

# MESOLITHIC HEARTH-PITS IN THE VEENKOLONIËN (PROV. GRONINGEN, THE NETHERLANDS), DEFINING A SPECIFIC USE OF FIRE IN THE MESOLITHIC

H.A. Groenendijk

*Biologisch-Archaeologisch Instituut, Groningen, Netherlands*

**ABSTRACT:** The principles of construction and use of Mesolithic hearth-pits are examined in the Groningen part of the Veenkoloniën, a peat reclamation district where a uniform 'Mesolithic' landscape came to light when the peat beds were dug away. Put in a broader context, these Mesolithic hearth-pits seem to have been 'designed' for food-processing mainly and used in specific areas within the settlements. They are tentatively compared with Late Palaeolithic hearths from adjacent areas, in an attempt to demonstrate that a new type of hearth emerged at the beginning of the Mesolithic. Post-glacial environmental adaptation may be reflected in these hearth-pits according to the 'form follows function' principle.

**KEYWORDS:** Late Palaeolithic hearths, Mesolithic hearth-pits, Younger Coversand II landscape, flint distribution, non-domestic hearths, hearth-pit experiment.

## 1. INTRODUCTION

Our knowledge of the Late Palaeolithic and Mesolithic in the Netherlands is based mostly on finds from dry, inorganic, Pleistocene and Early Holocene deposits. The camp sites first discovered all lie in coversand formations, as the search strategy used to focus exclusively on these easily accessible areas. Above all, elevations in the terrain were investigated. The state of Late Palaeolithic and Mesolithic research in fact still bears the marks of this bias towards surface collections. This selective sampling is one of the factors responsible for the fact that in the Netherlands no camp sites are known from organic deposits, while in Denmark, on the contrary, the emphasis in research has for a great part been on Maglemosian sites in low-lying areas.

The discrepancy between the numbers of known Late Palaeolithic and Mesolithic sites in coversand areas is due to the same tendency. Mesolithic sites in coversand formations have a far greater chance of lying at the modern surface than do their (mostly) dune-covered Late Palaeolithic counterparts. Surface sites of course are the most frequently excavated. Sites of this category do, however, have a major drawback: they seldom represent a single occupation phase. At such sites Late Palaeolithic elements may lie intermingled with Mesolithic assemblages and often younger ones as well. Distinguishing the various constituents is very difficult with a large part of the flint material. However, ground features may contribute towards a positive identification of the various traditions represented at the site. Yet when it comes to the Late Palaeo-

lithic and Mesolithic, we are confronted with a lacuna in our knowledge. Only traces of the use of fire may serve as 'index fossils'.

Hearths, more than anything else, are clear indications of the use of fire. 'Mesolithic hearth-pits' especially are remarkable for their homogeneity in shape and contents. Their carbonized botanical contents are particularly suitable for analyses. They may yield radiocarbon dates with comparatively narrow standard deviations. Investigation of the hearths' shape and contents may provide information about their use, while identification of the kinds of wood may contribute to a reconstruction of the Mesolithic vegetation.

An analysis of the shape and contents of this type of Mesolithic hearth together with those of Palaeolithic hearths can be a method of comparing aspects of the use of fire in the two periods and more particularly of investigating the Late Palaeolithic and the Mesolithic partition and use of space in settlements.

The data are inevitably distorted by the small number of Late Palaeolithic hearths uncovered in the Northwest-European Plain, against the profusion of Mesolithic hearth-pits. Moreover it is unknown what kinds of hearth are being compared; an analysis of the two groups may at best bring to light functional differences.

The findings from the many hearth-pits that have come to light in the district known as the Veenkoloniën ('Peat Colonies'), in the east of the province of Groningen, in this study provide the database for the 'Mesolithic approach'.<sup>1</sup> The investigated area (fig. 1) is characterized by a sub-

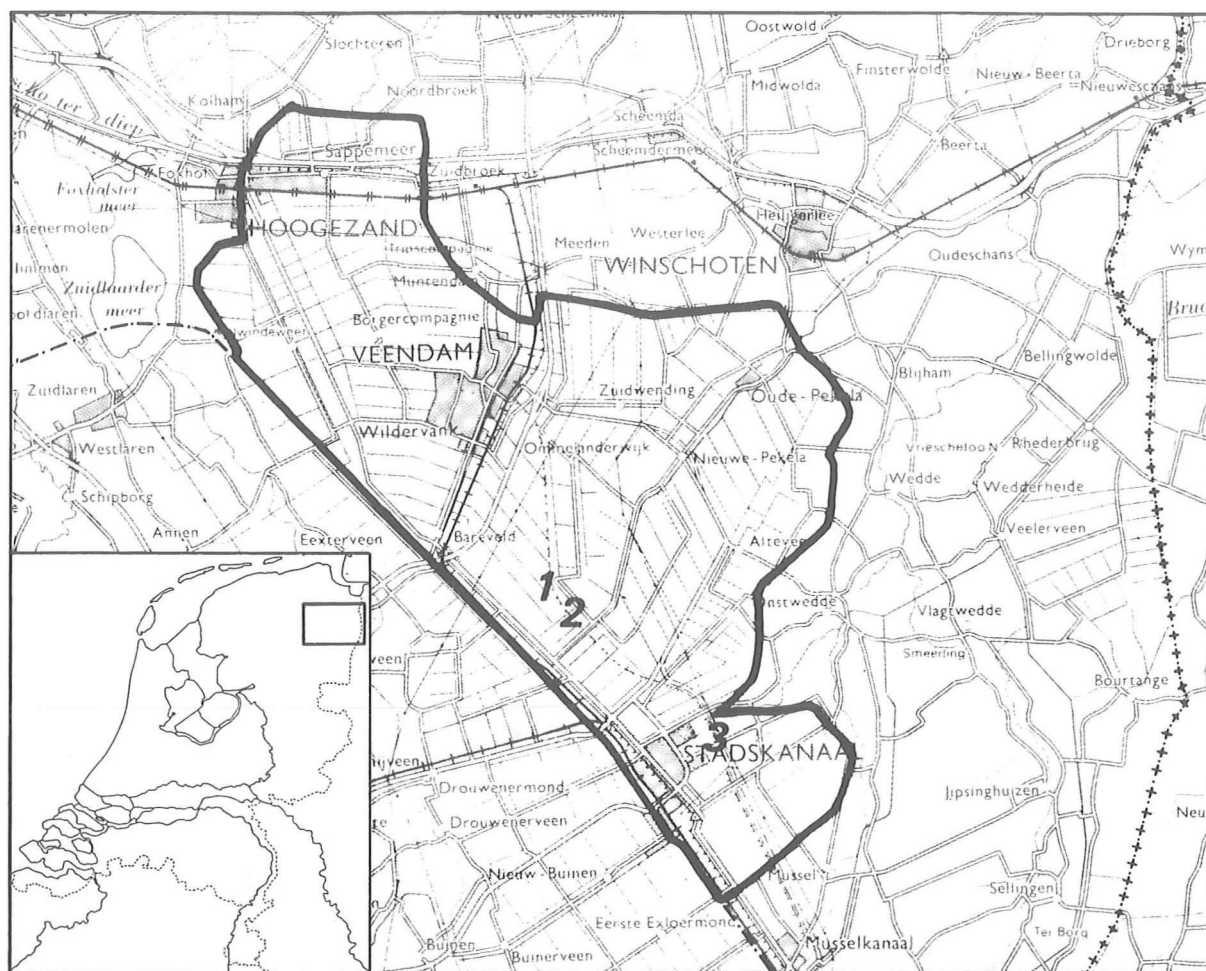


Fig. 1. Location of the study area (outlined) in the province of Groningen. The location of three frequently mentioned sites is also given (1 = NP3; 2 = S51; 3 = S6).

stratum of coversands with a relief that is typical of coversand; locally it is a confused pattern of ridges and depressions. Yet the differences in height never exceed two metres. As a result of poor drainage, this coversand region became boggy and inaccessible to Mesolithic people roughly from the Early Atlantic period onward. Eventually it was covered by a blanket of peat many metres thick. Now that the peat has been dug away, the Late-Glacial Younger Coversand II lies at the surface almost everywhere.

The sites that so far have been radiocarbon-dated point to an occupation phase lasting from c. 9400 to 7500 BP. As no younger dates have been recorded, this may have been followed by the widespread development of bogs.<sup>2</sup> The flint assemblages too suggest that this coversand region was visited no more after the Early Atlantic. Nothing is known about the possible exploitation of the area by Mesolithic man during the growth of the peat blanket.

It is assumed that the coversand landscape as it emerged during the reclamation of the peatlands represents the Mesolithic surface. During and immediately after the Mesolithic occupation, some local erosion will have taken place through the action of water and perhaps some deflation and sedimentation through the action of wind.

Flint artefacts have so far shown up both in the A2 and B2 horizons of the podzol profile, and just occasionally in the B3 horizon. No buried palaeosols were found. Sites with erosion gullies as well as sites with an intact old surface<sup>3</sup> were encountered.

A few sites do contain some elements reminiscent of the Tjonger (Federmesser) industry (Molema, 1988), but the distribution of such sites is limited to a small area. Their litho-stratigraphy has not yet been investigated.

Thus it can be said that in the major part of the Veenkoloniën the Mesolithic belongs in the Pre-

boreal and Boreal, and that younger contamination can be ruled out.<sup>4</sup> Not only the unmixed character, but also the early date of the Mesolithic sites in these parts were incentives to investigate the Mesolithic hearth-pits.

## 2. THE NATURE OF THE HEARTHS

### 2.1. Late Palaeolithic hearths

From the Netherlands two Hamburgian hearths and a single Ahrensburgian example are known. Even if we add the other Late Palaeolithic hearths of the Northwest-European Plain that have been published so far, the total number still is not significantly greater. In this section, the published hearths from comparable lowland contexts (the Netherlands, northwestern Germany) will be briefly discussed.

A well-preserved and carefully excavated example is the Hamburgian hearth of Oldeholtwolde, province of Friesland (Stapert, 1982; Stapert et al., 1986). The charcoal contained in the hearth was radiocarbon-dated to  $11,540 \pm 270$  BP (GrN-10274). This hearth lay at the centre of a Hamburgian flint concentration. The hearth itself consisted of a heart-shaped arrangement of flat stones, c. 1.5 m across, at the centre of which was a hollow measuring 0.35 by 0.50 m and with a depth of 0.10 m. Traces of the action of fire on some of the hearth stones indicated that the hearth had been cleared out and re-used several times.

A possible second hearth of the same period was found at the Hamburgian site of Luttenberg, province of Overijssel (Stapert, 1986; Stapert & de Vries, in prep.) There are indications that stones were a constructional part of the hearth. Because of a later disturbance it was not possible to reconstruct the exact size of this hearth.

In Geldrop, province of Noord-Brabant, an Ahrensburgian hearth was encountered in a section (Geldrop I; Wouters, 1957; 1983). There were no stones, but in the somewhat wedge-shaped 'hearth-pit', which was c. 0.5 m deep and c. 0.8 m wide at the top, not only charcoal was found but also calcined animal bone; at its edge lay some red ochre.<sup>5</sup> The hearth lay within a charcoal-rich zone, from which it was not very distinct. Radiocarbon analysis of the charcoal produced a date of  $10,960 \pm 85$  BP (GrN-1059).<sup>6</sup>

Three hearths lying close together were uncovered near Querenstede in Northwest Germany (Zoller, 1963). Given the associated flint finds they must belong to the Hamburgian tradition. All three of them were marked by a configuration of stones, among which lay charcoal – most of it at the centre – and flint artefacts. Two of the hearths, one of them

c. 1 m and the other c. 0.5 m in diameter, lay one meter apart, but yet were connected through an area of sand coloured dark by its admixture of charcoal. This layer of dark sand nowhere was thicker than 0.10 m. Its contours suggest that both hearths had peripheral zones of charcoal of c. 1.5 and 1 m across respectively, which partially overlapped. Outside these zones the soil contained no finds. The dark sand may have been the result of clearing-out, hence repeated use, of the hearths.<sup>7</sup> A third hearth, also featuring stones with charcoal and flint artefacts among them, lay at a distance of c. 9 m from the other two. The documentation allows little more than a surmise that this possible hearth was less than 1 m across. No radiocarbon dates are available.

At Rissen, near Hamburg, a hearth was uncovered amidst an Ahrensburgian assemblage. Only a plan of the hearth has been published (Rissen 14a; Schwabedissen, 1954). This shows a crescent-shaped patch of charcoal, with a maximum diameter of c. 2 m. A description was given of an Ahrensburgian layer with a thickness of 0.05 to 0.10 m, which contained the hearths (apparently there were several, although only one was illustrated). Flint artefacts were found both within and outside the immediate vicinity of the described hearth. The charcoal, being *Pinus*, actually suggests a date younger than Ahrensburgian; no radiocarbon date is available (pers. comm. J.N. Lanting).

The Late Palaeolithic hearths mentioned above, sealed between coversand deposits, may all be regarded as closed finds. Therefore they are particularly useful for morphological comparison. Table 1 summarizes some relevant characteristics.

Hamburgian hearths predominate in this catalogue. What characterizes this fairly homogeneous group is the use of stones, and usually a wide diameter combined with a shallow depth. The two Ahrensburgian hearths of Geldrop and Rissen contained no stones, and morphologically they differ from each other. Geldrop I is the only hearth that appears to have been cut into the ground. Some of the hearths demonstrably were the focus of flint-working activities (Oldeholtwolde, Querenstede 1 and 2, 3?); others at any rate lay within concentrations of flint artefacts (Luttenberg, Rissen 14a). Late Palaeolithic hearths generally are features of habitation sites ('domestic hearths'); those mentioned in table 1 all are associated with flints. However, this must be qualified in the sense that often only the hearth and its immediate surroundings were investigated. It is for this reason that we cannot say whether in these parts Late Palaeolithic hearths for other purposes may not have been constructed at the periphery of the habitations to which they yet belonged.<sup>8</sup>

Table 1. Morphology and associated finds of Late Palaeolithic hearths from the Northwest-European Plain.

Site	Tradition	Structure	Dimensions in m	Contents
Oldeholtwolde (NL)	Hamburgian	Stone lining of of central pit with peripheral stones	Diam. 1.5, depth 0.1; central pit 0.350.50.1	Charcoal (Salix), burnt + unburnt flint
Luttenberg (NL)	Hamburgian	Stones	?	Charcoal, burnt flint
Geldrop I (NL)	Ahrensburgian	Pit	0.8 wide 0.5 deep	Charcoal, burnt flint, calcined animal bone, red ochre
Querenstede (BRD), hearth 1	Hamburgian	Stone concentration in shallow depression	Diam. c. 1, 0.1 deep	Charcoal, 'flint'
Id., hearth 2	Hamburgian	Id.	Diam. c. 0.5, 0.1 deep	Id.
Id., hearth? 3	Hamburgian	Stone concentration	Diam. under 1	Id.
Rissen 14a (BRD)	Ahrensburgian	Shallow depression?	Diam. c. 2	Charcoal (Pinus), 'flint'

## 2.2. Mesolithic hearth-pits

Focussing on 'Mesolithic hearth-pits' in order to compare them with Late Palaeolithic hearths we are confronted with heavy restrictions in several respects. Not only is the abundance of excavated hearth-pits from the Mesolithic all over the Pleistocene coversands of the Northwest-European Plain in sharp contrast with the number of known Late Palaeolithic hearths, but the knowledge about any other types of hearth one might expect on Mesolithic sites is very poor. The hearth-pits most probably formed only part of the Mesolithic features relating to the use of fire.<sup>9</sup> One advantage of focussing on the hearth-pits is that they form a large and homogeneous group.

Although being a very common phenomenon and occurring in many excavations (sometimes even considered as unwelcome archaeological by-products as they tend to contaminate radiocarbon samples from other periods), Mesolithic hearth-pits have rarely been the subject of scientific study as to form and function. Their primary analytical function has been to provide reliable radiocarbon dates for the associated Mesolithic flint industries and thus they have in fact provided the absolute chronological framework for the Mesolithic stages in the Netherlands.

When occurring amidst Late Palaeolithic flint assemblages their dates were considered too young to be of a Late Palaeolithic origin and thus they would be called Mesolithic hearths; when accompanied by a Mesolithic flint industry they

would be used to support its supposed date. Their identification as hearth-pits is widely accepted, as is their Mesolithic origin, although arguments to connect them with flint industries on the same site often are lacking.

In the following paragraphs an attempt is made to list some aspects of Mesolithic hearth-pits found in the Veenkoloniën, to arrive at a more specific idea of how fire was used in this type of hearth. Since the observations started in 1982, a great number of 'classical' Mesolithic hearth-pits have been uncovered in the Veenkoloniën; over a hundred of them have been analysed.<sup>10</sup>

### 2.2.1. Frequency of occurrence and location

Theoretically, the chance of discovery of Mesolithic occupation in the Veenkoloniën is much greater than with part of the Late Palaeolithic, as the predominantly Younger Coversand II surfaces did not stabilize until the beginning of the Mesolithic. In the many man-made exposures in the Veenkoloniën only habitation at the surface of the Younger Coversand II has been observed. The few sites with Late Palaeolithic elements mixed in with the Mesolithic flint assemblages also are known to have been surface collected. At several Mesolithic sites where excavations took place, hearth-pits were encountered. Table 2 shows that their occurrence seems to be restricted to the top and slopes of the largest sand dunes. Smaller and lower dunes carrying Mesolithic flint concentrations did not contain hearth-pits.

Table 2. Frequency and location of hearth-pits on Mesolithic sites in the Veenkoloniën.

Site/Code	M <sup>2</sup> excavated	Number of hearth-pits	Geomorphology of the part uncovered
NP3	2500	38	Top/upper slope of elongated, pronounced dune
NP4	250	-	Top/upper slope of elongated, pronounced dune
Vm24	520	1	Lower slope of elongated, pronounced dune
HS16	170	-	Edge/upper slope of extended elevation
HS17	160	6	Edge/upper slope of extended elevation
HS22	390	7	Upper slope of elongated, pronounced dune
S6	485	28	Top/upper slope of pronounced dune
S51	750	40	Top/upper slope of elongated, pronounced dune
S60	150	-	Top of low, small dune
S67	200	-	Low, small dune

Within a time-span of less than 2000 years of the Mesolithic according to the radiocarbon dates available at present, the digging of hearth-pits at some sites proves to have been a frequent activity. The larger and fairly pronounced elevations in the coversand landscape of the Veenkoloniën seem to be favourable locations for the settlements containing hearths under discussion. Mesolithic flint concentrations also occur on the smaller elevations, although there no hearth-pits were observed. Different locational requirements for hearth-pits compared to flint-working areas may be the cause of this, though the argument cannot be further substantiated.

#### 2.2.2. *Non-coincidence with flint industry?*

In their introduction to the Mesolithic Lanting and Mook (1977) warn that the dates for Mesolithic hearth-pits are frequently not in accordance with the typological assignments of the flint tools from the immediate surroundings. Repeated occupation of a site is mentioned as a main reason, contamination of the charcoal being of little influence (J.N. Lanting, pers. comm.). With this point of view I totally agree; exactly because the charcoal, lying at the bottom of these deep hearth-pits, will quite soon have been covered in, it is unlikely to be contaminated.

There are two levels of observation: on the site level there is the distribution of Mesolithic flint

artefacts in relation to the distribution pattern of hearth-pits and on the hearth level there is the analysis of their contents. Results of the latter are discussed in section 2.2.5; the approach on site level is discussed in this section.

If one wants to demonstrate non-coincidence of the distribution of flint artefacts and hearth-pits this is only possible if both categories exclude each other spatially in two dimensions, both horizontal and vertical, or if the radiocarbon dates of the hearth-pits differ clearly from the accepted age of the 'associated' flint industry.<sup>11</sup>

From the Veenkoloniën an example of non-coincidence of the horizontal distribution of flint artefacts and hearth-pits is given here (apart from a few stones, flint is the only artefact category observed in this area). At the extensive Mesolithic site NP3, part of which was excavated, four or five main flint concentrations occurred. In the SW part of the site lies a small concentration with over 100 pieces per m<sup>2</sup>; at the centre and SW of it are two partly overlapping concentrations, with maxima of 49 and 24 pieces per m<sup>2</sup>; in the NE lies a minor concentration of up to 15 pieces per m<sup>2</sup>; and the far NE has a probably limited concentration with a maximum of 68 pieces per m<sup>2</sup>. In the excavation the limits of flint occurrence were reached all along the steep slope of the coversand dune in the SE, as well as in the NE, N and NW on the top of the dune (fig. 2). For the uncovered part of the site the distribution of hearth-pits does not correspond with these

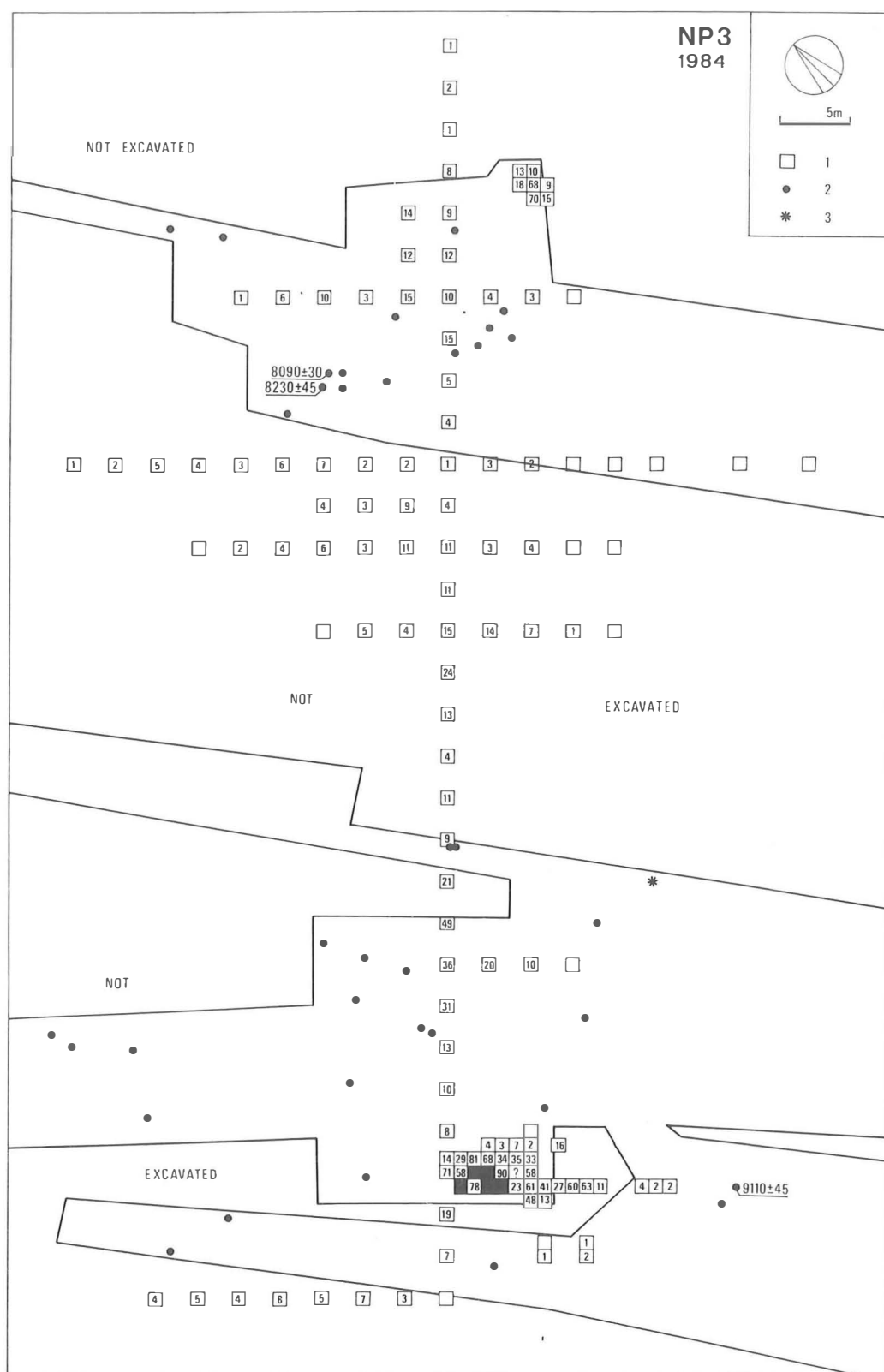


Fig. 2. Excavation plan of the Mesolithic site NP3, gemeente Nieuwe Pekela. The extent of the site was tested by pits of one square metre; the area eventually uncovered is heavily outlined. Of the ground features only the Mesolithic hearth-pits are shown. Legend: 1. test pits with the total number of flint artefacts (blank squares: no artefacts; black squares: more than 100 artefacts; 2. Mesolithic hearth-pits, three of which are radiocarbon dated (dates BP); 3. nest of c. 25 pieces of flint occurring together ('cooking stones').

Fig. 3. Part of the uncovered area of the Mesolithic site S51, *gemeente Stadskanaal*. The black spots are hearth-pits measured exactly; open circles: hearth-pits whose location could not be measured exactly, but whose measuring error does not exceed one metre. In the southeastern part the observed cluster of nine hearth-pits. Underlined figures are radiocarbon dates; numbers in *italic* beside the hearth-pit indicate the total number of burnt flint artefacts in their contents.



flint concentrations, although the overall distribution of flint artefacts largely covers the distribution of the hearth-pits. Yet several hearth-pits lie in an area where no flint was found. The picture of site NP3 appears to indicate a multiple compoency with a considerable spread in time, which is corroborated by the radiocarbon dates from hearth-pits both from a group of four in the N part and from a hearth-pit in the S part. This spread in time of hearth-pits at any rate, occurs at other Mesolithic sites in the Veenkoloniën too.

With excavations lacking detail similar to NP3, it is impossible to say whether hearth-pits together with low concentrations of flint do or do not form behavioural units. The discussed examples can only demonstrate the possibility of single (groups of) hearth-pits occurring outside flint concentrations. It is this which seems to be in contrast with the few Late Palaeolithic hearths observed; they all feature a flint concentration or even form the focus of flint working (see 2.1). This seemingly different position of the hearth in relation to flint concentrations in the Mesolithic and in the Late Palaeolithic is an important observation. However, some factors that may have affected this picture must be taken into account. There are the different find circumstances, as for the Mesolithic a difference in the vertical position of flints and hearth-pits, which are associated with and have their origin at the same surface, can be noticed: of Mesolithic hearth-pits generally only the base is observed, at a level where flint may be absent. Fortunately in the Veenkoloniën the reconstruction of the old surface has been possible in some cases (see section 2.2.4).

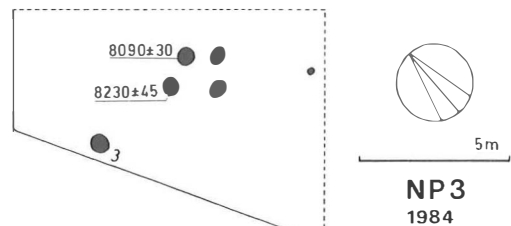


Fig. 4. Detail of the excavation plan of site NP3 (see fig. 2) with the cluster of four hearth-pits. Underlined figures are radiocarbon dates; the number in *italic* indicates that this hearth-pit contained three burnt flint artefacts, while the others were sterile.

Furthermore, an analysis of the contents of Mesolithic hearth-pits demonstrates that some of these are nonetheless associated with contemporaneous flint working (see section 2.2.5).

Finally, it is very likely that the chosen examples from the Late Palaeolithic and the Mesolithic represent two different types of hearths; testing their position in relation to flint concentrations is affected by their numerical inequality and the fact that excavations of Late Palaeolithic hearths mostly cover only a very limited area.

### 2.2.3. Clusters of hearth-pits

Considering the density of hearth-pits on some Mesolithic sites, it is striking that in spite of the long time-span of intermittent habitation hardly any hearth transects another. It looks as if abandoned

hearth-pits could be recognized for quite a while and that re-use of the same pit was not the practice. On the other hand, the way some hearth-pits cluster is suggestive of groups of contemporaneous hearths on Mesolithic camp sites. We observed this on the sites S51 (fig. 3) and NP3 (fig. 4).

On S51 nine hearth-pits were found in a close group, lying apart from the others, in an area of c. 3.5 m diameter. None of the hearths transected another. Some were faintly outlined, others showed clear contours (most probably depending on the amount of charcoal left after burning, see below; formerly erroneously interpreted as a difference in age). The largest hearth-pits were also richest in charcoal. Two of these have been radiocarbon dated to check their contemporaneity; the results are  $7615 \pm 40$  BP (GrN-13747) and  $7480 \pm 40$  BP (GrN-13748). The calibration curve in the reach of these dates shows a steep slope (Kromer et al., 1986), so that after correction the contemporaneity of the two hearths remains credible. This together with the similarity of contents and the similarity of the rest of the hearths within the cluster (e.g. the low quantities of burnt flint artefacts found in them) indicates a clearly delimited area where fire was used. The burning of fires need not have taken place in one session, but in any case the place must have been recognizable when people came to reoccupy it.<sup>12</sup>

The same may apply to an area on NP3 with four equally large hearth-pits, one of them faintly outlined, lying together in the form of a rectangular trapezium. The spot measures c. 2.5 m across. Two hearths were radiocarbon dated:  $8230 \pm 45$  BP (GrN-13750) and  $8090 \pm 30$  BP (GrN-15313), which for the same reason as the dates from S51 suggest contemporaneity of this group of four.

Similar observations were made at Mesolithic sites outside the study area. A.D. Verlinde excavated 'numerous' hearth-pits adjacent to possibly Mesolithic grave-pits at Mariëenberg, province of Overijssel (Verlinde, 1982; van Es et al., 1988). Neither the hearth-pits, nor the six grave-pits showed transections, in spite of the density of the features observed. Five hearth-pits were radiocarbon dated; they cover a time-span of  $6195 \pm 35$  BP to  $6290 \pm 45$  BP (uncalibrated), which together with the archaeological evidence suggests a contemporaneous burning of fires.

In Stöcken, West Germany, J.J. Assendorp drew attention to a very dense cluster of hearth-pits in a limited area of c. 220 m<sup>2</sup> underneath a barrow on a coversand elevation (Assendorp, 1985). Over 70 hearth-pits were observed; they showed hardly any transection. Furthermore the excavation plan suggested that several among them lay in pairs, as if derelict hearths could easily be recognized but re-use was avoided, or that these hearths burned

simultaneously. Two radiocarbon dates from hearths lying less than 4 m apart ( $6750 \pm 75$  BP and  $6870 \pm 85$  BP) support the suggested contemporaneity of the group. On one side the edge of the concentration was reached. Clearly dug within a narrow time-span, the delimited group of hearth-pits is referred to by the excavator as a 'cooking centre', although this is supported only by ethnographic parallels.

Thus Mesolithic hearth-pits may occur in contemporaneous clusters of varying dimensions; their possible relationship with the distribution of isolated hearth-pits at the same site was not investigated here. The intensity of the discoloration caused by charcoal in the fill of the pit apparently does not allow any conclusion with regard to age.

#### 2.2.4. *Similarity of hearth-pits*

Two aspects of Mesolithic hearth-pits determine the similar appearance of the hearths involved, their apparent great number and their good conservation: (a) their similar construction, especially the narrow range of variation in depth in relation to the old surface, and (b) the appearance that these hearth-pits were not cleared out.

a) *Similar construction.* Recognition of Mesolithic hearth-pits depends heavily on the stratum exposed in relation to the Mesolithic surface. In the Veenkoloniën the greater part of the hearth-pits were only recognized in the B3 horizon of the podzol profile, c. 0.40-0.50 m beneath the top of the coversand in which this profile developed. This is because generally only the dark, charcoal-flecked base of a hearth-pit is noticed, whereas the upper part of the pit remains invisible by lack of charcoal and as a result of soil development.<sup>13</sup> In the Veenkoloniën we encountered several hearth-pits in section (fig. 5), allowing us to reconstruct their original size and depth. An average depth of 0.40-0.50 m for the Mesolithic hearth-pits, as had been estimated already from their predominant position within the B3 horizon was thus confirmed (the geological arguments for believing that in the Veenkoloniën the top surface of the coversand dunes will generally represent the Mesolithic surface, have been discussed in the Introduction). The deep-lying fires must have been less liable to contamination with other organic material such as charcoal from other hearths, than would shallow pits and depressions.

The homogeneous morphology of the hearth-pits in the Veenkoloniën (see fig. 5) sets them apart from other ground features. The bowl-shaped, but more often lenticular base forms the bottom of a shaft that varies in diameter from 0.40-0.80 m. In fact the hearths generally measure 0.40-0.60 m across and



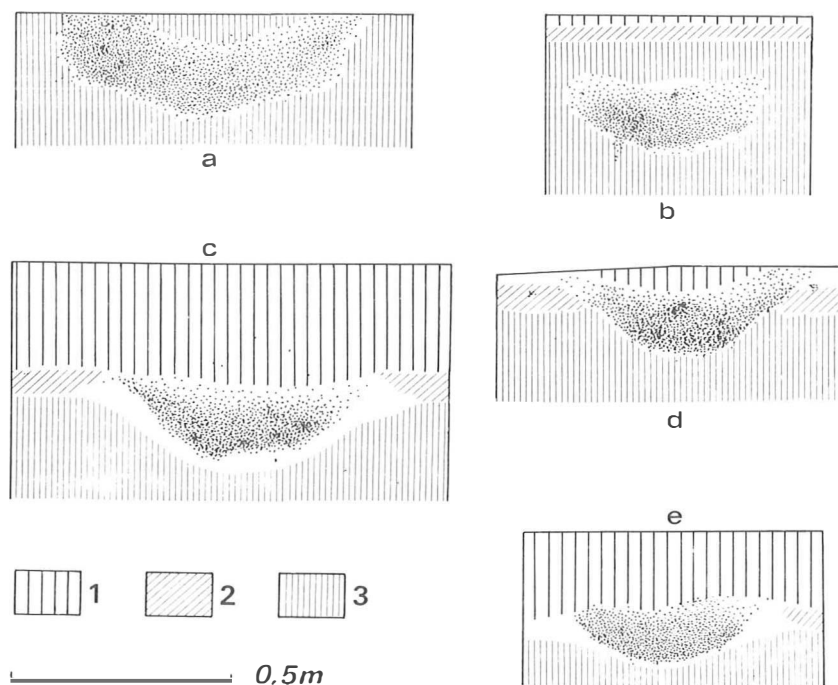


Fig. 5. Hearth-pits with an 'intact base' as they were observed in section (a, b: site NP3; c, d, e: site S51). Legend: hatched are the areas where the main horizons of the humus podzol were recognized; 1 = A2; 2 = B2, 3 = B3.

only exceptionally reach a width of 0.80 m. The diameters of Mesolithic hearth-pits outside the Veenkoloniën may exceed this maximum value. Seen from above, the base is mostly round to oval; in the latter case no dominant orientation could be found. What form the mouth of the pit possesses could not be recorded, as this zone is completely bleached by the A2 horizon. The colour of the fill of the pit may be any shade from grey to black, depending on the amount of charcoal left, often with a greenish tinge. The lower part of the pit usually contrasts sharply with the reddish-yellow of the surrounding B3 horizon, although infiltration of humic matter is often lacking in the immediate vicinity of the pit. The concentration of charcoal is densest at the base, gradually fading out upwards. In the charcoal no horizons were observed; the fill at the base of the hearth-pits offers a very homogeneous picture.

To collect information about the effort required to dig a Mesolithic hearth-pit and about the effect of burning a fire in it, experimental hearth-pits were constructed in unpodzolized coversand (Groenendijk & Smit, in prep.). Some relevant results are mentioned here. Scooping out an arm-deep shaft not only gives a depth of c. half a metre, but automatically produces a bowl-shaped base. Provided there is some draught, burning a fire of *Pinus*, after a slow start, combines a high temperature with low fuel consumption due to the construction of the shaft. Widening the shaft makes the fuel run out faster under the same conditions. After the phase of

open fire is finished, the charcoal may continue to glow for hours. Controlling the fire is much facilitated by the shape of the pit and a little wind. Where the subsoil is suitable for digging a hearth-pit (as with the unpodzolized coversands in the Mesolithic) its construction is a job that takes only a short while.

Furthermore, the experiment suggested that it is primarily the process of burning that determines how much charcoal is left rather than the extent of leaching or clearance of the hearth. The fires that were extinguished will have more charcoal remaining than those which were left to burn out.

b) *The fill of the pit.* The majority of the Mesolithic hearth-pits have a very dark-coloured base, as generally there is a lot of charcoal left. The charcoal may be encountered in fragments that retain their botanical identity, such as bits of branches, or consists of strongly fragmented material and even charcoal dust the botanical determination of which is not possible. However, not all the hearth-pits are rich in charcoal, some showing a less contrasting, grey-coloured fill with only very fine particles of charcoal left. In none of the hearth-pits was any layer found in the fill, that could be indicative for multiple use or incomplete clearance. The objection could be raised that one is unable to recognize cleared pits in field situations. This may be true as long as the charcoal was completely removed, not only from the pit but also from around the opening of the pit, and subsequently dumped elsewhere.<sup>14</sup> No clear patches of charcoal around hearth-pits

were observed in cases where the old surface around the hearth-pits was virtually intact. In fact the opposite was recorded: mere smudges of charcoal with vague contours, often observed at the top of the A2 horizon, hardly ever turned out to be hearth-pits when pursued at a deeper level. But even if clearance did take place, an impressive number of abandoned hearth-pits full of charcoal remain to be explained.

Even though clearance is unlikely, multiple use cannot be ruled out, although both phenomena can be part of the same activity. Multiple use (i.e. interrupted use) is much more difficult to demonstrate; the absence of stratification in the charcoal does not necessarily prove single use. Single use on the other hand may have extended to a length of days. The large quantity of charcoal left as a homogeneous layer in many of the hearth-pits, is an argument for the extended (single) use hypothesis. The hearths will then have been continually refuelled.

We do not know if the process of eventually refilling the pits with coversand was a natural one or was done deliberately. Mostly the sand in the upper part of the shaft appeared sterile, but it might also contain fine particles of charcoal as well as unburnt flint artefacts. In the case of unburnt flint occurring in the fill above the charcoal base one is inclined to think of a gradual refilling of the pit after the fire burnt out.

### 2.2.5. Contents

For the analysis of the contents the excavated bases of the hearth-pits were wet-sieved; a sieve of 2 mm mesh was used. Figure 6a shows what was encountered in the 111 hearth-pits from the Veenkoloniën (the few analysed hearths from beyond the study area displayed no obvious differences). Apart from charcoal, burnt flint is the main category observed; occasionally what we think to be unburnt

flint was found in very small quantities (only fissured and red-coloured flint was registered as 'burnt'; pieces without these characteristics may however have been in contact with fire too). On the whole, the category of 'unburnt flint' sinks into insignificance in comparison with the quantity of clearly burnt flint artefacts found in hearth-pits. This was to be expected, for only the charcoal bases of the hearth-pits were analysed. The observation that burnt flint artefacts dominate the lithic material found in hearth-pits (only in one hearth-pit minor fragments of sandstone were found) is a first step in the interpretation of the role of these hearth-pits within a Mesolithic site; this point will be worked out in the following.

Identifying and counting burnt flints is complicated and precarious because of fragmentation through contact with fire. Nevertheless the majority of the burnt flints could be identified; flakes and blades dominate, but cores are also found. This underlines the waste character of the flint found in the hearth-pits. Sporadically retouched tools occur: two points, two scrapers, one backed blade and one retouched blade were recorded altogether.<sup>15</sup> Probably these retouched artefacts must be considered as waste too, although the damage caused by burning does not allow a detailed examination. The small-sized waste material must have got into the fire accidentally. Virtually all flint found in the hearth-pits was heavily burnt; both a high temperature and prolonged exposure to the fire may be responsible for this. Obviously flint working was done near some of the hearth-pits while they were in use. Theoretically, the presence of flint in a hearth-pit could for a part be explained as flints, falling into the pit from the dug-out soil already containing them. However, such a situation would only account for very low numbers of burnt flint present in hearth-pits.

With figures 6b-d we aim to demonstrate that not just the total of hearth-pits containing burnt flint in

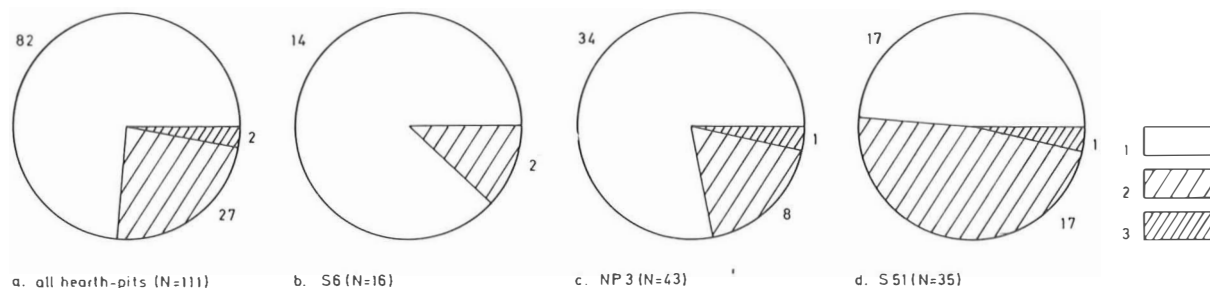


Fig. 6a-d. Diagrams of the contents of Mesolithic hearth-pits from the Veenkoloniën. Legend: 1. charcoal only; 2. containing charcoal and burnt flint; 3. containing charcoal, burnt flint and unburnt flint. The numbers represent the totals of all hearth-pits concerned. 6a: all 111 analysed hearth-pits (from 6 sites altogether); 6b, 6c and 6d: the contents of the sites S6, NP3 and S51; only sites with a sufficient number of hearth-pits have been selected for this purpose.

addition to charcoal may vary from site to site, but also that the number of burnt flints per hearth-pit may vary with the proportion of hearth-pits containing burnt flint from any single site: in the 2 hearth-pits containing burnt flint among the 16 on site S6, only 3 burnt pieces were counted altogether. Site S51 represents the other extreme; 17 hearth-pits out of 35 contained burnt flint, with an average of 12 pieces per hearth. This site, with the highest rate of hearth-pits containing burnt flint, allows a more detailed examination. The meaning of the cluster of hearth-pits on this site, presumed to be contemporaneous, has already been discussed (section 2.2.3). The burnt flint found in them, occurring in low quantities, is distributed over the hearth-pits at the western edge of the cluster. If, as suggested, the hearth-pits really functioned with only a short time interval (or even simultaneously), flint working may have taken place to the west of this cluster. The waste material then just fell into the hearths that lay nearby.

The same applies to an area in the W part of the site. There, three hearth-pits lying no more than six metres apart (though divided by an unexcavated strip), contained 116, 20 and 15 pieces of burnt flint artefacts against 5, 5 and 6 pieces for adjacent hearth-pits. Again, it is tempting to locate a flint

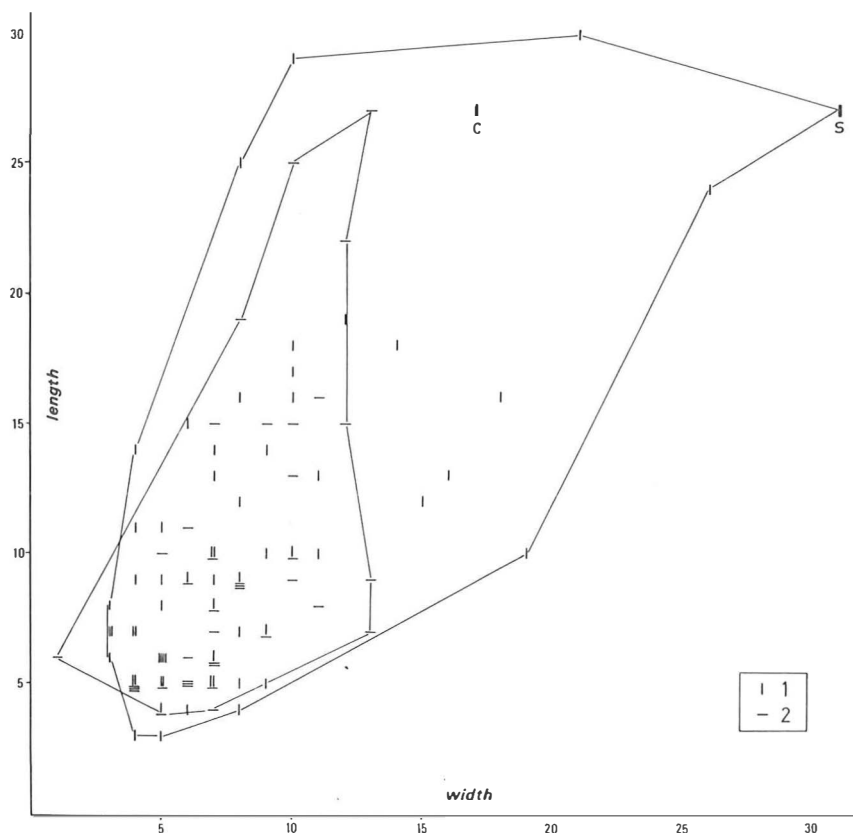
working area next to these high-scoring hearth-pits; implicitly this presupposes contemporaneity. This could still not be substantiated however: an attempt to refit the flint material did not yield positive results and none of the hearths in question has been radiocarbon dated so far. But another observation may be of importance.

Among the burnt flint artefacts from the three hearth-pits, the varying extent of exposure to fire is seen to produce a bipartition: both white-burnt, fissured pieces and fissured pieces that have more or less kept their original transparency occur. With figure 7 it can be demonstrated that:

a) Whitened, fissured pieces predominate in number over the 'fissured-only' pieces, in spite of the fact that whitened, fissured pieces are the most heavily burnt and thus would have had less chance of surviving as complete artefacts. Moreover flints of this category surpass the 'fissured-only' pieces in size. This provides an argument for the idea that more than one flint-working session is reflected in the contents of the three hearth-pits.

b) Dimensions of under 10 mm are the most numerous with both categories, emphasizing the waste character of the flint in both cases (in fact only the scraper is questionable as such).

Fig. 7. The burnt flint from the three high-scoring hearth-pits on site S51 taken together, showing the difference in length and width as well as in number of whitened, fissured flints and 'fissured-only' flints (the difference is emphasized by contouring the values of both categories, s = scraper, c = core). Measured are the complete artefacts; scale is in mm. Legend: 1. whitened, fissured flint; 2. 'fissured-only' flint.



With a bipartition in the extent of burning as well as in the size and number of the pieces from both groups, we wish to argue that on two separate occasions flint waste got into the hearth-pits while they were in use: one batch of flint was heavily burnt, the other was burnt to a lesser extent. The effect of the position of the flint within the fire with respect to temperature (referring to hotter or cooler areas in the fire) can be neglected, as the type of hearth – given a very concentrated and well-insulated fire that moreover may burn for a long time (see below) – suggests a uniform process of fissuring and discolouring of the flint; the only difference would be at what phase in the use of the hearth-pit (right at the start or at the end) the flint came into contact with the fire. If this hypothesis is right, multiple use, or perhaps rather an extended single use of these hearth-pits, long enough to cover two sessions of flint working, is indicated. The initial point of discussion, the possible contemporaneity, may even apply to this group of three hearth-pits. The levelling of the Mesolithic surface at this spot however makes a comparison with the actual flint assemblage at the surface impossible. Future radiocarbon dates may support or refute this view.

In the charcoal, *Pinus* is dominant in the Pre-boreal and Boreal hearth-pits from the Veenkoloniën. *Quercus* emerges in small quantities in the Boreal and increases only at the end of the Boreal and the beginning of the Atlantic. In the charcoal other wood species such as *Ulmus* and *Populus* appear towards the Atlantic.<sup>16</sup> This may reflect the changing supply of firewood, although *Pinus* predominates by far throughout the Mesolithic occupation of the Veenkoloniën. Of this species often large chunks of charcoal (of branches with a diameter of up to 5 cm) are encountered. We suspect a relationship between the preservation of these large lumps and the abundance of *Pinus* charcoal in the hearth-pits. *Pinus* must have been a highly appreciated fuel for many centuries because of its charcoal that keeps glowing for a long time; this indicates a preference for a slow, smouldering fire. Especially in the Boreal *Pinus* was abundant. It is a tree under which broken branches can be easily collected.

A carbonized shell of hazelnut was found in one hearth-pit only, although a more frequent occurrence could be expected because of the presence of scattered carbonized nutshells on several of the excavated sites in the Veenkoloniën. Storage of hazelnuts may have been the case with a pit in the shape of the hearth-pits under discussion, as it seemed full of complete, carbonized hazelnuts near Stadskanaal (an observation made in 1952 by J.H. Keizer, Groningen). The Mesolithic, human origin of this pit seems certain.

A material category from Mesolithic hearth-pits elsewhere, not encountered in the Veenkoloniën, is bone. The presence of human calcined bone in Dalfsen, province of Overijssel and Oirschot, province of Noord-Brabant (Verlinde, 1974; Newell, 1975; Newell et al., 1979; Arts & Hoogland, 1987) is clearly connected with Mesolithic hearth-pits. However, for the interpretation of intentional human cremation taking place in such hearth-pits, the evidence in both cases is rather thin.

Stones (as part of a stone structure within the hearth or as cooking-stones) sporadically occur in Mesolithic hearth-pits, although cooking-stones are known in Mesolithic contexts (see e.g. Arts & Hoogland, 1987 for Oirschot V; and Groenendijk, 1986 for NP3). Some of the flint 'cooking-stones' from NP3 (location: see fig. 2) showed clear traces of contact with fire, others looked unaltered, but none of them were as heavily burnt as the majority of flints found in the hearth-pits.

A distinction therefore should probably be made in the application of fire with respect to cooking-stones against the flint artefacts that were casually thrown/accidentally fell into the fire.

The most important conclusions from the sections 2.2.4 and 2.2.5 are:

- a) The hearth-pits did not include structural elements such as stone constructions.
- b) In most of them only charcoal was observed, carbonized remains of vegetable foodstuffs or calcined bone seldom occur.
- c) Some hearth-pits lay next to flint-working areas, as the flint material found in the hearth-pits is waste.
- d) This flint working apparently was done while the hearths were in use, indicating extended use of the fire; a functional relationship between the use of hearth-pits and flint working may exist, but cannot be demonstrated.

#### 2.2.6. Restriction in time

The earliest Dutch Mesolithic radiocarbon samples date from after roughly 9500 BP (Lanting & Mook, 1977; in prep.). This is in agreement with the first appearance of Mesolithic occupation in adjacent areas, such as Duvensee, Germany, which has ample radiocarbon dates (Bokelmann, 1971). These dates, slightly earlier than the Dutch ones, do not concern hearths, but culture layers and peat sediments. The same goes for Denmark, where dated hearths even are relatively young (Tauber, 1973).

For the beginning of the Mesolithic in the Netherlands, Lanting and Mook follow Newell's chronology (Newell, 1973; 1975a). It is striking to see that these earliest Dutch Mesolithic samples are taken from hearths, morphologically belonging to the type of 'Mesolithic hearth-pits'.<sup>17</sup>

Waterbolk suggests that the absence of radiocarbon dates before c. 9400 BP in the Netherlands may partially be explained by the combustibles available and their archaeological properties (Waterbolk, 1985). According to this argument, firewood of *Betula* – a predominant tree throughout the first half of the Preboreal – would leave little or no charcoal, contrary to *Pinus*. Thus we would not be able to recognize the earliest Mesolithic '*Betula*' hearths. Although the preservation of charcoal will primarily depend on the burning process, as discussed in section 2.2.4, we think there is an argument against Waterbolk's considerations. Even if we accept that *Pinus* was absent before c. 9400 BP, *Betula* is suitable for kindling an open fire only, but is no good for keeping a slow fire going as is *Pinus* (or rather, *Pinus* charcoal). This makes us turn to another of Waterbolk's suggested explanations for the lack of dates earlier than c. 9400 BP: the practice of digging pits to construct hearths did not develop until that time. It was with the first appearance of Mesolithic man in these regions, that 'Mesolithic hearth-pits' were introduced.

From the samples of hearth-pits delivered at the Groningen Centre for Isotope Research, an increase of sites in the Netherlands from the Early Mesolithic onwards (c. 8700-8200 BP) can be noticed (Lanting & Mook, 1977). This tendency will mainly reflect the traditional strategy of investigation, which was hardly directed at exploring the earliest Mesolithic sites (R.R. Newell, pers. comm.). The radiocarbon-dated hearth-pits from the Veenkoloniën suggest an increase in the number of sites, which started around 9000 BP (= Basal Mesolithic); this is slightly earlier than in the Netherlands as a whole. However, only twelve dates are available at present, a number still too small to draw conclusions.

From c. 6300/6200 BP onwards Mesolithic occupation in the Netherlands can no longer be traced (that is, younger samples have not been delivered at the Centre for Isotope Research). The reason behind this is not yet clear; it does not seem reasonable to assume that the Mesolithic just disappeared from the radiocarbon screen and proceeded without leaving any traces (J.N. Lanting, pers. comm.).

Be that as it may, it is definitely wrong to connect 'Mesolithic hearth-pits' with the Mesolithic only. Near the study area, in the *gemeente* Stads kanaal, a charcoal-stained pit, which morphologically can be ranked among the 'Mesolithic hearth-pits' was found underneath a Late Neolithic/Middle Bronze Age barrow; any association with the barrow can be excluded. Determination of the charcoal by W.A. Casparie, B.A.I. (fast-grown *Quercus*) already raised doubt as to its Mesolithic origin; besides the radiocarbon age turned out to be Middle Neolithic (4750±40 BP, GrN-15315). Thus a Neolithic hearth-pit, similar to the Mesolithic ones (and

possibly used in the same tradition) was found here by chance.

The same problem may be involved at the De Leien-Wartena settlement Bergumermeer S64, province of Friesland (Aarts, in prep.; Newell, 1980; Lanting & Mook, in prep.; and R.R. Newell, pers. comm.). A diversity in hearth-pits was noticed both on the site and after laboratory analysis; yet a group of 'Mesolithic hearth-pits' could be isolated. A part of the radiocarbon dates from this group proved to be younger, namely from Early/Middle Neolithic to Iron Age.

These examples may show that setting cultural boundaries for the use of 'Mesolithic hearth-pits' does not make sense, unless we know more about their use and function within a site. Partly due to the fact that most Neolithic excavations focus on house-plans and funerary rites, the type of the 'Mesolithic hearth-pit' gradually slips out of view. The tradition of using this apparently successful type of hearth may however have survived long after its 'Mesolithic' application.

### 3. TOWARDS A FUNCTIONAL INTERPRETATION

#### 3.1. Outside the domestic area

It has been argued that the Mesolithic hearth-pits discussed here probably reflect only one type of hearth present on Mesolithic sites in the Pleistocene coversands of the Northwest-European Plain, in spite of their numerosity and the great number of sites that include these hearth-pits. Surface hearths, especially those lacking resistant structures like stones, exposed to the weather, may have been easily eroded by the wind and become 'invisible' in the archaeological record. Of their actual presence in the study area hardly anything is known, nor have they been described from other Mesolithic sites in the Netherlands.

The nearest examples of Mesolithic hearths of a different type have come to light at Duvensee, northern Germany (Bokelmann, 1971; Bokelmann et al., 1985; Bokelmann, 1986). Their central position in 'domestic' contexts (viz. associated with bark floors and flint artefacts concentrated around or near the hearths), as well as their construction as surface hearths and their multiple use (as indicated by the clearing zone around the 'big' hearth from *Wohnplatz* 13), rank this hearth-type among what might be called 'domestic hearths', in contrast with the hearth-pits under discussion and in spite of the fact that the excavator explicitly suggests an open-air location for the 'big' hearth of *Wohnplatz* 13 (Bokelmann, 1985).

With the Early Boreal Duvensee hearths in mind, we consider the lack of 'domestic' hearths in the

Dutch Mesolithic so far to be due to an observation hiatus in connection with the very different conditions of preservation. Nevertheless the fact that the Duvensee hearths were built on top of wet organic deposits should not be neglected. It is an open question to what extent the subsoil determined the type of hearth used.

We wish to put forward here that Mesolithic hearth-pits, other than 'domestic' hearths, lay outside, or at least not at the centre of, a domestic area (hut, tent or living floor).

Several arguments support this hypothesis. In the first place, with the Mesolithic hearth-pits we miss elements that characterize hearths which are part or the centre of a domestic unit, such as a peripheral zone with charcoal (clearing zone) and worked flint, indicating activities around the fire that include flint working (in the acid coversands other materials such as bone have only sporadically been preserved). Besides, 'domestic' hearth-pits as a rule would have contained flint waste, and not incidentally as they do now. Nor were any structural elements observed, as in the case of Late Palaeolithic, presumably domestic hearths, such as a stone lining or stones in the hearth-pit itself. The shape of the hearth-pit will not have necessitated any additional stone structure.

Moreover, Mesolithic hearth-pits are not morphologically suited to use in a domestic area, where one would expect a fire burning at or near the surface, well accessible and able to radiate heat. The form of a hearth-pit is fundamentally different and produces an encased fire. The relatively deep shaft does not fit in with the use in a domestic unit (presumably protected against the winds somehow, while hearth-pits need at least a little wind). It hardly radiates any heat. One might perhaps put it the other way around: because of their location in the open air the fires were protected against too much wind by burning them in deep pits. In this light, the separate location is likely to have been tied to peripheral activities.

For Mesolithic hearths that include (some of) the 'domestic' elements we thus have to turn to Duvensee. The Late Palaeolithic hearths listed in section 2.1 may in the same sense be considered as 'domestic', i.e. associated with a hut or tent structure. They are surface hearths, include flint working around the hearth, stone structures and clearing zones with charcoal. For a 'domestic'/'non-domestic' comparison to test this hypothesis, Late Palaeolithic data unfortunately are lacking for the Northwest-European Plain.

Secondly, the observed contemporaneous clustering of hearth-pits suggests a location outside the domestic area as well. It is the extent of the cluster areas as well as the scarcity of transections that point in this direction. Even if the clusters were

formed during several visits to the camp site this argument is valid, for it is reasonable to expect that in the limited space of a domestic area a hearth would be used again and again instead of new adjacent ones being constructed.

Re-occupation of a camp site apparently did not entail the clearance of hearth-pits. It may have been the ease of digging a new pit in the loose coversand compared to clearing an old pit why the latter was avoided. Instead, old pits may have been filled up deliberately for other, e.g. hygienic reasons. This raises the question of whether in the case of a seasonal re-occupation of the camp sites in the Veenkoloniën, the remains of abandoned domestic hearths within domestic units were incorporated into the new camp site, including clearance of old hearths. This question cannot be answered now through lack of appropriate analyses of Mesolithic sites, but would be of great importance to testing the suggested distinction of 'domestic' and 'non-domestic' hearths in the Mesolithic.

### 3.2. Functional aspects

The specific construction and the prevalent use of *Pinus* firewood over thousands of years, supposes a firm tradition in the use of hearth-pits that correspond with a slow-burning fire.

Our hearth-pit experiment showed that a short phase of open, fierce fire could soon be followed by a long phase of actual use with live embers, the duration of which depended on the strength of the wind. The experimental roasting of food (in our case: hazelnuts) needed a smouldering fire and in fact only the surrounding sand thus heated was found useful for roasting. Bokelmann et al. (1985) came to the same conclusion with respect to roasting technique with the 'big' hearth of *Wohnplatz* 13. With these remarks on experimental roasting, based on the fact that carbonized hazelnut shells are sometimes encountered in Mesolithic hearths, a first interpretation in terms of use is already given. Not only does the taste of hazelnuts improve by roasting, it makes conservation possible till the next harvest. The hazel does not emerge before the end of the Preboreal, so that the idea of storing hazelnuts could only have come up since that time. Nevertheless the roasting of hazelnuts is not associated with hearth-pits only, as is clearly shown by the Duvensee surface hearths. Here too it could be demonstrated that consumption of unroasted hazelnuts must have been the practice as well (see the 'small' hearth, *Wohnplatz* 13).

Mesolithic hearth-pits however do not seem to be 'designed' for food preparation exclusively. The smoking and drying of non-food objects (e.g. hide smoking and the drying of animal and vegetable foodstuffs) can be mentioned as another possible

application. Further, the roasting of meat (and smoking of meat as a preservative?) must be seriously taken into consideration. Possibly the size of the shaft was varied according to the application. Whether the object was placed above the fire, into the glowing embers or into the underlying heated sand, in all cases the great advantage over a surface hearth is a highly controllable fire, giving a moderate, even heat for an extended period. As a further technical advantage procedures can be facilitated by placing stakes over the fire into the wall of the shaft at varying distances from the fire. The technology of storing seasonal resources may have developed parallel to roasting for immediate use.

The archaeological evidence in the Netherlands offers little perspective on other explanatory application than food processing. Nevertheless, a continuous fire at a camp site actually may have stimulated multiple applications. Indeed it may have been necessary to have more than one hearth in use at the same time, which could explain the presence of clusters. This should be a point of further investigation; detailed study of the contents of Mesolithic hearth-pits in other areas, and in the Veenkoloniën a further examination of the burnt flint artefacts from hearth-pits and the question of whether flint working can be associated with them, may offer clues to this suggested multiple function. Activities connected with the use of fire, which perhaps needed more space than was available within the domestic unit, or were thought too messy or generated too much smoke to be performed within, may have played their role in demarcating an area of specialization involving the use of fire outside the domestic area. We can not corroborate this supposition with archaeological evidence. The possibly relevant flint material has not been spatially analysed until now, and the study of micro-wear traces on flint artefacts from the Veenkoloniën has proved unsuccessful, considerable mechanical wear after site abandonment being the reason (information provided by A.L. van Gijn, Instituut voor Prehistorie, Leiden).

### 3.3. Conclusion: a new type of hearth?

Especially for food processing a deep, shaft-like pit with a smouldering fire at its base constitutes an enormous improvement over surface hearths. A surface hearth on the whole makes for a rather inefficient use of fire, combining high fuel consumption with low return. In surface hearths heat can only be retained by means of (a structure of) stones and always needs protection against weather influences. Not so hearth-pits. Their dependence on atmospheric conditions basically will be confined to the starting phase, when a bit of wind is required. Arriving at the stage of glowing embers, the fire can

stay unattended for a while, food being processed above or in it; only reloading with fresh firewood entails an interruption as the wood has to pass through the stage of forming charcoal again. The success of this type of hearth is evident from the extremely high numbers encountered in the North-west-European Plain and the apparently long life of this hearth-pit tradition.

Does the Mesolithic hearth-pit constitute an innovation, emerging in the second half of the Preboreal? With a glance at the excavated Late Palaeolithic hearths from the Northwest-European Plain one is inclined to think so. Our tentative comparison with Late Palaeolithic surface hearths is based on incommensurable data however. Yet some indirect arguments in favour of the emergence of a new type can be mentioned. Let us therefore put the question the other way around: were environmental conditions in the Late Palaeolithic favourable for using hearth-pits? Climatic change for one thing is unlikely to have altered the coversand subsoil in a way to affect the digging of pits for fires. The composition of the topsoil and the vegetation on the camp location are liable to have played a more decisive role.<sup>18</sup> These circumstances were not unfavourable for the use of hearth-pits in the Late Palaeolithic. The absence however of plant food resources that would have stimulated food processing for storage may serve as an argument to suggest a Mesolithic origin. With food processing still regarded as the main objective of the use of hearth-pits, the Mesolithic environment offered an extending range of small-sized edible items, both of floral and faunal origin, perhaps consistent with fires in narrow pits. This implies that the size (or more specifically the width of the shaft) of the hearth-pit may depend on the type and size (of the pieces) of the food prepared. Hearth-pits may thus reflect changing environmental conditions, in that their form may follow the function of the hearth.

A continuation of Late Palaeolithic traditions in the use of fire (i.e. 'domestic' hearths) might be present in the Mesolithic Duvensee hearths. For the investigated area we lack such information. The absence of hearth-pits in a Late Palaeolithic context is suggested by the archaeological record and is supported by indirect arguments of an environmental nature. Seen from this point of view the quest for the oldest 'Mesolithic hearth-pit' has become relevant.

Concerning the role of hearth-pits within the range of activities on Mesolithic camp sites some tentative ideas were put forward, especially with regard to their location outside the domestic unit(s) proper, as well as to their extended burning for special purposes. Finding out to what extent these reconstructions are valid must be one of the objectives of future study.

#### 4. ACKNOWLEDGEMENTS

The discussion about Mesolithic hearth-pits actually started when in 1984 excavations at several Mesolithic sites yielded an impressive number of hearth-pits. When in the text the 'we' form is used, this is done in recognition of the many discussions I had with my fieldwork comrade John Smit (Wildermark), who critically followed the subject culminating in a hearth-pit experiment (1986); but I remain solely responsible for the content of this article. During the writing of this paper J.N. Lanting and R.R. Newell (B.A.I. and B.A.I./SUNY, Binghamton) kept me from the worst slip-ups. I wish to thank the Centre for Isotope Research, Groningen University, for rapidly providing me with some radiocarbon dates, and W.A. Casparie (B.A.I.) for the determination of the charcoal. The English text was corrected and in parts translated by Xandra Bardet (Groningen).

#### 5. NOTES

1. In his survey of Mesolithic and Neolithic settlements in the northern Netherlands, H.T. Waterbolk draws attention to the occurrence of Mesolithic hearth-pits (Waterbolk, 1985). Some of his remarks on the subject have prompted me to investigate this subject in greater detail, and to take the many hearth-pits uncovered in the Veenkoloniën as the starting-point for this contribution.
2. The geomorphological aspects of research into the Mesolithic occupation are part of a study prepared by the author, dealing with the landscape and settlement history of the redevelopment area 'Herinrichtingsgebied Oost-Groningen en de Gronings-Drentse Veenkoloniën'. The Veenkoloniën are part of this area (for some of its geomorphological aspects see Groenendijk, 1988).
3. On the site NP3 we gathered detailed information on the vertical distribution of flint artefacts. A flint concentration lay partly undisturbed under a residual layer of raised bog. From the top of the coversand dune down to the B2 horizon of the podzol profile the distribution of artefacts was recorded with reference to their frequency and size. The following depths are mean values: from 0-5 cm (A2 with secondary infiltration of humic matter in the upper 2 cm) only some splinters of flint were encountered; from 5-7 cm (A2) the number of artefacts increased but they remained under 1 cm in size; from 7-9 cm (A2 down to transition B2) a sudden increase in number and size was observed and from the top of the B2 downwards (9 cm and lower) only sporadically artefacts were found, though both larger pieces and splinters occurred at this level. This distribution in our opinion indicates a long period of bioturbation after the camp site was abandoned; sedimentation apparently did not take place.
4. An exception must be made for the Mesolithic site S6, situated near a stream valley (the Pagediep), part of a drainage system that is likely to have become frustrated not until the second millennium BC (unpublished research). In this valley peat growth started much later than elsewhere in the Veenkoloniën because of a better natural drainage. Besides Mesolithic flint material and Mesolithic hearth-pits, further investigation also brought to light Neolithic flint artefacts.
5. The interpretation of the shape of the hearth is on the account of the present author; the original publication merely contains a section drawing of it.
6. This dating corresponds with that of the Usselolayer in the Netherlands, although for an Ahrensburgian hearth a younger date would be expected.
7. This interpretation of the zones is the present author's view.
8. For instance, at the Magdalenian site of Pincevent in the Paris Basin 'satellite hearths' were encountered at some distance from the 'domestic hearths' which they were associated with. They differed from the latter in their morphology and function (Julien, 1984).
9. On the investigated sites in the Veenkoloniën other features are possibly associated with fires. These are: (a) heterogeneous, shallow 'pits', presumably man-made, with smudges of charcoal; (b) high concentrations of burnt flint artefacts without hearth-pits. An example is site NP3 (fig. 2) with flint concentrations in the extreme NE and SW, both with a clear centre and associated with charcoal, but in different ways: the NE concentration with a 1.5 m wide depression including a central pit specked with particles of charcoal, the SW concentration with particles of charcoal around the level of the old surface in a density that exceeds the general degree of charcoal pollution at the site.
10. The homogeneous nature of Mesolithic hearth-pits is contested by R.R. Newell on the grounds of his analytical data concerning the total amount of ground features that may occur in a single site: by means of this ground feature analysis, including all hearth-pits, he recognizes a differential use of fire within settlements (R.R. Newell, pers. comm.; Aarts, in prep.; see also Newell, 1975; 1980). In view of the fact that so far no complete Mesolithic sites have been excavated in the Veenkoloniën, such an analysis cannot be performed here. However, there has been extensive coverage in the form of field observations and the number of hearths thus found is considerable. Therefore a different approach has been opted for in this case. From among the ground features within the investigated area only the Mesolithic hearth-pits immediately recognizable in the field as 'classical' specimens (see section 2.2.4) were selected, and these have been analysed on a number of relevant points (see section 2.2.5).
11. An example of the latter is Havelte-De Doeze, province of Drenthe (Price, 1975). There the few radiocarbon samples dated so far from six adjacent, but separate Mesolithic sites were not in accordance with the typological assignments of the flint tools found in them.
12. Once contemporaneous or even simultaneous use of Mesolithic hearth-pits on one site can be deduced from the archaeological evidence, these clusters could act as a cross-check for the application of the calibration curve for the period in question. In that case all hearth-pits of a cluster should be radiocarbon dated. For the clusters under discussion this has not yet been done.
13. T.D. Price has suggested that infra-red photography could be a help in distinguishing otherwise invisible minor organic particles in the dark brown B2 horizon or the bleached A2 horizon of features in podzolized coversands. Thus the shape of a feature may be reconstructed up to the original surface level (Price, 1975). We did not apply this method in the Veenkoloniën.
14. For a charcoal dump we possess an indication at site WV10, gemeente Veendam, where carbonized branches of *Pinus* were found without evidence of a hearth-pit (Groenendijk & Smit, 1984/85).
15. Radiocarbon dating of hearth-pits in which tools are found could give a *terminus ante quem* for the artefact type. This has not yet been systematically studied; the tools found so far do not allow a narrow chronological attribution.
16. Determinations and provisional conclusion by W.A. Casparie (B.A.I.).



17. We can add an early radiocarbon date from such a hearth-pit in the study area (*gemeente Hoogezand-Sappemeer*) of  $9470 \pm 70$  BP (GrN-11996).
18. The same may apply to wet organic sediments as at Duvensee. Using hearth-pits in the way as was current in coversands, in a wet subsoil is likely to fail. In this context, further study of Mesolithic hearth-pits dug into different soil types would be very useful.

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