

# Neolithic Settlement and Subsistence in the Wetlands of the Rhine/Meuse Delta of the Netherlands

*Leendert P. Louwe Kooijmans*

Settlement sites of the earliest inhabitants of the extensive marshes along the estuaries of the Rhine and Meuse are scarce. In spite of a dense modern population, intensive prospection, and many large scale commercial digging operations, only a few sites have been discovered, and these almost entirely in the last thirty years. Well-excavated sites, as opposed to small groups of pottery sherds and flint artefacts which provide only very limited information, number less than ten. Fortunately, because of the excellent conditions for preservation of organic material and the protection against later disturbance by layers of young deposits, these few sites are very informative. As a result, although it is not possible to make detailed studies of spatial distribution patterns on a regional level, the lack of sites is compensated for by a few spectacular results. This allows us to gain some insight into former settlement systems and organization of Neolithic communities in the extreme wetland conditions.

In this contribution I have chosen to restrict myself first to the estuarine and peat zones of the delta, and secondly to two phases for which detailed knowledge has recently been acquired. First, the phase of the initial Neolithic in the delta, c.3300 bc (4000 BC) with Hazendonk, Swifterbant, and Bergschenhoek as key sites, and secondly the phase of the Vlaardingen Group, about one thousand years later (2700–2100 bc/3200–2600 BC) with Hazendonk (again), Hekelingen III, and Vlaardingen as key sites. We have to start, however, with some general remarks on the peculiarities of the conditions in the delta area.

## The Landscape

We use the expression 'Rhine/Meuse Delta' as shorthand for the extensive complex of marine, estuarine, organic, lacustrine, fluvial, and even aeolian deposits which form a large and irregular triangle with its apex in the environs of Nijmegen and its base along the coastline between Zeeland Flanders and the

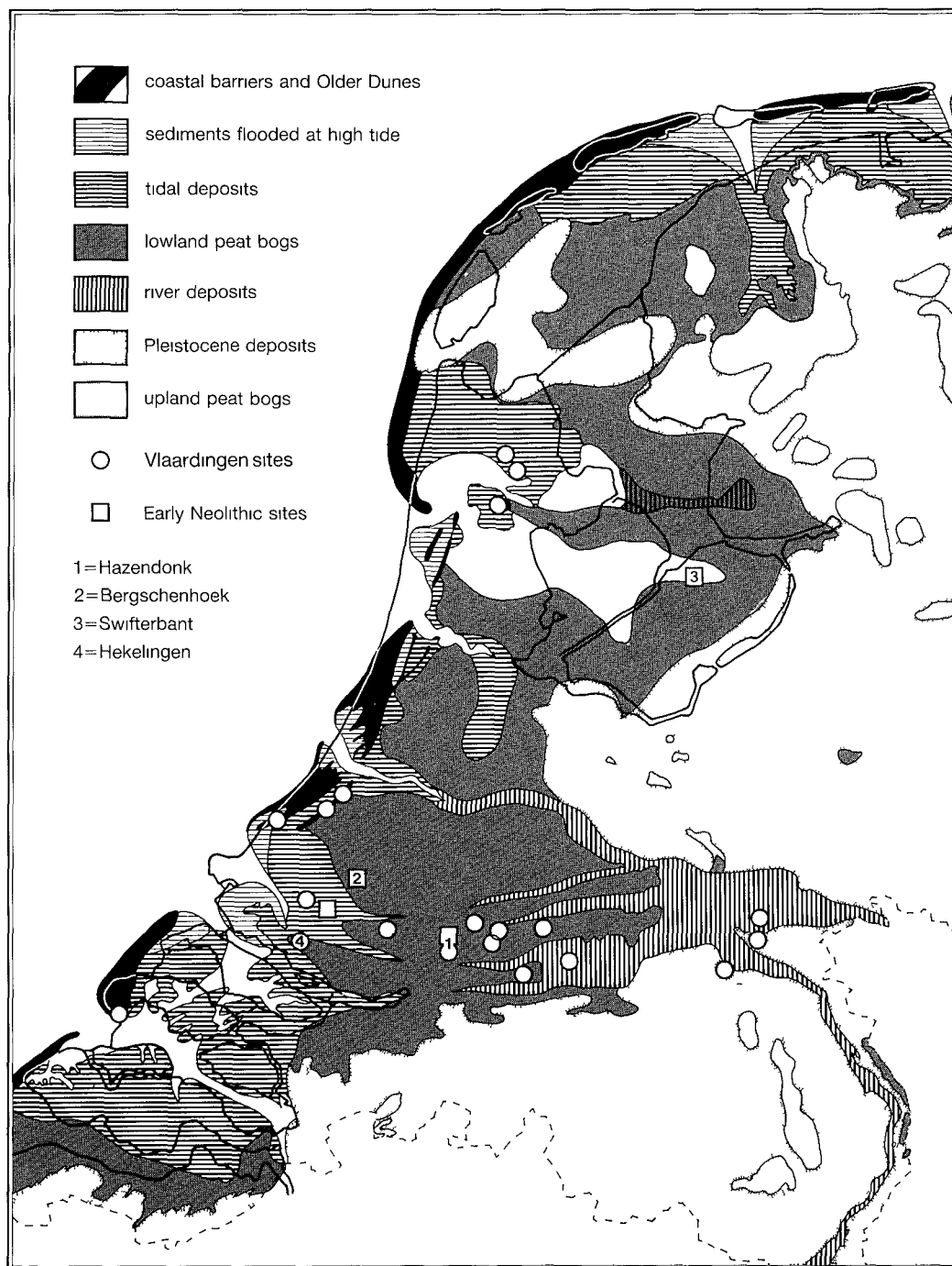


FIG 139 Palaeo-geographic reconstruction of the western Netherlands during the Calais IV transgression phase, *c.* 2400 bc, with the location of the Vlaardingen settlements and sites from an earlier occupation phase, *c.* 3300 bc

Isle of Texel. This triangle, with sides of *c.* 180 km, consists of two sedimentary basins, separated by the Saalian ice-pushed ridges of the Central Netherlands. Until the eleventh century AD, when large-scale embankment and artificial drainage began, this was one extensive, much differentiated wetland. During the last thousand years this has gradually been changed into the fully artificial landscape of today in which only a few nature reserves give a faint impression of the former inland living conditions. Large parts of the coastal and tidal environments are still in their natural state. In the past there has been a constant change in the landscape pattern which is documented in the sequence of sediments deposited on top of each other as a result of the rising sea-level. In fact, the delta is one enormous stratigraphic complex of natural Holocene deposits in which prehistoric sites and relics are embedded. Large-scale geological mapping has made the reconstruction of the pre-embankment palaeogeography in its various stages possible, in spite of the destruction of large areas by natural forces through the millennia, and by human interference in the last few centuries (Fig. 140) (Zagwijn 1975; Oele *et al.*, 1979).

The original delta appears to have consisted of five major environmental zones. These are, from the coastline moving inland:

1. A belt of coastal barriers, covered by low dunes and broken by wide tidal inlets.
2. Tidal flats, bordered to the east by salt-marshes.
3. A zone with estuarine creek systems, extending from these salt-marshes into the peatbogs behind.
4. Extensive peatbogs, with eutrophic brushwood and reed-bordered lakes along the river courses and creeks, and with oligotrophic *Sphagnum* bogs in the central parts.
5. A region of fluviatile mineral deposits in the eastern part, forming the 'apex' of the triangle.

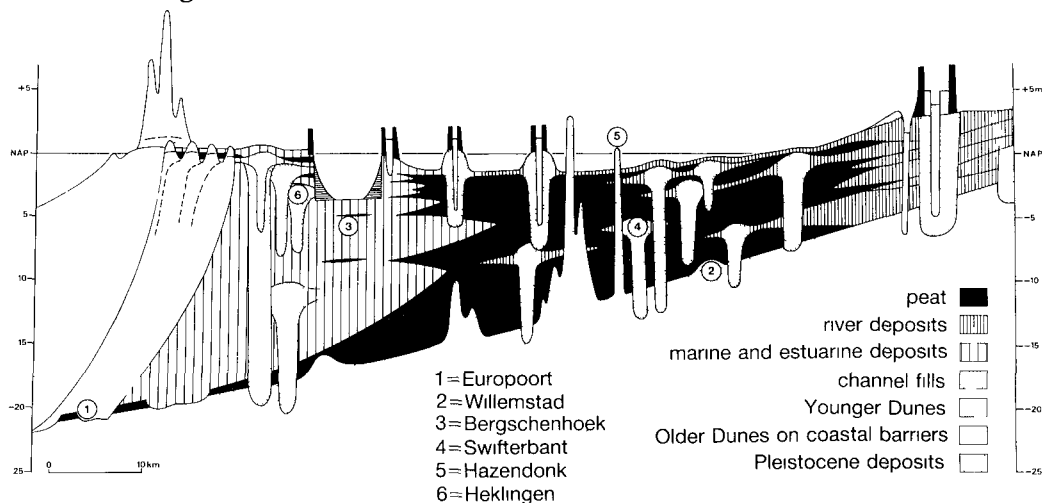


FIG. 140. Schematic West-East section through the Rhine-Meuse delta showing the main sedimentary environments and the stratigraphic position of the sites discussed in the text.

The main changes in the landscape pattern, that is the varying extent of these five major zones, form a sequence of about eight cycles of transgression-deposition-regression, related to the gradually diminishing rate of sea-level rise. A major change in the landscape development took place during the Neolithic, around 3000 bc, when the gradual landward shift of the narrow and discontinuous row of coastal barriers came to an end and was followed by a period of coastal barrier aggradation. The wide and firm coastal barrier belt restricted the incursion of sea water into the intracoastal zone. This zone consequently changed from a landscape of continuous tidal flats and salt-marshes bordered by a relatively narrow peat zone, into one of predominantly peatbogs, with estuarine creek systems around the inlets where the rivers discharged into the sea.

There are only modest traces of occupation from the period before 3300 bc: more than 400 Mesolithic bone and antler implements (almost exclusively barbed points) have been dredged from Europoort, probably from *c.*22 m below sea-level (Fig. 141). They date from the Boreal period (Louwe Kooijmans 1970/1); an unusual wooden statuette was found during the construction of a lock near Willemstad at  $-8.0$  m and dated to *c.*4450 bc (Van Es and Casparie 1968). Mesolithic fire places and a few microliths have been discovered on the top of old river dunes near Swifterbant, Ridderkerk, and Leerdam (Deckers, De Roever, and Van der Waals 1980; *Aut. div.* 1976–9, nos. 4 and 5; Louwe Kooijmans 1974, 15; Van Trierum and Henkes 1986).

Only a few sites from the Early Delta Neolithic (*c.*3300 bc) have been

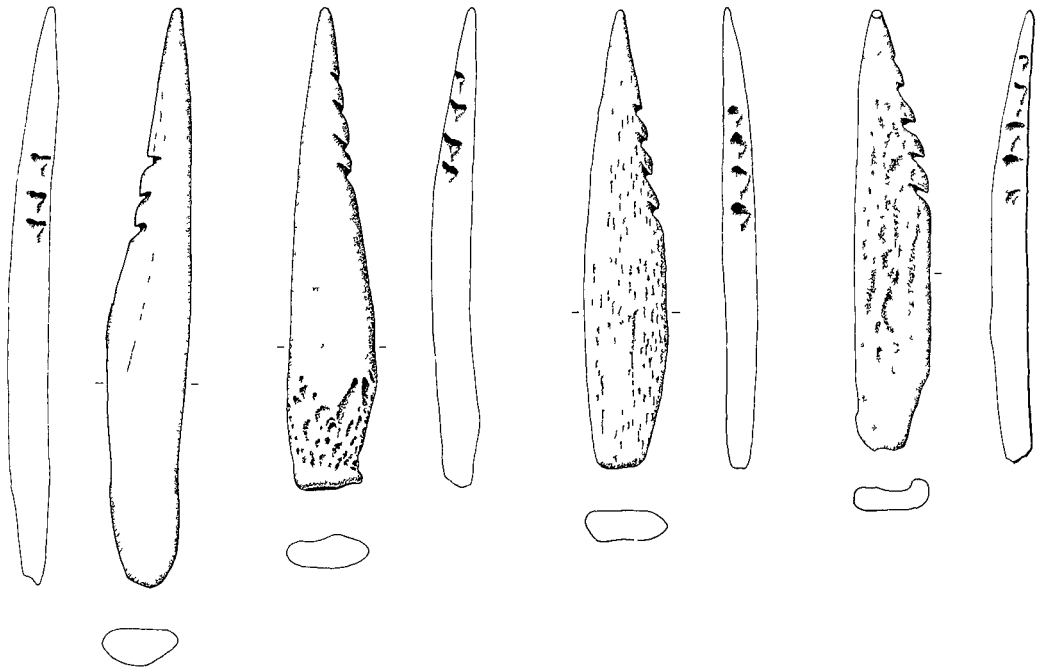


FIG. 141. Europoort. A selection of Mesolithic barbed points.

discovered. These are all situated in the peat zone, but this is not surprising in view of the landscape changes occurring in this period. This pattern changed, however, by the period of the Vlaardingen Group when settlement sites are known in all five landscape zones. Those on the coastal barriers and on the saltmarshes were fully agrarian, and a similar economy probably existed in the river district. However, the conditions along the estuarine and freshwater tidal creeks, and in the peatbogs, must have been so restrictive to animal husbandry and crop farming that the functions and activities within the recovered sites are difficult to perceive.

## Hazendonk

A small outcropping river dune situated in the central part of the southern sedimentation basin, the so-called *Hazendonk*, is of great value to the study of the Neolithic in the delta district, since it offers a firm chronological sequence to which all other sites can be linked. The first traces of prehistoric occupation were discovered in 1963. A small test excavation took place in 1967 and a large-scale programme was carried out between 1974 and 1976 (Louwe Kooijmans 1974; 1976).

The top of the dune appears to have been used as a settlement site during the greater part of the Neolithic, that is between 3300 and 1700 bc. In most cases this type of location was not covered by later deposits until comparatively recently. Thus, all former settlement structures have been lost because of erosion, and animal and root activity. Fortunately, as a result of the small dimensions of this particular *donk*, dump areas and former living areas extended downslope into the surrounding sedimentation zone. In this position surfaces and refuse concentrations are well preserved both in and between the Holocene deposits that cover the slope of the dune. These deposits were laid down as a result of the gradually rising ground water-table, which was itself related to the general rise in sea-level. As a result of this change of water-table the outcrop was reduced in area from 250 m by 50 m to 100 m by 40 m during the period of use. The stratigraphy shows a discontinuous use of the site. Seven main periods of occupation, of varying archaeological character, extent, and duration, may be identified, some of them comprising more than one activity area and having several sub-phases. The main outline of this sequence is illustrated in Fig. 142.

Information for each phase was obtained about material culture (pottery, flint, bone working etc.) and food economy (pollen analysis, charred and uncharred seeds, fish, mammal and bird bones). A palaeogeographic study by Van der Woude (1984) has examined the economic changes in relation to the severe environmental changes resulting from the repeated variations between undifferentiated peatbogs, extensive lakes with clay deposition and creek systems (Fig. 143). The pollen diagrams (Fig. 142; Van der Wiel 1982) show that

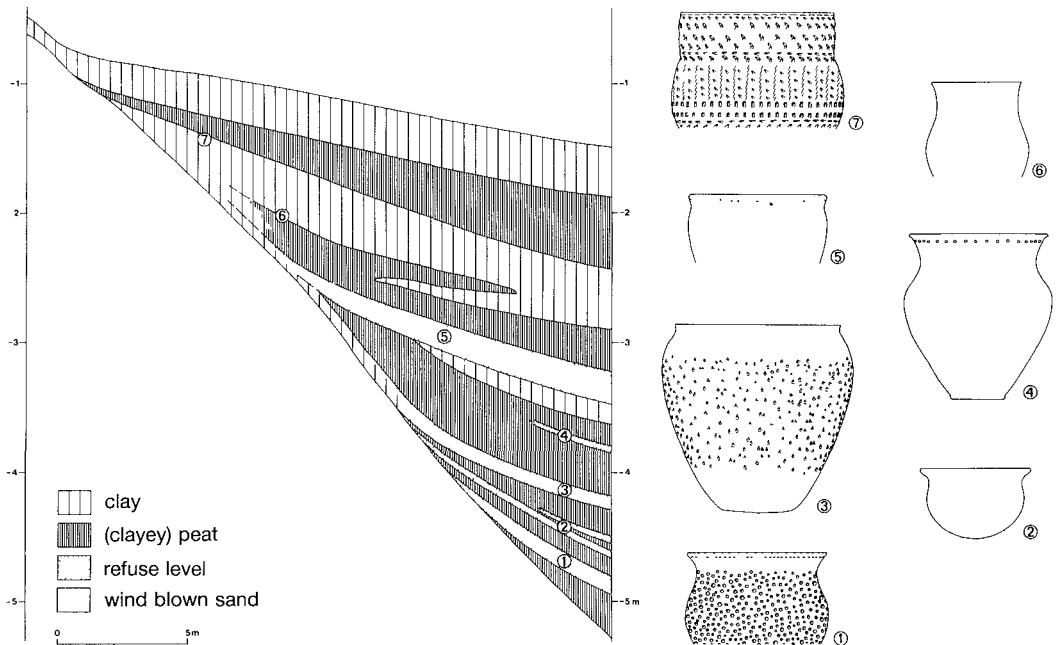
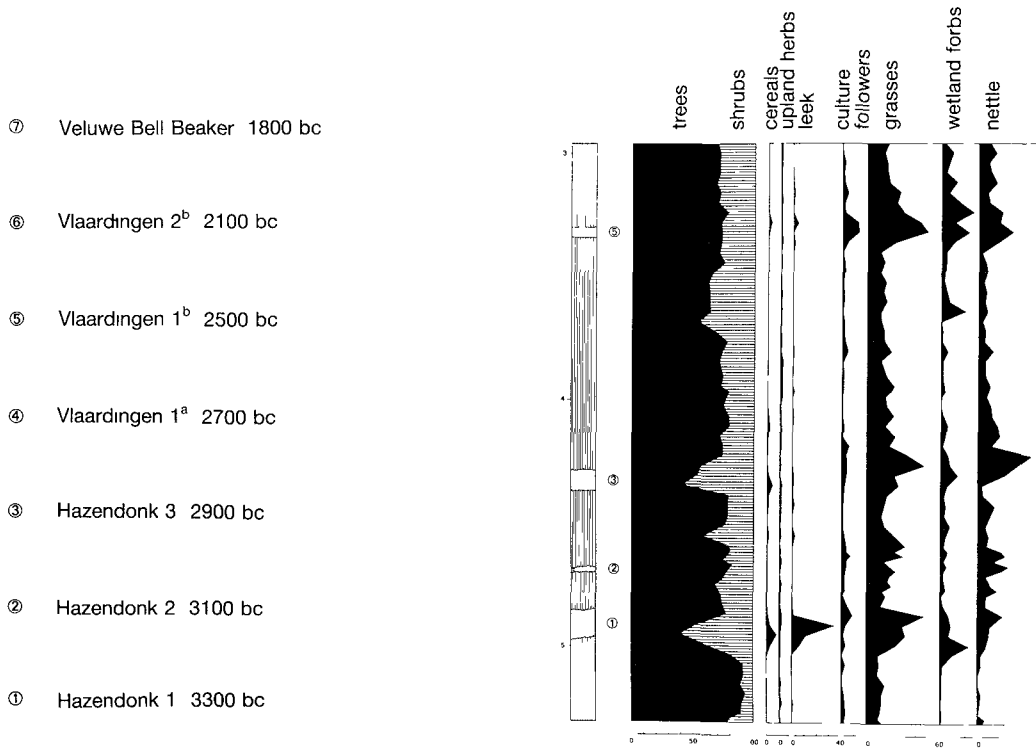


FIG. 142. Hazendonk. An idealized section of the Neolithic stratigraphy, mean radiocarbon age (bc), and characteristic vessels from each level; diagram of selected pollen curves for phases 1–5. In phase 5 vegetation along the margins was affected by the occupants although not as much on the sand outcrop itself.

the phases of occupation were also phases of deforestation, and were separated by periods of partial forest recovery. Cereal pollen is present in the pollen diagram during the occupation phases, and charred cereal grains were collected by wet sieving from most cultural layers. This is particularly noticeable in the first phase (Hazendonk-1) from which large amounts, not only of cereal grains, but also of chaff and internodes, were preserved in a dump area at the dune-peat transition (Bakels 1981). No detailed archaeo-zoological data are available at present, but various domestic animals (cattle, pig, dog) were present in various phases. Although geological mapping (Van der Woude 1984) revealed one or two similar small dunes near the Hazendonk it can confidently stated that the site was unsuited for a fully agrarian way of life due to its dimensions and wet environment. Even a 'semi-agrarian' subsistence economy hardly seems possible. Stock raising and cereal growing can only have been of restricted importance to the basic economy. Consequently, the main function of the Hazendonk in all periods is seen as a safe (high and dry) base for a broad spectrum of activities. The relative importance of these will have varied according to the resources available in the ever changing environment.

It would be interesting to use the area covered by domestic refuse at the



Hazendonk to estimate the site population in each phase. There are, however, severe restrictions to such calculations. First, the total area used in any phase is hard to assess with accuracy. We have based our estimates on the extent of domestic refuse as recorded in trenches and test pits, and as revealed by additional borings. Second, these surfaces were not necessarily totally used during any particular occupation phase, but could have been considerably larger than the site dimensions at any one moment, if the activity area shifted in the course of time. That this might very well be the case is suggested by the fact that the well-preserved margins of the occupation areas seem to have the character of a series of separate refuse dumps of rather restricted duration. Third, we do not know of any relationship between settlement area and the number of occupants in comparable economic and geographic situations. However, to overcome these problems to some extent we can use a comparison of actual site dimensions. For instance, the surface used during Hazendonk-1 covered at least 1200 m<sup>2</sup>, and at the most 3000 m<sup>2</sup>. This is larger than the major sites of the same age at Swifterbant (300–1200 m<sup>2</sup>, see below) and similar to those of the base camps of the Late Mesolithic De Leien-Wartena complex (1800–2600 m<sup>2</sup>; Newell 1980). For Swifterbant S3 and Bergumermeer, a micro-

band comprised of a few households (20–50 persons) is suggested by the presence (at Bergumermeer) of five or six hut sites. The dimensions of occupation areas in later phases (Hazendonk-3, Vlaardingen-1<sup>b</sup> and -2<sup>a</sup>) at the Hazendonk are considerably larger. In view of the presumed subsistence economy we are more inclined to explain this as the shift of refuse dump areas, a longer duration of use, or more permanent settlement, rather than by an increase in group size.

No human interference with the vegetation is apparent in the pollen diagram before the Hazendonk-1 phase. In view of the apparent attractiveness of the site to semi-agrarian groups in later times, one can speculate that this type of economy was introduced in the area around 3300 bc, but that in earlier times the region was either unoccupied, or inhabited by hunter-fisher-gatherer groups with preferences for different site locations. This hypothesis accords with the Neolithic data so far obtained from the area of sands bordering the Meuse in the southern Netherlands. Here Michelsberg sites represent the earliest Neolithic, with Rössen sites only attested at one or two places south of Venlo. However, we must be cautious of conclusions based on a restricted number of

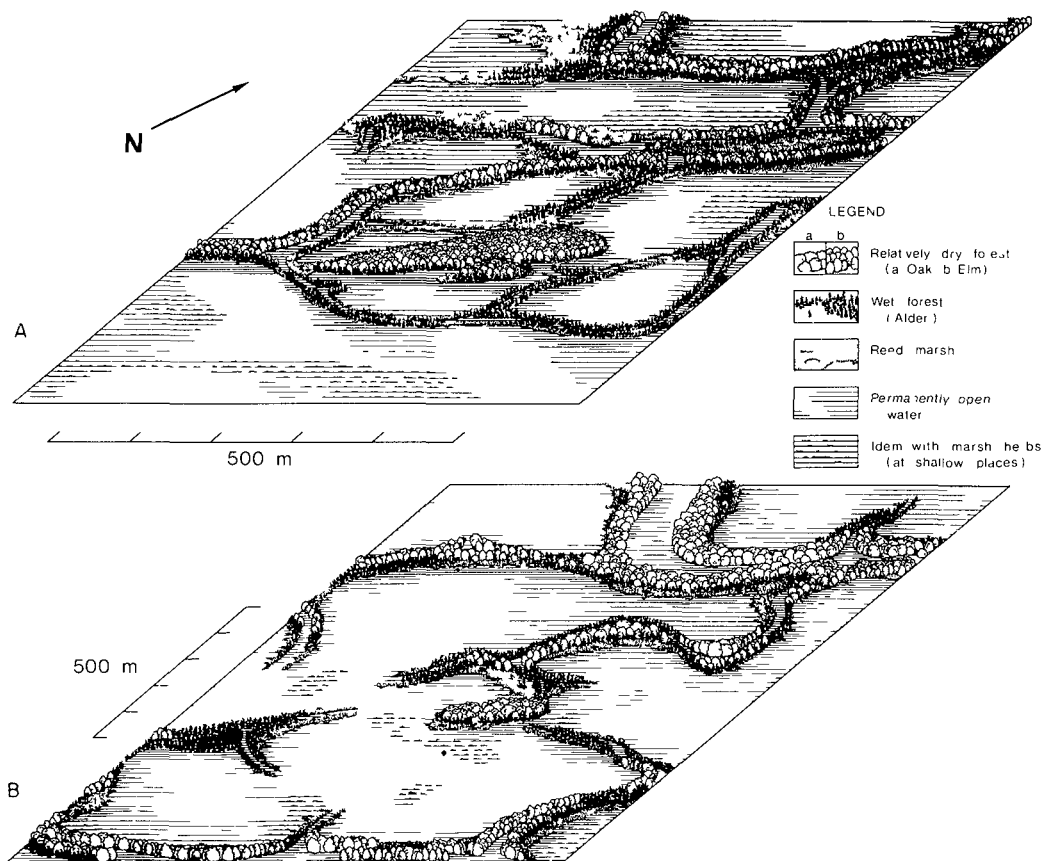


FIG. 143. Hazendonk. Landscape reconstruction: (A) c.4300 bc, (B) c.2000 bc. Wet phases like these are separated by periods of general brushwood cover and peat formation.

observations and in the future must not exclude surprises, such as those of the last twenty years presented here.

## Swifterbant

The Hazendonk excavations provided us with comparatively little information about the actual structure of the earliest Neolithic settlement on the site. Sites which do provide such information are restricted to the isolated small camp site of Bergschenhoek and the settlement cluster near Swifterbant in the northern sedimentation basin. Sites similar to those near Swifterbant can also be expected in the southern basin, but here they would lie beneath a thick cover of later deposits and consequently would be beyond normal archaeological reach. Sites might be predicted on covered Calais-II ridges in the peat district, but are as yet unrecorded.

The sites near Swifterbant were discovered in 1961 and in subsequent years some preliminary excavations were carried out. These were followed by a large-scale research programme carried out by the Biological-Archaeological Institute of Groningen University. A number of reports have been published (Aut. div. 1976-9; Clason and Brinkhuizen 1979; Deckers 1979; Deckers, De Roever, and Van der Waals 1980; Meiklejohn and Constandse-Westerman 1978; Van der Waals 1972; Van Zeist and Palfrenier-Vegter 1981).

The sites are situated on the tops of river dunes (Fig. 144), similar to the Hazendonk, and also on creek levees, the latter being more informative. The creeks form the eastern part of a more extensive system of freshwater tidal creeks which were formerly connected to an inlet in the coastal barrier far to the west, and active during the Calais-II phase (4500-3300 bc). The sites are dated by radiocarbon and stratigraphy to the end of the Calais-II sedimentation and the subsequent Calais-II/III regressive interval. Older sites are currently unknown. The sedimentary environment was very stable during the period of occupation. The mean tidal range was not more than 20 cm and the levees would only rarely have been flooded. The natural vegetation of these narrow levees consisted of a strip of varied forest with some oak, ash, elm, lime, wild apple, and alder, together with hazel, hawthorn, and dogwood. A wider belt of alder carr separated this woodland from the willow marshes and open water in the backswamps. Two sites were discovered on the bank of a major creek, while six others cluster around a confluence of minor creeks. All the sites are of modest dimensions (*c.*300-1200 m<sup>2</sup>), but there is sufficient variation in size, situation, and age to suggest strongly that they would not have been exactly similar in function or duration. S3—the major excavated site—might, however, be considered as representative. This site covered 800 m<sup>2</sup>. Radiocarbon dates point to a period of use of less than one hundred years. During this period the surface was artificially raised by bundles of reeds and twigs and by

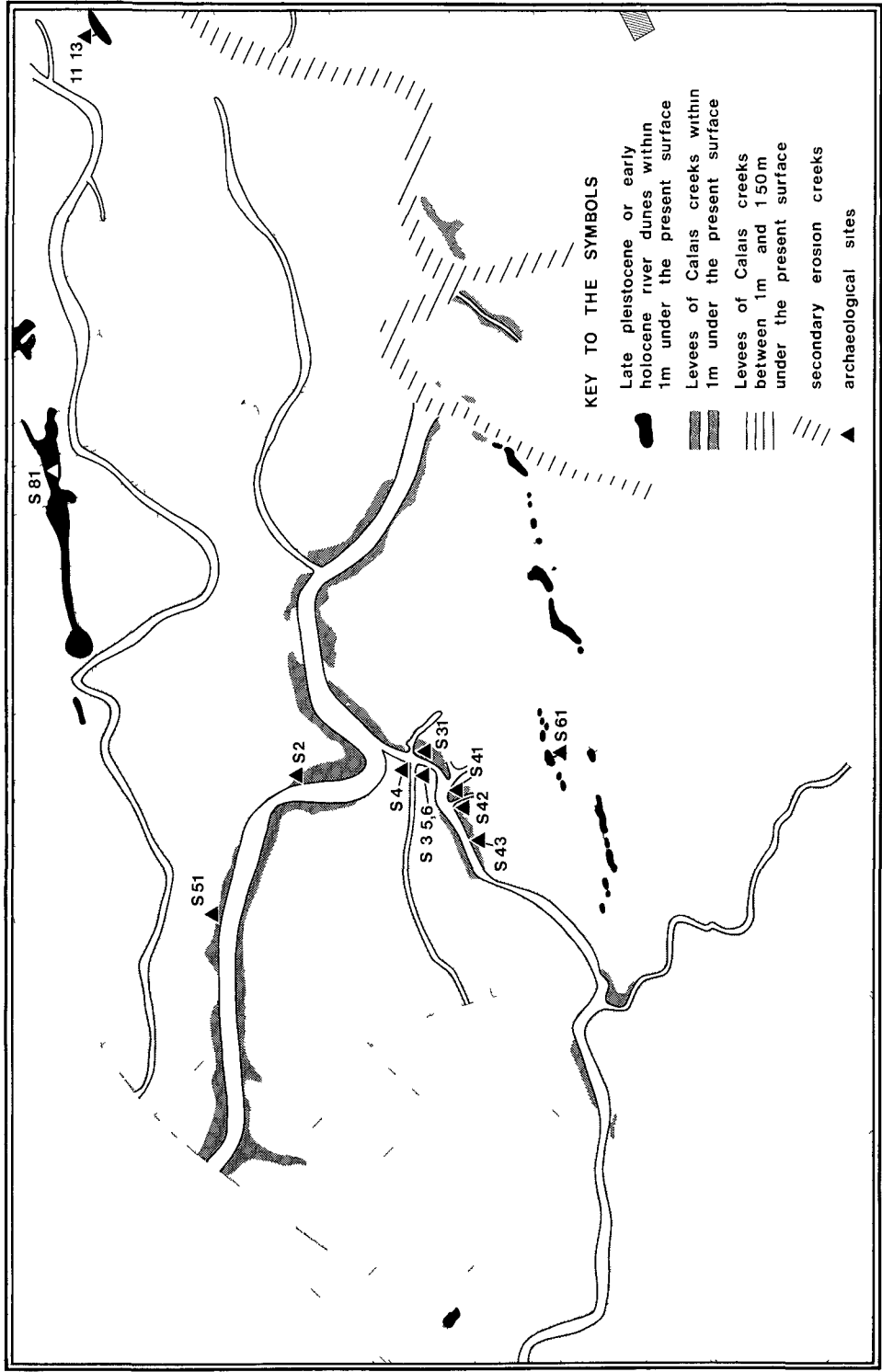


FIG 144 River dunes and sediments of a freshwater creek system near Swifterbant, both with Early Neolithic settlement sites (triangles)

sedimentation, which resulted in a 'culture layer' 75 cm thick. In S3, the 750 (mostly) thin posts and stakes recovered do not reflect heavy structures, but are more probably the remains of (round) huts that were repeatedly reconstructed. A series of repeatedly renewed lenticular clay hearths reflect a certain degree of fixed internal layout over the period of site use. Overall, the sites are more Mesolithic than Neolithic in their appearance.

The economy of the inhabitants of S3 was semi-agrarian. Cattle and pigs were raised and slaughtered at the site. The normal series of wild animals were hunted: red deer, elk, aurochs, brown bear, otter, beaver, and polecat. Horse is also represented in the animal remains. Water-birds such as cormorant, mute swan, mallard, crane, and white-tailed eagle were taken. In the fish remains, not only are the fishes still common to this ecological zone represented, but also other species such as sturgeon, salmon, grey mullet, and the large catfish which is now almost extinct. The botanical part of the diet consisted of wild apples, blackberries, hawthorn fruits, rose hips, hazel-nuts, and doubtless many other plants that leave no direct traces in the archaeological record, such as tubers and leafy vegetables. Charred grains, predominantly of Naked Barley but also some of Emmer Wheat, together with chaff and ear spil internodes are considered to be proof of crop farming on the site. Of great importance to the functional interpretation of the sites is the presence of human skeletal remains, both intermixed with the domestic refuse and, on some other sites, in true cemeteries. It appears that men and women are represented equally and that some children were also buried. Apparently, complete households lived here but no special activity groups. The number of inhabitants of S3 is estimated at between four and ten households, or twenty to fifty individuals. This estimate is based mainly on the number of huts that might have been present on the site simultaneously, and on comparison with Mesolithic data (Newell 1980).

The next major question is whether the sites (or at least S3) were occupied all the year round or only during the summer. The fish species and the collected fruits both provide secure evidence for long summer stays lasting through into autumn, or at least a frequent reuse of the sites in this season. A still better argument results from the evidence for cultivation on the site, but the new evidence obtained at Hekelingen (see below) in a very similar situation stresses caution over the interpretation of the cereal remains, because cereals in the ear could have been brought to the site. The artificial cover of the settlement site with plants in order to raise the living surface is, moreover, an indication that the creek levees were not very suitable for crop farming. Indications of winter occupation are hard to obtain, but the absence of migratory arctic-breeding birds may be significant.

The main dry-land connections with the Swifterbant area are in the west, where the creek levees would have been slightly higher and were connected to the intracoastal saltmarsh zone. We may assume that the winter settlements were here, or at least the route to the winter settlements passed along

these corridors. However, until now such settlement sites were unknown.

Culturally the sites are characterized by pottery of Late Ertebølle affinities, a modest flint tool kit based on blades that can be considered as local Late Mesolithic derivatives, and by perforated stone axes that must have been imported from Late Rössen contexts.

Taking everything into consideration a picture emerges of native Mesolithic groups adopting Neolithic elements such as pottery, perforated stone axes, crop cultivation, and animal husbandry, but retaining other aspects of their cultural system. Because of the lack of sites, it is not known when this process started but it must have been somewhere between 4000 and 3300 bc, perhaps only shortly before the Swifterbant levee sites were founded. It is interesting to see here, in contrast with Denmark, agrarian elements in combination with pointed-base Ertebølle-related pottery around 3300 bc.

## Bergschenhoek

In 1976 a very small site (Fig. 145) was found near the village of *Bergschenhoek*, north of Rotterdam, 8 m below sea-level. It was excavated in 1978 and appeared to be a short-term fowling and fishing camp site, principally in use in the winter season by Neolithic people, c.3450 bc. The great depth at which the site was found can be explained by a later compaction of about 2 m of the soft sediments.

The site was situated in a landscape of freshwater lakes with reed belts along their margins. This landscape represents an interruption of the generally brackish or salt environment at the end of the Calais-II transgressive phase, and explains the remarkable situation of the site so far to the west in the intracoastal area. Central to the site was a living platform only 3 m by 4 m located on a raft of peat. This raft was initially floating, but gradually became caught in a clay deposit and eventually became covered by it. Implements and refuse were found in the clay around this platform.

An extraordinary microstratigraphy could be observed on the island and in the surrounding deposits:

1. A sequence of thin clay beds alternating with levels of plant remains, mainly reed, could be made out in the clay around the raft of peat. We consider that this sequence reflects a seasonal sedimentation in which the plant remains were laid down during winter and the clay beds in spring and summer. At least six years could be counted, but deposition must, in fact, have lasted longer, especially as the individual years were difficult to trace in the upper part of the sequence because of the slow sedimentation rate. Artefacts were predominantly found in the reed levels.

2. The living surface on the peat raft was repeatedly reinforced and raised with bundles of reed, a number of irregular boards, and small trees which were

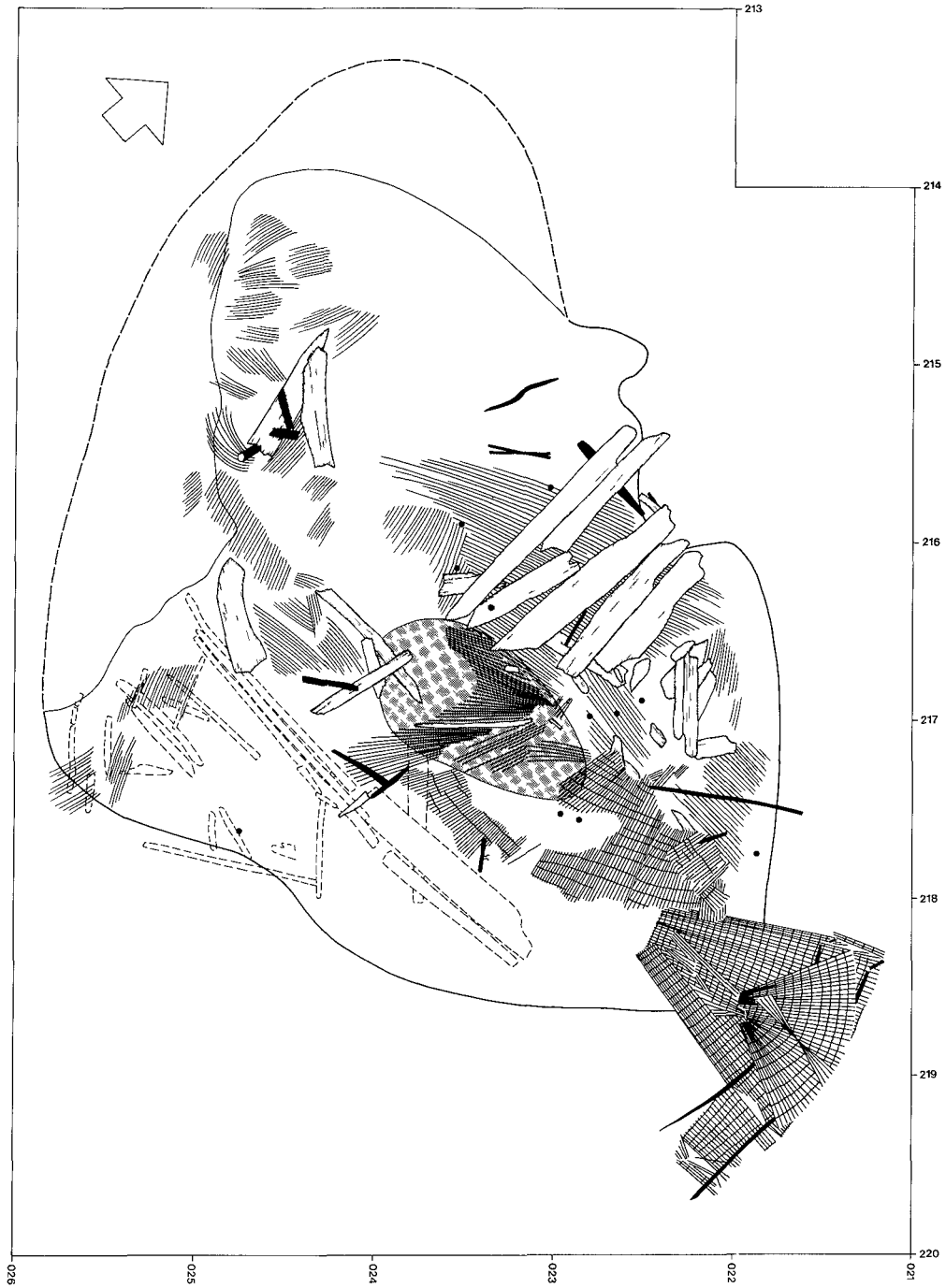


FIG. 145. Bergschenhoek. Map of the third phase (out of four) of the living platform. Covered wood of earlier phase indicated with broken lines. Black dots are artefacts. Grid in metres.

laid in two directions at right angles to each other. The boards are considered to be the remains of a dug-out canoe.

3. A fireplace was situated in the centre of the site. Eleven phases of construction and reuse could be distinguished in a fine sequence of peat mud, reed, and charcoal layers. The first fire was made when the island was still floating, but the major part of the sequence is contemporaneous with the second, slower part of clay sedimentation. Overall it can be concluded that the site was occupied intermittently, on a short-term basis, over a period of about ten years.

The implements and zoological and botanical remains can be combined to reveal the cultural affinities of the people, the activities carried out on the site and the season of use. A polished stone axe fragment and some large sherds reveal the Neolithic character of the people that used the site and their close cultural affinities to Hazendonk-1 and, in a wider sense, to the Bischheim-early Michelsberg tradition. This attribution agrees well with the radiocarbon dates. On the other hand, some bone and other tools are less culturally diagnostic.

We can list the following activities which were carried out on the site.

1. Fishing for large species such as catfish, and small species like eel, perch, and various carp, roach, bream, and tench (Clason and Brinkhuizen 1979). With the exception of the catfish, these are all species that are still abundant in Dutch lakes. Fish remains were beautifully preserved, as were three impressive fish traps made of long twigs of red dogwood (Fig. 146). Cut-off root systems of this shrub prove that the traps were made on the site.

2. Fowling. The list of species comprises present-day resident birds such as mallard, tufted duck, and bittern in combination with present-day winter guests that breed in the far north, like Bewick's swan, goosander, golden eye, and widgeon. The eider is also present; this species is rarely found in inland waters today and then only during severe winters.

3. Hunting of aquatic mammals, attested by remains of grey seal and otter. Hunting, fowling, and fishing equipment of wood includes long pointed arrows (used without any flint inserts or points) and double-pointed, hooked sticks made from the natural angle between a branch and side branch. They are probably part of leisters or eel-spears similar to those known from Late Mesolithic and Early Neolithic sites in Denmark and north Germany (Meurers-Balke 1981; 1983).

4. Collecting of fruit and nuts, attested by charred remains of apple, hazelnuts, and blackthorn kernels.

We must interpret this site at Bergschenhoek as an extraction camp, subsidiary to (semi-)permanent settlements like those near Swifterbant and on the Hazendonk, that is, of semi-agrarian communities of the earliest Neolithic known in the delta district.

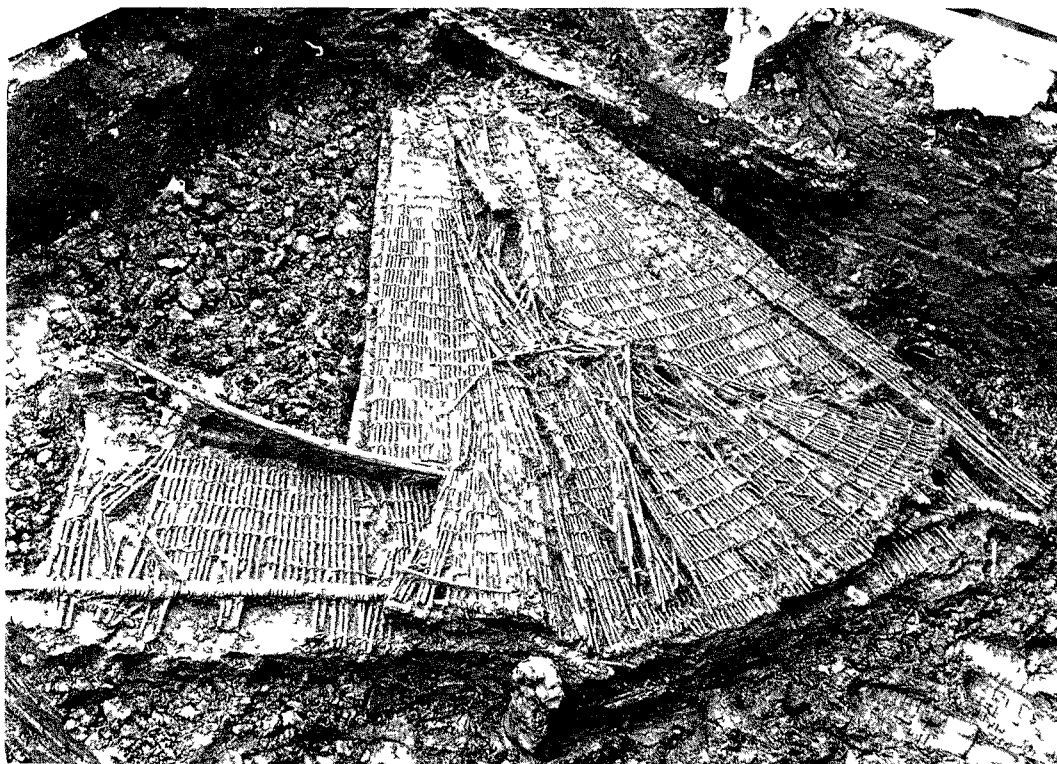


FIG 146 Bergschenhoek. The major fish trap Overall length 140 m.

According to the base camp/extraction camp concept, it follows that the distance between the two types of site must have been fairly considerable, more than two hours' canoeing distance, in order to justify the setting up of a separate camp with semi-permanent and therefore archaeologically visible structures. This being the case then, despite the dominance of the elaborate fish-traps and fish remains in the site assemblage, fishing can hardly have been the main activity at Bergschenhoek, since the type of fishing carried out there could have been accomplished everywhere in the delta, including close to any base camps. It is our opinion that fishing was only a subsidiary activity, and that the main purpose of the site was to take advantage of the dense concentration of water-fowl that would have assembled in this unique fresh-water lake environment situated so near to the coast. Only the bones of those few birds that were actually consumed at the site were found; most of the carcasses must have been taken to the main settlement where they no doubt provided a welcome supplement to the diet during the leaner months of the year.

Culturally Bergschenhoek is firmly linked to the Hazendonk (Hazendonk-1 phase) by typological and technological similarities in the pottery. The absence of settlement structures at the Hazendonk makes a direct comparison

impossible, but we can point out some striking similarities in this respect with the Swifterbant sites. On the levees at Swifterbant traces were found of a similar reed cover over the living surface and of fireplaces, in this case underlain by clay instead of peat mud, which had been renewed in a similar way.

The Early Neolithic settlement types now attested for the Rhine/Meuse delta have their counterparts in the Mesolithic of north-west Europe (Newell 1973; 1984; Price 1978). Base camps of varying duration could be identified, some being more extensive aggregation camps, and a large number of small extraction camps. Mesolithic sites of a very similar character and with similar structural remains are, moreover, known from Denmark and especially from north Germany, where small scale camps on floating islands have been carefully documented at Duvensee (Bokelmann 1971; 1981).

As a result of their modest remains and dimensions, extraction camps are easily overlooked and are, therefore, under-represented in the settlement record. In spite of the much better preservation conditions in the delta compared with the sand regions, the same must be the case in that region. We have no doubt that many hundreds, or even thousands, of sites similar to Bergschenhoek lie hidden in the Holocene clays.

## The Vlaardingen Group

A second phase for which there is abundant evidence is that of the Late Neolithic Vlaardingen Group. To what extent had food economy and settlement pattern changed in the 1000 years that had elapsed since Hazendonk-1/Swifterbant/Bergschenhoek times? In answering this question I will concentrate on the new evidence from the excavation of Hekelingen-III in 1980, but will first make some remarks on the Vlaardingen Group in general. The number of known Vlaardingen settlement sites now amounts to about twenty. They are spread over all inhabitable former landscapes of the delta: the coastal barriers (Haamstede, Loosduinen, Leidschendam, Voorschoten), salt-marsh ridges (Zandwerven), estuarine creek systems (Vlaardingen, Hekelingen I–IV), *donken* in the peat district (Ridderkerk, Hazendonk, Goudriaan, Schoonrewoerd, Waardhuizen, Bommelse Loo), and in the river-clay district (Ewijk) and the adjacent sands (Wijchen, Oss). The earliest Vlaardingen phase has only been attested at the Hazendonk and at Ridderkerk. All other sites are dated to the later (1<sup>b</sup>–2<sup>b</sup>) phases, 2500–2100 bc. Two sites in Westfrisia (Aartswoud, Kolhorn) (Van Iterson Scholten and De Vries-Metz 1981) are contemporary with the end phase of Vlaardingen, but have a distinct late Protruding Foot Beaker character.

In a recent article (Louwe Kooijmans 1983a) I pointed out that at least the material culture of the Vlaardingen Group has much in common with some assemblages found in the Limburg Meuse Valley. I named the latter 'Stein Group' and proposed to consider both as parts of a more extensive cultural

entity that could fill the void between the *Trichterbecher* (TRB) and the *Seine-Oise-Marne* (SOM) cultures, a culture of which the Hessian Wartberg Group is probably a more easterly component. In this way Vlaardingen is relieved of its isolated and purely local significance as far as material remains (pottery, flint, bone industry) are concerned. We must, however, consider the settlement pattern and food economy independently from this view and be aware, as ever, of specific environmental adaptations.

Some Vlaardingen sites are no more than accidentally collected find assemblages, but quite a number of sites have been excavated systematically. On the coastal barriers a normal Neolithic agrarian food economy has been attested, taking advantage of the good conditions for crop cultivation and animal husbandry on these wide sand ridges (Glasbergen, Groenman-van Waateringe, and Hardenburg-Mulder 1967). Small rectangular houses of sound construction were documented at Haamstede. A preliminary study of a bone sample at Ewijk (river-clay district) has demonstrated a similar reliance on domestic animals. Thus, in suitable environments, Vlaardingen people behaved in an orderly Neolithic way and had (probably permanent) agrarian settlements. In Zandwerven and the late Protruding Foot Beaker sites of Aartswoud and Kolhorn we find a combination of cattle raising with the collecting of shell fish. In all three regions there might have been subsidiary sites for special activities, such as the hunting of water-fowl or sea mammals, but these have not yet been found. In the estuarine sites of Vlaardingen and Hekelingen a local dominance of hunting over stock breeding is apparent. At Vlaardingen cereal pollen and cereal grains were presented as proof of crop cultivation, though the pollen evidence for cereals, as well as for woodland clearances, is very modest (Groenman-van Waateringe and Jansma 1969). Some plans of small rectangular houses were separated out from the posthole clusters, but in another occupation site no such plans could be made out. The major point in the functional interpretation of Vlaardingen and Hekelingen is whether both were (semi-)permanent settlements for complete households, or special activity sites of seasonal use. Moreover, although similar in many respects, there are rather important differences between these sites, and the interpretation of Hekelingen given below will not necessarily be true for Vlaardingen.

### Hekelingen III

The first traces of Neolithic occupation at Hekelingen were discovered in 1949 during a soil survey. Modderman excavated a part of the site in the following year (Modderman 1953). In 1970 a second site was discovered, and in 1980 a rescue campaign was started ahead of large-scale construction works during which the site of Hekelingen III was discovered and excavated. The site of Hekelingen I which is, in fact, just a continuation of the new site, was saved from destruction due to its status as a Scheduled Ancient Monument

(preliminary reports: Louwe Kooijmans 1983*b*; Louwe Kooijmans and Van de Velde 1980). The Vlaardingen sites of Hekelingen were situated to the south of the estuary of the Meuse and in the extreme west of the peat area, which was bordered to the south-west by extensive saltmarshes situated in the present province of Zeeland. The polder where the sites are found is, in fact, a small remnant of this old landscape, surrounded by younger deposits. The main feature of the remnant is a 3 km long section of a 50 m wide tidal creek, its gully fill, levees, high water clays, back swamps, and small side creeks (Fig. 147). In the 1980 excavation a 200 m stretch of the northern levee was recorded. It is a distinctive stretch, slightly higher, more sandy, and broken by a number of side creeks. The traces of occupation continue to the north-west into the protected site of Hekelingen I and are cut off in the south-east by later erosion and deposition. Apart from a small site, Hekelingen IV, no other Vlaardingen occupation traces could be made out in the preserved part of the old deposits. In the investigated section about fifteen separate concentrations of primary refuse were mapped as well as about ten dump areas with secondary refuse. Thanks to the subsequent sedimentation of levee deposits, four stages of occupation could be separated (Fig. 149). Three belong to the Vlaardingen Group, the fourth to the Bell Beaker/Barbed Wire Beaker period. The levee deposits can be correlated with three Calais-IV sub-stages (CIVa, a2 and b).

The detailed landscape mapping, pollen analysis, and molluscan studies confirmed that this was a freshwater tidal environment, with extensive backswamps filled with alder carr and brushwood peat. The narrow levees were covered with deciduous trees: oak and elm were restricted, while ash, maple, hazel, and others joined the ubiquitous alder. The tidal range must have been at

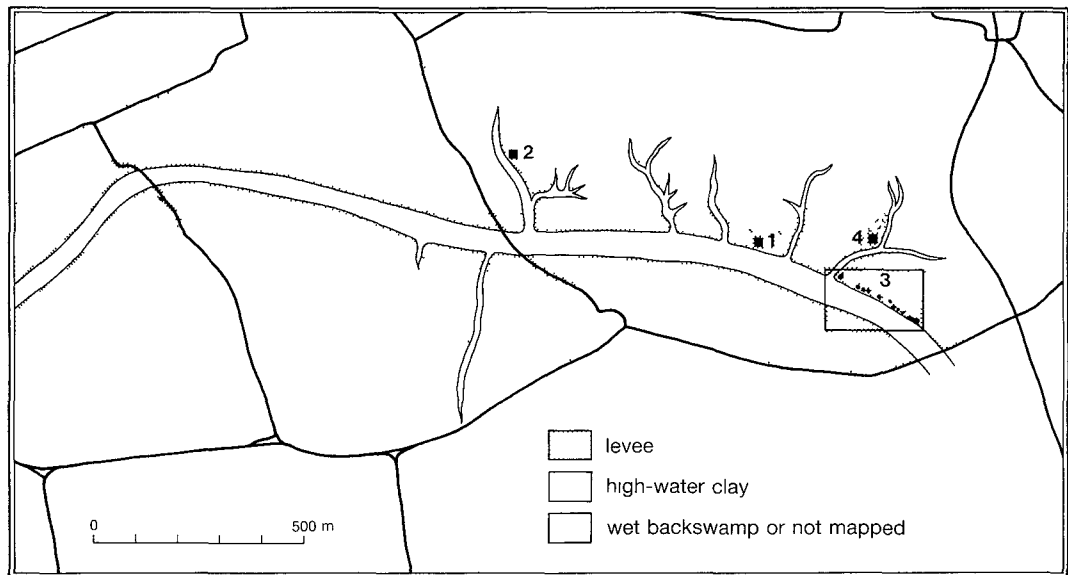


FIG. 147. Hekelingen. Palaeo-geography with Late Neolithic settlement sites in black.

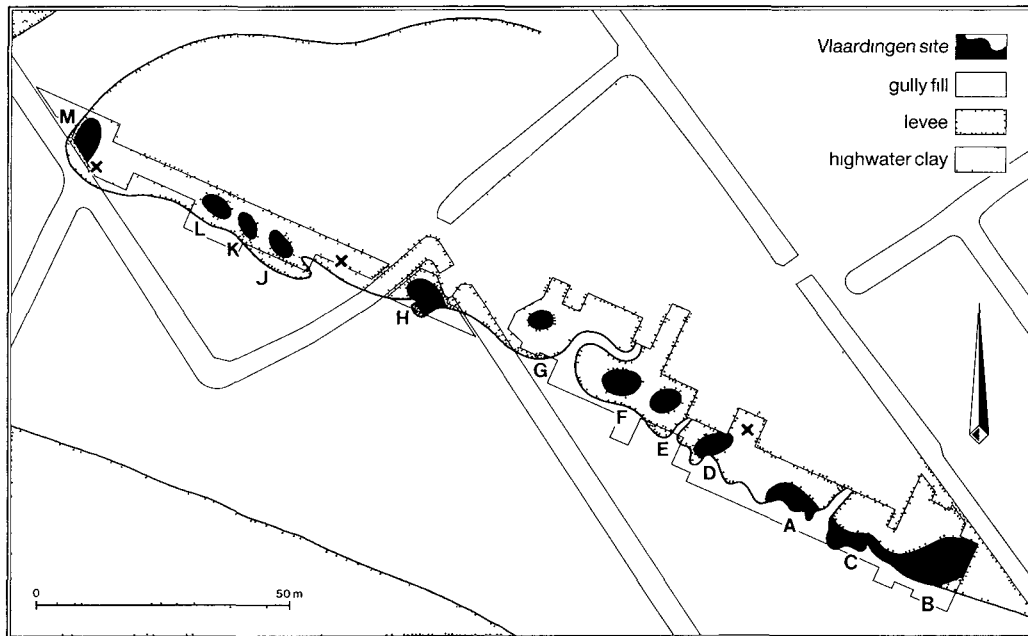


FIG 148 Detail from Fig 147, showing the modern subdivisions, the excavation trenches, the main find concentrations (black), and three interments (crosses) The sites can be attributed to various sub-phases, but D, E, and F are contemporary

least one metre, as can be estimated from the difference between the occupation levels and the new, very accurate sea-level curve, constructed by Van der Plassche (1983).

The artefact concentrations (Fig. 148) considered here as primary refuse are certainly hut sites. They occur on the highest points of the levees. Where they are most distinct, they coincide with clusters of small posts that are considered to be the remains of round or oval huts. In the better-preserved, older sites lenticular clay fire places, very similar to those at Swifterbant, were present.

Initially we considered these small distinct sites, next to good fishing water and seemingly in a rather unfavourable position for agriculture, as short-term, special activity sites, particularly used for summer sturgeon fishing. In due course, however, arguments were developed against this model and a whole series of activities could, in fact, be distinguished in the assemblage:

1. Flint was brought to the site, especially in the form of nodules, and finished axes, both originating from a main source somewhere in south-west Belgium. Broken axes and nodules were worked on the site. In addition to cores, retouchoirs and antler punches were also recovered.

2. Bone and antler were worked systematically, especially deer metapodials which were used for making various types of chisel, awl, and needle. Grinding stones and quartzite whetstones were used in the final modelling of the bone implements and for reshaping both these and the flint axes. These stones must have been brought into this stoneless region from at least 30 km distance.

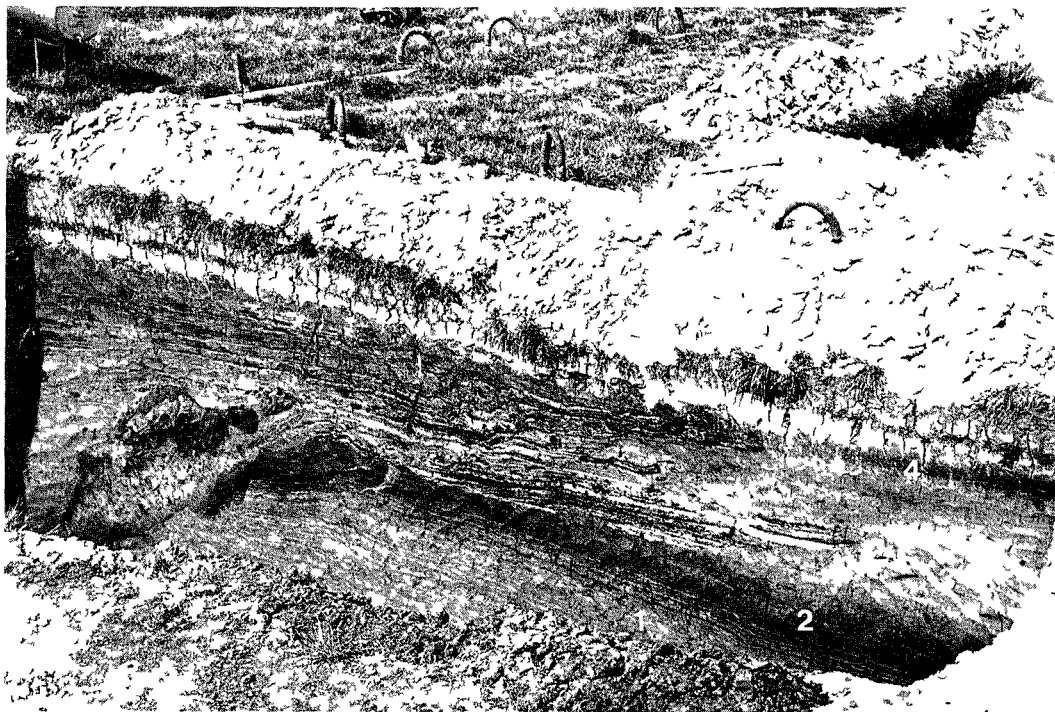


FIG 149 Hekelingen III Section across levee deposits of Calais IV age (3), with dark culture layer of late Vlaardingen occupation (4) on top Calais III salt marsh deposits (1) with peaty deposit of regression interval (2) at the base of the section Complex sequence of gully fill at the left Modern surface at c 1.80 m below sea-level

3. Three spindle-whorl fragments must be considered as peculiar necessities for a fishing camp.

4. The quantity and diversity of broken pottery (250 kg and a minimum of 560 pots) may be explained either as the result of long stays by complete households, or by the repeated use of the site over shorter periods, lasting some weeks or months, by special groups.

5. Bone refuse of good quality was found in large quantities. Big game animals were more important than domestic animals: red deer and cattle are by far the most dominant in each group respectively. There were almost no sheep/goats and there is, as yet, no certainty as to whether any of the pigs represented in the bones were domesticated. The wild animals show the normal series of species: red deer, roe deer, boar, brown bear, beaver, and small predators. A grey seal and one porpoise were taken. A complete paddle and half a bow made of yew are dramatic evidence of such activities, as are flint arrowheads (Fig. 150). A major problem is raised by the presence of cattle. There is hardly any space on the levees for grazing and it seems most likely that cattle were not grazed locally but on the saltmarshes to the south-west. Anyway, there

are no indications that joints of meat were brought to the site, since all skeletal parts occur in normal proportions. This suggests that cattle were actually slaughtered here.

6. More confusing are the arguments for crop cultivation. In more than half of the hut sites, charred grains of linseed and cereals (emmer and barley) were recorded, together with chaff and internodes. However, and this appears to be

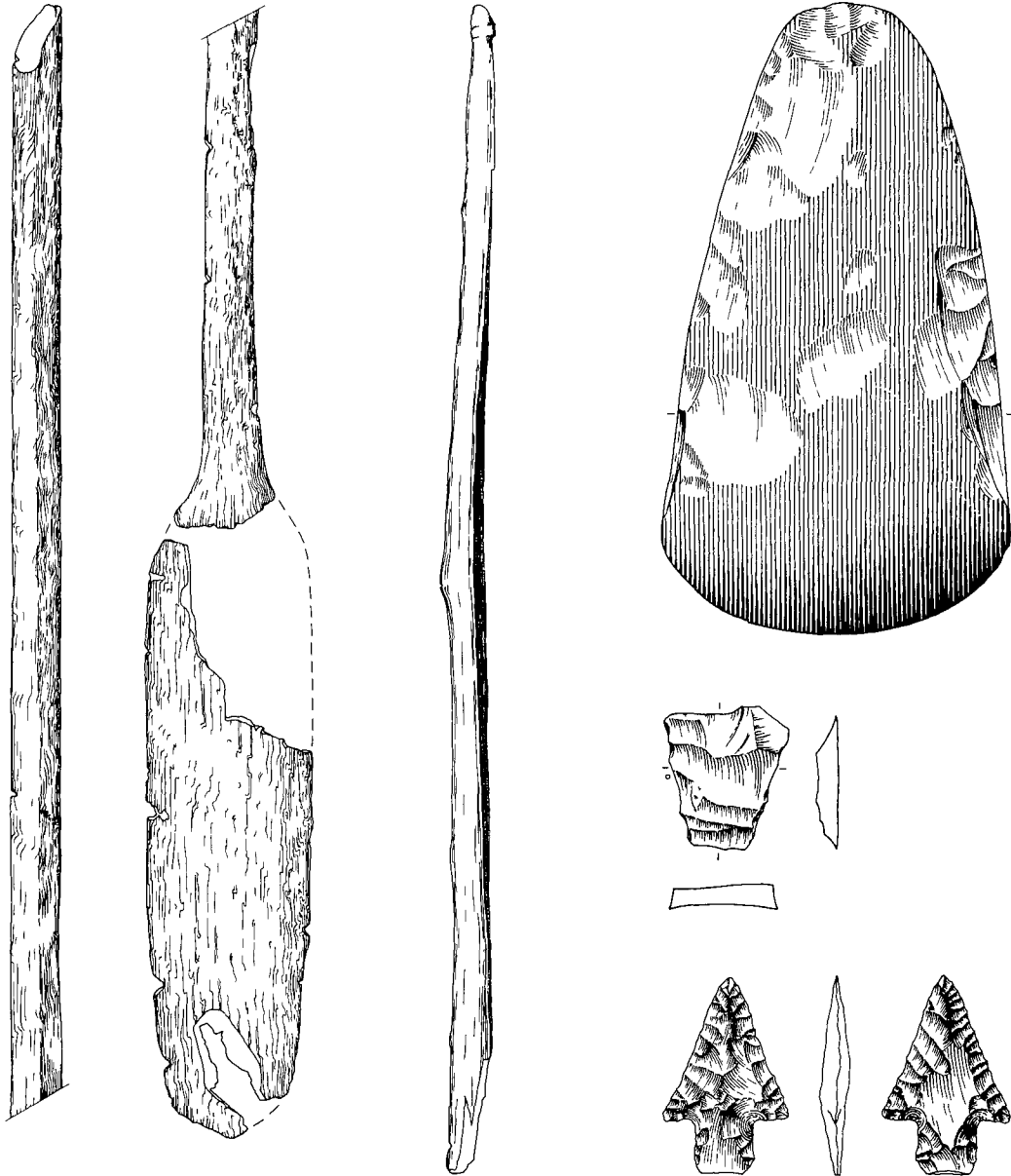


FIG. 150. Hekelingen. Selection of artefacts: ash-wood paddle and yew bow fragment (1:5), imported oval flint axe, and flint arrowheads (1:1).

decisive in the functional interpretation of the site, there are no indications in the pollen diagrams that the forest cover of the creek levees was affected by human activity. The curves for both oak and hazel do not show lower values. One wonders whether oaks were really growing on the rather low levees, especially since the oak is absent in the sample of twigs and branches collected from the creek fillings. On the other hand, acorns, including immature specimens, are present in some samples, and a special structure, made in connection with a human burial, was made of oak-wood. There are, moreover, no ecological objections to oaks growing on the levees, so we must conclude that a narrow strip of woodland with oak and hazel existed on both levees along the creek and that this was not seriously affected by the Neolithic occupants. There is, however another complication: in one of the pollen diagrams cereal pollen is attested in low percentages in levels that are contemporaneous with the Neolithic occupation. It might be considered that this pollen had been washed in, since it appears to be connected with a more clayey level. If this is true, we may conclude that crop cultivation was practised elsewhere in the same district. Much is clarified by the observation of recent cereals; their pollen is dispersed in very modest quantities, only in the flowering season, and it is usually released when the ears are threshed. The inevitable conclusion, when all paleobotanical observations are considered together, must be that cereals were not grown on the site but were brought to it in the ear and threshed there for daily consumption. This conclusion has far-reaching implications, but before we extend these, let us first consider other information on the subsistence economy.

7. Gathering is only documented by foodstuffs with hard parts: hazel-nuts, apple, and water chestnut, all of which are indicators for summer and autumn occupation. We can only guess at the importance of tubers, roots, and leafy vegetables.

8. Fish remains have been found on all sites and in concentrations in refuse dumps in gully fills, with some bones of sturgeon, catfish, and pike widespread. Fish remains do not preserve well and it is difficult to overestimate the contribution of fish, especially the large species of sturgeon. In sediments at the bottom of one side creek the remains of a wooden construction which might have been used as a sturgeon weir were found. This was similar to constructions at Vlaardingen interpreted by the fishing expert, Boddeke. A fragment of a plaited fish trap from Vlaardingen is identical to those from Bergschenhoek. Clay weights from one of the Hekelingen sites and net remains from Vlaardingen demonstrate net-fishing.

9. There are many more aspects of the material relics from the sites that add information on the former activities. It would take too much space, however, to discuss all these in detail. The spectrum of vessel shapes and dimensions, diatom analysis of pottery, details on the hunted animals and birds, some enigmatic rows of thin wooden stakes, three interments (two cremations and

the remains of a disarticulated inhumation) are mentioned simply to illustrate this.

As far as the relationships of the various sites to one another are concerned, we may argue that at least three adjacent huts (D, E, F of phase 3) were occupied simultaneously. Fragments of a single axe of a special type of flint were found on all three sites, some of which could be refitted. This at least indicates that at one moment three working groups or households lived together, probably for collective work (for example, sturgeon fishing) and mutual support.

As outlined above, two basic models present themselves. If crop cultivation did occur in the immediate vicinity of the sites then we can suggest that a repeatedly used and rebuilt dwelling-place was located here, occupied by a few households at least during the summer season. This would have been a short, semi-permanent, semi-agrarian summer base camp, very similar to the Swifterbant sites of 1000 years earlier.

On the other hand, if cereals and linseed were being imported, then the sites must be considered to be relatively short-term special activity camps used for hunting and sturgeon fishing during the summer spawning season. If this was the case, it must be assumed that more permanently occupied sites were located at the same time in the Zeeland saltmarsh (which might actually have had rather freshwater conditions in the east), where cattle were grazed and crops grown. Such sites are, as yet, unknown, but a few have been discovered in North Holland at Zandwerven, Aartswoud, and Kolhorn in a very comparable ecological environment. Plough marks at Zandwerven are proof that crop cultivation took place in that type of location. If we extrapolate these observations and conclusions to the Zeeland saltmarsh district, then a preference for the extraction camp model manifests itself.

A choice between two options has now to be made:

1. The sites are relatively short-term activity camps of special working groups, split off from larger groups living elsewhere in permanent semi-agrarian settlements from which, among other things, cattle and cereals were brought to the site. If these were single-season sites, one is inclined to think of late summer/early autumn, in view of the combination of sturgeon fishing, the collecting of nuts, and the availability of cereals.

2. The sites are camps of possibly longer duration of a more independent non-agrarian group that had specialized in the exploitation of the estuarine resources, and that maintained certain exchange relationships with other, agrarian groups living in ecological zones that were more suited to animal husbandry and crop farming. One can imagine fish, especially sturgeon, and fur going in one direction, and flint, cattle, and cereals in the other. In view of the relatively small extent of the estuarine zone one can hardly think of a totally independent community but only of an ecological specialization in subsistence economy.

We wonder whether correlates can be found in the archaeological record that will allow a choice between these options. At the moment it seems wise to delay this choice until all the specialists' reports are available. However, some points can be made. First, the differences in the raw flint utilized in the various Vlaardingen sites is striking. A twinning of Hekelingen with Haamstede, with the South Holland coastal barrier sites, or with sites on the *donken* in the peat district, is very unlikely, because of the utilization of different flint sources. This might argue for an independent status for Hekelingen. The large number of pots broken on most sites, the range of activities documented in the archaeological record, the presence of a few spindle-whorls as typical relics of female activities and the occurrence of human interments can all be seen as evidence in favour of the second option. On the other hand, the modest dimensions of some of the Hekelingen sites and the absence of well-constructed houses argue against this. We must await the results of further research, including micro-wear study of flint artefacts and diatom analysis of the pottery, before we try to make a choice.

## Vlaardingen

It is not necessary to go into detail about the eponymous Vlaardingen site (Glasbergen *et al.* 1961; Van Regteren Altena *et al.* 1962/3; Van Beek 1977), but only to point out some essential differences between it and Hekelingen that must make us cautious about applying the Hekelingen interpretations to all estuarine sites. First, Vlaardingen is situated at the opposite (the northern) side of the Meuse estuary. The presence of a few early Protruding Foot Beaker elements (a battle-axe and sherds of an amphora) at Vlaardingen and the absence of them at Hekelingen might simply be explained by geographical position. From an economic point of view, the modest extent of salt-marshes north of the Rhine seems of great importance. Vlaardingen is situated on both banks of a small creek which is considerably smaller than the Hekelingen stream. This raises the question of whether the evidence of pollen and charred grains at Vlaardingen indeed proves crop cultivation at, or next to, the site, in spite of lack of space and well-drained soil (Groenman-van Waateringe and Jansma 1969). The predominance of sturgeon remains, and the ageing of young red deer jaws, point to summer residence (Clason in Van Regteren Altena *et al.* 1962/3). However, a long series of typical winter guests have been identified amongst the birds: black- and red-throated divers, brent and barnacle geese, goosander, widgeon, and long-tailed duck, although the Dalmatian pelican is also present (Clason and Brinkhuizen 1979). In my opinion, we must not be too eager to conclude that occupation was permanent, all the year round, but should seriously consider some alternatives; for instance, summer occupation with short-term winter use of the site as a fowling/hunting station, or fundamental changes in site function throughout the period of use. A final difference which

should be mentioned is the presence at Vlaardingen of secure posts apparently representing the remains of much firmer structures (houses) than at Hekelingen (Glasbergen *et al.* 1961). There is a great need for a more detailed analysis of the extant rich and well-documented Vlaardingen material, and especially for separation of the evidence from the various find concentrations in order to obtain better answers to these questions.

## Retrospect

The Rhine/Meuse delta offered not only an exceptional environment with considerable restrictions for agriculture to Neolithic man, but also a marginal position during the gradual introduction of Neolithic traditions to Northern Europe. It lay beyond Bandkeramic influences, marginal to Rössen influence and only on the fringe of the Michelsberg distribution. Hunting, fowling, and fishing were important activities into the Late Neolithic, either as one of the main activities in semi-agrarian, semi-permanent sites (Swifterbant, Vlaardingen (?)), or in subsidiary extraction camps of variable character (Bergschenhoek, Hekelingen-option 1), or perhaps even as the main activity of special groups in the same ecozone (Hekelingen-option 2). It seems a matter of preference rather than principle whether we should call this a persistence of Mesolithic tradition or an adaptation by Neolithic people.

As yet, no impressive cultural evolution during the Neolithic can be made out. There is no remarkable difference between the Swifterbant/Bergschenhoek/Hazendonk-1 phase and the Vlaardingen period one thousand years later. In both phases we see communities that profited from various environments in a seasonal rhythm, not only from environments within the delta, but possibly also in combination with the sand margins. The results obtained on any one site can only be used in a general sense with great caution, and certainly can not be extrapolated beyond the delta district. A long period (3100–2500 bc) is still poorly understood, but we are now beginning to recognize and understand the Neolithic delta communities.

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