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STATISTICS AND GRAPHS IN THE STUDY OF FLINT  
ASSEMBLAGES

III. *A Preliminary Report on the Statistical Analysis of the Mesolithic in North-western Europe*

(pl. II; figs. 6-7)

THE TYPES

The exact distinction of microliths from macroliths is not without difficulty. For some forms absolute size is not decisive. One finds, for example, finely worked points, or small blades with blunted back which are identical in length to middle-sized Gravette points of the Perigordian, but which in a Mesolithic industry would without doubt be reckoned as microliths. The same applies to very long, thin triangles. In these cases the whole *habitus* is decisive. It is our experience that large microliths are most readily distinguished from macroliths not so much by their length or breadth as by their thickness. A small but thick implement even when finely worked is generally not to be considered as a microlith. For various kinds of flint the boundary lies between 3.5 and 4.5 mm. To establish an objective distinction we suggest fixing the boundary at 4 mm.

Among the group of microlithic points we distinguish between very narrow types, with a width-length ratio of less than 1:5, and broad types. The very narrow types are further divided into lanceolate points (Dutch: *lancetspitsen*; Ger.: *Lanzetspitsen*; Fr.: *Pointes lancéolées*), with one edge steeply retouched and needle-shaped points (Dutch: *naaldvormige spitsen*; Ger.: *nadelförmige Spitzen*; Fr.: *pointes aciculées*) with two steeply retouched edges. In both these types there is only one clearly defined point; the lower end is rounded or unretouched. Double points (Sauveterrean points) have, in contrast, both ends intentionally worked to a point, and in most cases are also retouched on both edges. Double points may, however, have a width-length ratio greater than 1:5.

Two intentionally pointed ends also occur on the double points with surface retouch (Dutch: *dubbele spitsen met oppervlakteretouche*; Ger.: *Doppelspitzen mit Oberflächenretusche*; Fr.: *doubles pointes à retouches empîétantes*).

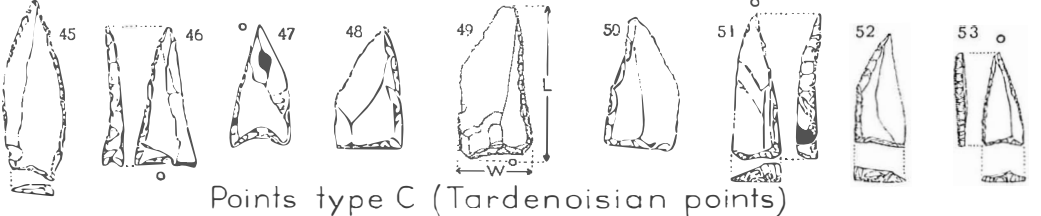
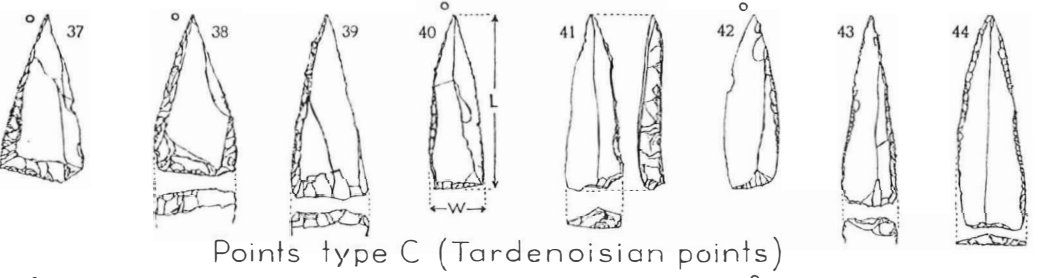
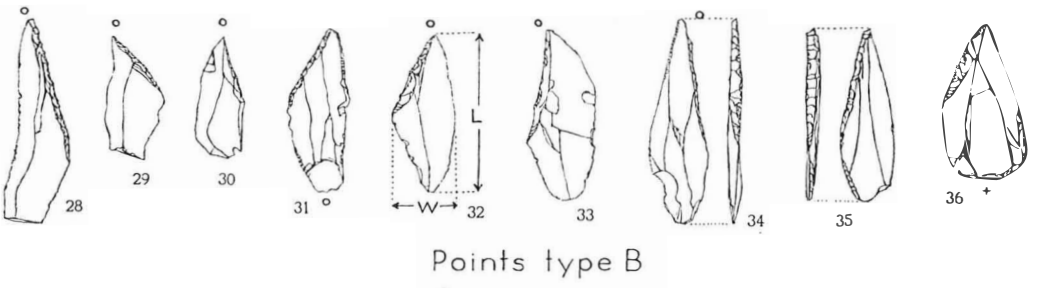
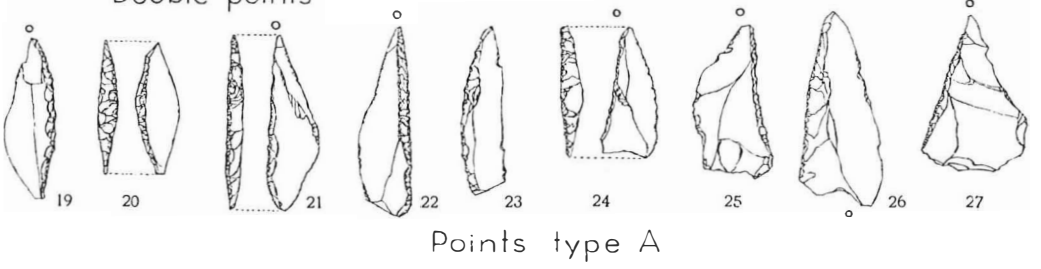
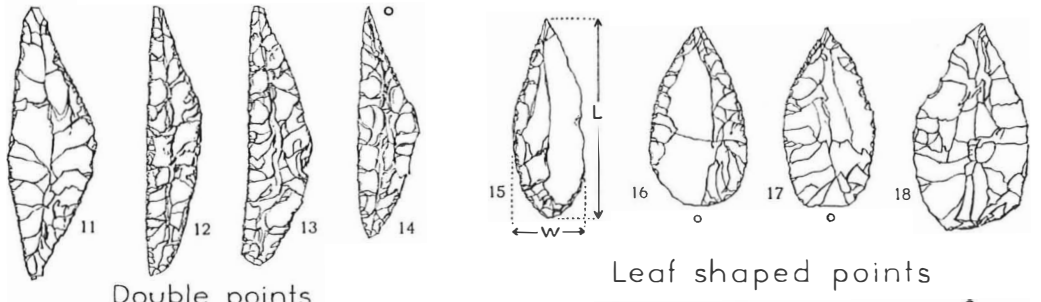
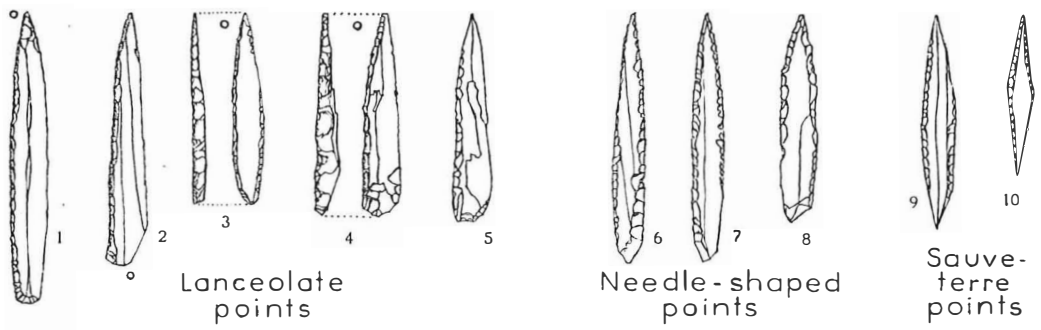


Fig. 6

For the most part these have a very distinctive form, with one or two rather convex edges and one rather blunt or rounded point.

In the group of broader points we include the leaf-shaped points (Dutch: *bladvormige spitsen*; Ger.: *blattförmige Spitzen*; Fr.: *pointes foliacées*). These are more or less symmetrical, with the point on the longitudinal axis, and have a rounded lower end. They occur with or without surface retouch.

Points of Type C (Tardenoisian points) (Dutch: *spitsentype C*; Ger.: *Tardenoisspitzen*; Fr.: *pointes de Tardenois*) are also more or less symmetrical. They are triangular, with a straight or somewhat concave base which is always retouched. Basal retouch may also occur on the bulbar face. Retouch may occur on one or both of the edges.

The points which we distinguish as Type A and Type B are less typical than those previously described. They are mostly asymmetrical and have always one steeply retouched edge. In the points of Type A the edge-retouch extends to the base. In the points of Type B it does not; the retouch stops short of the base, and the unretouched portion of the edge often makes a more or less distinct angle with the retouched portion. Absence of the angle does not, however, remove the point from Type B, as long as there is an unretouched portion of the edge. On neither of these types is there ever basal retouch. Type B can be distinguished from a short blade with diagonally retouched end by the thickness of the base, or through the form of the bulb of percussion. Points cannot have a thick bulb of percussion at the lower end, since a thick bulb would prevent its being attached to a shaft and used as a point. In most cases the lower end of a point is the thin lower end of the original flake or blade from which it was made. In both types of point the lower end may be a narrow or naturally pointed end, or it may be broad, for example a broken-off blade end. In the latter case the point will tend to be triangular in form. There is, however, never a retouched base. This permits the more triangular points to be distinguished at once from Tardenoisian points. The larger and wider points of Type B have often been classified with the Zonhoven points.

Triangles are divided into isosceles and scalene triangles (Dutch: *gelijkbenige en ongelijkbenige driehoeken*; Ger.: *gleichschenkelige und ungleichschenkelige Dreiecke*; Fr.: *triangles isocèles et scalènes*). In both types there must be three distinctly worked angles. It is not always easy to distinguish rather long and symmetrical triangles with a basal angle approaching a right angle from Tardenoisian points. In such cases the thickness becomes a criterion. Tardenoisian points show

Fig. 6: 1, 2, 3, 32 de Leien; 4, 20, 23, 33, 34, 35, 39, 42, 44, 45 Venlo; 5, 6, 8 Elmer See; 7 Detmold; 11 Oirschot; 12, 13, 15, 16, 17, 18, 26 Sweykhuisen; 14 Ermelo; 19, 27, 37, 41, 43 Luiksgestel; 21, 22, 24, 25, 28, 31, 38, 40, 49, 52, 53 Hulshorst; 29, 30, 36 Haule; 46, 51 Bakkeveen; 47 Appelscha; 48, 50 Klein Heppach.

no great variation in their thickness at the base, which is usually thin to facilitate shafting. With the triangles, on the contrary, the thickness at the base is often much greater at the angle with the retouched side than it is on the angle with the unre touched side.

Triangular implements with one natural end which is not deliberately pointed, *i.e.* without three clearly defined angles, are not counted as triangles, but as triangular blunted-back blades (see below).

Crescents (Dutch: *segmenten*; Ger.: *Kreisabschnitte*; Fr.: *segments de cercles*) always have two distinctly worked pointed ends and an arched back.

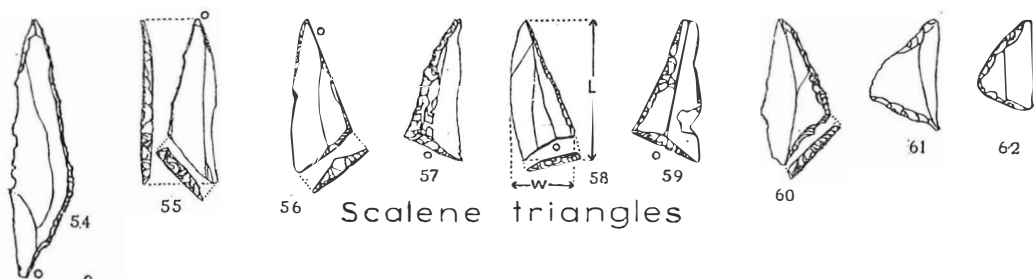
We suggest dropping the terms 'trapeze', 'Zonhoven point with basal retouch', and 'querschneidige Pfeilspitzen' and substituting for all these the name trapezoids. We found it impossible, for example, to separate Zonhoven points with basal retouch from trapezes.

The trapezoids are most readily subdivided by regarding them purely geometrically, orienting them so that the longer unretouched edge forms the horizontal base. Then we have in the first instance those with a width greater than their height, and secondly those with a height greater than their width. The latter are called narrow trapezoids (Dutch: *hoge vierhoeken*; Ger.: *hohe Vierecke*; Fr.: *trapèzes plus hauts que larges*). The trapezoids with a greater length than height can be subdivided into (a) trapezoids with two acute basal angles, (b) trapezoids with one or two basal right angles and (c) trapezoids with one obtuse basal angle. This gives us four clear and easily distinguishable varieties of trapezoid.

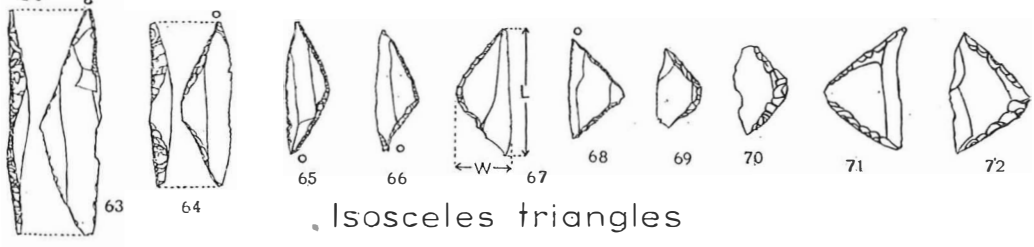
Microlithic blunted-back blades (Dutch: *mesje*; Ger.: *Messerchen*; Fr.: *lamelles a dos abattus*) have a thickness of less than 4 mm (if thicker they are classified as macrolithic). One or both ends may have straight or diagonal retouch; if so they belong to a distinct group, blunted-back blades with retouched end. Some of these have a more or less triangular form, with the diagonally retouched end distinctly broader than the other end, which is usually the natural end of a blade. The bulb of percussion was thus in the direction of the diagonally retouched end. If the natural end becomes pointed as a result of extended retouching of the blunted edge, the form becomes that of a scalene triangle; if not, it is a triangular blunted-back blade. This permits a rather precise distinction between the two types.

Points thicker than 4 mm may be subdivided into the types described in Part II (p. 7-11), should they occur in significant numbers in a microlithic industry.

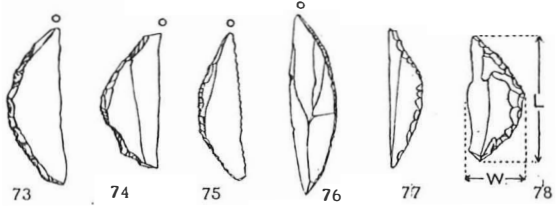
Fig. 7: 54, 57, 58, 63, 69, 70, 95, 96 Haule; 55, 58, 74, 76, 79, 80 Venlo; 56, 64, 65, 68, 83, 85 Hulshorst; 59 Appelscha; 60, 73, 75, 89, 98, 99 Luiksgestel; 61, 62, 88 Kappelberg; 66, 67, 86, 87, 93, 100, 102, 103, 104, 105, 106, 107 de Leien; 72, 94 Klein Heppach; 81 Oirschot; 82 Ermelo; 84, 92, 97, 101 Bakkeveen; 77, 108, 109, 110 Springbjerg; 90, 91 Montfort.



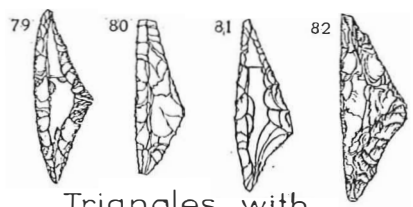
Scalene triangles



Isosceles triangles



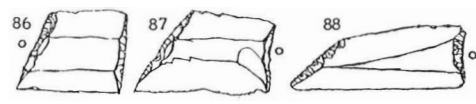
Crescents



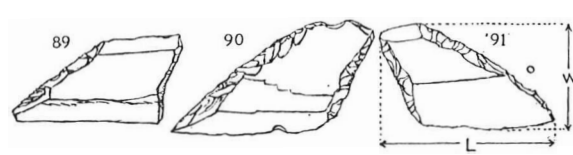
Triangles with surface retouch



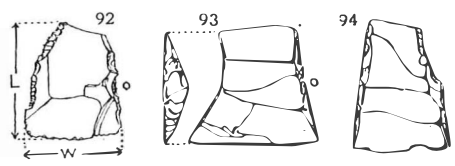
Trapezoids with 2 acute basal angles



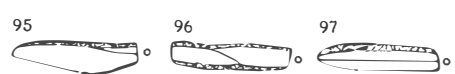
Trapezoids with 1 or 2 basal right angles



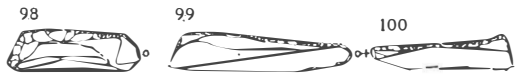
Trapezoids with 1 basal obtuse angle



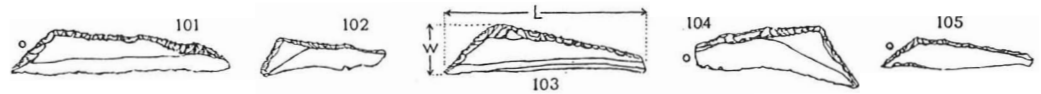
Narrow trapezes



Microlithic blunted back blades



Microlithic blunted back blades with retouched end



Triangular blunted back blades

Fig. 7

Here, since they are rather rare, they are all treated as one group. The same applies to the gravers.

As borers we have grouped all implements with a borer-like form, including the so-called reamers (Dutch: *opruimers*; Ger.: *Räumer*; Fr.: *alésoirs*). In the Mesolithic we find many atypical borer-like points; these are all counted together.

Scrapers are classified as in the Palaeolithic (p. 15) with the addition of one typically Mesolithic form, very small and circular, and not more than 17 mm in length, called micro-scrapers.

Notched blades and truncated blades are classified as in the Palaeolithic. It should be noted that there are often small notched blades which can be regarded as unsuccessful products of the 'micro-burin technique'. For the most part they have a small but deep notch on one side just above the bulb of percussion. The 'micro-burins' are counted but not further distinguished.

Small blades with diagonally retouched end are often difficult to distinguish from points of Type B. The presence of a thick bulb of percussion eliminates such specimens from the category of points, since these, for shafting purposes, must have a thin lower end, with at most a very shallow bulb; any with a thick lower end are classified as blades.

Core axes, flake axes, and triangular implements are not further differentiated in the present publication, partly because we are here concerned principally to explain the method, but also because they are rare in the sites here described.

In the tables which will be provided in the forthcoming full publication the counts will be given for cores, core scrapers, core gravers, the various types of blades. Here these types are also omitted from the graphs.

#### THE MEASUREMENTS

From a functional point of view, one of the most important characteristics of a microlith is the angle of its point. There is normally a relationship between this angle and the width-length ratio; the broader the implement, the wider the angle. There are however exceptions, as for example the narrow Points of Type B with a wide point-angle, or the broad Points of Type A with a narrow point-angle. But this angle is often difficult to measure exactly since the sides are often curved rather than straight, and we therefore prefer to make use of the width-length ratio, which is easily measured. The width-length ratios are given in the graph, grouped with 1-5 as the unit. The manner of measurement of the various types is shown in Part I (p. 3) of this issue.

If one does not wish to record the exact ratio for each individual implement (which in most cases is not really necessary) one can for quickness and convenience use the measuring instrument shown in Part I (p. 3), which is best made of cellu-

loid. It enables the implements to be placed in size-groups without recording the exact ratio of each. In using this method it is unnecessary to distinguish between the different kinds of triangles (*e.g.* narrow or broad, isosceles or scalene), which greatly reduces the number of types.

It may at times also be desirable to treat the points and triangles as one group, so as to obtain a general impression of the width of the implements of a culture; this is useful if the volume of available material is small. The graph shows, however, that there are significant differences between the width of triangles and points, and they should therefore normally be separated. As the graph shows trapezoids must always be dealt with separately.

For the blunted-back blades, which are always very narrow and have no distinct point-angle, the width-length ratio is not so important, and is replaced by the measurement of the absolute width, grouped in units of 2 mm.

For all implements, the absolute dimensions are important. Here we give the lengths, grouped in units of 5 mm. They may be measured with the same instrument as is used for the width-length ratio.

For the dimensions of macroliths we have singled out the scrapers, and give the extremely important scraper-angle, grouped in the graph in units of 10°, and one absolute dimension, the length. The width, thickness and side-retouch are probably less important for the Mesolithic, but these dimensions will be given in the table.

For evaluating the quality of the raw material and the technique of blade, flake and microlith production, the dimensions and types of blades are important. The graph gives only the length and breadth of unbroken blades; the Table will also give the types and when necessary the thickness.

#### EXPLANATORY NOTES ON THE GRAPHS

1. The percentages of the types of the macroliths are given in relation to the total number of implements. The total number of counted and measured implements is indicated on the graph. The uppermost figure gives the total number of microliths, the next the total number of macroliths, and then follow the totals of the various types counted separately.

2. The percentages of the types of microliths are given in relation to the total number of microliths only.

3. For the implement-types, one graph-square represents 5%; for the indices and all other counts, 10%.

4. The indices are calculated as follows:

$$\text{index of points} = \frac{\text{points} \times 100}{\text{total number of microliths}}$$

The indices of triangles, trapezoids, blunted-back blades and implements with surface retouch are calculated in the same manner.

5. In the full publication the percentages for each of the graphs will be given in a table.

#### NOTES FOR THE INTERPRETATION OF THE GRAPHS

The Mesolithic finds of this region are, more often than its Late Palaeolithic finds, surface collections from areas of heath reclamation, ploughed fields, or dune areas. Mostly they occur spread over a considerable area, and not in very distinct concentrations. The possibility of such sites containing a mixture of cultures, especially in sites in areas which were comparatively densely settled in Mesolithic times, is therefore considerable. Furthermore, these sites contain proportionately fewer retouched, measurable and countable implements, and a higher proportion of waste material, than those of the Late Palaeolithic. In order to have available for counting at least 100 microliths (the minimum number needed) one generally must have a collection of 1000 to 1500 pieces or more, collected from a surface which is clearly defined and not too extensive, *e.g.* at the most 10000 sq.m. Even so, one must reckon with the possibility of mixture; which is of course equally true of sites which are excavated.

The graphs presented here represent a selection of the best and richest sites from the Netherlands. Of these, Haule, Luiksgestel, de Leien and Oirschot were excavated partly by the writers; the others are surface collections. The least reliable are Hulshorst and Bakkeveen. The German and Belgian sites are surface collections; of these the best have been chosen. The Danish Sites were excavated.

In examining the graphs we may note that the two Danish sites, Bindeballe and Springbjerg, contrast greatly with those from the Netherlands (Bakkeveen, Appelscha and Haule in the North, Hulshorst in the centre, and Oirschot, Swaykhuizen, Luiksgestel and Venlo in the South), Belgium (Overpelt) and Germany (Klein Heppach and Kappelberg in the vicinity of Stuttgart, Thalmässing near Nürnberg, Drüffelbeck near Brunswick, Elmer See near Cuxhaven). Briefly summarized, the differences are:

1. The Danish sites have core axes, flake and triangular implements; the others (with the exception of Drüffelbeck) do not.
2. The Danish sites have graves, the others (again, except Drüffelbeck) do not.
3. The Danish sites have many large triangular blunted-back blades, the other sites have fewer and smaller ones. Unfortunately the length measurements from Springbjerg were not completely carried out, and are therefore not included in the graph.
4. The Danish sites have no points type C (Tardenoisian points) (the count of the point-types was not completed and is not graphed) while all the other sites do.



De Leien in Friesland (Netherlands) is, however, exceptional among the sites outside Denmark and Schleswig-Holstein, as had already been recognized by J. Siebinga. De Leien has graters, core axes, flake axes, triangular implements, and many long blunted-back blades; Points type C (Tardenoisian points) are present only to the extent of one piece.

A few sites are also known in the southern part of the Netherlands with graters, core and flake axes, triangular implements, and a microlithic inventory with many trapezoids and without Tardenoisian points. A typical example is a site near Kessel-Eyck in the province of Limburg. From this site we have at present 52 microliths and 64 macroliths, which are not enough for a graph. In general the proportions correspond with De Leien; but there are more long trapezoids and the scrapers are somewhat larger. An excavation is planned. For De Leien there are C<sup>14</sup> date of  $69\ 60 \pm 140$  (Gro 685) and  $69\ 90 \pm 65$  (Gro 1683).

A second more general observation to be made from the graphs is as follows. In the South German sites Klein Heppach, Thalmässing and Kappelberg the percentages of types of implements are not essentially different from the other non-Danish sites. The proportion of points, including Tardenoisian points, is about the same. This is also true of the triangles, trapezoids, and blunted-back blades. Even the scrapers, blades and micro-burins are in agreement; and in both regions we find sites with few trapezoids and sites with many. Nor are there any distinct types at the South German sites which do not appear in the Northwest.

But if we compare the dimensions of the implements from these South German sites with those of the Northwest, we at once perceive a very great difference. In the Northwestern sites, and also in the Danish ones, for the points and the triangles, the width-length ratio has its peak distribution between 1:5 and 2:5, and secondarily between 2:5 and 3:5, compared to 2:5-3:5 and 3:5-4:5 for the South German sites. For the trapezoids, the width-length ratio shows a somewhat more emphatic peak between 2:5 and 3:5, compared with between 3:5 and 4:5 for the other sites. The graph also shows that in the South German sites the absolute length of all microliths is shorter than in the other sites.

Without going into detail here, it appears to us that this difference is not to be attributed solely to the difference in the available raw material. The South German artefacts are made of a *Jurahornstein* which is coarser than the flint of the Northwest. In the full work a larger number of sites will be measured, and the problem of the blade-material will be gone into in detail. For this problem the length and breadth dimensions of the unbroken blades in the various sites and site-groups is of particular importance. It appears even from the counts and measurements of the larger South German sites presented here, that there will be more than one variant in this region. Klein Heppach differs distinctly from Thalmässing and Kappelberg in that it has fewer scalene triangles, more trapezoids and more

blunted-back blades. Klein Heppach also lacks microburins, which are very numerous at Thalmässing and Kappelberg. This points to a different technique of microlith production. The Klein Heppach material also differs in its dimensions; for example, the points are significantly smaller and the scrapers have a more acute angle.

The Danish sites also show differences between themselves. Although in this article the question of variants within the South German and Danish material cannot be pursued further, we may take note of the degree of variation among the sites of Bindeballe, Springbjerg and De Leien, which are here deliberately selected to illustrate how greatly the material can vary. Only after the measurement of a large number of unmixed sites can one begin to define the variants.

The sites from the Netherlands are chosen to illustrate the different variants within this region.

First we consider the sites of Luiksgestel (North Brabant, the Netherlands) and Overpelt in Belgian Limburg.\*

In these two sites the percentages of the types and the dimensions are virtually identical. The only significant difference is in the width-length ratio of the triangles and crescents; which is somewhat lower at Overpelt. Typical for this Luiksgestel-Overpelt variant is the occurrence of few implements with surface retouch and few trapezoids. The  $C^{14}$  date for Luiksgestel is  $7260 \pm 60$  (Gro 1510).

An entirely different picture is presented by the sites of Oirschot (North Brabant) and Sweyckhuizen (South Limburg). These two sites also have few trapezoids and micro-burins. They have many fewer triangles, but very many larger points, often with surface retouch; leaf-shaped points are especially numerous. They also have rather more blunted-back blades, which are smaller and narrower. The blades are characteristically small and narrow. Of special importance at these two sites is the high content of very finely worked implements with surface retouch.

This variant thus differs in many respects from the other Mesolithic sites. It has often been suggested that they are younger than the others, and represent a kind of youngest Mesolithic group. The  $C^{14}$  dating of material from hearths excavated at Oirschot in 1957 gives, however, an age of  $7775 \pm 60$  (Gro 1659). This agrees in age with another site containing microliths with surface retouch: Ermelo on the Veluwe ( $C^{14}$  date  $7970 \pm 75$ ; Gro 1559).

Between the two sites very few differences are evident. In Sweyckhuizen the points are somewhat narrower and the number of scrapers is somewhat smaller. There are other sites belonging to this variant, which will be discussed in the full work.

It is obvious at a glance that the two sites of Appelscha and Bakkeveen represent

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\* The counting and measurement of the material from Overpelt were carried out by Mr. J. Verheyleweghen of Brussels, who kindly made the results available to us.

a different variant. These two sites from the province of Friesland have many fewer points and triangles, but more trapezoids and many more blunted-back blades than the four sites previously described. The points are of comparable size, but the triangles are somewhat smaller. There are a number of sites of this Appelscha-Bakkeveen variant, several of which have been dated by  $C^{14}$ : Duurswoude I  $7460 \pm 100$  (Gro 1173); Duurswoude III  $7470 \pm 70$  (Gro 1175); Drouwener Zand  $7635 \pm 90$  (Gro 1513).

Still another variant of the Northwest European microlithic culture is represented by the sites of Venlo (Limburg) and Hulshorst (Gelderland). Both of these sites have many points and many triangles. They are thereby distinguished from Appelscha-Bakkeveen and Oirschot-Sweickhuizen, all of which have few triangles. They also have very many trapezoids, which distinguishes them from the other sites, since even Appelscha-Bakkeveen have many fewer trapezoids. They show fewer blunted-back blades than Appelscha-Bakkeveen and have a few implements with surface retouch. The triangles and points are perhaps somewhat narrower than in the previously described sites, but the blunted-back blades are significantly larger and wider. It is noteworthy that this difference in the size of the blunted-back blades cannot stem from the raw material, since the dimensions of their unbroken blades are the same as in the other sites. A site of the same variant, Hatert in the neighbourhood of Nijmegen, has been dated by  $C^{14}$ :  $7430 \pm 110$ . There are also agreements, especially in the percentages of the types, with the sites at Cuxhaven and Drüffelbeck (Elmer See) in Germany. The latter site has, however, some core-axes, flake axes and triangular implements; considered together with the extreme length of the trapezoids at this site, it might be possible to speak of an element of the Northern core axe culture at this site. But we do not believe that such a formulation is justified in the present state of knowledge.

Finally we may mention a fifth variant of the Northwest European microlithic culture, represented in the graphs by the site of Haule. The material of this site comes from a larger excavation, and has a  $C^{14}$  date of  $7525 \pm 200$  (Gro 128). Other sites of this variant include Waskemeer ( $C^{14}$  date:  $7435 \pm 120$ ; Gro 615) and Siegerswoude ( $C^{14}$  date:  $7720 \pm 70$ ; Gro 1509).

The Haule variant is distinguished from that of Appelscha-Bakkeveen only by the absence of trapezoids and the larger number of points and triangles. It and Appelscha-Bakkeveen differ from all other sites through the large number of blunted-back blades. But the differences are not on the whole very great. The Haule site may after all be attributable to the Appelscha-Bakkeveen variant, but further counts and measurements are needed before this can be determined.

The tentative but clear identification of these four or five groups within the Northwestern European microlithic culture in the territory of the Netherlands and Belgium illustrates the utility of the method here presented. It is noteworthy that

all  $C^{14}$  dates from sites of this region so far obtained are between 7210 and 7970 ( $7270 \pm 60$ ;  $7430 \pm 110$ ;  $7435 \pm 120$ ;  $7460 \pm 100$ ;  $7470 \pm 70$ ;  $7485 \pm 100$ ;  $7525 \pm 200$ ;  $7635 \pm 90$ ;  $7720 \pm 70$ ;  $7775 \pm 60$ ;  $7970 \pm 75$ ). Only the site of De Leien, which belongs to the Northern core axe culture, has given a result of less than 7000 years old, *i.e.*  $6960 \pm 140$ .

In the full work, in connection with the detailed description of all the sites, we will have more suitable opportunity to express our gratitude to the many museum directors and owners of collections who have made the material available to us.

While this paper was in press, we were able to obtain counts and measurements of two sites in the neighbourhood of Paris; of the site of le Martinet (Sauveterrian); and of two sites in North Brabant. At these sites the complete material was collected, except at le Martinet, where only a selection was recovered. We present the graph of le Martinet because of the importance of the site, but with the reservation that counting and measuring of the complete material might yield a significantly different result.

The graphs for the sites from North Brabant, Budel and Maarheeze, show that these two sites are almost identical. If we compare them with the Oirschot-Sweykhuisen variant, we see that the former have almost the same quantity of double points with surface retouch, but fewer leaf-shaped points and fewer points of Type B. They have, however, numerous trapezoids, which are rare in the Oirschot-Sweykhuisen variant, and far fewer microlithic blunted-back blades. The latter are significantly longer and wider at Budel and Maarheeze. Thus we have in the Netherlands at least two quite distinct variants in which implements with surface retouch are common. A number of other sites not given here belong also to the Budel-Maarheeze variant.

Of the French sites we can say briefly that at Boutigny sur Essome V there are almost exclusively trapezoids; which is not the case at any of the Mesolithic sites hitherto discussed. At le Martinet there are, except for a few Sauveterre and needle-shaped points, only triangles and microlithic blunted-back blades. All the implements at this site are particularly small and narrow. The types and dimensions are, however, reminiscent of the Frisian sites such as Haule and Appelscha. Buthiers-Malesherbes has many points, triangles and microlithic blunted-back blades, and few trapezoids; it is distantly reminiscent on the one hand of the Luiksgestel-Overpelt variant in Brabant (also as far as the dimensions are concerned), and on the other of the South German sites such as Thalmassing and Kappelberg. The large number of microburins also agrees with the latter, but their dimensions are quite different. We can only comment that it appears to occupy a somewhat intermediate position in the Western European microlithic culture cycle.