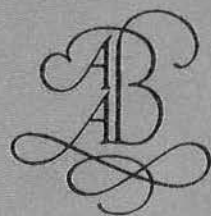


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THE COLONIZATION OF THE SALT MARSHES OF FRIESLAND AND GRONINGEN: THE POSSIBILITY OF A TRANSHUMANT PRELUDE

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ABSTRACT: An inventory of anthropogenic sand-drift phenomena from the late prehistoric and early historic period on the Drenthe plateau (Northern Netherlands) casted doubt on the idea that these drifts had caused a 'crisis' situation on the plateau, inducing large-scale emigration of the people to the salt marshes. It is argued that, instead, the combined effect of sand-drifts, peat formation and soil exhaustion during the Early Iron Age diminished the economic potential of the area with its steadily increasing population. Simultaneously, the salt marshes became available for exploitation and it is suggested that the inhabitants of the plateau gradually incorporated these areas into their economic system, *i.e.* to graze their herds. The idea is put forward that during the Early Iron Age transhumance was practised between the plateau and the marshes preceding the permanent settlement of the latter during the Middle Iron Age. The lightly built structures at the base of the site of Middelstum-Boerdamsterweg are interpreted as summer encampments.

KEYWORDS: Northern Netherlands, Middelstum-Boerdamsterweg, Iron Age, sand-drifts, peat formation, overpopulation, transhumance.

1. INTRODUCTION

At various occasions the second author has described the Iron Age colonization of the salt marshes in the Dutch provinces of Friesland and Groningen (Waterbolk, 1959; 1961; 1962; 1965-1966; 1979). The main reasons for dealing once more with this theme were an essay by the first author (van Gijn, 1983) on sand-drifts in archaeological context on the Drenthe plateau and the resulting discussions on a possible causal relation of these sand-drifts and other environmental changes on the plateau to the colonization of the marshes. These discussions also dealt with the nature of this colonization process. A summary treatment of these themes would give an opportunity to actualize earlier concepts and to react upon some recently formulated opinions (Halbertsma, 1975; Achterop & Brongers, 1979; Kossack, 1984).

The present paper is by no means intended as a final treatment of the subject. It serves rather to demonstrate that many problems remain unsolved and to encourage further research.

2. THE ORIGIN OF THE COLONISTS

The palaeogeographic maps of Griede & Roeleveld (1982) indicate the area which was silted up during the Dunkerque Ia transgression phase and reached a level above mean high tide at the beginning of the Holland VI regression phase, about 2600 B.P. It then became suitable for human habitation for the first time.

The archaeological material characterizing the earliest habitation in the salt marshes (Waterbolk, 1962) has the same composition throughout the area. The pottery includes the RWI-type in addition to late Harpstedt-types, flat bowls, small cups, *etc.* The same association occurs in the uplands of the Drenthe plateau, where it is characteristic of an early stage of the Middle Iron Age (Zeijen culture)¹. Therefore the conclusion that the origin of the colonists should be located in the Drenthe uplands, the natural hinterland, seems valid.

Obviously one could think of other areas where the same pottery association occurs. This is the case on the banks of the river Ems in Lower Saxony (Nortmann, 1983), on the banks of the river Vecht in the province of Overijssel south of Drenthe (van Beek, 1974), in the northern part of the old dune landscape (Modderman, 1960-1961) and on the isle of Texel (Woltering, 1975). Perhaps parts of the ice-pushed ridges of the Veluwe and in Utrecht should also be considered, but Iron Age material from these areas is scanty. What exists rather suggests an affinity in southern direction of the latter two areas.

The problem of localizing the origin of colonists of newly-formed Holocene deposits is not restricted to the salt marshes of Friesland and Groningen. It is also of interest in the estuaries of the rivers Oer-IJ, Rhine and Meuse to the west and Ems, Weser, Medem and Elbe to the east. In some of

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these estuaries we are not only dealing with treeless salt marshes under marine tidal influence, but also with river marshes occurring upstream in a fresh-water, forested environment. These river marshes respond to the same rhythm of deposition as the salt marshes (Zagwijn & van Staalduinen, 1975). Iron Age habitation of river marshes occurs *e.g.* along the lower Ems and in the Rhine-Meuse area of the central Netherlands.

Some authors (*e.g.* Halbertsma, 1975) have referred to the presence in the western part of Westergo of flint sickles of the type which is so characteristic for the Late Bronze Age habitation of West-Friesland. On the basis of these finds Halbertsma supposes that the colonists of the salt marshes of Friesland and Groningen originated from West-Friesland. Such flint sickles have a wide distribution in the context of the Late Bronze Age and the Early and Middle Iron Age of the northern Netherlands and north Germany, but their concentration in West-Friesland is striking. So far no complete inventory has been published, but the number of sickles is estimated to be well over 100. In Westergo 8 sites have produced a total of 21 sickles; an inventory of this area, kindly provided by G. Elzinga, is given in appendix B.

There are, in our opinion, many objections against Halbertsma's view. First, there are no clear relations between the Late Bronze Age pottery of West-Friesland and that of the earliest Westergo settlers (type RWI). The West-Friesland pottery has a character of its own (young Hoogkarspel group, Bakker *et al.*, 1977). It contains elements, such as the all-over-ornamentation with fingertip or nail impressions and the barrel-shaped forms, which are absent in contemporary pottery of the Drenthe plateau. The RWI-pottery type, on the other hand, seems to have been derived from earlier pottery types occurring on the Drenthe uplands (Kooi, 1979). Second, the earliest house-plans known from the Friesland/Groningen marshes are of the Hijken-type, and do not have the surrounding ditches which predominate in West-Friesland. Admittedly, we only know early houses from Ezinge and Middelstum in the Groningen part of the area (van Giffen, 1936; Boersma, 1983). However, the large number of circular ditches of West-Friesland have not been observed at excavations in Westergo, such as in Tritsum. Third, radiocarbon dates indicate a time difference between the 'young Hoogkarspel group' and the earliest RW I-dates (c. 2650 and c. 2500 B.P., respectively). In accordance with earlier views (Waterbolk, 1965-1966) we do not exclude the possibility that some of the Late Bronze Age settlers from West-Friesland incorporated parts of Westergo in their sphere of influence or that even some of them moved into that area. But the main area of origin of the colonists must have been the uplands of the Drenthe plateau, with

which the salt marshes are connected by a number of small rivers, such as the Boorne, the Lauwers, the Peizer Diep, the Drentsche A, the Hunze, the Munter Ee and the Westerwoldse A.

3. POSSIBLE CAUSES FOR MIGRATION

In the past certain authors, particularly in the Scandinavian countries, have pointed to a severe deterioration of the climate at the beginning of the subatlantic period (*e.g.* Brøndsted, 1960) as a possible cause for archaeological changes. Recently, however, this correlation has been questioned (*e.g.* Jensen, 1982). The transition of the subboreal to the subatlantic period corresponds roughly with the transition of the Bronze Age to the Iron Age. Pollenanalytically we see an increase of beech and a decrease of hazel, ash, elm and lime. This development was probably caused by a somewhat higher humidity, which might have resulted from either a fall in temperature or an increase in precipitation. We are dealing with modest climatic changes of possibly cyclic nature which could not seriously have affected the quality of the environment. The same would apply to our own area of study.

In an original paper on early sand-drifts the second author suggested that this phenomenon might have been the result of a large-scale lowering of the ground-water table due to a marine regression (Waterbolk & van Anandel, 1951). For such an hypothesis there is no basis left, now that we know that the so-called regressions represent only slackenings of the main post-glacial transgression (Griede & Roelleveld, 1982). Recent geological research in the Leuvenumse Beek and Drentsche A river systems, however, has shown that locally, *e.g.* on the highest sandy parts of the plateau, a lowering of the ground-water table actually did occur. As a result of a too intensive exploitation of the sandy uplands, which hitherto had mainly been covered with woods, the infiltration capacity of the soil diminished and the run-off increased. As a result the upper reaches of the brooks incised, and the ground-water table fell wherever an impervious boulder-clay deposit did not prevent it (Cleveringa *et al.*, in prep.).

In his first paper on the origin of the colonists of the salt marshes in Friesland and Groningen the second author (Waterbolk, 1959) emphasized that the sand-drifts, which appeared to have occurred on a fairly large scale during the Iron Age, were a possible explanation for the 'exodus' from Drenthe. Since this process could only have started on the cultivated fields, it would imply an agricultural catastrophe for the local farmers, who would have been forced to look for other settlement areas. More recently (Waterbolk, 1979) another environmental factor was taken into consideration, *i.e.* the

formation of raised bogs, which, paralleling the general sea-level rise, would have diminished the area suitable for tilling and grazing. This process could, at least locally and especially in the lower parts of the plateau, have led to ecological constraints. The simultaneous occurrence of drought in the more elevated terrain and moistness in the low-lying areas and along the brook-valleys would thus have caused a deterioration of the environment and produced an incentive to emigration.

At the present stage of research the sand-drifts are perfectly understandable as an adverse side effect of an intensive agrarian exploitation of the higher sandy soils of the plateau. The peat formation can primarily be considered a natural process in a humid climate, which will continue as long as man lacks the technology to stop the process by large-scale drainage. The question, to what extent these processes have occurred and whether they alone can satisfactorily explain the apparent extensive emigration from the plateau to the salt marshes that seemingly took place, will be dealt with in paragraphs 3.1. and 3.2. The possible effects of soil

exhaustion and large-scale charcoal burning will be treated in paragraphs 3.3. and 3.4., respectively. Last, in paragraph 3.5 overpopulation as a possible causative factor for emigration will be discussed.

3.1. Sand-drifts

Appendix A comprises an inventory of the post-glacial sand-drift phenomena in the northern Netherlands (provinces of Friesland, Groningen and Drenthe). We restrict ourselves to drifts that can be dated before 1500 A.D. or to those on which a well-developed podsol profile, suggesting an age of at least a couple of centuries, has developed. We should emphasize that our data are not the result of a systematic mapping. They are a by-product of excavations or other field activities. It is therefore doubtful whether the survey is complete. Insignificant layers of drift-sands may have been overlooked in the past.

Only where sand has accumulated over a soil profile that remained intact it is possible to identify prehistoric sand-drifts. Such places may be expect-

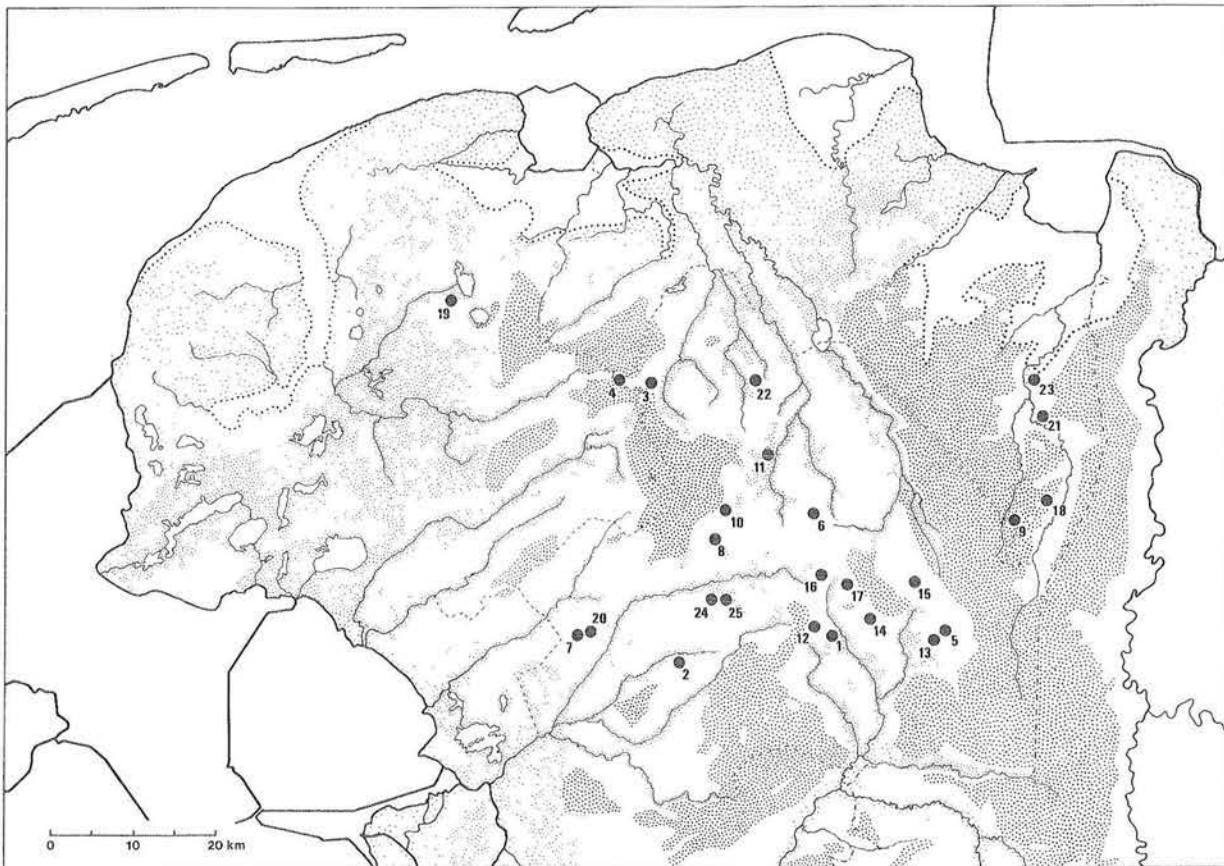


Fig. 1. Location of sand-drift sites 1-25. For further information see fig. 2 and Appendix A.

ed at the periphery of the drift area. Obviously it is difficult to estimate in any single case the extent to which the cultivated field complex was affected by the drift and became sterile. At Hijken, where a very large field complex still shows on air photographs, we have the impression that the drifts occurred only locally, on a small, relatively elevated part of the complex. At Havelte, Emmen and Wijster, on the other hand, the drifts were somewhat more wide-spread and probably had a more serious effect. However, when comparing the distribution of the prehistoric field complexes and that of the early sand-drifts both on a local and on a regional scale one gets the impression, that the drifts occurred only in limited areas and affected a minor part of the field complexes. In this respect we have to modify our earlier concepts.

The inventory comprises 25 places (fig. 1) with 37 occurrences in total (figs. 3-9). In the 6 cases, where we report 2-4 different drifts, they were either stratigraphically succeeding each other (e.g. figs. 4, 8), or they were found at a short distance from one another, with dating evidence of a different nature.

As much as possible we have tried to date the phenomena. A distinction is made between (1) the date of the finds in the soil profile covered by the sand, (2) the date of the sand-drift itself, e.g. by means of finds in the drift layer (fig. 3), or through finds which immediately precede or succeed the drift (which is the case when they are not separated from the drift layer by a soil profile) (figs. 5-6) and (3) the date of the finds that occur in layers on top of the drift layer and which are separated from it by a soil profile (fig. 9). Concerning the dating the following should be remarked. On the basis of experience with soil profiles covering and underlying prehistoric barrows (e.g. Waterbolk, 1964) it is assumed that a well-developed podsol-profile overlying a dune goes back to at least the Early Medieval period (e.g. fig. 7). Considerations of the same nature lead us to expect that a well-developed podsol profile underlying a drift layer is in general not older than the Middle Bronze Age (e.g. fig. 3). If a *Plaggenboden* directly covers the sand-drift a date in at least the Late Medieval period is supposed.

In addition to the description of the sites and the dates of the sand-drifts we have noted the presence of archaeological finds in the neighbourhood (within c. 1 kilometer) which might be associated with the drifts. Finally a description is given of the nature of the blown-over layer (peat, natural soil profile, arable, house-site, etc.).

The dating evidence is summarized in figure 2. We can distinguish three main periods of sand-drifts. One case, Emmerhout a (fig. 4), dates from the Early Bronze Age (or perhaps the Late Neolithic period). In two cases (Wijster-Looveen b, fig. 8, and Odoorn b) sand-drifts can be attributed

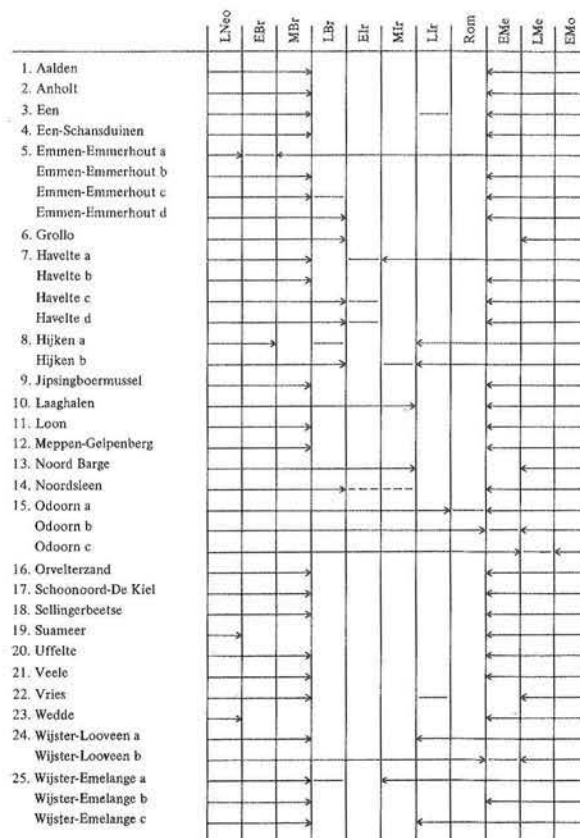


Fig. 2. Summary of dating evidence. Arrows indicate *termini post quem* and *ante quem* for the drift formation. Horizontal lines indicate dating evidence for the drifts themselves. For further information see Appendix A.

to the Early Medieval period (starting perhaps in the Late Roman period and continuing into the Late Medieval period at Odoorn). All other drifts can be dated to the Late Bronze Age or the Early, Middle or Late Iron Age. Throughout this period Celtic fields were in use. Within this latter time span a relatively early date is well-established at Emmen-Emmerhout c and Hijken a, whilst a comparatively late date is documented at Een, Hijken b and Vries. In most cases, a precise date cannot be given. There is a fair probability, however, that the date of the remaining sand-drifts will in most cases have to be placed in the Middle Iron Age, because finds of RW I pottery show that during that period the Celtic fields had their maximal extension. Moreover in three cases dikes of Celtic fields have been covered by sand-dunes (Havelte c, Sleen, Hijken b); elsewhere Celtic fields have usually been identified in the immediate vicinity of sand-drifts. The evidence suggests that the intensity of the sand-drifts decreased during the Roman period. The Celtic field system was in that period probably

replaced by another agricultural system, which at least in the beginning was less susceptible to wind erosion. Elsewhere it has been demonstrated that in the Roman period most settlements were relocated and that the same was likely to be true for the fields (Waterbolk, 1982).

In any case, it is evident that there has not been one period of drift formation: the phenomenon manifested itself during a long time span, with a concentration in the first millennium B.C. The conclusion can only be, that contrary to the suggestion given in earlier papers, there was no synchronous occurrence of sand-drifts in the Early or Middle

Iron Age. Therefore they cannot have been the only reason for the large-scale emigration during that time.

3.2. Marine transgressions and peat formation

Distribution maps of finds from the Neolithic and Bronze Age in the uplands of the northern Netherlands (Waterbolk, 1965-1966) show that the extent of the settled area decreased considerably in the course of time. In the Late Neolithic period the habitable area reached all the way from Gaasterland in the southwest of the province of Friesland

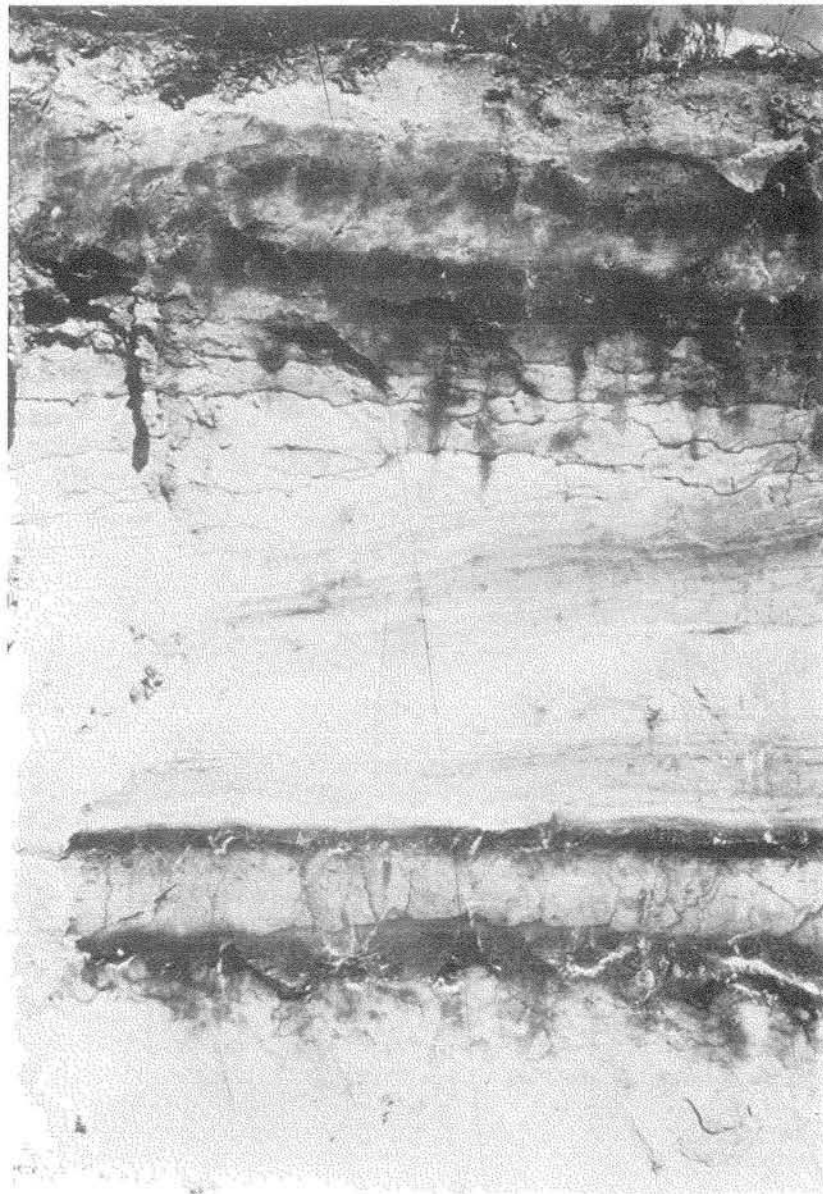


Fig. 3. Double podsol profile at site 3 (Een). The drift layer contains potsherds dating to the Late Iron Age.

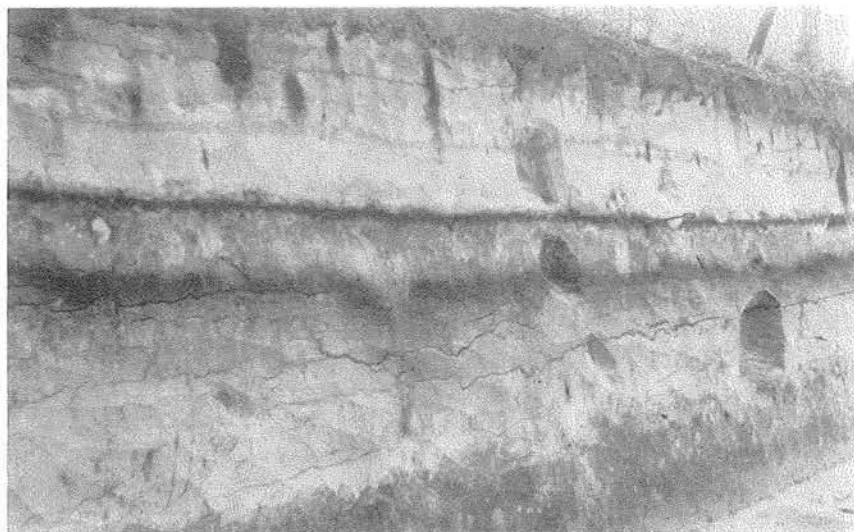


Fig. 4. Two layers of drift-sand at site 5 (Emmerhout a/b). The lower layer dates from the Early Bronze Age. The upper layer dates from the Iron Age or Roman period.



Fig. 5. Drift covered Late Bronze Age house site at site 5 (Emmerhout c).



Fig. 6. Site 14 (Noordsleen). A podsolized drift layer covers a bank of a Celtic field. It probably dates to the Early or Middle Iron Age. The podsol profile is covered by a recent dune.



Fig. 7. Site 17 (Schoonoord-de Kiel). A weakly developed podsol profile marks an interruption in the dune formation.

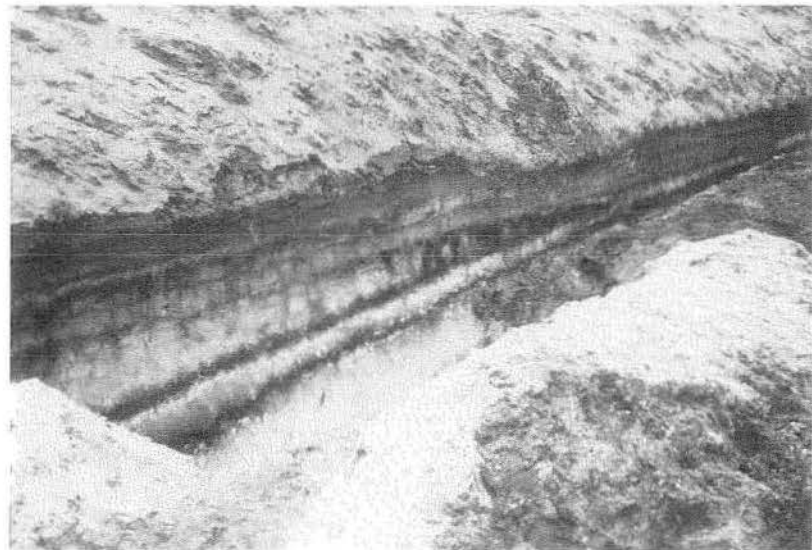


Fig. 8. Site 24 (Wijster-Looveen a/b), showing two drift layers. The lower layer dates to the Late Bronze Age or the Early or Middle Iron Age. The upper layer dates to the Early Medieval period.



Fig. 9. Site 25 (Wijster-Emelange a). A Late Iron Age barrow - with cremation pit - is built on top of a podsolized drift layer probably dating to the Late Bronze Age.

to the Delfzijl area in the northeastern part of Groningen, and from the Dokkum area in northern Friesland to the banks of the Vecht in the province of Overijssel. In the Roman period the inhabited area was restricted to the higher regions of the province of Drenthe.

From the Late Bronze Age we know a few urn fields, such as Bornwird (van Giffen, 1920) and Zuidbroek (Harsema, 1968-1969) in areas that were deserted afterwards, and the lower parts of which are covered by peat and marine sediments. In both instances we are dealing with isolated occurrences

outside the main distribution in Drenthe and the Westerwolde part of Groningen. Stray finds of a certain stone tool type ('Muntendam-axes') in peat areas between Drenthe and Westerwolde show, however, that the isolation was not as complete as suggested by the distribution of the cemeteries (Achterop & Brongers, 1979). The process of peat formation went on through the Iron Age. Many Celtic fields are situated at places which later became covered by peat (Brongers, 1976). There are several examples of this in the eastern part of the province of Groningen (Westerwolde), as well as

some on flat parts of the Drenthe plateau (e.g. Smilde, Steenberg and Zeijen). Large raised bogs did not only occur in valleys and other low-lying areas close to the zone of marine influence, but also on badly drained, relatively flat parts of the plateau. Small local bogs could also affect the habitable area. At Zeijen the Celtic field beds close to the bog 'Witteveen' became covered with peat (Waterbolk, 1977).

From these observations we can draw the conclusion that the development of raised bogs diminished the habitable area, thus affecting the quality of the environment for man. Peat-growth can partially be attributed to the increased run-off from the more elevated areas of the plateau (Cleveringa *et al.*, in prep.), partially to the rise in sea level. Especially in relatively low-lying areas and at the periphery of the large raised bogs the effect will have been considerable. Elsewhere the consequences were probably minor - depending on the efficiency of the natural drainage and the extent of local tendencies towards peat formation. It is difficult to estimate the size of the habitable areas in the various periods. A few relatively flat subzones may fairly suddenly have become completely unsuitable for habitation. This seems to be the case in Westervolde, where ample evidence exists for human activity in the Late Bronze Age and Early and Middle Iron Age, but hardly any for the Late Iron Age and the Roman period.

It is evident that peat formation and rise of ground-water table negatively affected the area suitable for agriculture and cattle grazing. Some habitable areas in the lower parts of the plateau were completely lost. For the area as a whole, however, it was a gradual process, and, therefore, cannot have been the sole cause for the emigration of so many people in a relatively short period.

3.3. Soil exhaustion

It is obvious that one should take into consideration a decrease in soil fertility as a possible cause for emigration - if only because many people unjustifiably assume a correlation between exhaustion of the soil and the origin of sand-drifts. Our problem is that we actually know very little about the exploitation of the Celtic fields. This field system had a wide distribution and it was applied to very different soil types (Wieringa, 1954). The system was introduced some time during the Bronze Age, possibly in the Middle or Late Bronze Age, and it stopped suddenly - in our area as early as the beginning of the Roman period, elsewhere a few centuries later. From excavations, e.g. at Hijken (Harsema, 1974) we know that the large Celtic fields there not only served to grow crops, but were also used as locations for building houses. In the course of time small groups of these houses appar-

ently shifted location within the fields. The beds were not only surrounded by earthen banks, but often also by fences, suggesting that they were used for cattle grazing as well. Small granaries were quite common along the edges of the beds. The banks consisted of undifferentiated arable soil and they gradually grew in height, which suggests that they developed because plant debris, pulled out after the harvest, was deposited on them. There are indications that some kind of manuring was practised (Brongers, 1976), but there is no proof for this supposition. We know the plants which were grown in the fields and also the weeds (van Zeist, 1974). But all this is not enough to understand the system as it was applied in our area, and certainly not enough to know its weak points. Nor is it clear whether after half a millennium of normal functioning the productivity could decrease to such an extent that it would be a reason for emigration. Much research is still needed here. But as with sand-drifts and peat-formation, it is highly improbable that a possible agricultural crisis would be a synchronous phenomenon all over the area.

3.4. Charcoal burning

In their paper about the Iron Age stone hammer axes in the Netherlands Achterop & Brongers (1979) assume that these objects could have been used in the process of extracting bog iron. For the production of iron large quantities of charcoal are needed. In this connection, these authors suggest that the Iron Age sand dunes could have originated as a result of large scale deforestation for charcoal production. In their opinion a supporting argument for this supposition would be that according to them the distribution of Celtic fields and sand-drifts does not coincide. As we have seen, however, there is every reason to believe that a correlation between cropped areas and sand-drifts does exist.

Of course, this does not exclude the possibility that a deforestation for the production of charcoal, could not have been a contributive factor in making the uplands liable to wind erosion.

3.5. Overpopulation

At various occasions (e.g. Waterbolk, 1965-1966) it was suggested that overpopulation of the Drenthe plateau could have led to emigration. Reason for this supposition was the composition of the urn-fields from the Late Bronze Age. Alongside an autochthonous component with graves of the Vledder type and urns of the Gasteren type, there seemed to be three allochthonous components: (1) so-called *zweiheuklige Terrinen*, often placed in small stone cists, with a main distribution in the coastal districts of northern Germany, (2) biconical urns surrounded by keyhole-shaped ring-ditches, with a

main distribution in Westphalia, and (3) urns decorated with *Kerbschnitt* ornament, with a main distribution in the Rhine-Meuse area to the south. According to Kimmig (1964) the urnfield period would have been a period of unrest in entire Europe, as shown for example by the Dorian invasions into Greece. The northern Netherlands might thus have been an area that had to incorporate people driven away from other regions.

There are many reasons to abandon this model. In the first place there are the data from the settlement of Elp. On the basis of ¹⁴C-dates and pottery finds, the site would fall exactly in the period of the substantial transformations in the Middle and Late Bronze Age, yet the farmhouses and accessory buildings did not change at all. In the second place we have to mention the recently excavated urnfields in Westphalia in which both long beds of the Vledder-type and keyhole-shaped grave monuments were found - the latter being a somewhat later phenomenon than the former (Lanting & Mook, 1977). The same chronological difference seems to exist in our area; the striking dissimilarity in distribution of both grave types must have other causes. In the third place it has become obvious that even considerable changes in material culture do not always have to be ascribed to immigration of foreign people. Indeed, the Late Bronze Age in the northern Netherlands should rather be considered a period of great receptivity to cultural influences from elsewhere.

In his study of the urnfields Kooi (1979) has made calculations of the size of the population and demonstrated that for the region as a whole overpopulation cannot have been an important reason for emigration. Although he has paid little attention to the general deterioration of the environment and the effect this may have had in those territories that were particularly affected, his argument can be accepted in general.

Still, it can be assumed that the population gradually increased in the course of the prehistoric period. At the same time some communities experienced a deterioration of their environment, diminishing the size and quality of the area suitable for agricultural activities. However these processes were gradual and it is not necessary to suppose that the carrying capacity of the environment in ecological sense was reached, or even that famine or crisis had occurred. Rather there might have been a lessening of the margins and a diminishing of the possibilities for expansion, at the outset enhancing social tensions between villages. One can imagine several solutions to alleviate these social frictions such as warfare, a reorganisation of the system of food production and technological innovations (Boserup, 1981).

In this respect the Celtic field system in itself may be interpreted as a technological innovation, in

the sense that a shorter period of fallow (from 10-15 years to 2-3 years) became possible. As stated above, the problem is that we do not know exactly when the system was introduced. Nor do we know the agricultural system of the preceding period. Sometimes a Celtic field was laid out systematically, in the sense that it originated by clearing in a relatively short time a large expanse of forest. But in most cases the Celtic fields were situated in areas that were already inhabited during the Late Neolithic, the Early and Middle Bronze Age, and therefore were largely free of forest. The confusing combination of regularity and irregularity in the lay-out of the Celtic field can be explained by the fact that they developed on the basis of earlier exploitation patterns to which more systematically planned parts were superimposed.

4. TRANSHUMANCE, A MODEL

From the preceding it should be clear that during the Middle Iron Age part of the population of the plateau emigrated to the salt marshes of Friesland and Groningen. It has also been demonstrated that there is no direct mono-causal relationship between either drifting sand, formation of oligotrophic peat, or depletion of the soil on the one hand, and this emigration on the other. Nor is there evidence for a rapid growth in population which would have forced people to move, as was already demonstrated by Kooi (1979). It cannot be denied that peat-growth did pose a problem in the low-lying areas of the plateau, especially along the rivercourses, reducing potential grazing areas along the brook-valleys. Sand-drifts diminished the amount of cropping-space in the sandy, more elevated terrain of the plateau. It is also likely that during the Late Bronze and Early Iron Age the plateau was densely populated and that little unclaimed territory was left. However we believe that it is not justified to speak of a catastrophic or crisis situation on the plateau.

Instead we believe that during the Early Iron Age the combination of the factors mentioned above very gradually resulted in a diminishing economic potential of the area. It should be stressed that during the initial phase of this process the actual economic production probably did not diminish; it is sufficient that the inhabitants perceive or experience that the potential productivity decreases. This decreasing economic productivity of the plateau caused a tension between man and his environment, eventually resulting in social stress. Social stress might have come about because the arable land of one community gradually diminished due to peat formation, while the neighbouring village experienced no such problem. However, since the environmental change was gradual, the social stress

also built up slowly and the inhabitants would have found solutions before a 'crisis point' would have been reached.

We suggest that one possible solution would have been a reorganisation of the system of food-production *i.e.*, to use the salt marshes as grazing grounds during the summer. During the Early Iron Age the clay regions were only passable during the dry summer season and not yet considered suitable for permanent habitation. During such an intermediate phase the salt marshes could be exploited, alleviating the problems resulting from the diminishing productivity of the plateau. From the fringes of the plateau the herding could have taken place on a daily basis. However, from the more remote hinterlands this would not have been possible due to the great distances. We suggest that instead from these areas a system of transhumance was practised. This gradual incorporation of the clay district into the economy of the plateau, could eventually result in the emigration of part of the population of the sandy areas of the plateau, which we observe in the archaeological record.

Transhumance is best known from the Alps and Spain but was practised in many mountainous areas elsewhere. In these areas cropping is done in the valleys while the flocks roam the high mountain meadows. Even though no unequivocal definition exists for the term transhumance and the specific details of the transhumant systems differ among the various societies, we can say that generally speaking transhumance is practised wherever, during a certain part of the year, the quantity and/or quality of the pastures is insufficient (Geddes, 1983). In the context of this paper we are only concerned with the type of transhumance as practised in a sedentary agropastoral society. Hereafter we will use the term as it is defined by Geddes:

systems that involve the movement of herds of domestic herbivores - cattle, horses but especially sheep and goat - among complementary seasonal pastures, as an integral part of a more broadly based agricultural system which includes sedentary cultivation

(Geddes, 1983: p. 51).

Only a small segment of the population moves away from the permanent village with the herds. In Norway it is the group of young married women who go to the *seters*, taking along the boys of 10 to 14 years old. The boys herd the animals in the vicinity of the *seter* on a daily basis. Usually they remain on the pastures during the entire summer. The women process the milk, churning it into butter or cheese. They return to the farms regularly (Carlstein, 1982). In the Pyrenees the system is different: men, herdsmen by profession, take the animals of a village or a couple of families to the meadows (Le Roy Ladurie, 1975). The distances covered with the herds are relatively small in order to allow communication with the permanent village. This con-

tact is especially important when, during harvest time, all hands are needed and the aid of the herdsmen is also required.

4.1. The application of the model

During the Neolithic and up to the Late Bronze Age, before the intensification of the agricultural system by the introduction of the Celtic field, crops were rotated and the fields lay fallow for a considerable length of time (up to 10-15 years) before being cropped again. These fallow lying fields were ideal pasturage and provided an abundance of fodder. In addition, the manure deposited by the animals contributed greatly to the refertilization of the soil. In the new Celtic field system, however, the period of fallow was probably much shorter, resulting in a shortage of pasturage. Though much virgin forest remained, in which the animals might have been able to browse, it can be argued that such forest is far from ideal for herding because the vegetation is too dense. Nor could pasture be easily found in the brook valleys, because peat growth made these loci unsuitable for herding. Especially sheep dislike feeding on humid ground. The result was a lack of grazing space during the summer when simultaneously the fields had to be cultivated and the herds brought to pasture. This was especially the case in the northern and western parts of the plateau where oligotrophic peat growth was more severe. In these areas one probably preferred to allot most space for cropping.

It is during the summer that the competition over land between the agricultural and the pastoral component of the economy would have been most intense. In winter space would have been less of a problem because the cattle could have been stabled. This would have meant an additional advantage in that the dung could be collected. Because of the, probably, shorter fallow period of the Celtic field system, the soil had less time to regenerate and the farmers had to rely more upon fertilization. As for the winter feeding in the stables a number of possibilities can be suggested. First, during the summer twigs can be collected in the brook valleys. The collection of fodder is often practised in Norway (Carlstein, 1982). It also is possible that the animals were given cereal stubble and other agricultural waste-products. Stabling the animals during the summer would have been too labour-intensive, especially since all hands would be needed for the harvesting.

Removing the mobile pastoral component, the herds, during the summer in order to alleviate the shortage of space, was thus a logical thing to do, especially since ample pasture had become available with the development of the salt marshes which were awaiting exploitation. Most probably one was already accustomed to roam daily with the herds,

along the fallow-lying areas of the Celtic fields, returning to the farms in the evening. However, due to the fact that the inhabitants preferred to crop as much land as possible, the herdsmen were forced to roam at an ever greater distance from the village, gradually exceeding their local-day-prism habitat (Carlstein, 1982), so that it became impossible for them to return in the evening. The amount of time spent in moving from the village to the grazing grounds would have become excessive. Also, too much walking exhausts the herds resulting in a diminished milk production.

Around 600 B.C. the inhabitants of the area around Groningen could have gradually incorporated the clay covered peat deposits which became accessible within their daily round of herding. The distance is not too great and one can reach the grazing areas directly without having to traverse extensive peat. However, from other parts of the plateau the distance to be covered was much greater. The shift can therefore not be explained as the result of an unconscious process of migratory drift (Stenning, 1957) on a small scale. On the contrary, the herdsmen from the more remote regions of the plateau could not drift ever further away from their farms due to the fact that the plateau was rather densely populated and some sort of system of territorial rights certainly existed at that time, preventing outsiders to graze on ground of other villages. For them the shift from the habit of daily herding around their farms to the practising of transhumance must have been the result of a conscious decision. They must have realized that their 'arrangement of activities in space and time' was inefficient (Carlstein, 1982: p. 38). The change to a transhumant system of pastoralism was an attempt to 'combine the right inputs at the right times and places' (Carlstein, 1982: p. 38). The presence of the salt marshes and their suitability for herding (van Zeist, 1974; van Zeist *et al.*, 1976) must have been known widely due to communication between neighbouring villages. The time elapsed between the initial exploitation of the salt marshes by the inhabitants of the fringes of the plateau and the moment that the people from the hinterlands started to use the area in a transhumant mode, was probably short and will be difficult to trace archaeologically.

For the pastoral component of the economy of the central part of the plateau the shift to transhumance might have offered possibilities to continue to exploit the 'secondary products' (Sherratt, 1981) of the herds such as wool and various milk-products (intensive pastoralism), while in addition the size of the herds could be extended. Consequently, meat production could be raised on the marshlands because surplus animals, those for whom there was no place in the winter stables, could be slaughtered upon return to the plateau in

autumn. During the summer the production of the herds of cattle could further be raised by pooling the milk of the larger number of animals of several families, resulting in a sufficient quantity of milk to warrant cheese-making each day. Hence the use of transhumance enabled the inhabitants of the plateau to increase the production of the pastoral component of the economy which would not have been possible if the animals had been grazing on the plateau.

Obviously we do not know which segment of the population accompanied the herds to the pastures in the case of the plateau-salt marshes transhumant system. If the main villages were within easy reach of the grazing areas, it did not matter much who left since it would be easy to return. In these situations the system might have resembled that of the *seters* in Norway where young married women departed from the main village to the *seters* for a few days only to process the milk and returned afterwards with the products, leaving the young boys with the animals. When the village was further away, the herdsmen probably processed the milk themselves, staying for long periods at a time on the grazing grounds and only occasionally returning to the village. Probably older boys and girls, the ones still too young to take responsibility for the farm but old enough to stay alone for an extended period of time, might have spent the summer on the marshes. However, we need not speculate further since the social structure associated with the system is beyond the scope of this paper.

One question still remains: how could herds traverse the bog country between the sandy plateau and the salt marshes? This area has usually been regarded as impassable. However, the peat probably did not form an insurmountable barrier. In a number of places through the peat pleistocene outcrops, forming 'islands', were many and the intervening bog areas small. Along these routes it must have been possible to cross the peat belt even with herds (Cleveringa, pers. comm.).

A first route (fig. 10) has already been mentioned above: at the very northern tip of the plateau the salt marshes reached all the way to the sandy plateau with no intervening peat. Another possibility would be along the sandy outcrops of Duurswold, where a Late Bronze Age urnfield has been found (Harsema, 1968-1969). These two routes would open Hunsingo and Favelingo. A third itinerary appears to have been the row of pleistocene outcrops between Drachten and Dokkum; near Bornwird an urnfield dating to the Late Bronze Age has been found (van Giffen, 1920). Along this route one only had to cross a small stretch of peat area near Dokkum in order to reach Oostergo. Last, the area of Westergo could probably be reached along the spurs of the moraine plateau in the direction of Gaasterland. Moreover it should be stressed that

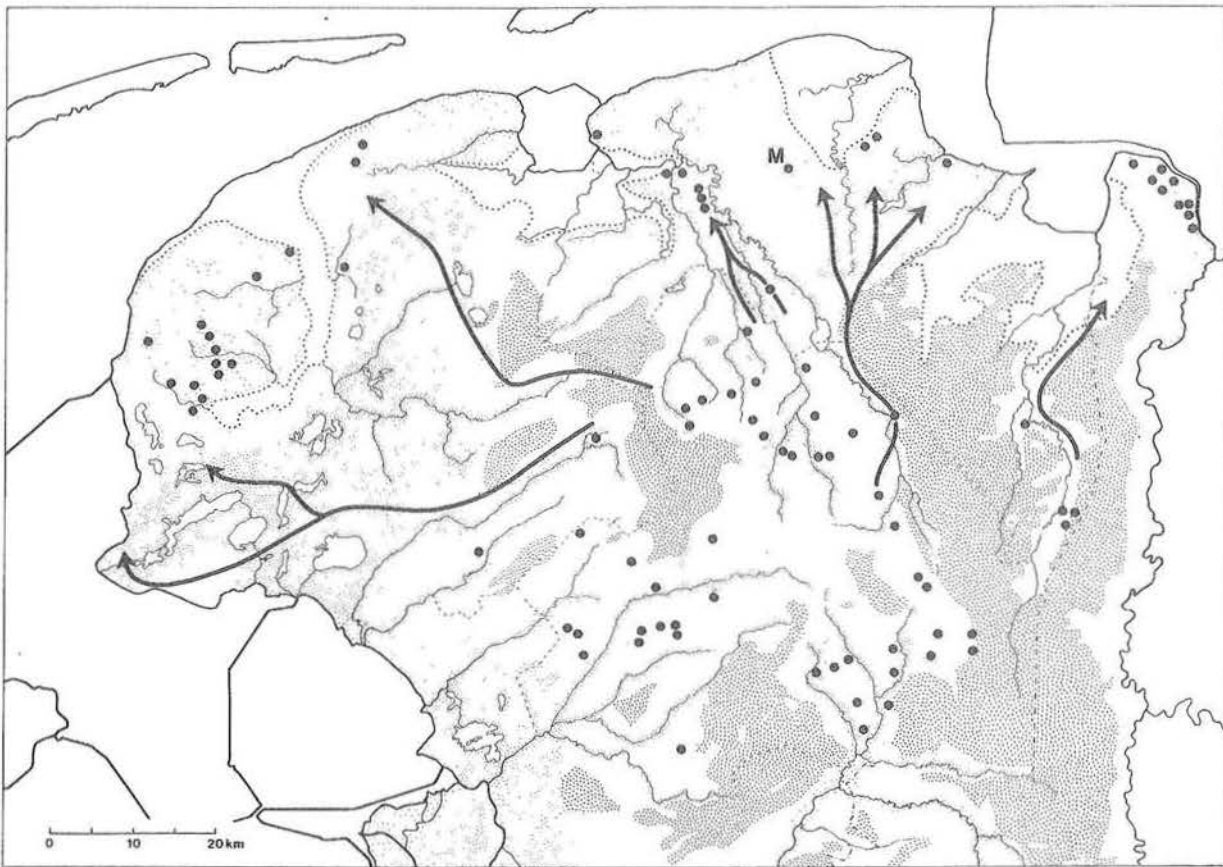


Fig. 10. Distribution of Middle Iron Age pottery (types RWI and RWII) in the northern Netherlands. Arrows suggest possible routes for transhumance and colonization. The site of Middelstum-Boerdamsterweg (see fig. 11) is indicated by the letter M.

during the summer the peat dried out sufficiently to enable people to cross it, especially if it concerned short stretches.

At first sight the distances covered with herds between the plateau and the salt marshes seem enormous. From Een to Dokkum (Oostergo) the distance is 40 km as the crow flies, from Appelscha to Westergo 70 km. If one assumes that the herdsmen could cover approximately 10 km a day with their herds (with calves) (Smith, 1978), it took a minimum of 4 days to reach Oostergo and at least 7 days to arrive in Westergo, starting from the northwestern edge of the plateau. From other parts of the plateau travelling times would certainly be much longer. However, these lengthy journeys are not unusual; in the Central Apennines in Italy the march took 10 to 15 days (Carrier, 1932). Also, some grazing possibilities existed along the way, especially around the sandy outcrops. On grazing territory of other villages, permission to pass with herds might have been obtained in exchange for

certain goods. Water would not have posed a problem either. It was thus not necessary to be in a great hurry to reach the pasturage on the salt marshes. Furthermore it is not imperative to assume that the more remote areas of the salt marshes were immediately, if at all, included in the transhumant system. It is plausible that, for example, Westergo was never exploited on a seasonal basis but only occupied when people moved to the marshes permanently.

It is difficult to guess for how long transhumance was practised. Certainly the change to a year-round occupation of the salt marshes has been a gradual one. The herdsmen could assess the economic potential of the marshes and determine the moment that continuous habitation of the area became possible. It is likely that the herdsmen already kept small gardenplots in the vicinity of their huts in order to be self-sufficient during the summer. In this manner they could also define the possibilities for agriculture on the marshes. When the feasibility

of permanent settlement was established, the herdsmen might have induced fellow villagers to make the move.

The first permanent inhabitants settled directly on the salt marshes ('*Flachsiedlung*'), most likely at places where spurs of the pleistocene sand were within 4 meters below surface (visible due to a different vegetation); here fresh water would have been available (Cleveringa, pers. comm.). The main source of subsistence of the settlers must have been pastoralism. Although experiments have proved that agriculture was possible on the more elevated parts of the flats (van Zeist *et al.*, 1976) this must have been a marginal enterprise. In archaeological context *Hordeum vulgare* and *Camelina sativa* have been encountered (van Zeist, 1974), two species which were demonstrated to be resistant against short-term flooding (van Zeist *et al.*, 1976). Agricultural products must have been subsidiary and only for home consumption. The pastoral products provided the main source of income. Large herds could be kept and the meat, hides, and milk products could be traded with the products from the sandy areas of Drenthe, where a mixed economy prevailed. Certainly contact will have been maintained between Drenthe and the salt marshes if only because kinship ties did exist, surely during the initial stages of permanent settlement. However, the two areas developed along different lines, as evidenced by the material culture: from the preceding RW I and II types of pottery RW III evolved, which in the clay regions was much more differentiated and more elaborately decorated than in Drenthe.

4.2. Archaeological evidence

Direct archaeological evidence for the model outlined in the preceding paragraphs, is scarce. Transhumance usually leaves few material remains. Moreover, the small temporary encampments of the herdsmen and the settlements of the first inhabitants, which were erected directly on to the surface of the salt marshes, have usually been subsequently covered with a thick clay layer during later transgressions of the sea. These sites will only be discovered by chance. An exception from those settlements which were not deserted during the D-Ib transgression phase (around 500 B.C.), but which were raised by the inhabitants (*terp*). In this manner the primary settlement on the marsh-surface ('*Flachsiedlung*') would be covered with a *terp*.

The only example of such a site, inhabited immediately after the salt marshes became accessible, is Middelstum-Boerdamsterweg (fig. 11). This site is the oldest settlement in the clay regions known up to now; the earliest ^{14}C date is 2555 ± 35 B.P. (GrN-7902) taken from a wooden post belonging to

a granary (Lanting & Mook, 1977). The site was excavated from 1970 to 1973 under the direction of J.W. Boersma (1983). In the context of this paper we are only concerned with the features belonging to the habitation preceding the erection of the first *terp*. The relative sequence of the structures attributed to phase I is difficult to ascertain. An eastern concentration of features consisted of a large 'granary' and a small farmhouse built alongside it. Since the excavator considered it unlikely that both structures functioned contemporaneously, he attributed the large 'granary' to phase Ia, and the farmhouse with some small 'granaries' to phase Ib. During phase Ia the farmyard was enclosed by a single ditch. In phase Ib a more extensive system of ditches had developed. About 90 meters to the west of this group of structures, a second concentration was found (phase Ic), consisting of two or three small houses with a few 'granaries'. To the houses annexes were attached. This concentration was situated on a natural levee of the sidecreek. It was later to become the site of the *terp*. The excavator suggests that both concentrations existed alongside each other (Boersma, 1983). It should be stressed that the phases which Boersma differentiates within the habitation traces directly on the salt marsh-surface do not have chronological implications. Until more light is shed on the relative chronology of these features, it would probably be more appropriate to refer to spatial concentrations Ia, Ib and Ic instead of to phases Ia, Ib and Ic.

The configuration of simple small houses, annexes and platform of the western concentration (phase Ic) conforms to the settlement structure we might expect as summer encampment. When a place is only used during part of the year and only by a segment of the population, large farms and barns were unlikely to be constructed. Barns were dispensable because the herds would spend most of the time on the grazing grounds. Only for milking would it have been necessary to drive the animals together. Some of the annexes might have functioned as corrals for assembling the animals to facilitate milking. In the Peloponnese the herdsmen use 'folds' into which the sheep and goat are driven; the milkers sit at the entrance and let the animals pass one at a time (Koster, 1977). In Central Italy circular enclosures served as milking places (Carrier, 1932). We can also imagine corralling to have been necessary to brand the animals. The small houses of the western concentration in Middelstum could have been used as domestic quarters for the herdsmen and the processors of the milk. The platforms ('granaries') could have served as storage places.

The house (phase Ib) of the eastern concentration might have been in use roughly during the same time. If anything it might be slightly younger

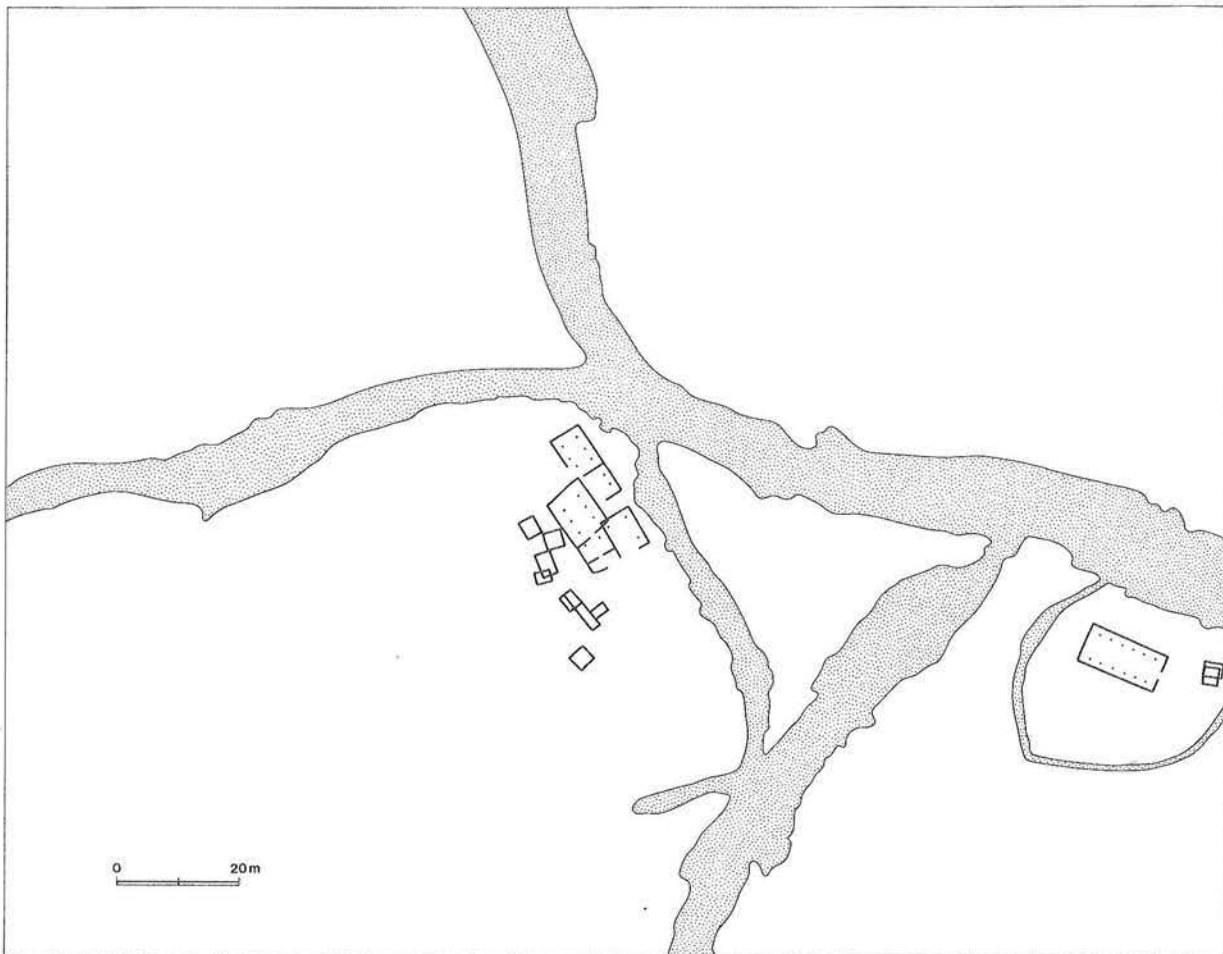


Fig. 11. Middelstum-Boerdamsterweg phase I. Small houses with annexes and platforms built on the surface of the levees along tidal creeks. After Boersma (1983), schematized.

than the structures of phase 1c. Although it is two-aisled and well-built, this dwelling cannot be interpreted as a farmhouse with a byre. There is no positive evidence for cattle stalling and a second entry to a byre is absent. This is in contrast with the large farmhouses with byres which we find later on the *terps* in the same area. The 'farmhouse' may well have functioned as living quarters only. The extensive system of ditches could be interpreted as corral ditches, used to separate herds. It is likely that this concentration too can be interpreted as a summer encampment for herdsmen.

The function of the large 'granary' attributed by Boersma to phase 1a is difficult to assess. The structure measures 15 × 5 meter and consists of four rows of heavy posts. It could have been a granary or storage place, but it might also have had a quite different purpose. It is possible that this construction functioned while the site was occupied on a

seasonal basis. However, until the relative chronology of the features is investigated further, it cannot be excluded that the 'granary' existed while the place was inhabited year-round (phase 2)³.

Against the proposition that Middelstum-Boerdamsterweg functioned in a transhumant mode of pastoralism, one can argue that one would expect a more diffuse settlement pattern: isolated huts each in a separate grazing territory. Although these isolated huts probably existed as well, it is not unusual to find a number of dwellings close to one another. In Norway one often encounters huts (*seters*) grouped together. This has the advantage that facilities such as cheese-making utensils and possibly corralling devices, could be shared. Also the herdsmen could keep each other company. Moreover, we often find that the grazing grounds are communal property. In Andorra the communal pasturage is administered through syndicates composed of as-

sociated villages; in the Alps similar organisations also coordinate cheese-making (Carrier, 1932). It can be suggested that a similar system existed in the Iron Age; if so Middelstum-Boerdamsterweg then might have functioned initially (phase 1c) as a central facility for an association of villages or family groups. The herdsmen with their live-stock (consisting of the animals from one village or a number of families) could roam the communal ranges.

4.3. Final considerations

Apart from Middelstum-Boerdamsterweg there seems to be little archaeological evidence at present for the proposition that the permanent occupation of the marshes was preceded by a phase during which transhumance was practised. In this respect we would like to put forward some hypotheses which might be tested in the future. As already touched upon in the preceding paragraph, we might expect a different internal organisation of the settlements inhabited during the transhumant phase as compared to the ones of the later permanent occupation. It is likely that a temporary summer encampment consisted of fewer houses than a permanent village. The dwellings of the former would generally be smaller and show less internal differentiation: byres and second entrances would not have been necessary. We can also postulate the absence of fences surrounding individual farmsteads.

Second we might be able to observe qualitative and quantitative differences in the bone-spectra between the initial seasonal habitation of the salt marshes and its subsequent permanent occupation. We can anticipate a less diversified bone-spectrum during the transhumant phase: only part of the total variety of live-stock on the plateau would have been selected to browse on the ranges of the marshes and used for consumption. Among the remains of wildfowl, migratory birds would be missing.

The third hypothesis pertains to the pottery. We expect that, during the transhumant phase, the herdsmen mainly used earthenware made on the plateau. During the following year-round occupation the pots would have been manufactured locally with marine clay from the salt marshes. Consequently, the chemical composition of the two kinds of clay used will not be the same. Furthermore, diatom analysis might point to differences as well.

Obviously, with these three hypotheses the possibilities for further research are not exhausted. A detailed study of the range of pottery shapes present might indicate functional differences between the assemblages of the transhumant and the permanent habitation, for example in the relative number of cheese-making utensils. Hopefully future research can shed more light on the early occupation of the salt marshes and test the explanatory value of the model presented here.

5. CONCLUSIVE REMARKS

For quite some time the problem of the apparently sudden colonization of the salt marshes of Friesland and Groningen during the early part of the Middle Iron Age has drawn attention. There is little doubt about the origin of the colonists: their material culture closely resembles that of the plateau (Zeijen culture). The emigration of part of the population of the plateau has usually been explained by postulating a crisis situation on the plateau. Several factors which would have caused this supposed crisis have been suggested, such as sand-drifts, peat formation, depletion of the soil and population growth.

Though sand-drifts were most frequent during the Middle Iron Age, they occurred throughout a long time span, ranging from the Early Bronze Age to the Early Middle Ages. Since the sand-drifts are not dating from one period, they alone cannot explain the sudden emigration to the clay marshes. The drifts were of local importance only and would hardly have destroyed the complete Celtic field on which they originated. The expansion of the raised bogs diminished the land suitable for tilling and reduced the quality of the low-lying grazing grounds. This process may have been a cause for emigration in relatively low-lying or badly drained areas. It is unlikely, however, that a critical situation arose simultaneously over the entire plateau. Soil exhaustion might gradually have affected the productivity of the Celtic field, but again this did not cause a 'crisis' situation. There is no evidence for overpopulation on the plateau, so this factor cannot have played a decisive role in the migration process either.

It is clear, however, that the combination of the above mentioned phenomena indeed caused a gradual decline in productivity of the environment of those communities affected most by sand-drifts and peat growth. Even though the actual production of most farmsteads might not have diminished, it was sufficient that the inhabitants perceived that the economic potential of the area decreased. Technological and logistical adjustments in the system of food production were thus necessary to keep sufficiently large margins. It is suggested that one such adjustment could have been the incorporation of the salt marshes into the economy of the plateau during the Early Iron Age. The marshlands, recently formed during the D-IB transgression, with their rich grazing potential, could have been exploited initially on a seasonal basis, that is to say, in a transhumant mode of pastoralism. Removing the mobile pastoral component from the plateau would have the advantage of freeing space for cropping. The herdsmen could judge the suitability of the marshes for permanent occupation and pass this information on to their

relatives on the plateau. During this pioneer phase the attractiveness of the new environment and its possibilities for agriculture, especially pastoralism, would become known and eventually large scale immigration resulted. It should be clear that, had the salt marshes not recently become accessible, the inhabitants of the plateau would have sought other adjustments in their economic system, to get out of the impasse. Using the salt marshes was probably just the easiest solution.

The model presented in this paper has the advantage that it incorporates several sources of information. It is also an attempt to get away from simple cause-and-effect relationships in archaeological reasoning. It explains why so many people moved in a relatively short time from the plateau to the salt marshes without having to refer to a non-attested catastrophic situation. It is hoped that future research will test the utility of this model.

6. NOTES

1. In this paper we follow the distinction between Early and Middle Iron Age as suggested by Lanting & Mook (1977).
2. In a paper written at high age, Van Giffen (1973) has reformulated his original views on an eastern origin of the marsh settlers. His arguments do not convince us.
3. The large structure shows a formal similarity to the large granary (or group of three granaries) that accompanies one of the oldest houses of Ezinge. It is also constructed directly on the surface of the marshlands. Admittedly the house (with living part and byre) has a later date than Middelstum-Boerdamsterweg, but the earliest part of the settlement has not been excavated (Waterbolk & Boersma, 1976).

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APPENDIX A: Inventory of phenomena associated with wind erosion in the provinces of Groningen, Friesland and Drenthe

All sheet numbers refer to the Topographical Maps of the Netherlands, scale 1:25.000 (Topografische Dienst Emmen, Delft, various editions).

1. *Aalden* (parish of Zweeko, sheet 17G).
De Roo, 1953.
Documentation: De Roo, 1953: photo 3.
Date: Late Bronze Age, Iron Age or Roman period.
Location: on the *es* (old arable land brought up during the Middle Ages) south of Aalden.
Description: on a layer of Pleistocene coversand we find a well-developed heather podsol, covered by a 50 cm thick layer of wind-blown sand. On this a second well-developed podsol formed. On top of this second podsol a 40 to 60 cm thick layer of arable soil was artificially brought up (hereafter referred to as *es*).
Archaeological associations: the Early Medieval cemetery near the Hoge Hof (van Giffen, 1952).
2. *Anholt* near Pesse (parish of Ruinen), sheet 17C.
Beijerinck, 1932; 1933a; 1933b; 1934.
Documentation: Beijerinck, 1933a: fig. 1, profile 1.
Date: Late Bronze Age, Iron Age or Roman period.
Location: in the small thicket north of the old road Eursinge-Ruinen.
Description: on Pleistocene coversand a well-developed podsol can be seen which was covered by a layer of wind-blown sand. On this a second podsol developed, covered by recent sand-drifts (Beijerinck, 1933a). For a long time Beijerinck asserted that the iron-pan of a podsol had formed during the cold tundra climate which prevailed during the Würm glacial period. The leached sand layer above developed during the warmer and more humid interstadia of the Würm as a result of the accumulation of humus and sand trapped by the cover of heather vegetation. When he could differentiate two podsol profiles, he attributed the bottom one to the first cold maximum of the Würm, the upper one to the second cold maximum (Beijerinck, 1933b; 1934). With respect to the profile near Anholt, Beijerinck stated that he had found artefacts attributable to the Tardenoisien in the upper leached sand layer (1932; 1933a). Closeby he came upon Late Neolithic and Early Bronze Age flint and pottery. These he attributed to the layer of sand-drift overlying the upper leached sand (Beijerinck, 1932).
Archaeological associations: the cemetery of Hilgensteen (Lanting, 1977). Tumulus and secondary internment dating to the Iron Age (van der Waals, 1964).
3. *Een* (parish of Norg), sheet 12A.
Waterbolck, pers. comm.; van der Waals, 1962b; 1963.
Documentation: fig. 3 (this publ.).
Date: Late Iron Age.
Location: southwest of Een.
Description: on a strongly developed heather podsol we find a thin layer of wind-blown sand. In this layer sherds of RW III type were found (Waterbolck, pers. comm.). Recently the area has again been prone to wind erosion.
Archaeological associations: Early Iron Age farm (van der Waals, 1962b). Celtic fields occur east of the village of Een (Brongers, 1976).
4. *Een/Schansduinen* near Een (parish of Norg), sheet 11F.
Waterbolck, pers. comm.
Documentation: none.
Date: Late Bronze Age, Iron Age or Roman period.
Location: east of the Schansduinen.
Description: double podsol.
Archaeological associations: close to the Eenerschans Van Giffen (1946) has excavated a Bell Beaker barrow. Celtic fields occur c. 1 km north of the site (Brongers, 1976).
5. *Emmen-Emmerhout* (parish of Emmen), sheet 17F.
Waterbolck, 1959; Lanting, pers. comm.
Documentation: laquer peels at the B.A.I.; figs. 4 and 5 (this publ.).
Date: a) Late Neolithic or Early Bronze Age; b) Late Bronze Age, Iron Age or Roman period; c) Late Bronze Age; d) Iron Age or Roman period.
Location: east of the Emmerdennen.
Descriptions: during the expansion of the town of Emmen traces of human habitation were discovered near the Emmerdennen. From 1960 to 1968 this area was excavated by the B.A.I.
a) Late Neolithic habitation traces were covered by wind-blown sand (Lanting, pers. comm.). On this sand a podsol developed on which houses of Elp type were located as well as cultivated fields.
b) These cultivated areas were subsequently covered by sand-drift (during the Late Bronze Age or Iron Age). On the sand a podsol developed.
c) Slightly north of this three-fold podsol, a double podsol was also found. It concerned sand-drifts dating to the Late Bronze Age, covering settlement remains and arable land from the Middle Bronze Age.
d) Last, Waterbolck has studied a double podsol east of the Emmerdennen, with remains of a Late Bronze/Early Iron Age urnfield in the lower one (Waterbolck, 1959).
Archaeological associations: closeby several Celtic fields were located by Brongers (1976). East as well as south of the Emmerdennen, urnfields were excavated (Bursch, 1937).
6. *Grollo* (parish of Rolde), sheet 11G.
De Roo, 1953.
Documentation: none.
Date: Iron Age and/or Roman times.
Location: on the Zuideresch.
Description: during pedological research for the reallocation program around Grollo, sherds were retrieved in the cores. It was decided to dig a profile pit: directly under the *es* a woodland soil was encountered, overlying a layer of wind-blown sand. Between the two levels the soil was more humic, indicating the presence of an old habitation layer (80-100 cm below surface). In this humic level sherds were found dating to the Iron Age and/or Roman times (de Roo, 1953).
Archaeological associations: on the southernmost tip of the Zuideresch a Late Bronze Age urnfield has been located (Kooi, 1979). Celtic fields occur c. 1 km east of the site (Müller-Wille, 1965).
7. *Havelte* (parish of Havelte), sheet 16H.
Waterbolck & van Aniel, 1951; van Giffen, 1951; Taayke *et al.*, 1978.
Documentation: none.
Date: a) Early Iron Age; b) Late Bronze Age, Iron Age or Roman period; c) Iron Age or Roman period; d) Early Iron Age.
Location: in the neighbourhood of the Havelterberg four locations with evidence for sand-drifts can be mentioned (van Giffen, 1951: pl. 1).
Description:
a) Close to the Meerkamp a barrow (Tumulus 3) was raised directly on wind-blown sand. This sand overlay peat which in turn covered a much earlier sand-drift. The peat could be dated to the Subboreal period (determ. Florschütz). In the barrow a bronze bracelet was found, attributable to the Early Iron Age (van Giffen, 1951: pl. 1, 5, 8, 29, 30).
b) Waterbolck and Van Aniel have, close to the Kogelvanger, drawn a profile with a double podsol, covered by a recently deposited layer of wind-blown sand (1951: pl. 35/3).
c) Close to the Studentenpad in the bank of a ditch, Waterbolck and Van Aniel located a dike of a Celtic field, covered by a podsolized sand-drift (1951: fig. 35/10). On the oldest podsol lay a thick layer of disturbed ground containing pieces of charcoal and sherds.
d) Behind the Kogelvanger Taayke and others investigated a cultivated field with plough marks of the Early Iron Age. This field was overlain by wind-blown sand (Taayke *et al.*, 1978).

- Archaeological associations: directly north of the area prone to wind erosion, a Celtic field has been located (Brongers, 1976). Near the Koningskamp an urnfield has been found (Kooi, 1979).
- The Uffelte site (see below, nr. 23) lies closeby.
8. *Hijken* (parish of Beilen), sheet 17A.
Harsema, 1971-1972; 1974; Lanting & Mook, 1977.
Documentation: field drawings at the B.A.I.
Date: a) Late Bronze Age; b) Late Iron Age.
Location: along the edge of the Noordhijkerveld.
Description: preceding the reallocation program, large scale excavations were carried out in 1969 and 1970, directed by O.H. Harsema.
a) Arable land attributable to the Middle or Late Bronze Age, was covered by sand-drifts (a t.p.q. is provided by the Barbed Wire sherds found within the plow zone). Within this layer of wind-blown sand we can differentiate humic laminations indicating periods without sand-drifts. On this layer of wind-blown sand a Celtic field was located.
b) The cultivated zone of this Celtic field was plowed along with a layer of wind-blown sand, overlying it, suggesting that wind erosion took place even while the land was under crop. On top of this uppermost layer of wind-blown sand pyremounds were erected. These mounds provide a t.a.q. for the sand-drifts overlying the Celtic field. In some cases the mounds directly overlay the sand-drift, sometimes a thin layer of humus intervenes. The primary interments of the mounds must be dated around 2300 B.P., the secondary ones around 2100 B.P. (Lanting & Mook, 1977).
Archaeological associations: the entire area has provided abundant finds dating from the Early Bronze Age to the Late Iron Age. Closeby a Celtic field and an Iron Age settlement have been investigated (Harsema, 1974).
9. *Jipsingboermussel* (parish of Vlagtwedde), sheet 13C.
Waterbolck, pers. comm.
Documentation: none.
Date: Late Bronze Age, Iron Age or Roman period.
Location: unknown.
Description: double podsol.
Archaeological associations: at a distance of 2-3 km the Valtherbrug has been excavated (van Zeist, 1958). This has been dated to 2295 ± 50 B.P. (GrN-1085) (Lanting & Mook, 1977).
10. *Laaghalen* (parish of Beilen), sheet 17B.
Van der Waals, 1964; Documentation B.A.I.
Documentation: field drawings B.A.I.
Date: probably Late Iron Age.
Location: in the Laaghalerveld north of the Laaghaler es.
Description: during a survey of the area Van der Waals and Waterbolck found a double podsol here. In the lowest one remnants of square ditches dating to the Middle Iron Age could be seen. These features were covered by wind-blown sand on which a podsol had developed.
Archaeological associations: close to the above-mentioned profile Waterbolck has found cremation remnants (van der Waals, 1964). In addition grave barrows are located on the parcel of heather vegetation southwest of the profile. A Celtic field occurs in the vicinity of the site (Brongers, 1976).
11. *Loon* (parish of Assen), sheet 12D.
Waterbolck, pers. comm.
Documentation: none.
Date: Late Bronze Age, Iron Age or Roman period.
Location: 1 km south of Loon, along the western bank of the Looner Diep.
Description: in a small scale, local sand-drift a double podsol was attested. This profile can still be seen.
Archaeological associations: on the Napoleonic map an area with grave barrows is visible, probably partly consisting of pyremounds. This cemetery has not been excavated.
12. *Meppen-Gelpenberg* (parish of Zweelo), sheet 17G.
Van Giffen, 1940; Modderman, 1957; Waterbolck, pers. comm.
Documentation: B.A.I. photo album 1938B/94f.
Date: Late Bronze Age, Iron Age or Roman period.
Location: northwest of Aalden, along the road Aalden-Witteveen.
Description: during the excavation of the 'Schepersbergje' and other Early Bronze Age grave barrows (in 1938), Van Giffen located a sand-dune in which a double podsol had developed.
Archaeological associations: an urnfield has been found east of the above mentioned terrain (van Giffen, 1940: fig. 31). During a survey of the terrain around the Gelpenberg Modderman has found an Early Bronze Age ossuary, and habitation traces and arable land dating to the Iron Age (Modderman, 1957).
13. *Noord Barge* (parish of Emmen), sheet 17H.
Kooi, 1974; and pers. comm.
Documentation: field drawing B.A.I.
Date: Late Iron Age through Early Middle Ages.
Location: alongside the road from Noord- to Zuidbarge.
Description: during the excavation of the local urnfield (Kooi, 1979) a layer of wind-blown sand showed up, which had been preserved in the lump of roots of a fallen tree. An old habitation surface covered by wind-blown sand was visible in the resulting treefall-structure (Kooi, 1974: fig. 7b). Reclamation trenches were situated on top of the covered habitation surface.
Archaeological associations: at the same location a Late Bronze Age and Early Iron Age urnfield is present (Kooi, 1979). Furthermore a pit containing Ruinen-Wommels II pottery (Middle Iron Age) was found (Harsema, 1979).
14. *Noordsleen* (parish of Sleen), sheet 17F.
Van der Waals, 1962a.
Documentation: field drawings B.A.I.; fig. 6 (this publ.).
Date: Early or Middle Iron Age.
Location: in the Sleenerzand.
Description: during the investigations in 1960 the following sequence was recorded: on top of a layer of coversand, overlain by woodlandsoil a grave barrow dating from the Early Bronze Age was situated. On top of this barrow a Celtic field tapered off. The latter was covered by a layer of wind-blown sand.
Archaeological associations: a Celtic field (not mapped by Brongers, 1976) is situated nearby (van der Waals, 1962a).
15. *Odoorn* (parish of Odoorn), sheet 17F.
Waterbolck, 1973; van Gijn, 1981; Lanting & Mook, 1977.
Documentation: field drawings and photographs B.A.I.
Date: a) Late Roman times; b) Early Middle Ages; c) Late Middle Ages.
Location: on the sports-ground south of Odoorn.
Description: during the excavation of the Early Medieval settlement phenomena associated with wind erosion were attested at several locations in the excavated area.
a) On top of the original podzol profile cropping had taken place, ultimately covered by wind-blown sand. A pit underneath this sand layer has been dated to 1645 ± 30 B.P. (GrN-6624) (Lanting & Mook, 1977).
b) Above the layer of wind-blown sand a new habitation and cropping phase was present (Early Medieval period). Several ditches filled up with sand-drifts suggest that the deposition of wind-blown sand continued during the habitation.
c) The latter sand layer was intersected by pits belonging to a burnt house, probably dating from the 9th or 10th century A.D. Finally, a thin layer of wind-blown sand separates the Medieval plow zone from the present one.
Archaeological associations: on the spot an Early Medieval settlement was unearthed. Stray finds date from the Middle Iron Age. Probably, an Iron Age cemetery was once situated nearby. West of the site a Celtic field occurs (Müller-Wille, 1965).
16. *Orvelterzand* near Orvelte (parish of Westerbork), sheet 17E.

- Waterbolk, pers. comm.
 Documentation: Waterbolk, 1962 (photograph 1).
 Date: Late Bronze Age, Iron Age or Roman period.
 Location: in the southern part of the wooded Orvelterzand, north of the Oranjekanaal.
 Description: during sand extraction activities a double podzol was studied (no written information available). Probably, this profile is still existing.
 Archaeological associations: none.
17. *Schoonoord-De Kiel* near Schoonloo (parish of Rolde), sheet 17E.
 Waterbolk, pers. comm.
 Documentation: laquer peel at the B.A.I.; fig. 7 (this publ.).
 Date: Late Bronze Age, Iron Age or Roman period.
 Location: along the road through the Ellertsveld, just north of the Tip.
 Description: during sand extraction activities a quadruple podsol was found. The bottom one is well-developed and is overlain by 50 cm of sand-drift. On the sand a slightly developed podsol could be seen overlain by 20 cm of wind-blown sand with a well-developed podsol. This third podsol was again covered by sand-drift (10 cm). The uppermost podsol is very well-developed.
 Archaeological associations: a Celtic field occurs at a distance of less than 1 km (Müller-Wille, 1965).
18. *Sellingerbeetse* (parish of Vlagtwedde), sheet 13C.
 Waterbolk, pers. comm. (letter by Ir. A.G. Swart, director Cultuurtechnische Dienst, Groningen, 1959).
 Documentation: none.
 Date: Late Bronze Age, Iron Age or Roman period.
 Location: on the Beetserweg opposite nr. 52, just past a sand-dredger business.
 Description: during coring fieldwork a double podsol was found at three places. These locations should still exist.
 Archaeological associations: a Celtic field is situated at about 3 km distance.
19. *Suameer* (parish of Tietjerksteradeel), sheet 6D.
 Waterbolk, pers. comm. (cf. documentation B.A.I.).
 Documentation: none.
 Date: none.
 Location: unknown.
 Description: double podzol.
 Archaeological associations: except for Mesolithic artefacts, Siebenga has found material dating from the Bronze Age, as well.
20. *Uffelte* (parish of Havelte), sheet 16H.
 Waterbolk & van Andel, 1951.
 Documentation: Waterbolk & van Andel: fig. 35, nrs 1 and 2.
 Date: probably Iron Age.
 Location: c. 600 meters east of the Studentenpad.
 Description: alongside the edges of a high coversand hill, the upper part of which has been cut off, lens-shaped deposits of wind-blown sand are situated, whereas on top of them a podzol has developed. At certain places the latter is overlain by younger deposits of wind-blown sand.
 Archaeological associations: the pyremound group of Holtinge.
 See also Havelte (above nr. 7) at a distance of 600 meters to the west.
21. *Veele* (parish of Vlagtwedde), sheet 13A.
 Waterbolk, pers. comm.
 Documentation: none.
 Date: Late Bronze Age, Iron Age or Roman period.
 Location: unknown.
 Description: double podzol.
 Archaeological associations: Van der Waals has found three Harpstedt-urns near Uitwedsmee, northeast of Onstwedde (van der Waals, 1972-1973: nr. 34).
22. *Vries* (parish of Vries), sheet 12B.
 Van Es, 1958; Waterbolk, 1977.
 Documentation: none.
 Date: none.
 Location: inside the recreation park Wedderbergen.
 Description: double podzol.
 Archaeological associations: the urnfield near Wedderveen (van Giffen & Waterbolk, 1944-1948). A Celtic field occurs in the vicinity (Brongers, 1976).
23. *Wedde* (parish of Bellingerwedde), sheet 13A.
 E.A. Koster, pers. comm.
 Documentation: none.
 Date: none.
 Location: inside the recreation park Wedderbergen.
 Description: double podzol.
 Archaeological associations: the urnfield near Wedderveen (van Giffen & Waterbolk, 1944-1948). A Celtic field occurs in the vicinity (Brongers, 1976).
24. *Wijster-Looveen* (parish of Beilen), sheet 17B.
 Van Es, 1965.
 Documentation: laquer peels at the B.A.I., fig. 8 (this publ.).
 Date: a) Late Bronze Age to Middle Iron Age; b) Early Middle Ages
 Location: north of the Noorder-Es of the village of Wijster.
 Description: phenomena associated with wind erosion have been encountered during the excavation of the settlement Wijster-Looveen (van Es, 1965).
 a) In the northern part of the excavation a deflation basin was present. In profile C and F (van Es, 1965: fig. 5) we see the following sequence: on the Pleistocene coversand we find a well developed podsol which subsequently was covered by sand-drift. On this sand a second podsol developed in which traces of human habitation were found, dating to the 2th-4th century A.D.
 b) After the abandonment of this part of the settlement, the area was kept under cultivation, most probably during the 5th-6th century A.D. These fields were again overlain by sand-drift. On this sand we find a third podsol. In this podsol reclamation trenches for the Early Medieval es were dug.
 Archaeological associations: Brongers has found remnants of a Celtic field closeby (Brongers, 1976).
 The site of Wijster-Emelange (see below) occurs at a distance of 700 meters to the east.
25. *Wijster-Emelange* (parish of Beilen), sheet 17B.
 Van Giffen, 1954; Waterbolk, 1957; Van Es, 1965.
 Documentation: laquer peels at the B.A.I.; Van Giffen, 1954: plate VI and VII, fig. 9 (this publ.).
 Date: a) Late Bronze Age; b) Late Bronze Age or Roman period; c) Late Bronze Age, Early or Middle Iron Age/18th and 19th century.
 Location: along the canal north of the Emelange.
 Description: rather large area in which various locations exhibiting the effects of wind erosion can be mentioned.
 a) Double podsol profiles were present under pyremounds number 1, 4 and 6 on the Emelange, excavated by Van Giffen in 1953. Under pyremound nr. 1, a weakly developed double podsol was found (van Giffen, 1954: fig. VII:D and E). Mound 4 was situated on cultivated land underlying wind-blown sand (van Giffen, 1954: pl. VII, A and B). This wind-blown sand layer overlies a well-developed podsol on coversand. Mound 6 was situated on a layer of wind-blown sand in which a plow zone could be seen. This layer overlies a well-developed podsol on coversand (van Giffen, 1954: fig. VI). The wind-blown sand under these pyremounds could be dated by the presence of long rectangular features belonging to the Middle Iron Age, which transect the cultivated land on top of the wind-blown sand (in the case of mound 4). These rectangular features have also been en-

countered in Looveen, during the excavation of the cemetery there (van Giffen, 1927). On the basis of radiocarbon dates the pyremounds erected on the sand-drift must be attributed to the Late Iron Age. On the pyremounds a second podsol profile developed, which was covered during the 18th or 19th century by a thin layer of sand-drift. Van Zeist has demonstrated that the layer of wind-blown sand on top of the bottom heather podsol was deposited most probably during the Late Bronze Age (Waterbolk, 1957).

b) Further to the west a double podsol was discovered in a sand extraction pit. This podsol could not be dated (van Giffen, 1954: pl. VII, C).

c) Under a sunken hut, found during sand extraction activities, a podsol profile was discovered. This podsol developed on wind-blown sand which overlay a thin layer of peat. The sand could not be dated directly. Some pieces of glass, found in the sunken hut, could be dated to 350-420 A.D. (van Es, 1965). Over the sunken hut a podsol developed; it is covered by a recent sand dune.

Archaeological associations: during land reclamation activities in the vicinity a cemetery with remains from the Middle and Late Bronze Age and Early Iron Age has been discovered (Kooi, 1982).

The site of Wijster-Looveen (see above) is located in close vicinity.

APPENDIX B: Inventory of flint sickles in Westergo (information kindly provided by Mr. G. Elzinga).

Municipality of Littenseradeel				
1	Baard	Fries Museum	inv.nr.	FM 1974 IX 5
2	Baard	Private coll.		
3	Oosterend	Fries Museum	inv.nr.	FM 63-10
4-6	Spannum	Fries Museum	inv.nr.	65-60, 61, 62
Municipality of Menaldumadeel				
7	Boxum	Fries Museum	inv.nr.	1984 III 10
Municipality of Wonseradeel				
8-11	Hartwerd	Fries Museum	inv.nr.	82d-1, 2 3, 4
12-14	Hartwerd	Fries Museum	inv.nr.	82d-13, 14, 15
15	Hartwerd	Fries Museum	inv.nr.	1977 XI 26
16	Hartwerd	Fries Museum	inv.nr.	1980 XI 1
17	Hartwerd	Private coll.		
18	Makkum	Fries Museum	inv.nr.	1976 XI 12
19	Pingjum	Fries Museum	inv.nr.	1960 X 53
20	Witmarssum	Fries Museum	inv.nr.	81-4
21	Witmarssum	Fries Museum	inv.nr.	v.G. 1539