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# The Mesolithic and Early Neolithic settlement of the Northern Netherlands in the light of radiocarbon evidence

Harm Tjalling Waterbolk

## 1. Introduction

A major problem with the application of radiocarbon dating to archaeology is the frequently uncertain association of the organic material used for dating – mostly charred plant remains – and the artefacts of stone, flint or baked clay for which a date is sought. The problem is particularly serious for surface and near-surface sites. Of the 144 samples from 68 such sites in the Northern Netherlands which will be dealt with in this article, more than 20 % have yielded dates outside the time range expected or hoped for by the submitters. A few examples may be mentioned (cf. J. N. LANTING and W. G. MOOK 1977). All four Upper Palaeolithic sites in this area, from which samples could be collected (Een, Donderen, Elsloo-'t Ronde, Eext-Hooidijk), have yielded dates that fall within the Mesolithic time range. "Mesolithic" dates were also produced by Beaker graves at Anloo and Angelsloo, and by a Bronze Age house at Rechteren, as well as by a number of charcoal-filled pits, which were thought to be *Brandgruben* from the Roman period, at Wijsster. Obviously Mesolithic man has left in the area much charred plant remains at shallow depths.

If materials charred in two or more periods become mixed quite anomalous dates will be the result. Such mixing has been held responsible for the dates of  $4780 \pm 80$  B. P. (GrN-853) for a pit with Early Bronze Age pottery at Anloo and  $4790 \pm 35$  (GrN-7405) for a pit containing a Late Bronze Age urn at Buinen. Mixing is, however, difficult to prove, and we shall see that there is an alternative explanation for these anomalous dates.

Whenever a pit is dug in a locality which has been previously occupied, the contents of that pit may consist of a mixture of organic materials from both periods. For radiocarbon dating we are only concerned with charred plant remains, which are much more resistant to oxidation and corrosion than any other organic material produced by man. If the quantity of charred remains produced on one spot in more than one period was large, we may expect a considerable effect on the outcome of the date. In most cases the effect of mixing will be small and one period of activity will dominate. As a general rule one may say that aberrant  $^{14}\text{C}$

dates from a surface site testify to human activity on the site at another moment of time than that at which the artefacts were deposited. On the other hand, in any single case some degree of mixing can never be completely excluded.

If this is realized, many dates that are not according to expectation, and which tend to be discarded, still contain valuable information. This can be used for the solving of other problems than those formulated by the submitters of the samples.

In the present paper the author studies the chronological and geographical distribution of all radiocarbon dates in the time range 10 000–4 000 B. P. from charred wood from fire places and settlement or grave pits at surface or near-surface sites in the Pleistocene part of the Netherlands north of the river Rhine. Most sites are situated on coversand elevations.

Interest is focussed on the differences in occupational history, which appear to exist for the different subareas that can be distinguished. These differences can be related to specific environmental features. The results of the analysis are used as an element in the current discussion on the course of the Mesolithic settlement and the origin of the Neolithic occupation of the area. For comparison  $^{14}\text{C}$  dates from the Holocene parts of the Netherlands and from some other adjacent upland areas will be used.

For a list of the samples and a discussion of them the reader is referred to the survey of Dutch radiocarbon dates by J. N. LANTING and W. G. MOOK (1977). A revision of this work, containing additional dates, is in preparation. The present author is grateful to these authors for enabling him to consult the revision.

## 2. The landscape

The area can be subdivided in a number of landscapes, each with different environmental properties.

a) *The Drenthe plateau* consists of a ground-moraine from the Saale glaciation, covered with coversands from the Late Weichsel period. At the S and SW rim the glaciers pushed up low ridges. The highest elevation is 30 m above sea level (NAP). The plateau slopes down in a NW direction. A wa-

tershed is present in the form of a straight line running SE–NW. Drainage takes place towards the NE and SW. In Post-Glacial times large raised bogs developed on the watershed and in the lower parts of the broad valley slopes. The surface water runs off via many small rivulets through wide brook valleys and is ultimately collected by the rivers Ems and Vecht and by the North Sea. Both rivers have their main source in the Münster basin in Westphalia. On the plateau small pingo remnants and blown-out basins are common. Pollen analysis has shown that most of them filled up quickly with gyttja and peat in the Late-Glacial and early Post-Glacial period. At present only two of them are true lakes. All the others developed into raised bogs. As a result of peat cutting in recent years, many of them are now shallow ponds. Mesolithic sites are common on the small sandy ridges around the depressions and along the brook valleys. Neolithic sites preferably occur on larger well-drained parts of the plateau.

b) At the low-lying NW end of the plateau two fairly large, but shallow lakes occur, the *Bergum lake* and *De Leijen*, with present water surfaces of 5 km<sup>2</sup> and 3.5 km<sup>2</sup> respectively. Both have originated in recent centuries as a result of peat-cutting, but pollen analysis has shown that in the early Atlantic period they were still open water. In the deeper parts lake sedimentation started in the Preboreal period; in the Atlantic period peat formation started (W. A. CASPARIE and W. VAN ZEIST, pers. comm.). Here a lake-side environment for some time provided attractive possibilities for human habitation. Many Mesolithic sites have been discovered in this area by amateur archaeologists. One site, called Bergumermeer B, has been intensively investigated by Newell (R. R. NEWELL and A. P. J. VROOMANS 1972). There are a few Neolithic finds from the area. In the Bronze Age the area had become unsuitable for habitation. Apart from the sites on the lake shores, the site of Wartena, two sites at Tietjerk and the site of Drachtstercompagnie – all at less than 10 km distance from the lakes – are included in this area.

c) To the south of the Drenthe plateau the river *Vecht* runs in an E–W direction. Its banks are characterized by low dunes, which in recent years have been the subject of intensive archaeological research, which has yielded indications of human activity in many periods. The close proximity of a river of considerable importance, with its seasonal floodings and oxbow lakes, provides for a much more varied milieu than the plateau.

d) The river Vecht forms one delta with the river IJssel, which also rises in Westphalia. It is now connected with the Rhine. In the former Zuiderzee, the IJssel river valley continues below the present polder bottom. At *Swifterbant* in the E. Flevoland polder, a series of river dune summits (at c.

5 metres below sea level) along the river contain Mesolithic habitation, which has been studied intensively in connection with the Early Neolithic sites found on the clay banks of the river itself. Geological research has shown that during the later parts of the Mesolithic period the IJssel valley near Swifterbant had the character of an estuary under tidal influence (P. H. DECKERS, J. P. DE ROEVER and J. D. VAN DER WAALS 1980).

e) Between the rivers Vecht and IJssel push-moraines of considerable importance stand out above a coversand landscape. The main features are a few parallel ridges, running N–S. They are treated as a unit (*Overijssel ridges*). Only a few dates are available from this area.

f) The eastern part of the area between the rivers IJssel and Rhine and the Zuiderzee is called the *Veluwe*. The area is characterized by large push-moraines from the main stage of the Saale glaciation with elevations up to 80 m + NAP. Coversands cover the slopes. Most surface water runs off through dry valleys. There are very few brook valleys with rivulets. Natural ponds are also rare. To the west the *Utrecht ridge* has the same characteristics as the Veluwe. For this analysis it is combined with the Veluwe, from which it is separated by the Eem valley.

g) Between 10 000 and 5000 B. P. the sea-level rose from c. –50 to –5 m NAP. The habitable areas originally extended far west and north below the present coastal dune, clay and peat areas, and polder bottoms. These parts are now inaccessible for archaeological research. A few morainic islands, however, stand out in the area. One is the present *island of Texel*, which has been well investigated archaeologically. It has yielded remains from most archaeological periods (P. J. WOLTERING 1979).

h) In the downstream parts of the valleys of the Rhine and the Meuse there are many river dunes, the highest of which stand out as *donken* in the polder bottom. These dune tops have yielded interesting Early Neolithic habitation. These natural elevations act as windows, through which some idea can be formed of the settlement history of the submerged parts of the Pleistocene landscape. We shall refer to this area, though, in a strict sense, it falls outside our study area.

### 3. The nature of Mesolithic habitation

Mesolithic remnants are common on coversand elevations, particularly on those along the brook valleys, pingo remnants and blown-out depressions. Large collections of flint artefacts were made by amateur archaeologists in the thir-

ties. Their main source were the dune areas formed in recent centuries in heathland, where wandering sheep and cart traffic exposed the coversand to the wind. After 1950 systematic excavations started in areas where the soil profile was intact. The main features at such sites are fire-places: faintly outlined pits with a diameter of 0.50–0.70 and a depth of 0.40–0.60 m, which contain much charcoal. These occur frequently where hardly any flints can be collected. Thus flints and fire-places may easily become associated by accident. In some relatively flat areas, suitable well-drained camp localities are rare. For that reason too, one must reckon with the possibility of repeated occupation. At the excavated site of Havelte-Doeze, six small flint concentrations showing significant typological differences occurred within a distance of 100 meters. Correspondingly there is a wide spread of  $^{14}\text{C}$  dates. The excavators conclude that it is impossible to assign the assemblages to a specific phase (T. D. PRICE, R. WHALLON and S. CHAPPELL 1974). The sequences of  $^{14}\text{C}$  dates do not correspond to the sequence of the individual sub-sites suggested by typology. In a few instances it has been possible to argue that some of the larger sites were base-camps. Many small sites may have been extraction or migration camps.

Apart from fire-places, some depressions occur which may be interpreted as hut-dwellings. As a result of deep soil formation in more recent periods, the outlines of these pits are extremely vague.

On the basis of flint typology, at least five successive stages can be distinguished, called "Basal", "Early", "Bo-real", "Late" and "Survival". A separate unit, the "de Leijen-Wartena complex" is held to be of non-local origin and to result from a southward movement of a northern Mesolithic group, which was threatened by the expanding North Sea. For details the reader is referred to papers by R. R. NEWELL (1973) and T. D. PRICE (1980).

It should be realized that the Early Neolithic Linear Pottery culture, with dates between 6400 and 6000 B. P. was present on the loess soils at the foot of the Mittelgebirge to the S and SE of our area in the southernmost Netherlands, Westphalia and Lower Saxony, at distances of less than 100 km from the Veluwe, the Overijssel ridges and the Drenthe plateau. One may expect some sort of influence from these groups on the contemporary Mesolithic groups of the "Survival" phase, which lived in the lower reaches of the valleys of the rivers Meuse, Rhine and Ems, that pass through the loess areas. The same holds good for the period following 6000 B. P., when the Rössen culture occupied the loess soils.

#### 4. The nature of Early and Middle Neolithic habitation

Many sites in the area were apparently suitable both for Mesolithic and Neolithic occupation. Yet there is a general difference in settlement location: Neolithic man preferred the large expanses of the higher, well-drained parts of the plateaus. For his settlements, he avoided the narrow ridges of the hilly younger coversand landscape, which were well suited for Mesolithic habitation.

The first fully Neolithic culture to occupy this area is the West Group of the Funnel Beaker Culture (TRB). It is present on the Drenthe plateau, on the Veluwe and Utrecht ridges, on the Overijssel ridges, and a few stray-finds suggest its presence also on the Vecht banks and along the Bergum and De Leijen lakes (J. A. BAKKER 1979). In both latter areas, the habitable land may have been, however, restricted as a result of peat formation. The Swifterbant dunes, at 5 meters below sea-level, must have been deserted by this period.

The most conspicuous remains of the TRB culture are the megalithic tombs. These occur mainly on the Drenthe plateau. Two are known to have existed on one of the Overijssel ridges. Flat graves have been identified in the Veluwe/Utrecht area.

Radiocarbon dates for the West Group of the TRB range from 4600 to 4100 B. P.

In contrast to the Linear Pottery culture, little is known of TRB house constructions. Our samples derive from pits with settlement refuse and from a few graves. In the field, settlement sites are identified by characteristic flint types, pottery sherds and a few, mostly broken, flint axes, which are ploughed up in cultivated fields.

There are archaeological indications for the presence of earlier Neolithic groups in the area, before its final neolithization, which can be estimated to have taken place at 4800–4700 B. P. These consist of scattered finds of Rössen-type adzes, T-shaped antler tools, a few pottery sherds, etc., that can be related to the Swifterbant culture (J. D. VAN DER WAALS 1972). Sites from this culture on levees of the river IJssel in the E. Flevoland polder have been intensively studied. For these sites many dates are available in the time range 5500–5200 B. P. There can be no doubt that this culture, which practised both fishing and hunting, and agriculture and animal husbandry, explored to a limited extent the uplands. The fact that the finds mainly occur in the brook valleys (and along the Vecht river) agrees with the assumption that this group was based in the delta.

## 5. The radiocarbon evidence

Fig. 1 gives the chronological distribution of the total of 144 dates per interval of 200 years, as well as separate graphs for the various geographic subareas that have been distinguished in paragraph 2. In each bar a distinction is made between the number of sites involved (black) and the number of dates. As a site I consider a homogeneous locality with a size that does not exceed 200 meters in any direction. For comparison additional graphs are given for Early and Middle Neolithic sites in the Southern Netherlands and the adjacent parts of Germany (fig. 4.1), and for Neolithic sites in the delta environment of the Western Netherlands: the Swifterbant culture from the levees, the Hazendonk site in the province of South Holland, and the Vlaardingen culture sites (fig. 4.2).

Fig. 2 gives separate graphs for sites with a well-defined Mesolithic flint industry, which – with one exception – have yielded two or more dates.

In fig. 3.1 dates are brought together from bog finds (canoe, trackways, wheels), as well as dates from levels in peat profiles, which indicate the beginning of human influence on vegetation. In all bars a distinction is made between the number of sites involved and the number of dates.

Fig. 3.2 gives the dates of three Mesolithic sites with no single well-defined flint industry. Fig. 3.3 presents the

dates from two sites (Anloo and Angelsloo) with various sorts of Neolithic (and Mesolithic) occupations. Fig. 3.4, finally, gives the dates of all samples from grave or settlement pits with well-defined finds from the TRB, PFB and AOC/BB cultures.

## 6. Discussion

The summary graph fig. 1 shows a number of peaks and depressions. Starting at the bottom we observe a complete absence of dates in the time range of 10 000–9400 B. P. In this period we may expect the presence of surviving late Upper Palaeolithic groups from the Ahrensburg culture (attested only at the site of Gramsbergen with date GrN-7793:  $9320 \pm 60$ ) or the Federmesser culture. The absence of datable material may be caused by the fact that birch charcoal has much less chance of survival than pine or hard wood charcoal. It is hardly ever present in Mesolithic fire places (observation of W. A. CASPARIE). This means that we can only expect dates after pine established itself in the area towards the end of the Preboreal period. This may be the main reason for the absence of dates before 9400 B. P. Two other possible causes should, however, be mentioned. Firstly, difficulties in adaptation to the Post-Glacial environmental changes reduced the local population. Secondly, the habit of digging deep pits for fire places, which is so

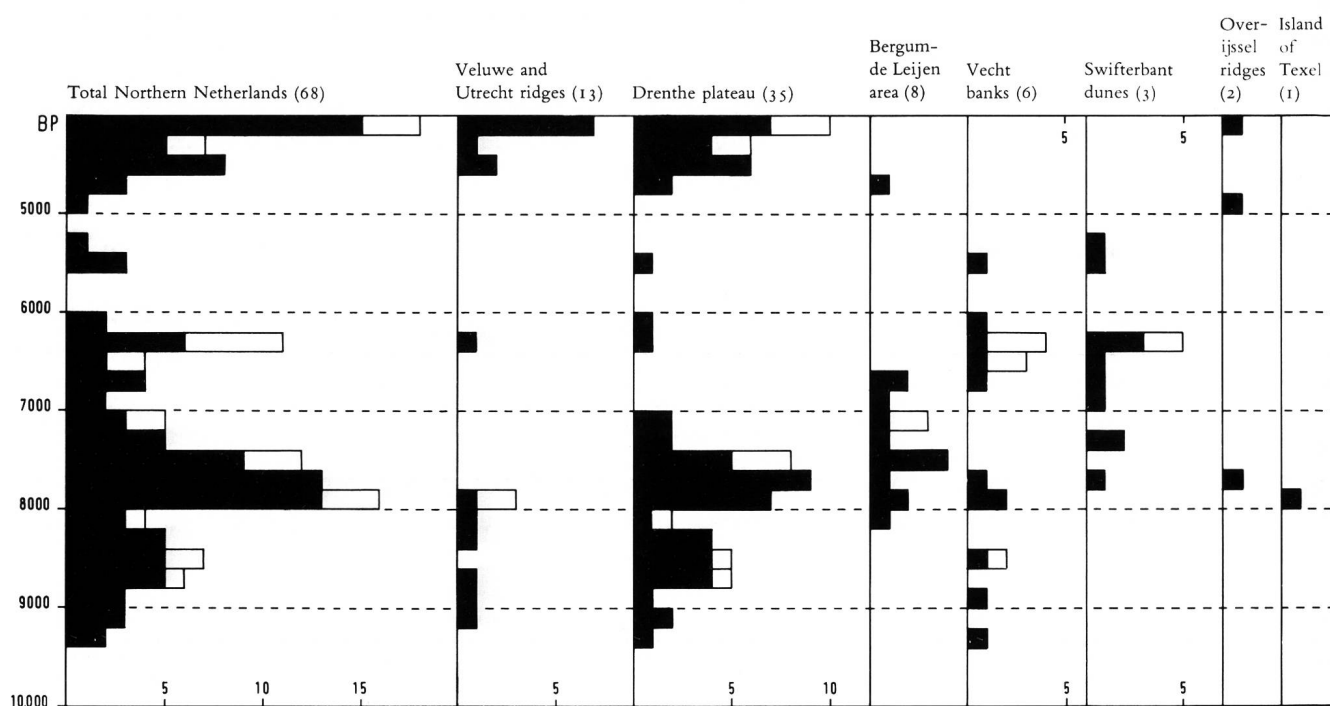


Fig. 1. Conventional radiocarbon dates in years B. P. from surface and near-surface sites in the Pleistocene part of the Northern Netherlands. Between brackets: total number of sites. Black part of bars: number of sites involved.

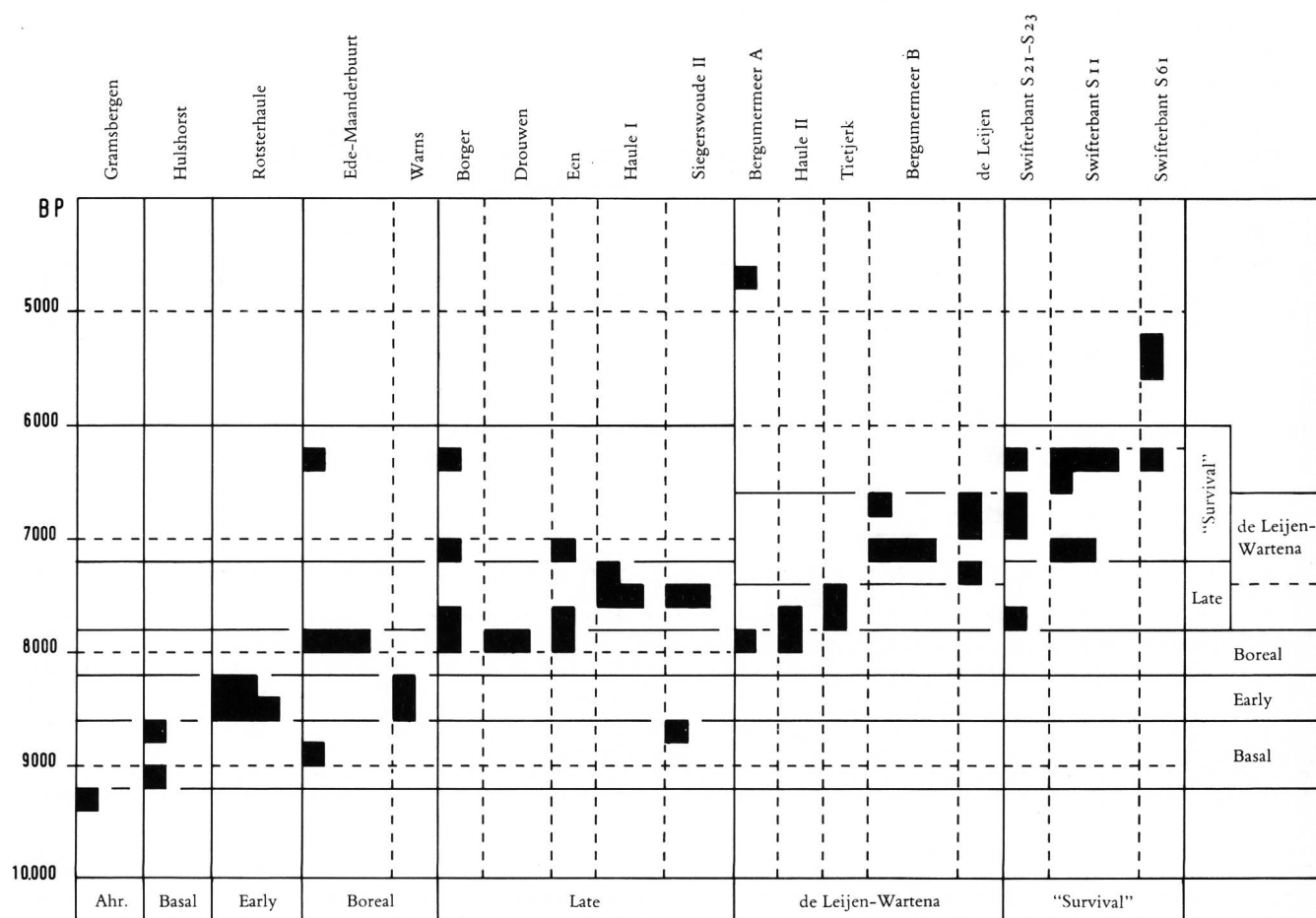


Fig. 2. Radiocarbon dates from a number of Mesolithic sites with a well-defined flint industry.

characteristic of the later Mesolithic periods, had not yet developed.

With an unexplained reduction at 8200–8000 B. P., human activity in the area increases to reach a maximum between 8000 and 7400 B. P. Looking at the various subareas, it is mainly the Drenthe plateau that is responsible for the maximum. After this, a decrease in activity takes place, which is interrupted by a small peak around 6400–6200 B. P. This peak is mainly produced by the Vecht banks and Swifterbant areas; in the Drenthe and Veluwe areas it is a phase of renewed activity after a long period of absence of dates. It should be noted that this period is exactly contemporary with the Linear Pottery culture. We shall come back to this phenomenon. After a new period without dates, the period of the Swifterbant culture produces a small peak at 5600–5200 B. P., attested in three subareas.

After another period without dates at 5200–5000 B. P., the final neolithization leads to a new maximum of activity, in which, however, only the Drenthe and Veluwe/Utrecht areas partake.

If we now look at fig. 2 we can see that there is a good agreement between the typological sequence of Mesolithic stages as established by Newell and the radiocarbon evidence. It is equally evident that repeated Mesolithic occupation at one site has occurred quite frequently. At the site of Ede-Maanderbuurt, in addition to the occupation which yielded the flint industry, there is both earlier and later occupation. At the site of Warns both dates seem too early. Clearly aberrant dates occur also at the sites of Borger and Siegerswoude II. At the De Leijen-Wartena sites one might wonder whether all dates preceding the 7200 B. P. level are not due to earlier occupation. At the site of Havelte (fig. 3.2) there is evidence of at least a four-fold occupation. At the Neolithic and Bronze Age settlement and cemetery sites of Anloo and Angelsloo (fig. 3.3) there is good evidence for Mesolithic occupation, which is only identified if its charcoal evidence gets into a Neolithic grave and is thus submitted for dating.

Comparing now the various subareas in more detail (fig. 1), we note some striking differences. Although we

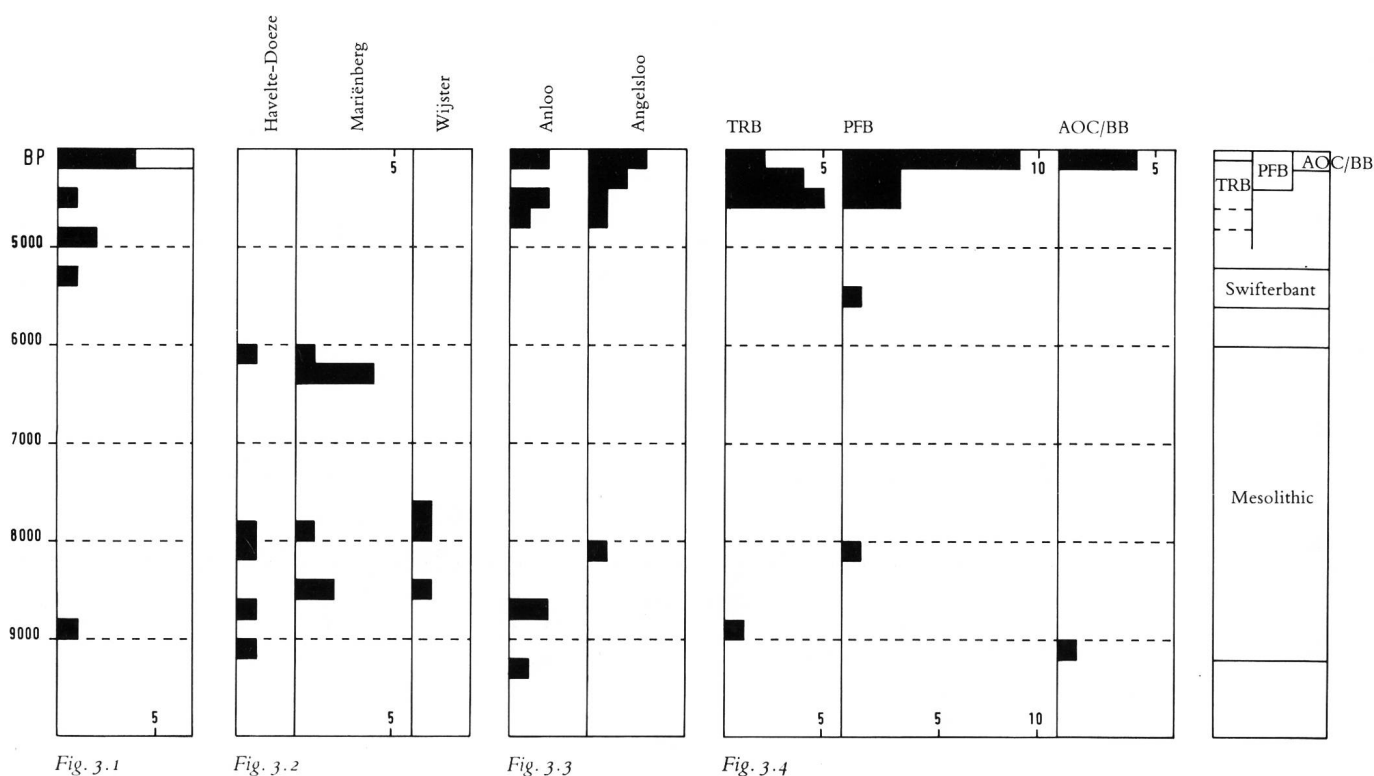


Fig. 3.1. Bog finds and pollenanalytically documented human influence on vegetation.

Fig. 3.2. Mesolithic sites with undefined flint industry.

Fig. 3.3. All dates from two sites with various sorts of Neolithic occupation.

Fig. 3.4. All dates from pits with Neolithic finds.

have only a few dates from the Veluwe, they stop as early as 7800 B. P. On the Drenthe plateau there is an abrupt decline in activity at 7400 B. P., at the beginning of the Atlantic period. Human activity continues, however, around the Bergum and De Leijen lakes. This area seems to have been abandoned by 6600 B. P., in the Middle Atlantic period. After this only the river banks remain occupied (until c. 6000 B. P.). The main reason for this shift in preference must be sought in environmental changes on the plateaus. These consist of the gradual replacement of the Boreal coniferous forest by the Atlantic mixed oak forest, and by the filling-up of the ponds and depressions by peat. The oak forest produced less grazing for large mammals. The filling-up of the ponds reduced the quantity of fish and waterfowl. This process started quite early; the canoe of Pesse (GrN-6257: 8825 ± 100) sunk when the pond was already partly filled up and had a water-lily vegetation. The absence of dates on the Veluwe from the last phase of the Boreal period may well be due to the virtual lack of ponds and rivulets in that area.

The special attraction of the lakes of Bergum and De Leijen probably did not last very long. In the shallow ba-

sins, the peat bog formation proceeded quickly from the flat shores towards the centre.

The continuous settlement of the Vecht banks and the Swifterbant dunes can be explained by the presence of the rivers IJssel and Vecht in the immediate vicinity. Yet there may be more to say about the habitation around 6400–6200 B. P., which is, as we have already noted, contemporary with the Linear Pottery culture. We have already drawn attention to the fact that, notwithstanding the unsuitable environment, we do find renewed activity in this period on the Veluwe and in Drenthe.

At Swifterbant excavations on the dunes have produced tiny pottery sherds in an otherwise fully Mesolithic context. As a conclusion of their very careful analysis the excavators do not doubt the contemporaneity of flint industry and pottery (T. D. PRICE 1981). If so, pottery might not be the only Neolithic element present. One could think of the keeping of sheep and/or goats, which is also one of the first elements of the Neolithic economy to be introduced in other areas along the Atlantic coast. Animal bones are not preserved at the site. Analysis of charred plant remains has not produced evidence for agriculture.

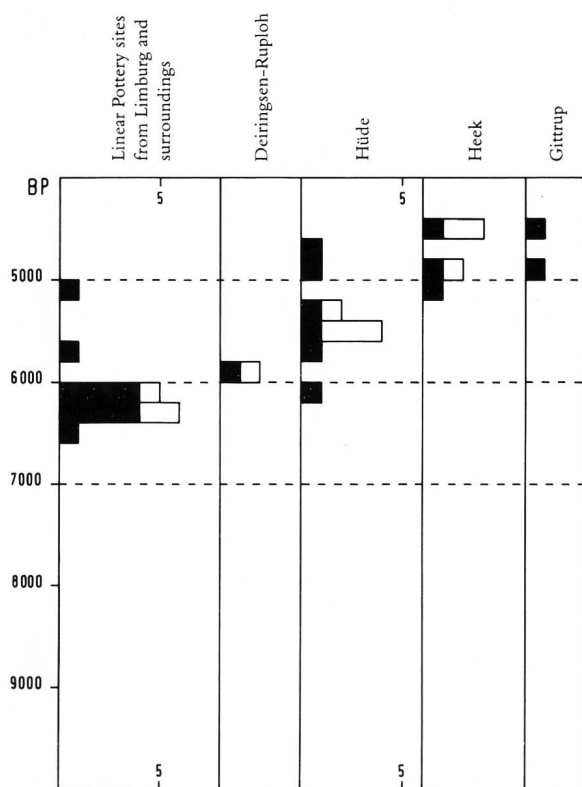


Fig. 4.1

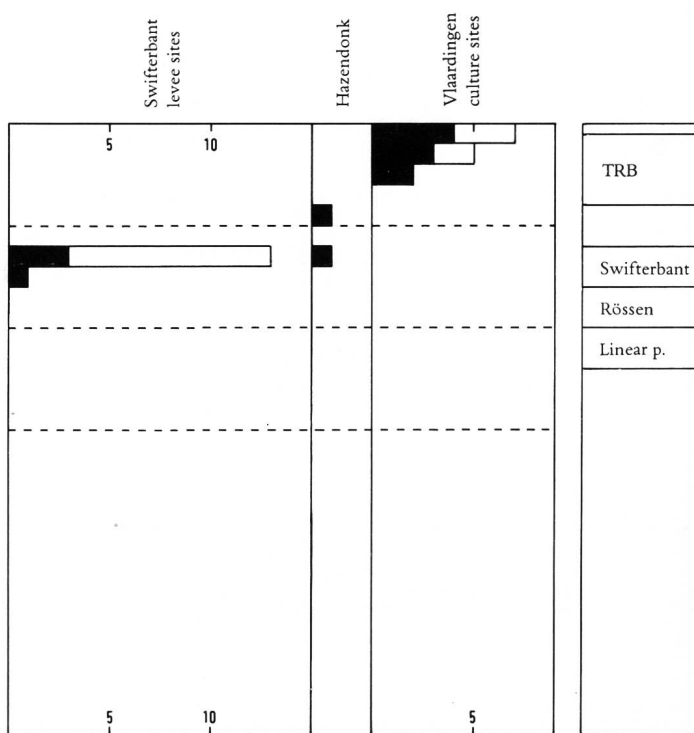


Fig. 4.2

Fig. 4.1. Dates from various Early and Middle Neolithic sites in the Southern Netherlands and Western Germany.

Fig. 4.2. Dates from Neolithic sites in the coastal districts of the Netherlands.

In this connection it is worth mentioning that the "Mesolithic" cemetery of Mariëenberg most probably dates from this period. Fire places, which clearly avoid the grave pits and therefore are probably contemporary have produced five dates between 6290 and 6195 B. P. The cemetery phenomenon itself is an indication of settled life.

It is my feeling that the radiocarbon evidence confirms the hypothesis that the Mesolithic "Survival" groups living on the river dunes of the Vecht and IJssel (and no doubt elsewhere in the delta) added Neolithic elements to their economy. Perhaps these innovations made it possible to explore anew the uplands for which the dates of 6345 ± 45 (GrN-6465) from Borger, of 6050 ± 75 (GrN-6655) from Havelte and 6205 ± 45 (GrN-6466) of Ede-Maanderbuurt are evidence. But this was of a temporary nature only.

After 400 years without any dates at all, and during which we may assume the presence in the delta of an apparently unexpansive people, contemporary with the Rössen culture in the loess areas (e.g. Deiringsen-Ruploh, with dates KI-583: 5820 ± 120 and KN I-759: 5890 ± 75) and early stages of the Ertebølle culture in the Baltic, the Swifterbant group manifests itself. The group occurs not only on

the levees of the former IJssel at Swifterbant itself, but also in various other places in the Dutch river delta area, such as at Bergschenhoek near Rotterdam (GrN-7764: 5415 ± 60). The culture is also present on the Hazendonk dune, and we find it on at least two of the Swifterbant dunes (on one dune with a cemetery). The archaeological evidence for its presence further inland has already been discussed. In the radiocarbon evidence we find this phase represented with the date of 5480 ± 70 (GrN-11917) for Schipborg (a PFB-grave) and perhaps also the date of 5535 ± 70 (GrN-7283A) of Dalfsen. There is palynological evidence for agricultural activity in a pollen diagram from Lelystad, with date GrN-5081: 5330 ± 60.

Afterwards history seems to repeat itself, for a new period of reduced human activity is evident, in particular if we look at the Drenthe and Veluwe areas. During this period we do have good evidence for human activity outside our area proper, for example at the Hazendonk site, where there is evidence for a roughly continuous habitation from 5320 ± 40 (GrN-6215) until at least 4935 ± 40 (GrN-6219). From the Hüde 1 site at the Dümmer in Southern Oldenburg there are Hannover dates of 4840 ± 130 (Hv-

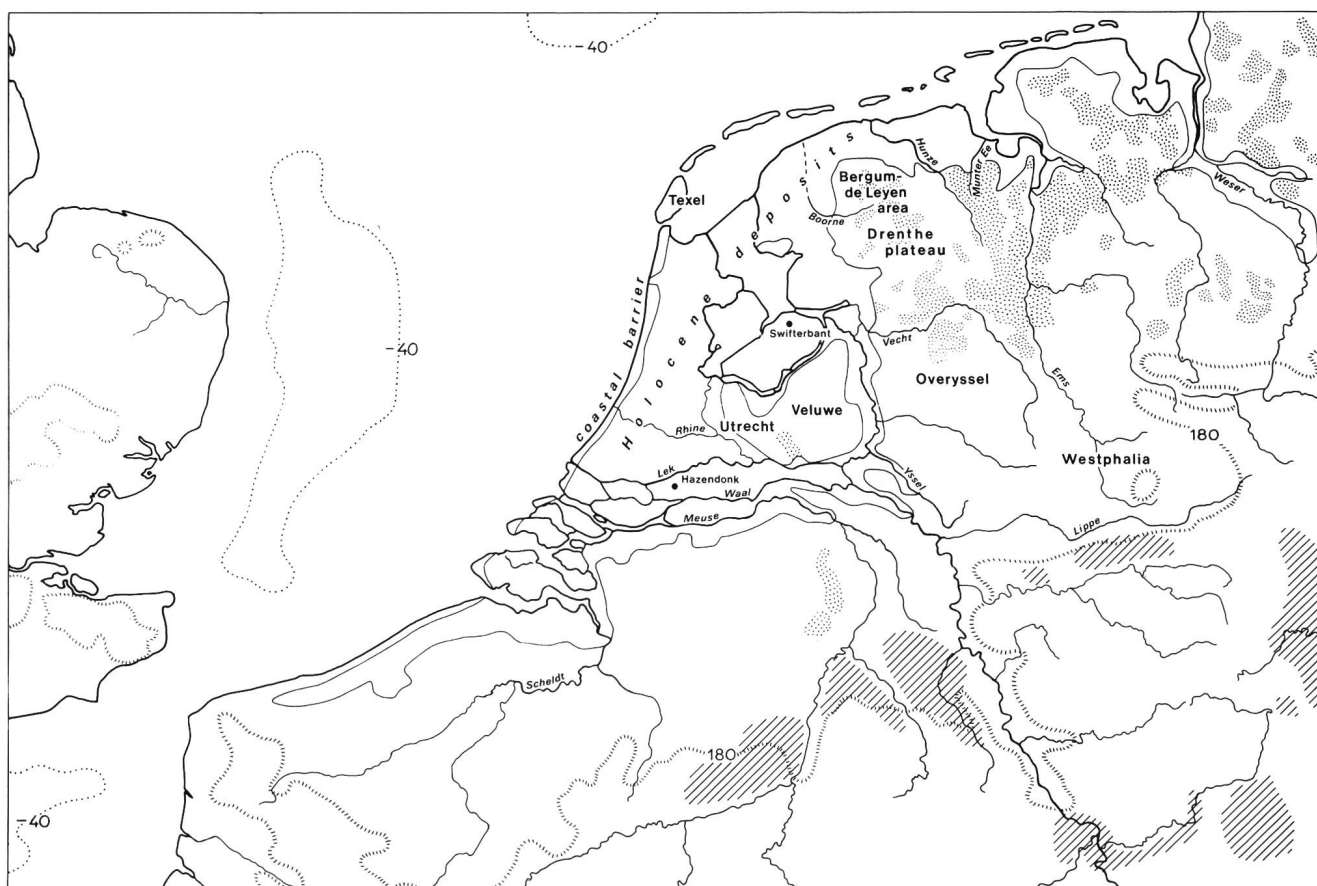


Fig. 5. The Lower Rhine Basin with the main areas and a few sites dealt with in the text. Stippled areas: raised bogs. Hatched areas: main distribution of Linear Pottery sites.

373) and  $4740 \pm 70$  (Hv-813). The TRB sites of Heek and Gitturp in Westphalia, at distances of 10 and 40 kilometers, respectively, from the Overijssel ridges, have also produced dates between 5100 and 4800 B.P. (fig. 4.1).

The four dates between 5000 and 4600 B.P. from our main series form an odd group. One date is from a deep charcoal concentration at the Klokkenberg in Overijssel (GrN-4092:  $4930 \pm 120$ ). There were flints and pottery sherds in the vicinity, but they were not culturally definable. The three other dates are from a Late Bronze Age urn pit at Buinen (GrN-7405:  $4790 \pm 35$ ), an Early Bronze Age settlement pit at Anloo (GrN-853:  $4780 \pm 80$ ) and from a supposedly Mesolithic hearth at Bergumermeer A (GrN-6846:  $4665 \pm 60$ ). As we mentioned before, one could argue for all of them that the dates resulted from mixing of charcoal from various ages. However, the possibility that each one does represent a single human activity, cannot be excluded. In this case, one might imagine that they are connected with the decisive Neolithic landnam, which can be expected to have taken place shortly before the massive Neolithic settlement of the Drenthe and Veluwe areas at about

4600 B.P. An argument in favour of this hypothesis is the fact that at two places the first human influence on the pollen diagrams has been dated: at Emmererfscheidenveen (GrN-431:  $4960 \pm 135$ ) and at Gieten (GrN-8075:  $4800 \pm 40$ ). There are a few archaeological finds in Drenthe that can be related to the period immediately preceding 4600 B.P.

The radiocarbon evidence thus seems to confirm the present archaeological picture that there is a lack of habitation in our area between c. 5200 and 4900 B.P. This means that we cannot draw a straight genetic line from the Swifterbant to the TRB-West Group people. Also there are archaeological arguments against such a relationship. For the origin of the TRB-West Group people we must therefore look in other directions. One may simply suppose a south-westward movement of people from the TRB-North Group, as many people do, or rather advocate a possible origin in the now inaccessible estuaries of the rivers draining the Drenthe plateau in a northerly direction; the Ems and its former tributaries, such as the Boorne, the Hunze and the Munter Ee – as the present author would prefer. But for

solving this discussion, the radiocarbon evidence cannot, for the time being, present any direct argument.

At Hazendonk, there is some evidence for a transition from the Hazendonk 3 stage towards the Vlaardingen culture. It is reasonable to suppose that this culture, which in its well-documented stages (fig. 4.2) is contemporary with the TRB and PFB cultures of the upland plateaus (fig. 3.4), originated in the delta of the rivers IJssel, Rhine, Meuse and Scheldt. This is an indirect argument for seeking the origin of the contemporaneous TRB-West Group elsewhere.

## 7. Conclusion

Our analysis has shown that the dates from surface sites, though often falling outside the expected or desired time range, as a whole present interesting and consistent patterns of shifting human activity. These patterns can be related on the one hand to changes in climate, flora and fauna, and on the other to the gradual introduction of elements of the Neolithic economy. None of the dates need to be rejected as obviously based on material of mixed origin. I fully realize that the number of samples on which this analysis is based is rather small. As more dates become available, the pattern showing up in this analysis may be confirmed or, as the case may be, rejected.

### Proof of illustrations

Fig. 1-5: Biologisch-Archaeologisch Instituut/Centrale Fotodienst, Rijksuniversiteit Groningen.

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