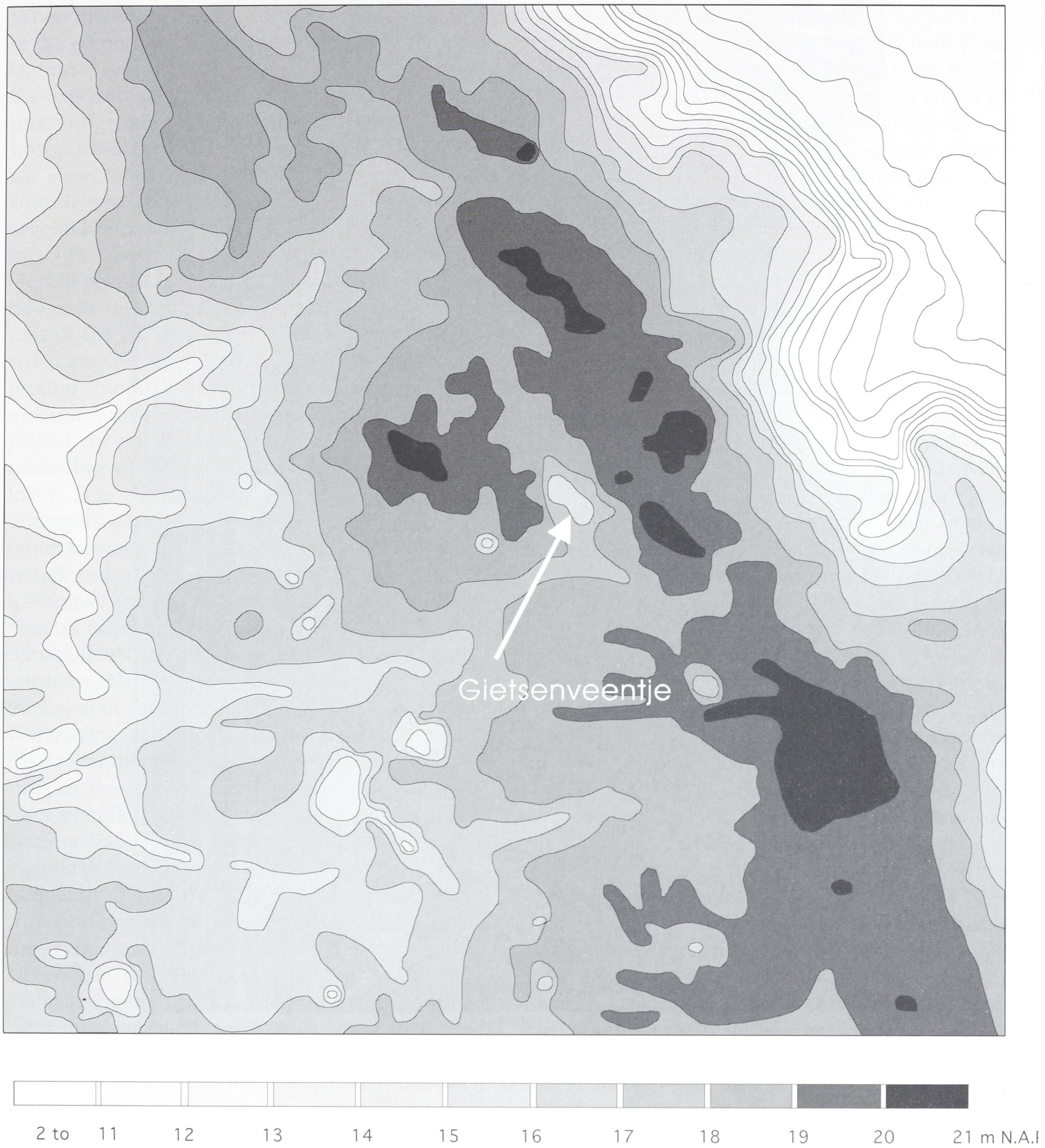


Fig. 16. Contour map of the Gietsenveentje and its surroundings, scale 1:25,000. The map covers the same area as the map of fig. 15. The location of the Gietsenveentje is indicated.

Fig. 17. Aerial photograph of the Gietsenveentje, taken in 1995 by the Dutch Topographical Service. © Topografische Dienst, Emmen.

III.2 Geology and geomorphology

III.2.1 Geological history

When the geological history of Drenthe is reconstructed, it can be seen that the ice sheets of the Saalian glaciation laid the foundation for the landscape as it is today. However, also older sediments, the so-called pre-Saalian sediments, played a role in the formation of the landscape (NIJLAND et al. 1982). In some places, these sediments even occur at or very near the surface.

In the Tertiary, the activities of large river systems prevailed, resulting in the deposition of thick sand layers. Later, from the beginning of the Pleistocene onwards, cold periods, called glaciations, dominated the climate. During the third last glaciation, the Elsterian, the ice sheet came very close to the northern part of the Netherlands (TER WEE 1983b), or even covered the area (BOSCH 1992, 67). Fine sand layers were deposited, as well as the so-called pottery clay (Dutch: *potklei*). These sediments were both deposited by meltwater from the ice sheet.

When the temperature dropped at the beginning of the second last glaciation, the Saalian, the vegetation progressively disappeared. This caused the exposure of the fine-sanded sediments of the preceding interglacial. These sediments were transported by wind and meltwater. When the ice sheet reached Drenthe, the already frozen subsoil was covered in ice with a thickness of several hundred metres. Ter Wee (1983a) has divided the Saalian glaciation into five phases. During phases A, B and C, the ice sheet advanced down to the central Netherlands; the northern part of the Netherlands was completely covered with ice. At the interface of land and ice, a ground moraine was deposited. This ground moraine consisted of material which the ice had picked up on its way down from Scandinavia, consisting of boulders, gravel, sand, clay and loam. This material was crushed and kneaded during its transportation under the ice layer to a quite homogeneous mass of sandy loam with stones and gravel and a few boulders. After the melting of the ice, this material remained as till. This till formed the rather flat Drenthe Plateau, a remarkable geomorphological feature in the northern Netherlands (TER WEE 1983a). The thickness of the till deposit varies from 2 to 8 m. Weathering and erosion have removed part of the Saalian tills. In some parts of the higher areas such as the Hondsrug ridge, the tills may have been completely removed, leaving only a thin boulder bed. The bluish-grey till deposited during phase C of the Saalian occurs in Drenthe most frequently (DE GANS 1981); it occurs also in the surroundings of the Gietsenveentje. The Hondsrug ridge and some other, less pronounced, NNW-SSE orientated ridges on the Drenthe Plateau, together called the Hondsrug complex, were most probably formed in phase C. In this phase, the ice did not move uniformly: a part moved in broad, southeast-orientated channels, while another part moved hardly at all or even stagnated. The Hondsrug complex was formed at the edge of these channels (VAN DEN BERG & BEETS 1986, fig. 9). During phase D of the Saalian, the ice sheet advanced only down to the line Coevorden-Hoogeveen-Steenwijk. Glacier lobes eroded tongue basins and pushed older material into ridges. The meltwater eroded a deep ice-marginal valley: the Proto-Vecht valley. During phase E of the Saalian, the ice sheet advanced even less far, and reached only the line Sellingen-Vlagtwedde-Delfzijl. Here also tongue basins and ridges were formed by the ice sheet. Also an ice-marginal valley was eroded by the meltwater: the Proto-Hunze valley.

The Saalian was followed by a warm period, the Eemian. During the Eemian, the tills were heavily weathered and leached. Practically all chalk, including limestone, disappeared from the tills. At the end of the Eemian, a temperature decline marked the beginning of the last glaciation, the Weichselian. The coldest phase of the Weichselian is also called Pleniglacial. During the Weichselian, the ice sheet did not reach the Netherlands. In Drenthe, only indirect effects of the ice expansion were noticeable. Because of the storage of water in the form of ice in the ice cap, the sea level dropped. This enabled rivers and streams to incise their courses deeper and further inland. On the Hondsrug, numerous erosion valleys were formed, including the cross-watershed channel near Borger (NIJLAND et al. 1982). Meltwater was flowing through the area in large quantities, so that material at the surface, including the Eemian soil and meltwater sands, was removed. Later, under cold but precipitation-rich conditions, the river and brook valleys were filled up by gravel, sand, loam and peat (DE GANS 1981).

The last phase of the Weichselian, which started ca. 12,800 BP, is also called Late Glacial. In this period, the climate became drier and the temperature already increased considerably. However, this rise in temperature occurred saltatorally: in the Late Glacial, various warm and cold periods can be recognized. During the cold periods, degeneration of the vegetation transformed Drenthe into a polar desert. Under these conditions, the dry sand of the valley plains, which were sparsely covered with vegetation, and of the weathered and leached till plateaus, was taken up by the wind and deposited elsewhere in the form of coversand. As its name already indicates, the coversand was deposited like a blanket over almost the entire landscape. It filled up depressions in the till surface, but also created coversand ridges. The thickness of the coversand locally varies strongly, from ca. 0.5 to more than 2 m. The gently undulating character of the coversand points to an aeolian origin and is characteristic for the coversand landscape. During the somewhat warmer periods, peaty sediments were deposited.

The landscape in Drenthe reached its present form during the Holocene. The Holocene began ca. 10,150 BP (see appendix II) and continues up to the present day. As a consequence of the climatic improvement, the tundra landscape of the Late Glacial could develop into an open forest with birch and pine. Later on in the Holocene, under the influence of an increasingly warmer and more humid climate, Drenthe saw the development of a deciduous forest with many species. The continuously rising sea level caused a rising water table inland, which subsequently caused the formation of marsh vegetation in wetter places and the consequent development of peat sediments. In the Holocene, three important types of sediment were formed: brook valley and fen peat sediments, ombrogenous peat sediments and driftsand sediments (CASTEL 1992). In the central part of the brook valleys, fen peat developed, made up of reed and sedge peat, in deposits with a thickness of up to a few metres. Ombrogenous peat consists particularly of peat moss (*Sphagnum*). Until a century ago, extensive raised-bog complexes occurred on the lower and flat parts of the Drenthe Plateau (RAPPOL 1992, fig. 1.1). Most of the peat has been removed to be used as fuel (*turf*). Driftsands are Holocene sands, deposited by the wind, formed by local shifting of the underlying Pleistocene sediments. They can be easily recognized by their chaotic relief: over short distances, relatively large differences in elevation can occur. Most of the present driftsands in Drenthe are man-made: because man destroyed the vegetation, the subsoil was exposed and the Pleistocene sand was taken up by the wind and deposited elsewhere.

III.2.2 The growth and decay of pingos

A conspicuous periglacial phenomenon is the growth of pingos. Because the Gietsenveentje is most probably a pingo scar, the growth of pingos will be discussed more in detail. The term "pingo" is an Inuit word for mound, which in the 1930s was adopted by geologists to indicate mounds with a core of ice. These mounds are common appearances in certain parts of Alaska, Canada, Siberia and Greenland (CASTEL & RAPPOL 1992). Pingos arise mostly in permafrost areas, through the forming of an ice lens a few metres below the surface. This lens grows gradually, but it cannot extend downwards because of the permanently frozen soil, so it can only grow upwards. In this process, the overlying soil is pushed up, so that a mound is formed. These mounds range in height from 3 to 70 m and in diameter from 30 to 600 m (MACKAY 1962). The ice lens mostly occurs between depths of 2 and 10 m beneath the surface. Two types of pingo can be distinguished:

- open-system (hydraulic) pingos, which are related to discontinuous permafrost conditions and are located on weak slopes and in valleys (HOLMES et al. 1968). They receive the water to grow their ice cores from artesian pressure (seepage);
- closed-system (hydrostatic) pingos, which are related to continuous permafrost conditions and are located on flat ground in former lake environments. They receive the water to grow their ice cores from pore-water expelled in advance of an aggrading lower permafrost surface (MACKAY 1979).

Continuous growth of a pingo leads to the sliding down of the covering soil layers under the influence of gravity. Consequently, the ice core is exposed to sunlight and begins to melt. The result will be that a depression remains, surrounded by a rampart of slope material: a so-called "pingo scar". However, the presence of a rampart around a depression is no clear criterion, because many pingo scars do not or no longer have a rampart, while aeolian depressions of later age may indeed have a rampart, built up of coversand (T.W.M. BAKKER et al. 1986).

On the Drenthe Plateau, there are hundreds of depressions filled with gyttja, peat and/or water. If these depressions have a depth of more than 2 metres, they are nearly always pingo scars (DE GANS 1981, 93). According to De Gans (1981, 89), the pingos on the Drenthe Plateau were formed during the last part of the Pleniglacial, the coldest period of the Weichselian, between ca. 25,000 and 18,000 BP. At that time, most probably a continuous permafrost prevailed in the Netherlands. So far, the earliest organic infilling of pingo scars is variously dated between the Upper Pleniglacial and early phases of the Late Glacial (DE GANS 1981, 89). However, the earliest infilling of a pingo scar does not necessarily indicate the point in time when the transformation from pingo to pingo scar was completed. Some pingo scars situated on high parts of the Hondsrug never even contained any water, so that no sediment was deposited at all (MOOKKAMPS & BOTTEMA 1987). On the Drenthe Plateau, the transformation from pingo to pingo scar is thought to have taken place between ca. 18,000 and 13,000 BP (T.W.M. BAKKER et al. 1986).

De Gans (1981) studied the locations of a large number of pingos on the Drenthe Plateau. He demonstrated that these pingos always lie in former, generally indiscernable, upstream parts of tributary valleys. During the Pleniglacial these

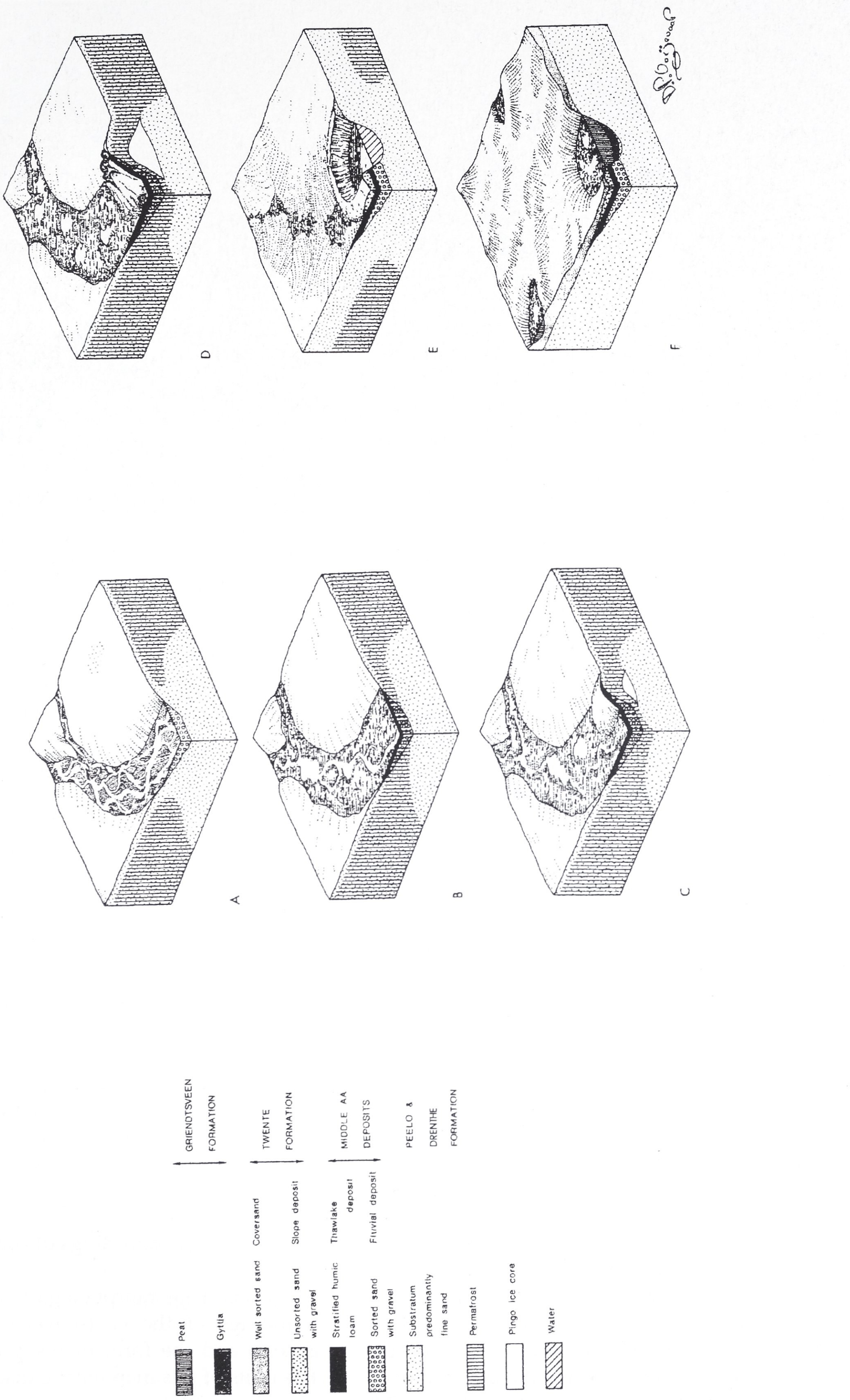
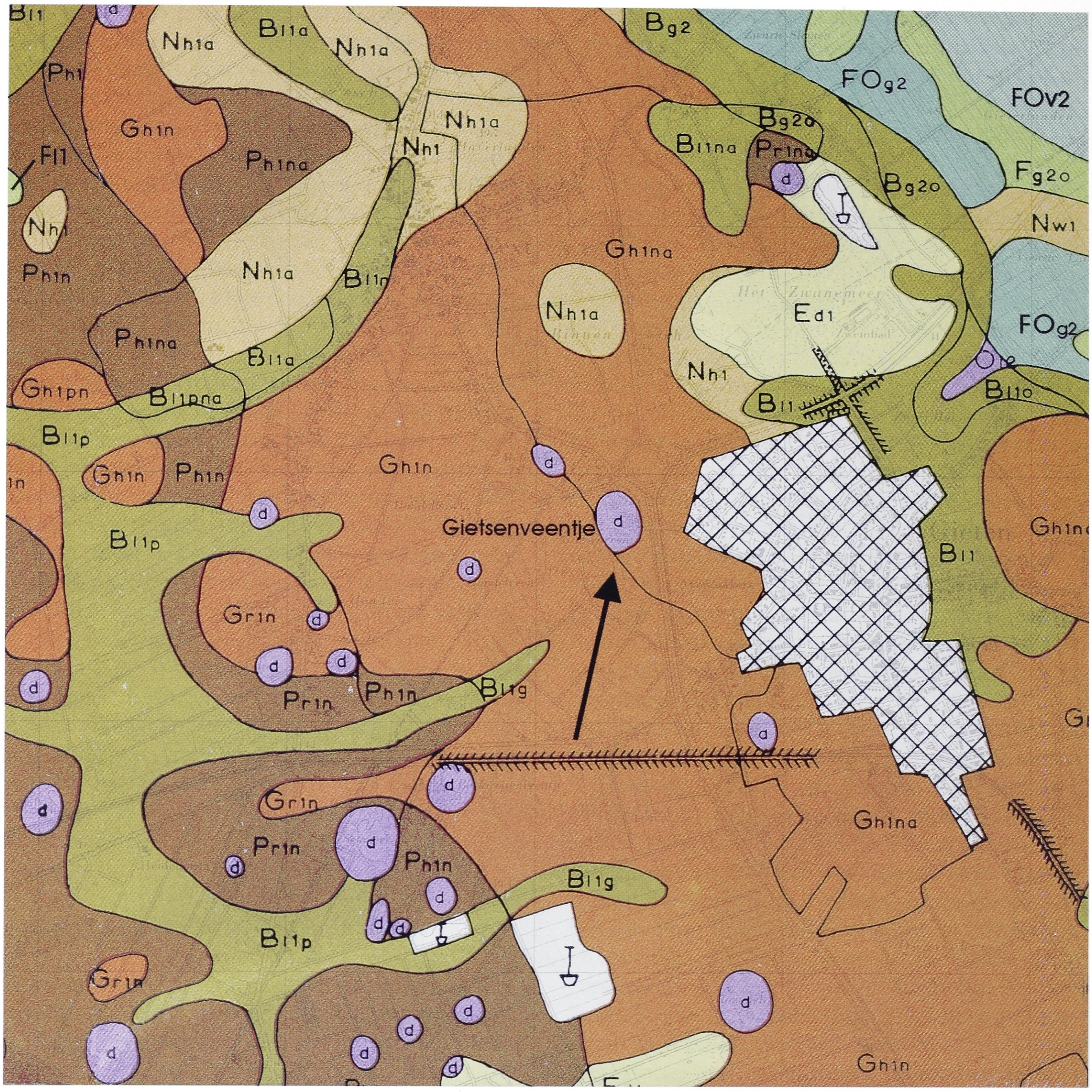


Fig. 18. Growth and decay of a closed-system pingo (after DE GANS 1981).



valleys were filled with fluvial sediments. At the top of these deposits, humic or peaty loam layers occur, which are thought to have been deposited in thaw lakes (DE GANS 1981, 45 ff.). The growth of pingos is believed to have occurred predominantly in a thaw lake environment. However, the presence of thaw lakes in Drenthe during the Pleniglacial is questioned nowadays (pers. comm. P. Cleveringa). The low relief on the Drenthe Plateau, the assumed presence of continuous permafrost and the occurrence of till on the watersheds which prevents the development of source areas for groundwater necessary for open-system pingo growth: all these circumstances seem to indicate that the pingos on the Drenthe Plateau, including the Gietsenveentje, are closed-system (hydrostatic) pingos. In fig. 18, the growth and decay of such a closed-system pingo is illustrated.

III.2.3 The surroundings of the Gietsenveentje

Fig. 19 is a geomorphological map of the surroundings of the Gietsenveentje, showing the genesis and the form of the present landscape. The units of this map will be discussed, classified according to their age.

Pre-Saalian. In the eastern part of the map area, where the Hondsrug descends gently, pre-

Fig. 19 (left). Geomorphological map of the Gietsenveentje and its surroundings, scale 1:25,000, made by the Planning Service of the Province of Drenthe (NIJLAND et al. 1982). The map covers the same area as the map of fig. 15. The map shows two aspects of the landscape: the genesis and the form (morphology). The following units can be distinguished, classified according to their age:

Pre-Saalian (Elsterian, beginning of Saalian)
P pre-Saalian deposits within 120 cm below the surface

Saalian
G till within 120 cm below the surface: glacial

Weichselian
N coversand with a thickness of more than 120 cm: niveo-aeolian
...n coversand with a thickness of 40-120 cm on top of other deposits: niveo-aeolian
Bl forms created by the effects of water and soil ice in a cold climate: periglacial: erosion valley
Bg forms created by the effects of water and soil ice in a cold climate: periglacial: talus slope

Holocene
E forms created by wind in a temperate climate: aeolian: driftsand
O deposits and forms created by peat forming and peat digging: organogenic
F stream deposits created under the influence of running water: fluviatile
FO peat deposits created under the influence of running water
...a cultural layer thicker than 40 cm on top of other deposits

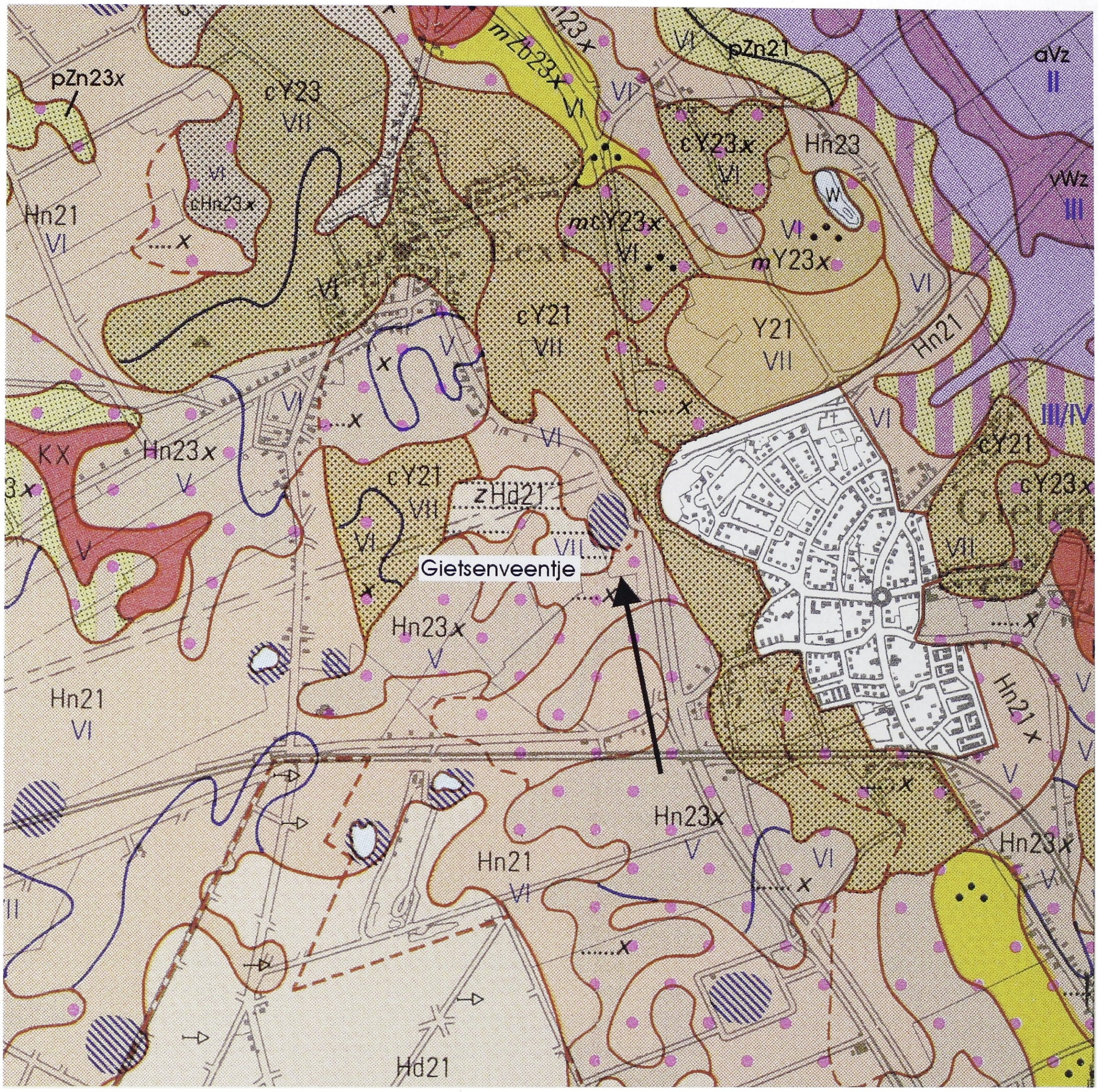
d circular depression (often a pingo scar)

Saalian sands occur within 120 cm below the surface. Here, the once present Saalian till has disappeared completely through erosion.

Saalian. On the highest parts of the Hondsrug (cf. fig. 16), including the Gietsenveentje, an extensive complex of Saalian till occurs within 120 cm below the surface.

Weichselian. In the eastern part of the map area, the contours of a Weichselian periglacial erosion valley are clearly visible. During the Weichselian, this valley, an embranchment of which almost reaches the Gietsenveentje, was part of the Drentse Aa valley. As a consequence of erosion in the Weichselian, pottery clay from the Elsterian (pre-Saalian) occurs near the surface in the lower part of the valley (see the soil map, fig. 20). Until about a century ago, the Scheebroekerloop flowed through the lower part of this valley (see fig. 27). Many circular depressions (mostly pingo scars) occur in the neighbourhood of the erosion valley, thus confirming the hypothesis that pingos are formed in upstream parts of tributary valleys (DE GANS 1981; see III.2.2). Another, smaller periglacial erosion valley occurs north-east of the village of Gieten. On part of the steep slope between the Hondsrug and the Hunze valley, the shape of a Weichselian talus slope can be recognized. At some places on the Hondsrug, particularly in the northern part of the map, the Weichselian coversand reaches a thickness of more than 120 cm. The pre-Saalian and Saalian deposits are mostly covered by a coversand layer of 40-120 cm.

Holocene. North of the village of Gieten, a Holocene driftsand area occurs, which in later times was planted with oak forest, in order to fix the sand. In the northwestern part of the map area, Holocene fluviatile deposits, sometimes mixed with peat, occur in the low-lying Hunze valley. In the vicinity of the villages of Gieten and Eext, a culture layer thicker than 40 cm occurs on top of the other sediments. These so-called plaggen soils (Dutch: *essen*) are artificial elevations in the neighbourhood of villages (see III.3.2).



III.3 Soil

III.3.1 General remarks

Soil is defined as the upper part of the earth's crust, with properties which differ from the underlying parent material as a consequence of the effects of climate, relief and living organisms. In the Netherlands, the parent material is to a large extent supplied from elsewhere by wind, sea, rivers and ice. The parent material can also be formed locally, for example by the accumulation of organic material (peat) (STIBOKA 1977). The most important soil-formation processes on the higher sandy soils of the Drenthe Plateau are podzolization, the forming of gley and pseudogley, disintegration of mineral compounds and homogenization by plant roots and soil fauna. Podzolization involves the eluviation of predominantly humic acids, formed by the decomposition of plants; as a consequence, various layers are formed, the soil horizons: the A horizon is the eluvial layer, the B horizon the illuvial layer (DE BAKKER & SCHELLING 1989).

Fig. 20 (left). Soil map of the Gietsenveentje and its surroundings, scale 1:25,000, made by the Dutch Foundation for Soil Mapping (STIBOKA 1977). The map covers the same area as the map of fig. 15. The soils are classified according to the classification by De Bakker & Schelling (1989).

Peat soils

aVz	earthy, clay-poor peat soils: *made* peat soils on sand

Earth soils

vWz	peaty earth soils on sand
pZn21/23	sandy hydroearth soils: *goor* earth soils

Glacial clay soils

KX	glacial clay soils: till or pottery clay (*potklei*) within 50 cm below the surface

Vague soils

*m*Zb23*x*	sandy xerovague soils: *vorst* vague soils

Podzol soils

Y21/23	moder podzol soils: *holt* podzol soils
cY21/23	moder podzol soils: *loo* podzol soils
Hn21/23	humus podzol soils: *veld* podzol soils
Hd21	humus podzol soils: *haar* podzol soils

code 21 in all units:	fine sand with little or no loam
code 23 in all units:	loamy fine sand

z...	sand cover of 15-40 cm
...*x*	and purple-stippled areas: till or pottery clay beginning between 40 and 120 cm below the surface and at least 20 cm thick

hatched:	circular depression

Groundwater stages

I-IV	average highest level less than 40 cm below surface, average lowest level less than 120 cm below surface
V	average highest level less than 40 cm below surface, average lowest level more than 120 cm below surface
VI	average highest level 40-80 cm below surface, average lowest level more than 120 cm below surface
VII	average highest level more than 80 cm below surface, average lowest level more than 160 cm below surface

Gley and pseudogley phenomena occur when the groundwater level is located near the surface. Gley appears as grey-coloured layers, formed as a consequence of a lack of oxygen, often with red-brown rust spots, which arise where air can penetrate into the layer. Pseudogley demonstrates an opposite rust picture: a red-brown, rusty matrix with grey spots. Pseudogley can be found near surfaces where rainwater temporarily stagnates, for example because of the presence of a till layer. Pseudogley is an indicator of water stagnation (SPEK 1993).

III.3.2 Soil types in the surroundings of the Gietsenveentje

Fig. 20 is a soil map of the surroundings of the Gietsenveentje. The units of this map will be discussed.

Peat soils. In the low-lying Hunze valley in the northeast, *made* peat soils occur: soils with a well-developed earthy layer (A1 horizon) on top of a more than 40 cm thick layer of mainly sedge peat.

Earth soils. Earth soils form the transition between peat soils and mineral soils. In the Hunze valley in the northeast, peaty earth soils occur: earth soils with a peaty layer of less than 40 cm. On the steep slope between the Hondsrug and the Hunze valley and on the slopes of the valley of the Scheebroekerloop (western part of the map area), *goor* earth soils occur. These soils have a distinct humic top layer, but lack a podzol profile. During the formation of these soils, the groundwater level regularly reached a level just below the surface. In *goor* earth soils, almost no gley is observed; they occur in areas without seepage (NIJLAND et al. 1982).

Glacial clay soils (pottery clay and till soils). In the former valley of the Scheebroekerloop in the western part of the map area, pottery clay occurs within 50 cm below the surface. In two locations on the Hondsrug, at the northern and eastern edge of the map area, till occurs within 50 cm below the surface. Because of the impermeable pottery clay or till layers not far below the surface, wet pseudogley profiles rich in stagnation rust were formed at these locations.

Vague soils. Locations where a more sandy and permeable till occurs within 50 cm below the surface may have brown earth soils. These soils, belonging to the *vorst* vague soils, occur in the map area on high parts of the Hondsrug in the north and southeast.

Podzol soils. Podzol soils, which can be formed in any type of sandy soil, are characterized by a clear illuvial layer (B horizon). They are by far the most common soil type in the vicinity of the Gietsenveentje. Two main types can be distinguished on the basis of the form of humus in the illuvial layer: moder podzols and humus podzols.

Moder podzol soils. In moder podzol soils, the illuviated humus is granular and loose-structured. Moder podzols show characteristics of podzolization as well as mineral disintegration. They occur high above the groundwater at locations which have traditionally been forested or where the soil characteristics have been conserved by a manure cover on top of the soil (NIJLAND et al. 1982). Two types of moder podzol are distinguished. *Holt* podzols are moder podzols with a thin (up to 30 cm) humic top layer. They are characteristic of ancient forest remnants, but also occur in the younger parts of the plaggen soils (*essen*). They are found north of the village of Gieten, in an area where a relatively old forest occurs (see figs. 25-28). *Loo* podzols are moder podzols with a moderately thick (30 to 50 cm) humic top layer (manure layer). They were formed by centuries of fertilizing with manured heather sods (plaggen). These soils occur near the villages of Gieten and Eext: they are equivalent to the plaggen soils (*essen*).

Humus podzol soils. In humus podzol soils, the illuviated humus is amorphous, i.e. it has no clear structure. The B horizon is often so much compressed, that it is almost impermeable to water and plant roots. The most common group of humus podzol soils is formed by the *veld* podzol soils. These soils are characteristic of moist heathfields, most of which are reclaimed nowadays (NIJLAND et al. 1982). *Veld* podzols, moist to wet, poor podzols, are formed when the groundwater level has regularly reached a level near the surface, but when net water movement has still occurred in a downward direction (SPEK 1993, 181). They show characteristics of podzolization as well as gley. In the map area, *veld* podzols occur on the high parts of the Hondsrug and also further west, in locations where heathfields have occurred in the recent past (see fig. 27). In better-drained sandy areas, where the groundwater level never reached the B horizon, *haar* podzol soils occur. *Haar* podzols, which have a strongly eluviated A2 horizon and a well-developed B horizon, are characteristic of dry heathfields and heath reclamations. All *haar* podzols under (former) heathfields are secondary podzols, formed by the degradation of moder podzol soils. In the map area, *haar* podzols occur in the south, on the western slope of the Hondsrug, and in a small area directly west of the Gietsenveentje; these also are locations where heathfields occurred in the more recent past (see fig. 27).

III.3.3 Determination of potential natural vegetation on the basis of occurring soil types

The process of soil formation depends on climate, relief, parent material and vegetation. The effects of parent material and vegetation on soil forming are strongly interrelated. The vegetation history is also heavily dependent on the influence of man. This means that there is an indirect relationship between occupation history and soil formation (SPEK 1993). An example is the forming of secondary podzols under heathfields, which have been created by man. The profile characteristics of the various soil types in the direct surroundings of the Gietsenveentje give a picture of soil genesis and, indirectly, also of vegetation history and man's influence on it.

Spek (1993, 178) has classified the modern soil types of the higher parts of the Drenthe Plateau

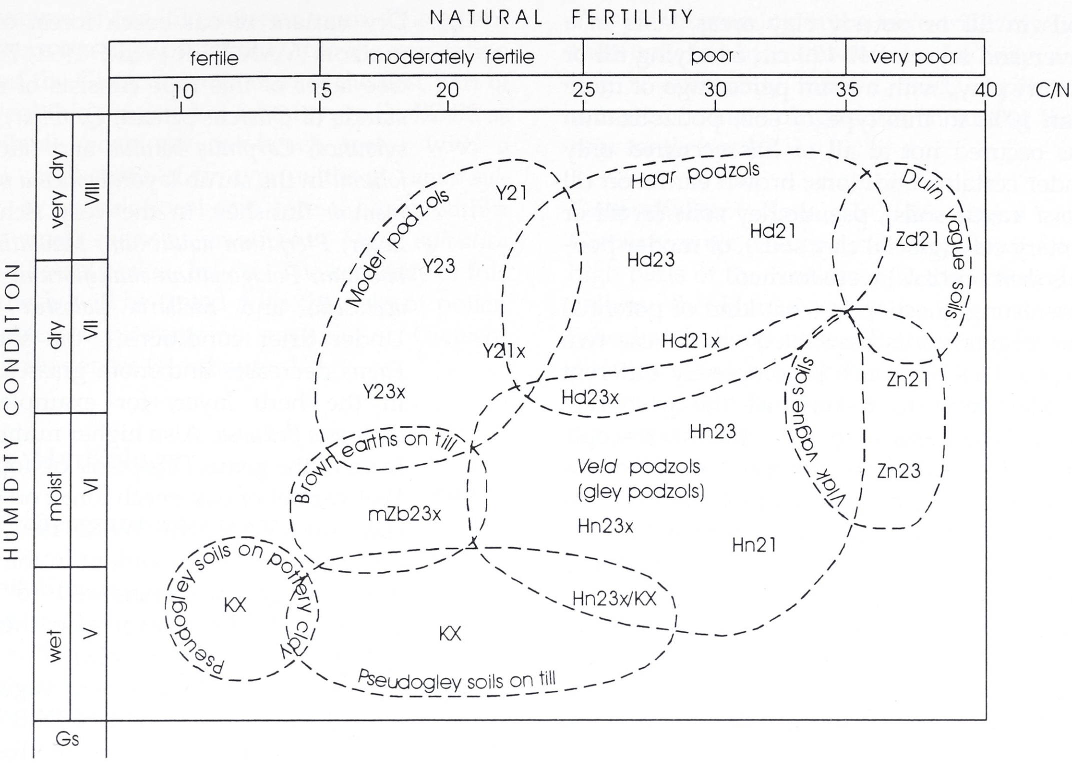


Fig. 21. Ecological soil diagram of the higher sandy parts of the Drenthe Plateau (after SPEK 1993). On the horizontal axis, the C/N ratio of the upper soil layer is plotted as a measure of natural soil fertility. On the vertical axis, the humidity condition is indicated, represented by the groundwater stage. The broken lines indicate the 70% confidence interval per soil group, which means that 70% of observations will fall within the envelope.

according to moisture conditions and soil fertility. The result is a so-called ecological soil diagram. This diagram is shown in fig. 21. The soil fertility is measured by the C/N ratio (C: carbon, N: nitrogen) of the upper soil layer: the poorer a soil is, the less nitrogen it contains, and the higher the C/N ratio. To characterize moisture conditions, groundwater stages (also indicated on the soil map of fig. 20) are used.

The poorest soils in the surroundings of the Gietsenveentje are the humus podzols: *haar* podzols, occurring under dry conditions, and *veld* podzols, occurring under moist to wet conditions. Somewhat more fertile are the moder podzols, occurring under dry conditions. The most fertile soils in the vicinity of the Gietsenveentje occur where pottery clay or till is present near the surface: brown earths on till (*vorst* vague soils), and pseudogley soils on till (glacial clay soils). The most fertile (but very wet) area in the surroundings of the Gietsenveentje is the former valley of the Scheebroekerloop, where pottery clay occurs near the surface. Pseudogley soils on pottery clay are somewhat more fertile than pseudogley soils on till (fig. 21). We have to keep in mind that man has played a very important role in soil formation around the Gietsenveentje: the *loo* podzols occur in man-made plaggen soils (*essen*); the *veld* and *haar* podzols occur in man-made heathland. It is likely that all recent *veld* and *haar* podzols in this area are secondary podzols. When the soil types occurring in this area at the beginning of the Neolithic are considered, the *loo* podzols and the secondary humus podzols can be discounted. A division of the "natural" soil types of the higher parts of the Hondsrug, which is essential with regard to the vegetation which in the past grew on these soils, is the following:

A. Soils in coversand or pre-Saalian sand areas: soils in a coversand or pre-Saalian sand layer of more than 120 cm, with a loam percentage of less than 10%; in this type of soil, podzolization has always occurred (primary podzolization); primary humus podzols (*veld* and *haar* podzols) were formed;

B. Soils in till or pottery clay areas: soils in a coversand layer of 40-120 cm overlying till or pottery clay, with a loam percentage of more than 10%; in this type of soil, podzolization has occured not at all or has occurred only under certain conditions; brown earths on till (*vorst* vague soils), pseudogley soils on till or pottery clay (glacial clay soils), or moder podzols (*holt* podzols) were formed.

An interesting question is what kind of potential natural vegetation is associated with these two soil types. This approach is completely different from attempting to reconstruct the past vegetation on the basis of pollen and macroscopic remains. The potential natural vegetation is defined as the highest developed natural vegetation which is possible in a certain location under the present environmental conditions (SPEK 1993, 181).

A. Potential natural vegetation of coversand or pre-Saalian sand areas: birch-common oak forest (*Betulo-Quercetum roboris*; VAN DER WERF 1991; STORTELDER et al. 1999): an open-structured forest rather poor in species. The wetter the soil, the larger the share of *Betula* compared to *Quercus*.
   - A1. Dry variant of birch-common oak forest on *haar* podzols (VAN DER WERF 1991, 64): domination of *Quercus robur* and *Betula pendula*. In the shrub layer, *Sorbus aucuparia* and *Rhamnus frangula* occur in small numbers. The herb layer is also rather poor, and is often dominated by the grass species *Deschampsia flexuosa* or by *Vaccinium myrtillus*.
   - A2. Wet variant of birch-common oak forest on *veld* podzols (VAN DER WERF 1991, 73): compared to the dry variant, the numbers of *Betula pendula* and particularly *Betula pubescens* increase. The shrub layer does not differ very much from the dry variant; however, in the herb layer, the grass species *Molinia caerulea* dominates; sometimes *Vaccinium myrtillus* and *Erica tetralix* occur in larger numbers.

B. Potential natural vegetation of till or pottery clay areas: on the most fertile, moist to wet soils, oak-hornbeam forest (*Stellario-Carpinetum*; VAN DER WERF 1991; STORTELDER et al. 1999); on the moderately fertile, dry to wet soils, oak-beech forest (VAN DER WERF 1991: *Fago-Quercetum petraea*; STORTELDER et al. 1999: *Fago-Quercetum*). These forest types have a more closed structure and are richer in species than the *Betulo-Quercetum roboris*.
   - B1. Dry variant of oak-beech forest on *holt* podzols (VAN DER WERF 1991, 78): the tree layer of this type consists of mixed stands of *Quercus petraea*, *Q. robur*, *Fagus sylvatica*, *Carpinus betulus* and *Ilex aquifolium*. In the shrub layer, *Lonicera periclymenum* florishes. In the very rich herb layer, *Pteridium aquilinum*, *Maianthemum bifolium*, *Polygonatum multiflorum*, *Oxalis acetosella* and *Stellaria holostea* occur. Under drier conditions, the share of *Fagus* decreases and more grasses occur in the herb layer, for example *Deschampsia flexuosa*. Also higher numbers of ferns of the genus *Dryopteris* are found.
   - B2. Wet variant of oak-beech forest on glacial clay soils (VAN DER WERF 1991, 95): it differs from the dry variant in the larger share of *Quercus* compared to *Fagus*, while in the herb layer also the grass species *Molinia caerulea* occurs.
   - B3. Oak-hornbeam forest on *vorst* vague soils and glacial clay soils (VAN DER WERF 1991, 147): the tree layer of this type consists of *Quercus robur*, *Carpinus betulus*, *Fagus sylvatica*, and sometimes also *Fraxinus excelsior*, *Ulmus* sp. and *Tilia* sp.. On the wettest soils, the share of *Fagus sylvatica* markedly decreases, while the share of *Fraxinus excelsior* and *Alnus glutinosa* increases.

It has to be emphasized that the potential natural vegetation cannot be equated with the actual vegetation as it occurred during the Neolithic. A first limitation is that in many locations the soil type has changed in the course of time. Most important among these are all man-made soils, which did not exist at the beginning of the Neolithic. A second limitation is the migration of tree species in the course of time. At the beginning of the Neolithic, *Fagus sylvatica* had only just arrived in northwestern Europe (LANG 1994, 160), while *Carpinus betulus* was not present at all (LANG 1994, 154). In spite of these limitations, defining the potential natural vegetation on the basis of soil types is very useful in the process of reconstructing the vegetation of the Drenthe Plateau during the Neolithic.

With the help of the geomorphological map (fig. 19) and the soil map (fig. 20) the method can be applied to the surroundings of the Gietsenveentje. It can be seen that the Gietsenveentje is situated in the centre of an extensive till plateau, covered by only a thin layer of coversand. Thick coversand or pre-Saalian sand layers occur only at distances of one kilometre or more. This means that there is a high probability that the vegetation around the Gietsenveentje during the first part of the Neolithic consisted of forest types B1-B2-B3 as described above: an oak-beech forest with a (very) small share of or even without *Fagus sylvatica,* or an oak-hornbeam forest, again with a (very) small share of or without *Fagus sylvatica* and without *Carpinus betulus.* The accuracy of this hypothesis will be tested with the help of pollen and macroscopic-remains analysis of Gietsenveentje sequences (see chapter VI).

III.4 Hydrology

III.4.1 General remarks

Precipitation surplus. In Drenthe, the modern average annual precipitation is ca. 800 mm (see III.5), while the average annual evaporation is estimated to be ca. 460 mm (NIJLAND et al. 1982, 39). This means that the average annual precipitation surplus is ca. 340 mm. This precipitation surplus is strongly seasonal: in most years, a small evaporation surplus occurs in summer, while the precipitation surplus is limited to the colder seasons.

Groundwater. Groundwater is defined as water in the saturated zone of the ground, i.e. the zone where no air occurs between the soil particles. A system of seven groundwater stages (I-VII) was developed for the Netherlands by Stiboka (1977). These groundwater stages are indicated on the soil map of fig. 20 and explained in the corresponding legend. In the Hunze valley (northeastern part of the map area), stages with the highest groundwater level occur: stage II and III. In the rest of the mapped area, only stages with a quite low groundwater level occur: stages V to VII. In the direct vicinity of the Gietsenveentje, the groundwater level is low: stages VI and VII. The lowest groundwater level (stage VII) is found particularly in plaggen soil (*essen*) and driftsand areas. The groundwater which stagnates above impermeable layers in the soil is called shallow groundwater. Impermeable layers can result from geological as well as soil formation processes. Gyttja (lake sediment), consisting of silt particles and organic material, may form such an impermeable layer (NIJLAND et al. 1982, 44). As the gyttja layer becomes thicker, at a certain moment the water accumulating above the gyttja layer is closed off from the deeper groundwater. The plants growing in the terrestrializing lake are then only fed by rainwater. In this way, a raised bog is eventually formed. Such a process has occurred in most pingo scars, including the Gietsenveentje (see VI.1).

Groundwater flow. In the area of the Gietsenveentje, the groundwater flows from the high parts of the Hondsrug to the (former) brook valleys: the Hunze valley in the east and the Scheebroekerloop valley in the west. Because of differences in electric potential between deep and shallow groundwater, flowing under and above the impermeable till layer, potential infiltration and seepage areas are formed (T.W.M. BAKKER et al. 1986; NIJLAND et al. 1982): in potential infiltration areas the net movement of groundwater is downwards while in potential seepage areas the net movement of groundwater is upwards. The higher parts of the Hondsrug, including the location of the Gietsenveentje, form a potential infiltration area, while potential seepage areas are found in the Hunze valley and Scheebroekerloop valley (see NIJLAND et al. 1982, 46). Since the soil resistance may differ strongly because of differences in the composition of the underground, the actually occurring infiltration or seepage may differ substantially within potential infiltration or seepage areas. In potential seepage areas with till, the seepage will occur mainly where the till is interrupted or sandy. On the other hand, when nearly impermeable layers occur in potential infiltration areas, some seepage of shallow groundwater may locally occur.

III.4.2 Hydrological changes in the past

The specific hydrological situation of an area is not only important with respect to soil formation, but it is also of vital importance for the vegetation growing in that area. This means that changes in the hydrological situation in the past caused changes in the environment, particularly in the vegetation. Important phenomena which may have caused hydrological changes in the past are climatic change, raised-bog growth and forest clearance (SPEK 1993). In the framework of this study, the effects of the Neolithic forest clearances on the hydrological situation deserve particular attention. Different vegetation types have different evaporation rates: forest evaporates more water than heath, farmland or grassland. Furthermore, in forest vegetation more precipitation is intercepted by the leaves, branches and stems of the trees, causing even higher evaporation. Consequently, the precipitation surplus in an open landscape is considerably higher than in a forested landscape. The hydrological effects of forest clearance differ for each type of landscape (SPEK 1993). In the moist parts of the coversand landscape and on the till plateaus, forest clearances may have caused a rising of the water table with tens to maybe even hundreds of millimetres. In some cases, this increase may have caused local peat growth. Because the Gietsenveentje is located on an extensive till plateau, possible forest clearances in the neighbourhood could have caused a considerable rise of the water table. However, in the drier parts of the coversand landscape, where the groundwater level lies far beneath the surface, forest clearances did not cause the soils to become wetter. On the contrary, the disappearance of the strongly buffering forest vegetation, in which a large amount of water was stored, caused the soils to become drier. In these areas, forest clearances could eventually even lead to driftsand (SPEK 1993, 184). Such a driftsand area with a very low water table (stage VII) occurs just north of the village of Gieten (see figs. 19-20).

III.5 Climate

Climate of the Netherlands. The present climate of the Netherlands can be characterized as a moderately oceanic climate with rainy summers, mild winters and prevailing westerly winds. Walter (1984, 44; 188) classifies the climate of the Netherlands in the "zonobiome" (ecological climatic zone) of the temperate-nemoral climate (zonobiome VI). The climate of this zonobiome, with a vegetational season of 4-6 months with adequate rainfall and a mild winter lasting 3-4 months, is especially suitable for the deciduous tree species of the temperate climatic zone. Such trees avoid the extreme maritime as well as the extreme continental regions and favour what is termed the "nemoral" zone (WALTER 1984).

Ecological climate diagram of Eelde. In fig. 22, a so-called ecological climate diagram (WALTER et al. 1975; WALTER 1984) of the weather station of Eelde Airport is shown. Eelde Airport is located in the northernmost part of the province of Drenthe, ca. 16 km northwest of the Gietsenveentje. In ecological climate diagrams, the mean monthly temperature and the mean monthly precipitation are plotted in a single diagram, in which 10°C is equivalent to 20 mm of precipitation. When the precipitation curve is above the temperature curve, a relatively humid season occurs; when the temperature curve is above the precipitation curve, a dry season occurs. It is clear to see that in Eelde (as in the rest of the Netherlands), the humid season persists throughout the year. In the right upper corner of the diagram, the mean annual temperature and mean annual precipitation are given: the mean annual temperature at Eelde is 8.5°C; the mean annual precipitation is 783 mm (KÖNNEN 1983). In the bar under the curves, information is given which is important for vegetation growth: the cold season (black) lasts from December to February; the months with incidental frosts (hatched) are March to May and October and November. The months in which the vegetation can grow optimally, also because the highest amounts of precipitation occur, are June to September.

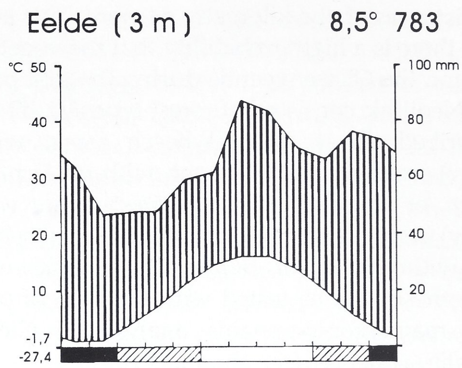


Fig. 22. Ecological climate diagram of Eelde (see WALTER et al. 1975; WALTER 1984)

Climate of Drenthe compared to the rest of the Netherlands. Although the climate in all parts of the Netherlands is characterized as a moderate oceanic climate, still considerable differences in climate can be distinguished. The influence of the sea rapidly diminishes towards the interior; the more continental character of the climate becomes noticeable at ca. 50 km from the coast. In the province of Drenthe, this is best expressed by the relatively high number of days with frost (70-90, against less than 80 in the rest of the Netherlands) and the relatively high number of summery days (20-25, against less than 20 in the coastal areas of the Netherlands) (NIJLAND et al. 1982, 14). The temperature fluctuations occurring at the change of the seasons are generally larger in Drenthe than in the rest of the Netherlands, which is caused particularly by the comparatively cold winter climate of Drenthe. This holds to an even larger extent for the eastern part of the province. The central part of Drenthe, together with parts of the Veluwe and southern Limburg, belongs to the most precipitation-rich areas of the Netherlands, with a mean annual precipitation of around 800 mm (BUISHAND & VELDS 1980). This high precipitation can be explained by the relief: the clouds supplied by the prevailing westerly winds are pushed up by the Hondsrug ridge, as a result of which they produce more rain (T.W.M. BAKKER et al. 1986). There is a striking difference regarding the distribution of precipitation over the year between the eastern and western parts of the Netherlands: in the eastern part, most precipitation falls in summer; in the west, most precipitation falls in autumn (BARKMAN & WESTHOFF 1969).

III.6 Vegetation

III.6.1 General remarks

As we saw in the preceding sections, the most important abiotic factors influencing the growth conditions of vegetation are geology, soil, hydrology and climate. As we shall see in the following two sections, the influence of man on Drenthe's vegetation, which first became noticeable at the beginning of the Neolithic, increased in the course of time. Nowadays, man is the most important factor influencing the vegetation in Drenthe. In this section, first a rough outline of the vegetation development in Drenthe since the last glaciation will be given. This will be followed by a short characteristic of the present vegetation of Drenthe.

III.6.2 Holocene vegetation history

The vegetation development of the Drenthe Plateau in the Holocene will be described on the basis of the Blytt/Sernander classification as described in I.4.1. The Blytt/Sernander periods and their durations are given in appendix II.

Preboreal. A strong increase of *Betula* at the end of the Younger Dryas announces the definitive transition to a warmer climate and marks the beginning of the Holocene. In the Preboreal, the first period of the Holocene, the climate was still dry. Trees were still dependent on the presence of moisture and were restricted to moister areas like stream valleys (BOTTEMA 1988). In these areas, open birch-pine forests occurred with an undergrowth of *Artemisia* among other plants. Because a dry climate prevailed, the evidence we have is restricted by a scarcity of sediment; only when local humid conditions allowed sedimentation could a pollen record be built up (MOOKKAMPS & BOTTEMA 1987). In the course of this period, *Ulmus* and *Corylus* immigrated into Drenthe, but their pollen values remain very low.

Boreal. The first conspicuous increase of *Corylus* marks the beginning of the next period of the Holocene, the Boreal. In only a few hundred years, *Corylus* spread from southern to northern Europe; because the autonomic spread of hazelnuts is not very efficient and very slow, it seems probable that hazelnuts were spread by water (for example the Rhine), birds or even Mesolithic people (BOTTEMA & WALSWEER 1997). During the Boreal, the conditions for tree growth were definitely better than during the previous period. In Drenthe, trees spread from the river valleys and the depressions to the uplands (BOTTEMA 1988). *Corylus* occupied more and more open spots, as a result of which *Betula* seeds especially could no longer germinate (IVERSEN 1973; BOTTEMA 1988). The pollen picture of the Boreal is dominated by *Pinus* and *Corylus*; the values of Non-Arboreal Pollen are low. In the course of this period, *Quercus, Alnus, Tilia* and *Fraxinus* immigrated into Drenthe. On the poorer soils, subarctic-looking forests developed with *Pinus, Betula* and *Populus,* to a greater or lesser extent mixed with *Corylus. Quercus, Tilia* and *Fraxinus* only grew on more favourable soils. On moist, peaty soils, carr forests with *Pinus* and *Betula* occurred, which later were displaced by *Alnus.* The Boreal is characterized by a lack of balance between climate, soil and vegetation, mainly because several important tree species were still immigrating into Drenthe (WATERBOLK 1954).

Atlantic. A decrease of *Pinus* and to a lesser extent of *Betula,* accompanied by an increase of *Alnus, Tilia, Fraxinus* and *Quercus,* marks the beginning of the Atlantic. This period is characterized by a dominance of mixed deciduous forest with mainly *Quercus, Ulmus, Tilia* and *Fraxinus.* Because of optimal climatic conditions, a stable climax forest was formed, which maintained itself for thousands of years, and was only affected by the activities of the first farmers (IVERSEN 1973; BOTTEMA 1988). In the second half of the Atlantic, pollen of *Fagus* is found for the first time, in very low percentages (VAN

ZEIST 1955a). It is not known whether small numbers of *Fagus* were really present in the Atlantic forests of Drenthe, or whether *Fagus* pollen grains reached Drenthe by long-distance transport (see WATERBOLK 1954, 10; BOTTEMA 1988; LANG 1994, 160). In the Atlantic, the forming of the large raised bogs began, partly by the drowning of forests, partly by the terrestrialization of eutrophic waters. The landscape in the Atlantic can be characterized by primeval forests of varying composition, and marshes which displayed all transitional stages from open water to alder and birch carr and real raised bogs (WATERBOLK 1954).

Subboreal. A decrease of *Ulmus* and somewhat later also *Tilia* and an increase of the culture-indicator pollen types, especially *Plantago lanceolata*, mark the beginning of the Subboreal. The Atlantic-Subboreal transition in Drenthe coincides with the beginning of the Neolithic Occupation Period. These phenomena have already been exhaustively described in chapter II. Here only some general remarks will be made. The Subboreal is the first period in which human influence on the landscape becomes visible in the pollen picture. The diversity of the vegetation increased, because the first farmers created new biotopes by opening up the dense Atlantic forest (WATERBOLK 1954). In the course of the Subboreal, *Tilia* disappeared from the forests; most probably it was displaced by *Fagus*, which shows slowly increasing pollen values. Because the migration pattern of *Fagus* through Europe resembles the spread of farming cultures throughout Europe, Bottema (1988) states that the expanding farming cultures brought *Fagus* in their wake as an oversized weed, passively or maybe even actively. *Alnus* and *Corylus* reach high pollen values; after a maximum with several peaks, *Corylus* strongly decreases at the end of the Subboreal. The maxima are possibly caused by an increase of open spots, which were created by the first farmers. The decrease might be explained by the beginning of the degradation of soils (WATERBOLK 1954; IVERSEN 1973). In the course of the Subboreal, also *Carpinus* appeared in the vegetation (LANG 1994, 154). The Subboreal landscape of Drenthe most probably consisted of extensive primeval forests, especially in the areas where till or pottery clay occurred near the surface (see III.3.3), with the settlements of the first farmers surrounded by grass-rich vegetation, arable and all kinds of intermediate forms between grass-rich vegetation, heath and deciduous forest (WATERBOLK 1954).

Subatlantic. Generally, the transition from the Subboreal to the Subatlantic is placed where *Fagus* for the first time occurs regularly or shows its first increase (VAN ZEIST 1955a, 10). However, in pollen diagrams from Drenthe, this level seems to be somewhat ambiguous, which is partly caused by the consistently low *Fagus* values, even in the Subatlantic. According to several authors (VAN ZEIST 1955a, 17; KILIAN et al. 1995; VAN GEEL et al. 1996), a level which much better indicates the Subboreal-Subatlantic transition, is the transition from the so-called Older *Sphagnum* Peat (mainly *Sphagnum cuspidatum* and *S. papillosum*) to Younger *Sphagnum* Peat (mainly *Sphagnum imbricatum*) in northwest European raised bogs, which indicates the transition to a more oceanic climate. A more humid climate probably benefited *Fagus* (VAN ZEIST 1959). According to ^{14}C dates of a large number of bogs in northern Germany, collected by Overbeck (1975, 608), the *Schwarztorf-Weisstorf-Kontakt*, as the transition is called in Germany, occurs between 1000 cal BC and cal AD 1000, which seems to indicate that this transition does not represent the same event everywhere. Characteristics of the Subatlantic in pollen diagrams are the increasing values of *Carpinus* and the culture-indicator types (VAN ZEIST 1955a). The increase of the culture-indicator types could occur because of strongly decreased forest areas on the one hand and increased areas of abandoned farmland on the other; the soils became poorer as a result of grazing by cattle and sheep, which caused an increase of especially *Calluna*. In the humid brook valleys, *Alnus* was cut and displaced by meadowland or summer pasture. The only type of landscape which was left undisturbed until a few hundred years ago, were the large raised-bog complexes (BOTTEMA 1984). The development of the landscape near the Gietsenveentje in the past two centuries will be discussed in section III.8.

III.6.3 Present vegetation

The Drenthian district. The Gietsenveentje is located in the province of Drenthe, which is part of the botanical Drenthian district (VAN DER MEIJDEN 1996; BARKMAN & WESTHOFF 1969). In the Netherlands, the Drenthian district encompasses the Drenthe Plateau; the neighbouring Pleistocene parts of northern Germany also belong to the Drenthian district. Up to the recent past, the most characteristic vegetation types of the Drenthian district were (anthropogenic) *Erica tetralix* heathfields and large raised bogs consisting of thick layers of *Sphagnum* peat. However, nowadays most of the heathfields and raised bogs are reclaimed and displaced by large-scale agricultural fields. Only small areas remain, which are all designated as nature reserves. The flora of the Drenthian district is characterized by Boreal and Atlantic species. These species are not only favoured by the relatively humid climate, but also by the predominantly poor soils of Drenthe, because most Atlantic and Boreal species are oligotraphent and acidophilous. Examples of typical Boreal species having their greatest density in the Drenthian district are *Andromeda polifolia, Drosera longifolia, Eriophorum vaginatum, Oxycoccus palustris* and *Sparganium angustifolium*; examples of typical Atlantic species having their greatest density in the Drenthian district are *Erica tetralix* and *Ilex aquifolium* (BARKMAN & WESTHOFF 1969). Within the Drenthian district, northern Drenthe, the part of Drenthe where the Gietsenveentje is located, is remarkable because of a conspicuous abundance of plants of brook valleys and of deciduous forests on till and pottery clay.

III.7 Archaeology

III.7.1 General remarks

In this section, an overview will be given of the archaeology of the Drenthe Plateau in the Mesolithic and Neolithic. The archaeology of the Swifterbant Culture and the Funnel Beaker Culture will be discussed in greater detail, because these cultures were involved in early agriculture on the Drenthe Plateau. A chronological overview of the various periods and cultures on the Drenthe Plateau from the Mesolithic onwards is given in appendix III.

III.7.2 Mesolithic (9000-4900 cal BC)

At the end of the Weichselian glaciation, the sea level began to rise slowly from 100 m below N.A.P. (Dutch datum) to 8 m below N.A.P. in the Atlantic (ZAGWIJN 1986). The amelioration of the climate made possible a considerable growth of the human population in the northern Netherlands (NEWELL 1975, 50). The inhabited area extended not only as far as the present clay areas of Friesland and Groningen, but also into the present North Sea. On the Drenthe Plateau, remains from this period, the Mesolithic, are common on coversand elevations, particularly on those along the brook valleys, pingo scars and blown-out depressions (NEWELL 1973; PRICE 1980; WATERBOLK 1985a). The Mesolithic people most probably hunted red deer, elk, wild boar and roe deer. Fishing was also important. Furthermore, eggs, berries and nuts were gathered.

The most typical finds of the Mesolithic are small objects with a geometric form, the microliths. They were used as arrowheads. Most probably, the Mesolithic people lived in dome-shaped tents, covered by hides or vegetal material. Generally, very few organic remains are left: usually only hearths with charcoal and large numbers of flint tools are found. An exceptional find from this period is the more than 9500-year-old tree-trunk canoe of Pesse (VAN ZEIST 1957; BEUKER & NIEKUS 1997). The most extensive habitation of the Drenthe Plateau by Mesolithic people occurred in the Boreal; in the Atlantic, the forest which became ever denser caused the Mesolithic people to migrate from the higher parts of the plateau to lake shores, valleys of large rivers and edges of the plateau near the coast. The Mesolithic people lived in small, wandering groups of ca. 20 people; from base-camps, food expeditions lasting several days were undertaken. There must have been regular contacts with other groups; the cultural basis units consisted of 200-500 persons. The distance between winter and summer camps would have been at most 100-200 km. The total population of the Drenthe Plateau numbered no more than a few hundred individuals (WATERBOLK 1985a). At the end of the Atlantic, the Mesolithic cultures may have been influenced by Neolithic cultures established on loess soils in the southern Netherlands and Germany, only a few hundred kilometres from the Drenthe Plateau: the Linear Pottery Culture (5300-5000 cal BC) and the Rössen Culture (4700-4300 cal BC) (LANTING & VAN DER PLICHT 1999/2000; LÜNING 1996).

III.7.3 Swifterbant Culture (4900-3400 cal BC)

The transition from a subsistence based on hunting, fishing and gathering to one based on arable farming and animal husbandry was a landmark in human history. On the Drenthe Plateau, agriculture may have been introduced by representatives of the Swifterbant Culture. The most important sites of this culture are found in the coastal areas; many of these areas are nowadays covered by marine clay because since 5000 cal BC the sea level has risen ca. 8 m (ZAGWIJN 1986). However, when parts of the IJsselmeer were impoldered, some of these sites could be excavated. Most settlement sites of the Swifterbant Culture are located on river dunes of the then IJssel river. It is clear that the Swifterbant Culture was influenced by various cultures that were simultaneously present in the southern Netherlands and in bordering parts of Germany and Belgium: these include not only the already mentioned Rössen Culture (4700-4300 cal BC), but also the subsequent Bischheim Culture (4300-4200 cal BC) and Michelsberg Culture (4200-3800 cal BC) (LANTING & VAN DER PLICHT 1999/2000; LÜNING 1996). In recent years, several new sites of the Swifterbant Culture have been discovered, most of which are located in the lower parts of the central and western Netherlands; however, also a few sites are known on the higher sandy soils of the eastern and northern Netherlands (RAEMAEKERS 1999, 108-111). Furthermore, pottery of the Hüde I site in Lower Saxony, Germany, has so many characteristics in common with Swifterbant pottery, that Ten Anscher (cited in GEHASSE 1995, 199) classifies Swifterbant and Hüde pottery in one group: the Hüde-Swifterbant Group. Raemaekers (1999) has distinguished the following three phases of the Swifterbant Culture:

- **Early Phase (SW-1): 4900-4600 cal BC.**
  The excavation of 1994-1995 at the Hoge Vaart, Almere (South Flevoland) has shown that this location was inhabited by small groups of people with pottery (partly produced locally), who practised not only hunting, but also animal husbandry (cattle, pig, sheep/goat). The habitation site reflects temporary and possibly even seasonal activities. Maybe this location was used as a base camp for hunting expeditions and possibly also for animal husbandry. So far no indications for arable farming have been found at this location (HOGESTIJN & PETERS 1996). In the subdivision of Ten Anscher (cited in GEHASSE 1995, 199), this phase is called SW-1, with pottery which is characterized by original Swifterbant elements and by Rössen influences.
- **Middle Phase (SW-2 and SW-3/Dronten phase): 4600-3850 cal BC.**
  The large excavation of 1971-1979 at Swifterbant, near the village of Dronten (East Flevoland), revealed habitation on river dunes, now lying 5 m below N.A.P.. The inhabitants of these locations processed cereal products, although it is not clear whether cereals were also cultivated locally. Pottery was produced, also partly locally; furthermore, not only animal husbandry was practised, but also hunting, fishing and gathering of nuts and fruits. On the basis of the range of activities, the group composition (adults and children) and the supposed duration of habitation, these sites are interpreted as semi-permanent principal settlements (DECKERS et al. 1980; HOGESTIJN & PETERS 1996). Ten Anscher (cited in GEHASSE 1995, 199), divides this phase into two subphases: SW-2 and SW-3. The pottery of SW-2 (4600-4350 cal BC) is characterized by Swifterbant elements and by Rössen and Bischheim traits. The pottery of SW-3 (4350-3850 cal BC), in addition to the already mentioned elements, displays faint Michelsberg influences. The finds of Rössen-type adzes also prove contacts between the Swifterbant Culture and the cultures in the southern Netherlands (HOGESTIJN & PETERS 1996). According to Lanting & Van der Plicht (1999/2000), these adzes were produced locally by people of the Swifterbant Culture.
- **Late Phase (SW-4/Nagele phase): 3850-3400 cal BC.**
  The excavation of 1984-1988 near Schokkerhaven (Noordoostpolder, Flevoland) revealed the first permanent principal settlements of the Swifterbant Culture: several sizeable house plans and an accompanying cemetery were discovered. At another location, a habitation area surrounded by a double row of oak posts was excavated. The finds from Schokkerhaven must be seen as the products of a further typological and technological development of the Swifterbant Culture (HOGESTIJN 1990; HOGESTIJN & PETERS 1996). According to Ten Anscher (cited in GEHASSE 1995, 199), the pottery from this phase is characterized, in addition to the already mentioned elements, by early TRB elements. However, Lanting & Van der Plicht (1999/2000) consider these "early TRB-elements" to be simply products of the late Swifterbant Culture; there is no connection with the development in Denmark and northeastern Germany, where indeed an Early Neolithic TRB phase occurs.

The Early and Middle Phases of the Swifterbant Culture are part of the Dutch Early Neolithic B, while the Late Phase of the Swifterbant Culture belongs to the Dutch Middle Neolithic A (LANTING & VAN DER PLICHT 1999/2000, 12). Hogestijn et al. (1995) have made a subdivision of the Swifterbant Culture into three phases, which differs only slightly from Raemaekers' subdivision (1999): Hogestijn's Early Phase coincides with phases SW-1 and SW-2 of Ten Anscher, his Middle Phase with phase SW-3, and his Late Phase with Ten Anscher's phase SW-4.

Traces of habitation on the Drenthe Plateau between 4900 and 3400 cal BC. On the Drenthe Plateau, some scattered finds are known which can be related to the Swifterbant Culture. These finds are indicated on the map of fig. 23. They mainly occur in the brook valleys. The finds can be divided into three categories:

A. *finds of Swifterbant pottery, most probably indicating the presence of Swifterbant people on the Drenthe Plateau:*

1-1. sherds of a Swifterbant pot, found in combination with two red-deer antlers in the canal Voorste Diep (Kanaal Buinen-Schoonoord) near Bronneger. This is the only dated find of Swifterbant pottery from the Drenthe Plateau: the date of organic remains which stuck to the pot is 5890 ± 90 BP [OxA-2908]; the dates of the two antlers are 5720 ± 90 BP and 5970 ± 90 BP [OxA-2909 and OxA-2910]. Combined calibration of these dates yields a result of ca. 4700 cal BC. This means that this find belongs in the Early Phase of the Swifterbant Culture (KROEZENGA et al. 1991; LANTING 1992; VAN DER SANDEN 1997);

1-2. a single sherd of a Swifterbant pot, found in the Weerdingerveen peat bog in 1943 (VAN DER SANDEN 1997); most probably, the sherd dates from the Middle Phase of the Swifterbant Culture (LANTING & VAN DER PLICHT 1999/2000);

1-3. pottery, flint material and T-shaped antler tools, found at De Gaste near Meppel, on the edge of the Drenthe Plateau (CLASON 1983; WATERBOLK 1985a). Part of the pottery unmistakably belongs to the Swifterbant Culture; some characteristics of the pottery point to the Early Phase (LANTING & VAN DER PLICHT 1999/2000);

1-4. pottery, flint material, red deer antlers, bone tools and remains of domesticated animals (cattle, pig, sheep/goat) and several wild animals, found at Heemse (near Hardenberg, Vecht valley) (CLASON 1984; WATERBOLK 1985a); the material seems to originate from various periods; according to Lanting & Van der Plicht (1999/2000) it is far from certain that it is Swifterbant material.

B. *finds of adzes, most probably imported from the Rössen Culture, which was established on the loess soils of the southern Netherlands and Germany between ca. 4700 and ca. 4300 cal BC; these indicate contacts between the Rössen Culture and contemporary inhabitants of the Drenthe Plateau:*

2. stray finds of Rössen-type adzes, used for woodworking. Two types can be recognized:

2-1. *Hohe durchlochte Schuhleistenkeile* (high perforated adzes), which were found at the following locations in Drenthe: Nieuw-Buinen, Gees and Bargererfscheidenveen (VAN DER WAALS 1972). Since 1972, specimens have been found near Donderen (1979), Diever (1983), Ellertshaar (1984), Bronneger (1986) and Eerste Exloërmond (1988). In adjacent parts of the province of Groningen, also two specimens turned up: one near De Wilp (Van der Waals, 1972) and one near Mussel (GROENENDIJK 1993). These adzes are also indicated on the map (fig. 23).

2-2. *Durchlochte Breitkeile* (perforated wedges), which were found at the following locations in Drenthe: Eext (see III.7.6), Veenoord, Zwiggelte, Hijken, Berkmeer (near Dalen) and Oud-Schoonebeek (VAN DER WAALS 1972). In 1974, another was found near Zwinderen. In the bordering part of the province of Overijssel, a specimen was found near Aneveld (VAN DER WAALS 1972).

3. stray finds of *Plättbolzen*, adzes with the shape of a flat-iron; one was found near Fochteloo (JAGER 1981); a second was found near Siegerswoude (FOKKENS 1990, 193: nr. 186); most probably, they were imported from the Linear Pottery or Rössen Cultures, and are related to the Rössen-type adzes.

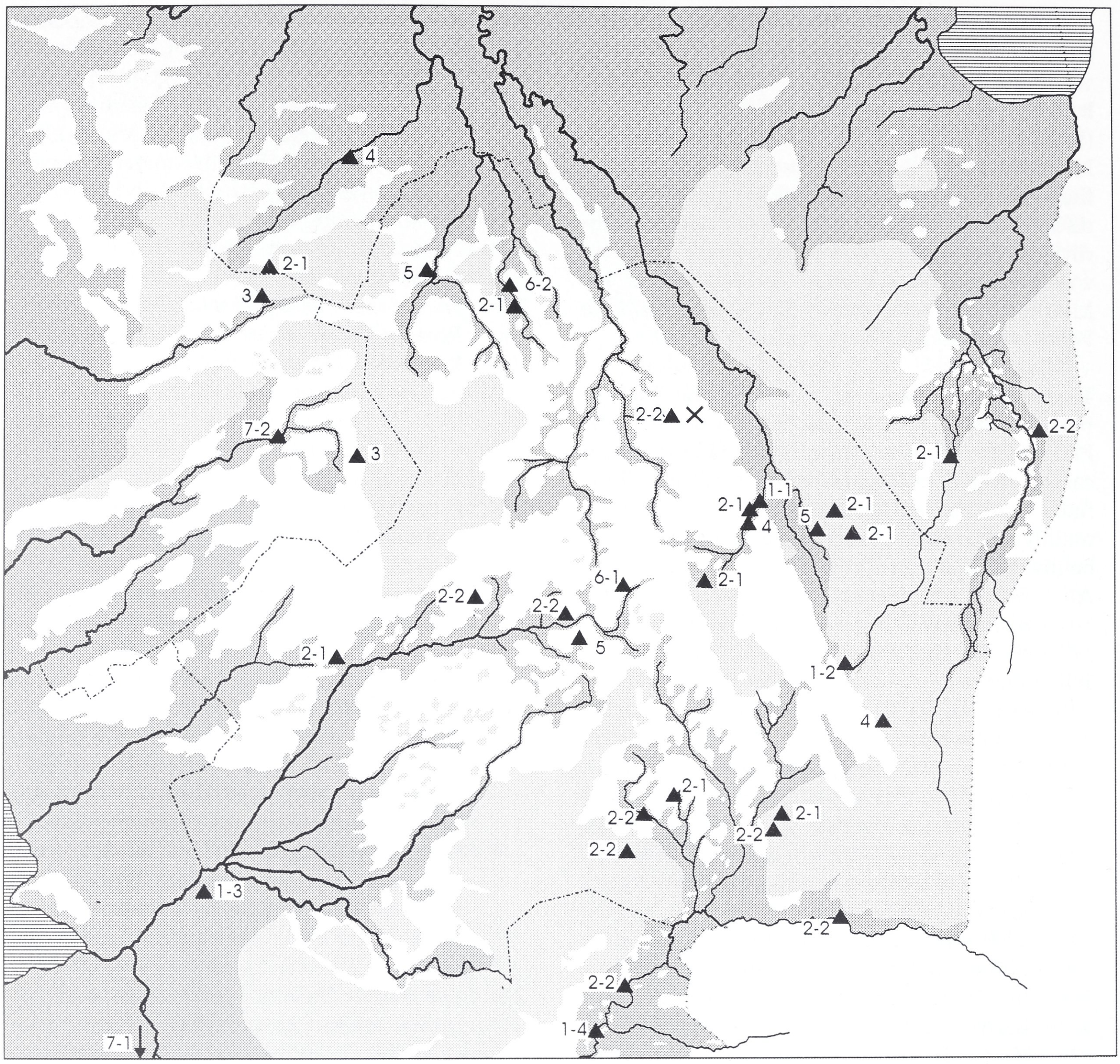


Fig. 23. Map with archaeological finds from the period 4900-3400 cal BC, indicated by triangles, on the Drenthe Plateau and its margins. The numbers of the findspots correspond with the numbers of the list used in the text. The cross indicates the location of the Gietsenveentje. In the dark-grey areas, raised-bog sediments are found; in the light-grey areas, stream valley sediments are found.

C. *finds that cannot be related to any culture, but which at least indicate habitation on the Drenthe Plateau between 4900 and 3400 cal BC:*

4. stray finds of T-shaped antler tools, which are most probably of early Neolithic age; several specimens were found in the canal Voorste Diep near Borger and east of the Hondsrug near Emmen (ELZINGA 1962); one was found near Tolbert (FOKKENS 1990, 190: nr. 136).

5. stray finds of horn sheaths of cattle: four horn sheaths, found in bogs in Drenthe, were dated to the period of the Swifterbant Culture (PRUMMEL & VAN DER SANDEN 1995):
Een, horn sheath of aurochs (*Bos primigenius*), 5530 ± 30 BP [GrN-20381];
"Drenthe" (findspot unknown, not indicated on the map of fig. 23), horn sheath of aurochs (*Bos primigenius*), 5360 ± 60 BP [GrN-20386];

Buinerveen, horn sheath of domesticated cattle (*Bos taurus*), 4960 ± 40 BP [GrN-20373];
Westerbork, horn sheath of domesticated cattle (*Bos taurus*), 4880 ± 60 BP [GrN-20384];
Prummel & Van der Sanden (1995) believe the horn sheaths to have been deposited deliberately in the bogs and to represent votive gifts. They reflect a sacrificial tradition which started in the early Neolithic and continued until the Middle Ages.

6. hoards of flint tools and material:

6-1. a hoard of one axe with an oval section and two large blades, found near Elp; the blade technique especially points to an early Neolithic origin (HARSEMA 1975; WATERBOLK 1985a);

6-2. one arrowhead, several large blades, flakes and core material, found near Donderen; here too, the blade technique points to an early Neolithic origin (HARSEMA 1974);

7. large collections of bone and/or antler tools:

7-1. a large collection of bone and antler tools and objects, found at Spoolde, in the IJssel valley near Zwolle. The findspot is located ca. 15 km from the Drenthe Plateau and ca. 32 km from the site of Swifterbant. Apparently, the material originates from various periods. One T-shaped antler tool was ^{14}C-dated to 6050 ± 30 BP [GrN-8800] (ca. 4900 cal BC) (CLASON 1983).

7-2. a large collection of animal bones, including twelve T-shaped antler tools, which are usually dated between 6000 and 5000 BP, found near Donkerbroek in the province of Friesland (FOKKENS 1990, 97; 197: nr. 268). The material originates from various periods; a worked humerus of domesticated cattle was dated to 4770 ± 80 BP [GrA-12712] (ca. 3520 cal BC) (PRUMMEL 2001).

Furthermore, there are two types of artefact which are found in late Mesolithic as well as in early Neolithic contexts: *Geröllkeulen* and *Spitzhauen* (these are not indicated on the map of fig. 23). A few dozen specimens of *Geröllkeulen*, which are perforated or unperforated pebbles, have been found in Drenthe and bordering provinces (HULST & VERLINDE 1976). In the Swifterbant excavation too, fragments of *Geröllkeulen* were found (VAN DER WAALS 1972). Of the *Spitzhauen*, which are hammer axes with one end blunt and the other pointed, about one dozen specimens have been found in Drenthe, notably at Zeyerveld, Een and Exloërmond (HULST & VERLINDE 1979). The *Spitzhauen* are dated between 7000 and 4300 cal BC (BEUKER et al. 1992, 126). Finally, a recent find of sherds of possibly the Late Phase of the Swifterbant Culture in the Wetsingermaar, ca. 10 km north of the city of Groningen (well north of the area covered by fig. 23), should be mentioned (FEIKEN et al. 2001). The occupation layer was dated to 4700 ± 40 BP [GrA-16659] (ca. 3500 cal BC). The scattered finds together indicate at least a temporary penetration into the North by people whose home territory was in the delta area. Unfortunately, no settlements of these people have so far been found on the Drenthe Plateau.

III.7.4 Funnel Beaker Culture (3400-2800 cal BC)

The first fully Neolithic culture on the Drenthe Plateau is the Funnel Beaker Culture (TRB), belonging to the Dutch Middle Neolithic B. The most conspicuous remnants of this culture are the famous megalithic tombs (*hunebedden*). In the direct vicinity of the Gietsenveentje there are several megalithic tombs (see III.7.6). Some aspects of this culture will be treated in more detail.

Settlements. So far, no TRB house plans have been found in Drenthe. In adjacent Germany, houses with axial posts have been excavated with a length of up to 15 m and a width of up to 5 m. The wall was made by wattle and daub. The roof must have been thatched with straw and/or reed. The settlements must have consisted of only a few houses, inhabited by no more than a few dozen people (WATERBOLK 1985a; BEUKER 1992). Southeast of the village of Anloo, only 4 km from the Gietsenveentje, traces of two enclosures (inner enclosure: 2150 m^2; outer enclosure: 4300 m^2) have been excavated. Within the enclosures, no house plans were found, but many TRB potsherds, quernstones, flints and organic remains. Probably the foundation of the TRB buildings was not very deep. Given the homogeneous pottery, this settlement from the middle Funnel Beaker Culture was probably used for only a short time. There has been much discussion about the function of the enclosures (see WATERBOLK 1960; HARSEMA 1982; JAGER 1985). According to Harsema (1982), their most important function was fortification of the settlement; their second function might have been to keep the livestock within or outside the settlement

area. The presence of cattle locks in the outer enclosure points to this second function.
Stone and flint artefacts. TRB people used bowl-shaped querns of locally found granite (HARSEMA 1979), perforated stone battle-axes, and sickles, scrapers, trapezoidal arrowheads, and axes of flint (J.A. BAKKER 1979, 76-110).
Pottery. The most typical pottery form is that of the funnel beaker, which gave its name to the culture. Other forms were collared flasks, biberons, shouldered pots, necked bowls and pails (J.A. BAKKER 1979, table VI). The pottery was often provided with beautiful, deeply incised ornamentation which was filled up with a white paste made of burned and ground bone. Various authors have tried to make a typochronology of TRB pottery: Van Giffen (1925/27) distinguished a Drouwen and a Havelte phase; J.A. Bakker (1979) distinguished seven phases (A to G); Brindley (1986) identified seven horizons (1 to 7).
Funerary monuments. The most conspicuous monuments of the TRB period are the megalithic tombs (*hunebedden*), of which nowadays more than 50 are known in Drenthe (WATERBOLK 1985a, 32; VAN GINKEL et al. 1999). These tombs must have been built as follows: first the side-stones were placed in pairs, with their flat sides facing each other. At either end an endstone was set up. Then the capstones were placed by an ingenious use of rollers and an earth mound. The gaps between side stones and capstones were filled up with smaller stones. Finally, the whole was covered by an earth mound; the upper part of the capstones remained visible. On the southern side of the mostly east-west orientated tomb, a closable entrance was built. The megalithic tombs could take several bodies and were used for many generations. Many grave goods were put in the tombs, like pottery, axes and beads. Apart from the megalithic tombs, two other grave types are known from the TRB period: flat graves and stone cists, the latter being flat graves containing a small cist built of stones (J.A. BAKKER 1992; BEUKER 1992).
Society. The TRB people were the first people in Drenthe that practised arable farming and animal husbandry on a relatively large scale. Products of hunting and gathering supplemented the menu. The most important cultivated crops were einkorn wheat (*Triticum monococcum*), emmer wheat (*Triticum dicoccon*) and the naked form of barley (*Hordeum vulgare ssp. vulgare*). The land was ploughed probably with an ard, a primitive plough which did not turn the soil (DRENTH & LANTING 1997). Besides agriculture, TRB society is characterized by permanent settlements, the use of ground stone axes and the production of high-quality pottery for domestic use (J.A. BAKKER 1982). The original total number of megalithic tombs in Drenthe is estimated at ca. 100. On this basis, the total size of the TRB population in Drenthe must have comprised at least many hundreds, maybe even two or three thousand people (LOUWE KOOIJMANS 1983; HARSEMA 1984).

III.7.5 Single Grave Culture and Bell Beaker Culture (2800-1900 cal BC)

Single Grave Culture or Protruding Foot Beaker Culture (EGK) (2800-2450 cal BC). On the Drenthe Plateau, the Funnel Beaker Culture was followed by the Single Grave Culture (the Dutch Late Neolithic A). The most conspicuous traces of this culture are its graves. The dead were buried in single graves lying in a crouched position; the grave was sometimes covered by a mound. The nature of the grave goods depended on the sex and age of the deceased person. Axes, flint daggers and battle-axes are considered to be typical male attributes. Beakers with an S-shaped profile and a protuding foot, which are characteristic of this culture, are found with male as well as female burials (BEUKER 1992).
There is no evidence for population growth in the EGK period compared to the TRB period; if we consider the number of known settlements, the number of people even appears to have markedly decreased: as against hundreds of TRB settlements, only a negligible number of EGK and BB settlements are known (VAN GINKEL & HOGESTIJN 1997, 78).

Bell Beaker Culture (BB) (2600-1900 cal BC). The next culture, the Bell Beaker Culture (the Dutch Late Neolithic B), is also for the greater part known from its graves; about BB settlements only little is known. Just as in the Single Grave Culture, the dead were buried in flat graves or under burial mounds; burial in a crouched position continued, but cremation also occurred. Among the grave goods, next to stone hammers, wrist-guards and flint arrowheads, also some copper and even gold objects are found. The typical pottery of this period has the form of an inverted bell and is often decorated (BEUKER 1992).

III.7.6 Archaeological finds in the surroundings of the Gietsenveentje

In the surroundings of the Gietsenveentje many archaeological findspots are known. In the 1920s and 1930s, several megalithic tombs (*hunebedden*) and burial mounds were excavated by Prof. A.E. van Giffen, the famous founder and director of the Biologisch-Archaeologisch Instituut of the University of Groningen. After the Second World War, many finds were collected by local amateur archaeologists, such as G. Holtrop and P. Kroezenga. The map of fig. 24 shows all archaeological findspots in the neighbourhood of the Gietsenveentje. The map was made on the basis of the archive of the Drents Museum in Assen and the archive of Dr J.A. Bakker. The most interesting findspots will be discussed in greater detail per period. The emphasis will be on the Neolithic finds.

Palaeolithic and Mesolithic. Most Palaeolithic and Mesolithic material is found in the vicinity of circular depressions, many of which are pingo scars. It seems obvious that late Palaeolithic and Mesolithic people should want to make their camps in the neighbourhood of (then) lakes.

Swifterbant Culture. Only one clear find dated to the period of the Swifterbant Culture is known from near the Gietsenveentje: in 1877, a *durchlochter Breitkeil*, a perforated wedge of the Rössen type, made of amphibolite was found "on the heath near Eext". Unfortunately, the exact findspot of this wedge is not known (fig. 24: no. 1). In a former pingo scar on the Eexterveld, which was filled up with sand for the construction of a road (fig. 24: no. 19), sherds of a funnel beaker with a globular body were found. Theoretically, this type of funnel beaker may originate from the (Danish) Early Neolithic TRB, dating from ca. 4000 cal BC onwards (J.A. BAKKER et al. 1999). However, there is no corroborating archaeological evidence at all of the Early Neolithic TRB in the northern Netherlands and northwestern Germany (LANTING & VAN DER PLICHT 1999/2000).

Funnel Beaker Culture (TRB). Many TRB remains are known from the neighbourhood of the Gietsenveentje. The most spectacular remains are three *hunebedden* (D-12, D-13 and D-14) and three destroyed small *hunebedden* or stone cists (D-13a to c):

D-12 (fig. 24: no. 2). This *hunebed*, a passage grave, was not investigated archaeologically. However, still a collared flask is known to originate from it (VAN GIFFEN 1943).

D-13 (fig. 24: no. 3). This *hunebed*, the only *hunebed* in the Netherlands with steps leading down into it, was investigated by Van Giffen in 1927. In the 18th century, however, the antiquary Van Lier had preceded him, so that the 1927 excavations yielded hardly any finds. D-13 consists of six sidestones, two endstones and one capstone. The underground consists of plain sand; no heath-podzol profile was found (VAN GIFFEN 1943).

D-13a (fig. 24: no. 4). The site of D-13a was dug over by the discoverer. Therefore, the later excavation by Van Giffen (1944a) only revealed a number of boulders, several TRB sherds and a virtually intact collared flask. Because of the inhomogeneous pottery (belonging to phases C, possibly B, and G), J.A. Bakker (1979, 155) concluded that D-13a may have been a long-dismantled *hunebed*. However, because there are no visible traces in the ground, it seems more plausible that D-13a was a shallow stone cist (JAGER 1985, 239).

D-13b (fig. 24: no. 5). In 1927, Van Giffen discovered remains of two small *hunebedden* not far from the *hunebed* D-13. The sites of these *hunebedden*, which were destroyed long ago, were recognizable only as patches of rock-debris. In D-13b, only some TRB material and the sherds of a Bell Beaker were discovered (VAN GIFFEN 1944b).

D-13c (fig. 24: no. 6). Here it seemed possible to reconstruct the plan of the small destroyed *hunebed*, because extraction pits of eight side stones and one endstone could be recognized in the ground: it must have had a length of 4,00 m and a width of 2,60 m. The finds consisted of TRB material and some EGK/BB sherds (VAN GIFFEN 1944b).

D-14 (fig. 24: no. 7). This *hunebed*, a large passage grave, consists of 27 stones: nine pairs of side stones, two endstones and seven capstones. D-14 is one of the few *hunebedden* with a more or less intact kerb of stones around it. The earliest pottery found in this *hunebed* dates from TRB phases Drouwen B and C. However, the larger part of the pottery belongs to later phases (TRB phases Drouwen D to G: J.A. BAKKER 1979, 155).

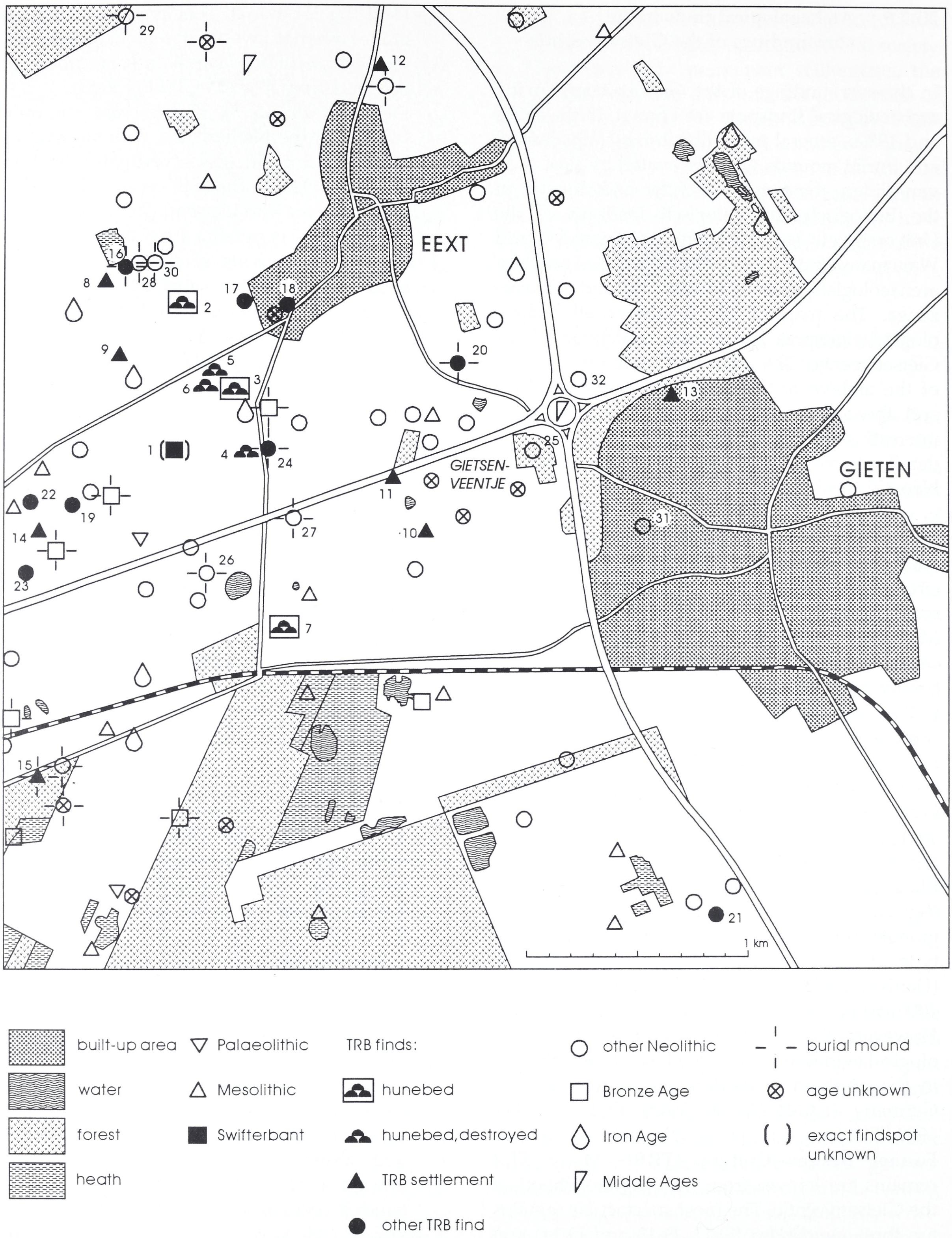

EEXT
GIETEN
GIETSEN-
VEENTJE
1 km
built-up area
water
forest
heath
Palaeolithic
Mesolithic
Swifterbant
TRB finds:
hunebed
hunebed, destroyed
TRB settlement
other TRB find
other Neolithic
Bronze Age
Iron Age
Middle Ages
burial mound
age unknown
exact findspot unknown

Fig. 24 (left). Map with archaeological finds of the Gietsenveentje and its surroundings, scale 1:25,000. The map covers the same area as the map of fig. 15. More information about the most interesting Neolithic finds is given in the table below. The numbers correspond to the numbers on the map. Swifterbant: Swifterbant Culture (Early Neolithic B/Middle Neolithic A); TRB: Funnel Beaker Culture (Middle Neolithic B); EGK: Single Grave Culture (Late Neolithic A); BB: Bell Beaker Culture (Late Neolithic B). Most information about the findspots and finds was provided by the Drents Museum, Assen.

No.	Period(s)	Description	Reference(s)
1	Swifterbant	a *durchlochter Breitkeil* (perforated wedge), found on the heath near Eext	VAN DER WAALS 1972, 172
2	TRB	*hunebed* D-12 "Kampakkers"	JAGER 1985, 239: nr. 44
3	TRB	*hunebed* D-13 "Eext burial-vault"	VAN GIFFEN 1943; JAGER 1985, 239: nr. 47
4	TRB	*hunebed* D-13a, destroyed	VAN GIFFEN 1944a; J.A. BAKKER 1979, 155; JAGER 1985, 239: nr. 49
5	TRB	*hunebed* D-13b, destroyed	VAN GIFFEN 1944b; JAGER 1985, 239: nr. 45
6	TRB	*hunebed* D-13c, destroyed	VAN GIFFEN 1944b; JAGER 1985, 239: nr. 46
7	TRB	*hunebed* D-14 "Eexterhalte"	J.A. BAKKER 1979, 155; JAGER 1985, 240: nr. 55
8	Mesolithic, TRB	settlement: flint material	archive J.A. Bakker, 12E: 29
9	TRB	settlement: flint material, undecorated sherds	archive J.A. Bakker, 12E: 30
10	TRB	settlement: scrapers, undecorated sherds, one sherd with deeply incised ornamentation	archive J.A. Bakker, 12E: 38
11	TRB	settlement 13 x 8 m: scrapers, TRB sherd (Bakker phase D)	archive J.A. Bakker, 12E: 37
12	TRB	settlement: stone material	archive J.A. Bakker, 12E: 26
13	TRB, Iron Age	settlement: pottery, stone, flint, iron, bronze: rim sherds of TRB pottery	(partly) VAN ES 1964, 205
14	Palaeolithic, Mesolithic, TRB, EGK, BB	settlement: flint, pottery: TRB sherd (Brindley horizon 4-5?), green-black stone with 5 cupmarks	G. Holtrop, Rolde (amateur archaeologist); J.A. BAKKER et al. 1999
15	TRB, EGK, BB	burial mound "Ketenberg"; pit with TRB sherds (Brindley horizon 6) just outside foot of hill; traces of post holes in subsoil: settlement?	JAGER 1985, 240: nr. 57; CUYPERS et al. 1994, 111; CASPARIE & GROENMAN-VAN WAATERINGE 1980, pollen spectrum N-21
16	TRB, EGK	burial mound; TRB material S and W of the tumulus	JAGER 1985, 233: nr. 41
17	TRB	pottery, flint	ROB 12G N34
18	TRB	pottery	ROB 12G N37
19	TRB	pingo scar Eexterveld: sherds of 5-6 TRB pots (Brindley horizon 1-3 or earlier, 3-4 and 7), flint material	VAN DER KAMP 1995, 72; J.A. BAKKER et al. 1999
20	TRB, BB, Bronze Age	burial mound; TRB sherds (Drouwen A phase) found in the primary mound's body and subsoil	JAGER 1985, 231: nr. 40
21	TRB, Bronze Age	flint material	Kaspers (amateur archaeologist)
22	TRB	flint axe	J.A. BAKKER et al. 1999
23	TRB	flint axe	J.A. BAKKER et al. 1999
24	TRB?, BB, Bronze Age	burial mound; stone with cupmarks of pink-red granite; battle-axe of "Emmen" type (BB)	G. Holtrop, Rolde (amateur archaeologist)
25	EGK	horn sheath of domesticated cattle, found in the Gietsenveentje; ^{14}C date: 4140 ± 35 BP [GrN-20374] (ca. 2750 cal BC)	PRUMMEL & VAN DER SANDEN 1995, 92; 128
26	EGK	burial mound	VAN GIFFEN 1930, 44; JAGER 1985, 240: nr. 54
27	EGK, Bronze Age	burial mound	HARSEMA 1977, 251; JAGER 1985, 239: nr. 51
28	EGK, Bronze Age	burial mound	JAGER 1985, 234: nr. 42
29	EGK?	burial mound	JAGER 1985, 229: nr. 37
30	BB, Bronze Age	burial mound	JAGER 1985, 235: nr. 43
31	Neolithic, Iron Age, Middle Ages	Neolithic flint material; one rim sherd of EGK/BB pottery	Drents Museum, Assen
32	Palaeolithic, Mesolithic, Neolithic, Bronze Age	flint, pottery, bronze, iron	G. Holtrop, Rolde (amateur archaeologist)

According to J.A. Bakker, there are at least five probable locations of TRB settlements in the area of the map of fig. 24. At these locations, TRB sherds and often also flint material have been found. Of these five locations, two (fig. 24: nrs. 10 and 11) lie within 500 m of the Gietsenveentje. At a site in the northern part of the village of Gieten (fig. 24: no. 13), sherds from several periods were discovered, including some TRB sherds. In or near several burial mounds originating from later periods, also TRB material was discovered. Below a burial mound very near the Gietsenveentje (fig. 24: no. 20), TRB pottery of the earliest known phase (Drouwen A) was found. In the subsoil of the burial mound "Ketenberg" (fig. 24: no. 15), traces of postholes were discovered that probably point to a TRB settlement. In several places within and under the mound, TRB sherds were found, some of which could be placed in Brindley's horizon 6 (Late TRB) (CUIJPERS et al. 1994). A former pingo scar on the Eexterveld (fig. 24: no. 19) contained TRB sherds of five or six pots, originating from different periods, ranging from Brindley's horizon 1-3 or earlier to 7 (VAN DER KAMP 1995; J.A. BAKKER et al. 1999). Finally, two locations (fig. 24: nos. 14 and 24) produced stones with cupmarks; at location no. 14, such a stone was found together with a TRB sherd. Cupmarks are sometimes found on the sides of megalithic tomb boulders, suggesting that they are of TRB origin. However, J.A. Bakker (1992, 32) found that cupmarks also originate from the Late Neolithic (EGK/BB), and even from the Early Bronze Age.

Single Grave Culture (EGK) and Bell Beaker Culture (BB). Several finds of the Single Grave Culture (EGK) are known from the neighbourhood of the Gietsenveentje. Most EGK material was found in four burial mounds (fig. 24: nos. 26-29). The most remarkable find from the EGK period is a horn sheath of domesticated cattle (*Bos taurus*, male), found in 1943 at a depth of 1.75 m, on the transition of *Sphagnum* peat ("brown peat") and gyttja ("black peat") in the Gietsenveentje itself (fig. 24: no. 25; PRUMMEL & VAN DER SANDEN 1995). Below the horn sheath, still 25 cm of gyttja occurred. According to a ^{14}C date (ca. 2750 cal BC), the horn sheath was thrown into the then lake by EGK people. Material of the Bell Beaker Culture (BB) was found in one burial mound (fig. 24: no. 30).

Two findspots very near the Gietsenveentje (fig. 24: nos. 31 and 32) produced a lot of material of various periods including the Neolithic, possibly pointing to settlements at these locations. However, as far as known, no TRB material was found. At the Neolithic findspots without a number in fig. 24, mostly only flint material is found, which could not be dated more exactly than as Neolithic.

Bronze Age. The most conspicuous remains of the Bronze Age are several burial mounds, located in the western and southwestern part of the map area.

Iron Age and Roman Period. From the Iron Age, three complexes of Celtic fields are known, located west of the *hunebedden* D-12 and D-13, and west of *hunebed* D-14 (BRONGERS 1976). An Iron Age urnfield was excavated very near *hunebed* D-13. An Iron Age and Roman Period settlement lay north of the village of Gieten ("Vijzelkampen"), on the slope of the Hondsrug ridge.

Middle Ages. Sherds of the typical *kogelpotten* (*Kugeltöpfe*, globular pots) were found in the centre of the village of Eext. During the construction of the roundabout next to the Gietsenveentje in the 1960s, a large number of sherds of *kogelpotten* were found among other sherds. Unfortunately, no more is known about this find immediately next to the Gietsenveentje (see Nieuwe Drentse Volksalmanak 1968, p. 290).

Age unknown. At three locations just south and east of the Gietsenveentje, the amateur archaeologist G. Holtrop has found flint tools of unknown age. Finally, the diary of the Conservator of the Pre- and Protohistoric Department of the Drents Museum in Assen (J.D. van der Waals), on March 24, 1959 contains the following vague and mysterious notice: "In the bog - the Gieter Veentje [sic] - on the western side of the Gieten-Eext road (...), which is also called Bolleveentje, a drowned settlement is located which is very similar to the drowned settlement in the 'real' Bolleveen near Zeijen [north of Assen]". The Bolleveen near Zeijen is known because of its (ritual?) finds from the Roman Period (oral comm. J.N. Lanting). Unfortunately, at the Drents Museum no finds are known from the Gietsenveentje, nor is any additional information available about Van der Waals' remark.

Preferred settlement locations. The TRB people seem to have had a strong preference for elevated and dry coversands and pre-Saalian sands: their favourite settlement locations were high coversand ridges, dry erosion areas and well-drained edges of brook valleys (J.A. BAKKER 1982; BAKKER & GROENMAN-VAN WAATERINGE 1988; SPEK 1993). Furthermore, the TRB settlements are always located in the neighbourhood of brooks or water-containing depressions (like pingo scars). Finally, TRB settlements are also often located at the edges of till plateaus, on the transition to coversand areas or erosion valleys. The *hunebedden* were nearly always built within 300 m of a till erosion edge. The boulders which were released from the till by erosion at the edges of the plateaus were used for building the *hunebedden* (BAKKER & GROENMAN-VAN WAATERINGE 1988, 153).

In order to discover the preferred settlement locations of the TRB people, the map of fig. 24 will be compared in the first place with the geomorphological map (fig. 19) rather than with the soil map: the current soils were in large part formed after TRB times (see III.3.3; BAKKER & GROENMAN-VAN WAATERINGE 1988, 161), while the geomorphology has been less subject to change.

The TRB finds are concentrated in two areas:

1. all *hunebedden* as well as several settlements and stray finds occur in the middle western part of the map area. The *hunebedden* are located on small coversand or pre-Saalian sand ridges at the western edge of the till plateau, on the transition to the low-lying erosion valley of the Scheebroekerloop (fig. 19). Because the coversand layer is not very thick in these areas, the sands on which the *hunebedden* were built are rich in loam (see the soil map, fig. 20: the soils in this area all have code 23, indicating the presence of loamy fine sand). The locations completely comply with the above-mentioned settlement factors. Also nearly all funerary monuments from later periods are located in this area.
2. several settlements (fig. 24: nos. 10, 11, 13) and one burial mound (no. 20) are located in the central part of the map area, on the highest part of the till plateau, near water-containing depressions (Gietsenveentje, Hondelveen, Molenveen). According to the soil map, the loam content of the sand is low or even zero in part of this area (fig. 20: soils with code 21), which points to a relatively thick layer of coversand.

III.8 The Gietsenveentje and its surroundings in the past two centuries

III.8.1 History of the landscape around the Gietsenveentje since 1812

Since the Middle Ages, and especially in the last few centuries, the landscape in Drenthe has undergone dramatic changes. Nowadays, the most typical elements of the landscape of the Drenthe Plateau, the large expanses of heath and raised bog, have been transformed into large-scale agricultural areas apart from small nature reserves. This development of the landscape of the Drenthe Plateau will be illustrated on the basis of four topographical maps of the surroundings of the Gietsenveentje.

Topographical map of 1812 (fig. 25). Although several older maps of the area are known (for example maps of 1794 and 1797, stored in the State Archives of Drenthe, Assen), the topographical map made by the French Ministry of War in 1812 is the oldest map on which the Gietsenveentje is shown. The pingo scar is indicated as a marshy area, surrounded by small pieces of arable land. Around the villages of Eext and Gieten, many small pieces of arable land occur; the plaggen soils (*essen*) are located somewhat further away from the villages. Also small patches of (ancient?) forest occur, for example north of the village of Gieten ("De Vijzelkampen"). In the low-lying Hunze valley to the north-east, pasture land is indicated, divided into narrow plots. The largest part of the area was covered with extensive heathfields, only interrupted by several water-containing depressions, mostly pingo scars. In Drenthe, the old agricultural system, in which the heath played an important role, was practised well into the 19th century (THISSEN 1994). Also some very old roads are indicated, which may date back to the Iron Age (WATERBOLK 1985a, 75), and the boundary between the *marken* (common land) of Gieten and Eext, which runs just north of the Gietsenveentje. The *hunebedden* D-12 and D-14, already discovered in the 18th century, are also shown.

Topographical map of 1855 (fig. 26). From 1850 onwards, parts of the extensive heathfields in Drenthe were reclaimed, mostly on a small scale (THISSEN 1994, 25). However, the topographical map of 1855 shows that the heath area has not decreased compared to the situation in 1812: the

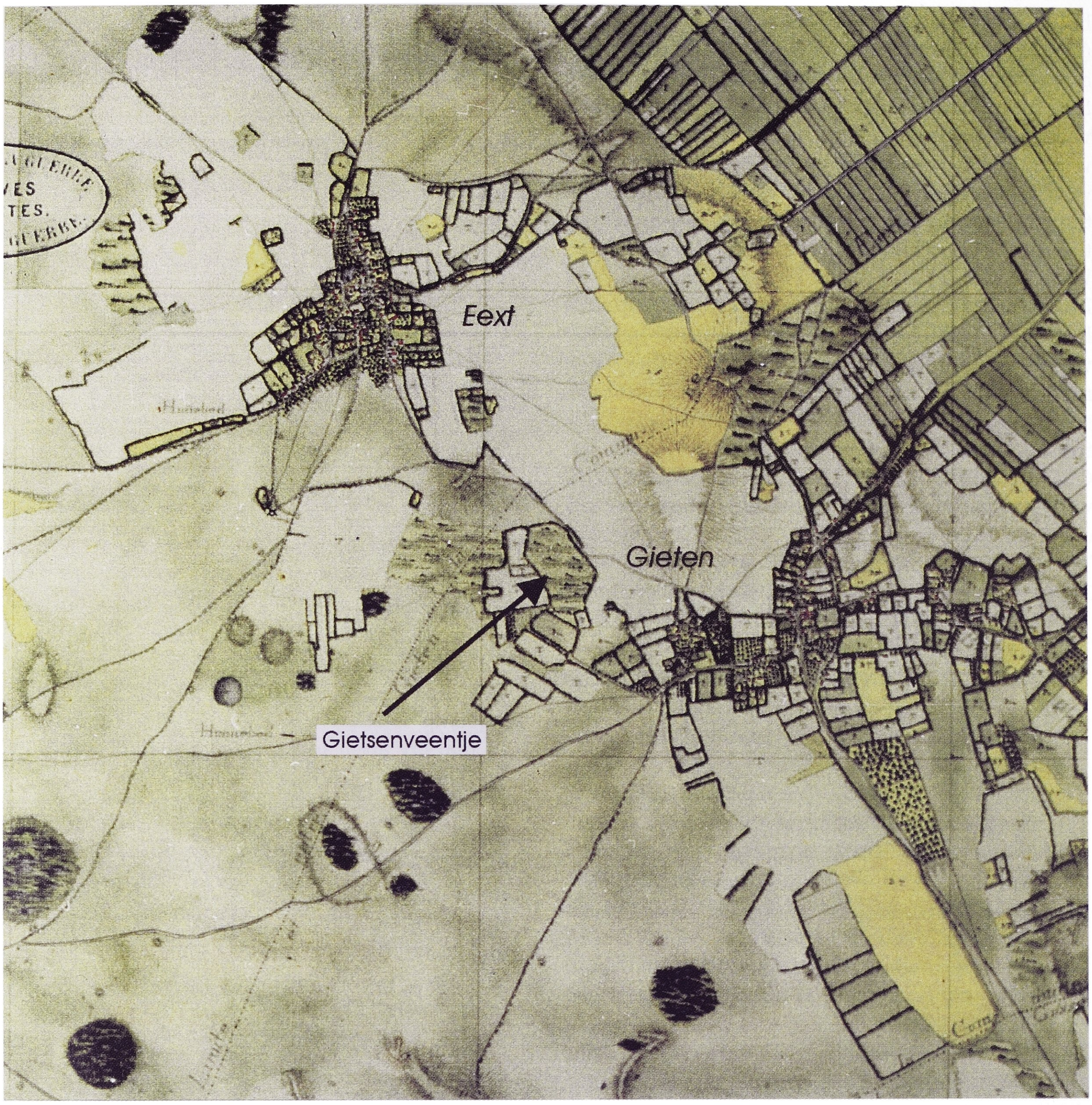


Fig. 25. Topographical map of 1812 of the Gietsenveentje and its surroundings, scale 1:25,000, made by the French Ministry of War. The map covers the same area as the map of fig. 15.

agricultural area has not or only slightly been extended. The Gietsenveentje is not shown very clearly on this map; however, it can be seen that a short road was constructed through it, indicating that the extraction of peat from the Gietsenveentje had started (see III.8.2). In this period, also several new "long-distance" roads were constructed, while some old roads fell into disuse. Besides *hunebedden* D-12 and D-14, also *hunebed* D-13 (indicated as *grafkelder*) is indicated.

Topographical map of 1896 (fig. 27). In the last part of the 19th century, the railway between Assen and Stadskanaal was constructed, with a stop near *hunebed* D-14 ("Eexterhalte") and a station near Gieten. Compared to the map of 1855, the agricultural area seems not to have been extended very much; the large heathfields are still unaffected. The Gietsenveentje (here called "Gieterveentje") is indicated as a marshy area, covered with (carr) forest. This seems to indicate

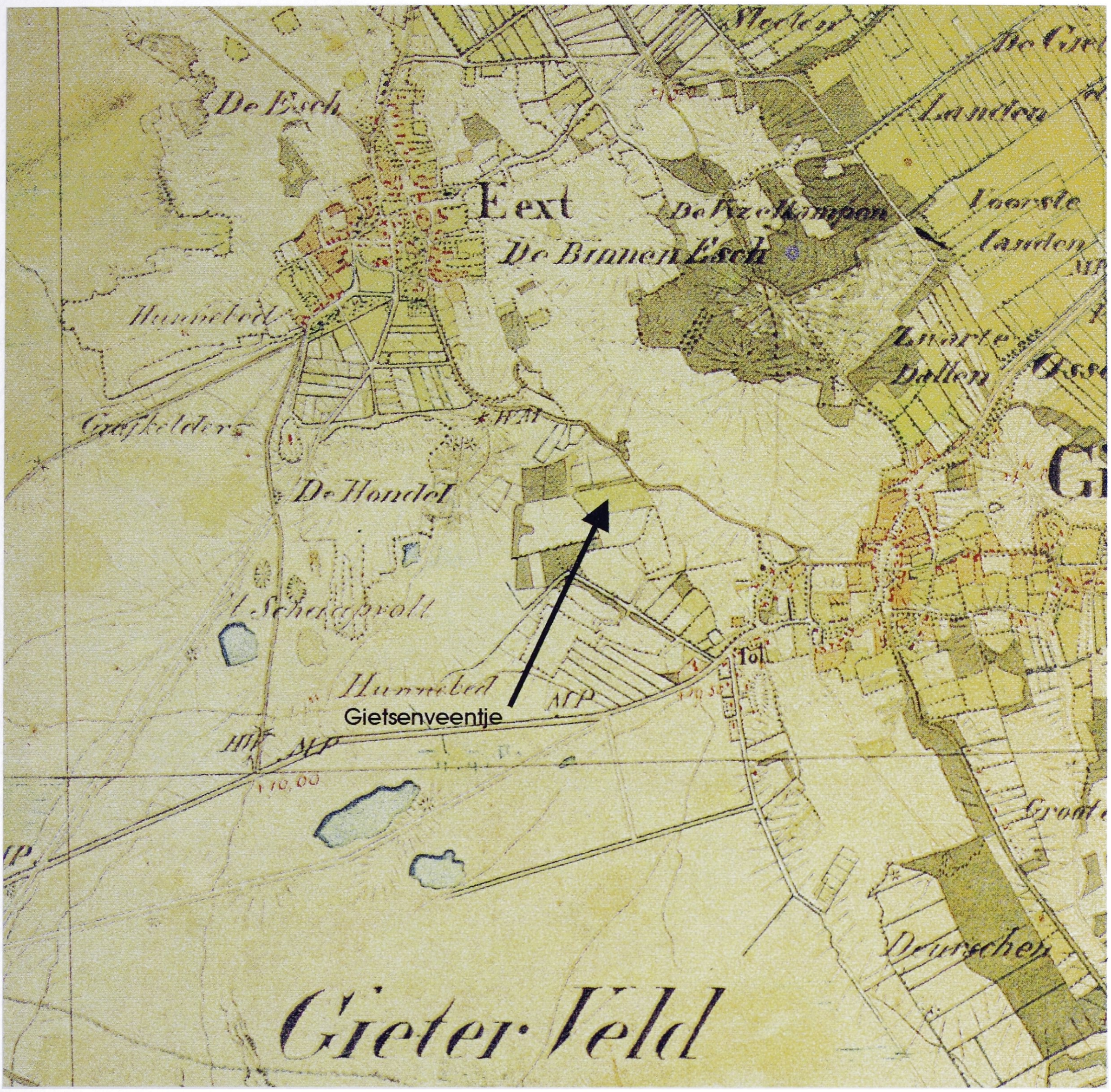


Fig. 26. Topographical map of 1855 of the Gietsenveentje and its surroundings, scale 1:25,000, made by the Dutch Topographical Service. The map covers the same area as the map of fig. 15. © Topografische Dienst, Emmen..

that no large-scale exploitation of the peat in the Gietsenveentje had taken place before 1896, because otherwise, areas of open water would occur. The Gietsenveentje is largely surrounded by agricultural land: on the western and eastern side, plaggen soils (*essen*) occur, the Grietsche Akkers and the Noordakkers, respectively. In the southwest, several old roads can be recognized, which had already fallen into disuse. In the west and northwest, marshy areas occur, which are part of the erosion valley of the Scheebroekerloop. The uppermost part of the Scheebroekerloop itself even occurs on the map. Curiously, this part of the brook is not shown on the maps of 1812 and 1855.

Topographical map of 1958 (fig. 28). Between 1896 and 1958, the landscape in the neighbourhood of the Gietsenveentje totally changed. As a consequence of reclamation, supported by the government (THISSEN 1994), the extensive

Fig. 27. Topographical map of 1896 of the Gietsenveentje and its surroundings, scale 1:25,000, made by the Dutch Topographical Service. The map covers the same area as the map of fig. 15. © Topografische Dienst, Emmen.

heathfields disappeared almost completely and were replaced by farmland. At various locations, for example in the south and far northwest, (mostly pine) forests were planted. In the wettest parts of the erosion valley of the former Scheebroekerloop (middle western part of the map area), pasture was created. In the Gietsenveentje itself, two short roads can be recognized, as well as small areas of open water, pointing to small-scale cutting of peat. The western and southern part of the Gietsenveentje are indicated as (marshy) heath, the central part as (carr) forest. At this time, the Gietsenveentje was also used as rubbish dump (unpublished notes by J.D. van der Waals, 1959).

Topographical map of 2001 (fig. 15). After 1958, the railway between Assen and Stadskanaal fell into disuse; two motorways were constructed, intersecting at the roundabout just north of the Gietsenveentje; the villages of Eext and especially Gieten were extended considerably; and because of land consolidation, the agricultural fields became larger in scale.

Fig. 28. Topographical map of 1958 of the Gietsenveentje and its surroundings, scale 1:25,000, made by the Dutch Topographical Service. The map covers the same area as the map of fig. 15. © Topografische Dienst, Emmen.

III.8.2 History of the Gietsenveentje since 1832

The history of the Gietsenveentje itself can be traced back as far as 1832, when a land registration system (*kadaster*) was introduced by the government. On the cadastral map of 1832, the Gietsenveentje is divided into five plots, owned by various farmers and one mayor. The largest part of the Gietsenveentje is indicated as "heath"; a small part at its northwestern edge is marked "meadow". On the most recent cadastral map, the Gietsenveentje is divided into 12 parcels. Three have been acquired by the Dutch State Forestry. Other parcels have various owners, some of whom live in Australia or Canada. The increased number of owners is the result of successive divisions of estate. Nowadays, the largest part of the Gietsenveentje is indicated as wasteland, except for two parcels: at the northwestern edge, the State Forestry has planted a plot of forest,

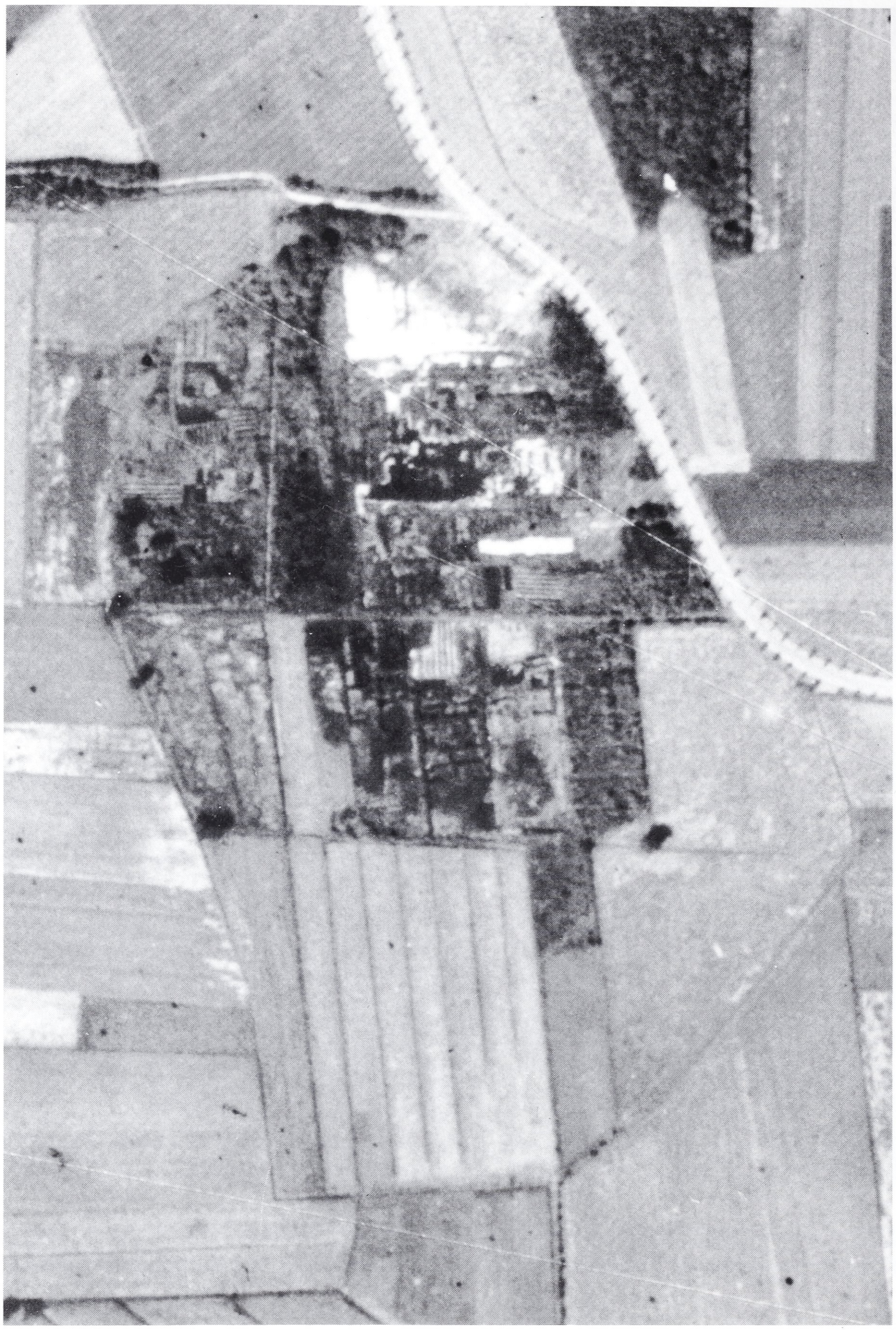


Fig. 29. Aerial photograph of the Gietsenveentje, taken in 1935 by the Dutch Topographical Service. © Topografische Dienst, Emmen.

while in the southwestern part there is grassland. By using the cadastral records, the history of each parcel can be followed from 1832 up till today. From these data, it appears that the first peat-cutting in the southern part of the Gietsenveentje took place between 1856 and 1871. Before this exploitation, the parcel was indicated as "heath", and afterwards, curiously, as "meadowland" rather than "peat" or "open water". Possibly further exploitation took place between 1887 and 1903: the indication of the parcel then changes from "heath" to "peat". The first exploitation of the northern part of the Gietsenveentje possibly took place between 1864 and 1868, because before 1864, the parcel concerned was indicated as "heath", and after 1864 as "peat".

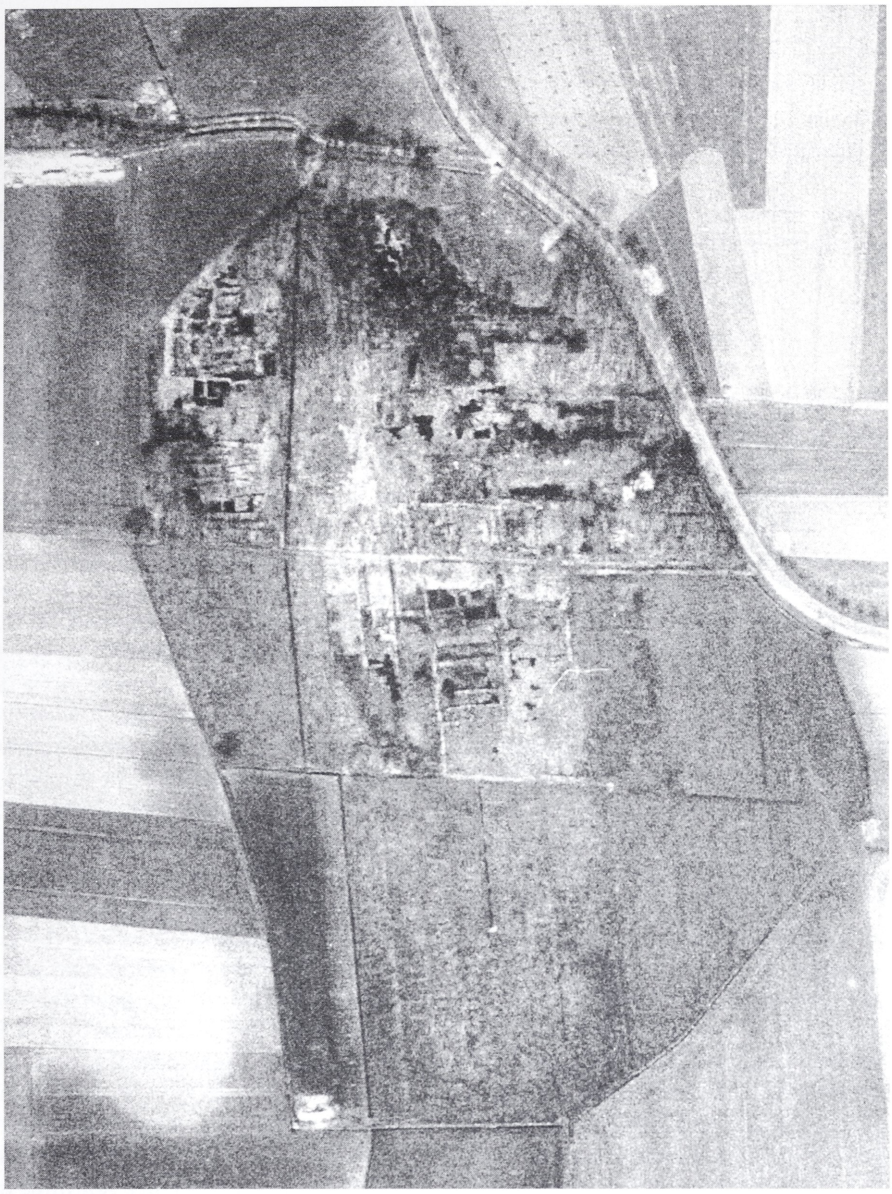


Fig. 30. Aerial photograph of the Gietsenveentje, taken in 1957 by the Dutch Topographical Service. © Topografische Dienst, Emmen.

Another source of information about the history of the Gietsenveentje are aerial photographs. The oldest aerial photograph of the Gietsenveentje, shown in fig. 29, dates from 1935. The presence of many areas of open water, especially in the central and northern parts, indicates small-scale peat-digging activities. An aerial photograph of 1957 is shown in fig. 30. It can be seen that the peat-digging activities have decreased since the 1930s: for instance, the northern part is already partly overgrown by (carr) forest. However, many small peat pits can be distinguished, especially in the western and southern parts, and a large part of the pingo scar is not covered by forest. In the 1960s, peat-cutting in the Gietsenveentje came to an end. Together with the lowering of the water table in the course of land consolidation, this has led to the Gietsenveentje being totally overgrown by forest. The situation in 1995 is shown in fig. 17. The current topography and vegetation of the Gietsenveentje are further discussed in sections VI.1 and VI.2, respectively.