CODED CULTURE; STUDIES IN NEOLITHIC FLINT
PART 1: CONSTRUCTING THE DESCRIPTIVE SYSTEM

P.H. Deckers

ABSTRACT: The present paper, which is part of a series of publications, is an attempt to revaluate the traditional study of flint material. A model is designed to describe all flint artefacts. For flint tools further information is added with one side of the tool as basic analytical unit. To integrate attributes of already existing typologies it was necessary to evaluate and when possible transform these attributes in measurable ones. For the integration it was further necessary to introduce a second analytical level, which includes those tool types, which are defined by a unique combination of specific sides. Furthermore, when possible, it is attempted to integrate in each level of analysis the determinants: raw material, available techniques and function.

In subsequent papers the levels of analysis, the whole assemblage and the grouping of assemblages, will be treated.

KEYWORDS: Flint typology, attribute analysis, style, function, tradition.

This thesis is the first part of a series of publications entitled 'Coded culture; Studies in Neolithic flint' which will consist of the following parts:

1. Constructing the descriptive system.
2. The flint material from Swifterbant, earlier Neolithic of the Northern Netherlands.
3. The flint material from the Funnel Beaker Culture, Middle Neolithic of the Northern Netherlands.
4. The flint material from Kolhorn.
5. Comparing Neolithic flint assemblages, evaluation and further goals and questions.

Although the entire study is almost completed, I decided to refrain from the original intention of publishing all parts at once and to publish them sequentially. The reason for this decision was that the estimated time required for preparation of all parts for publication, 4-6 years, would preclude timely circulation of certain portions of the study. Part one of the series, the code list, is a significant contribution to the description and analysis of lithics, and in view of the current growing interest in flint assemblages in the Netherlands should be immediately useful (Deckers, 1979; 1980-81; 1982). Parts 2-4 of the series include analyses of flint assemblages entrusted to me by their respective excavators; their publication should be delayed as little as possible. By publishing the parts sequentially as they are ready for publication, it is hoped that the publication of the entire study will be achieved at an earlier date.

The excavation of the Swifterbant sites, of which the Neolithic sites were mainly excavated by the B.A.I., resulted in, among other things, large quantities of sherds and flint. The poor quality of the pottery and its general lack of ornamentation gave little hope for the construction of pottery types and, consequently, the role pottery could play in chronological and functional analyses. This resulted in a more important role for the flint material in comparison with other Neolithic assemblages. The decision to excavate the Swifterbant sites with equal attention to all find categories was made before the excavations started because it was thought important to see whether or not the supposed differences between the Mesolithic and the Neolithic could be the result of different excavation methods used for Mesolithic and Neolithic sites. I was engaged in studying the flint material and also had the idea that differences in Mesolithic and Neolithic flint material could be partly related to different analytic methods. For the Neolithic flint material it would be better to speak of the lack of a method than a different method of approaching the flint material. I therefore decided to develop my own system of analyses of the flint material (not designed for Neolithic flint alone), which is ex-

plained in this publication.

I want to thank the following people for their contributions: my promotor, Prof. Johannes Diderik van der Waals; Susan Loving edited the text and contributed her comments and personal views regarding the study of flint material; Paula Bienenfeld who in an earlier stage of this publication commented upon and translated the parts which were completed at that time; and H. Roelink who made the drawings.

1. INTRODUCTION

The object of the present paper is to place in the hands of the expert and the amateur alike simple statistical methods which, when applied to the dimensions of a sufficiently large group of implements, will enable the implements in question to be differentiated from others. In other words, the statistical treatment of the dimensions of a group of implements from a given industry yields results which are characteristic of that industry.

(Barnes, 1929: p. 117)

Nous pensons que par les études de morphologie et les expériences de taille on peut exprimer en chiffres les moyennes ou les constances des divers industries et par les comparer entre elles, faisant abstraction du coefficient d'erreur que l'appréciation personelle peut donner (abbreviated version)

(Barnes & Cheynier, 1935: p. 288)

Statistics are never a substitute for thinking. But statistical analysis does present data which are well worth thinking about.

(Spaulding, 1953: p. 313)

As Lartet and Christy's *Reliquiae Aquitanicae* (1865-75: p. 130) shows, the measuring of flint as a standard procedure was already extant in the 19th century. The quotations above explain why this procedure has continued to be considered useful and how it has led, both logically and historically, to the use of computers. Indeed, Barnes, in 1929, would have undoubtedly found the computer an essential tool had it been available at that time.

Although the measurement of flint, the employment of statistical procedures, and the systematic organization of data suitable for computer processing are only a part of this study, they are a very important part and are done in accordance with the tradition and its rationale as outlined above. While these procedures cannot be undertaken in a theoretical vacuum, nor can they be considered an end in themselves, they are isolable and important to detail, not only because they affect the outcome of this study, but also because they are subjects of discourse among lithic specialists. It is hoped that the explicit description of these procedures will benefit the student or researcher about to begin a lithic analysis for the first time.

The design and use of code lists, especially when used in relation with computers, is of utmost importance, because it concerns the whole discipline of archaeology and entails what White (1969: p. 27) calls the necessity for making decisions and therefore more clear definitions. Thus, it is appropriate to begin by defining the term 'attribute' as it will be used in this study.

The term 'attribute' is used ... to signify any property or quality of a thing or event. The attribute may be one of a continuous group, a measurement of length, for example, or it may be a discrete quality as in the case of observing that an object is made of bone. The attribute may be a physical or chemical property of an object–weight, shape, chemical composition and so on–or it may be a position in time or space

(Spaulding, 1960: p. 61)

This general definition of the term attribute covers a virtual infinity of possibilities. In order to reduce these possibilities, the attributes are restricted to physical ones concerning shape, *i.e.*, to morphological attributes. The intention of the following code list is to establish a well-structured scheme for the definition of morphological attributes which are independent of the parameters of time and space of the assemblage under study and which are not directly related to or dependent on interpretations. The term variable is used to refer to an attribute integrated into the code list. Tools especially, but in principle all artefacts, are considered as clusters of attributes.

Although regular relationships among attributes are encoded in the typology, in this system different questions or problems will influence the attributes selected and their relationships, which will, in turn, result in different typologies. The tool typology treated in section 8 is therefore a result of only one way of using the attributes (see also section 7). After establishing regularities among attributes, or within or among assemblages, there will be a search for explanations of these regularities.

Provisionally, the possible factors which may result in regularities in the the flint material are as follows:

a. The kind of raw material used (section 11.1.).

b. The function of the tool (section 13.1.).

c. Style: regularities that cannot be explained by a or b (section 13.2.).

Group b includes the relationship between the artefacts and an environmental factor, be it the natural environment as such or the socioeconomic 'environment' created by the human group, such as seasonal movement or activity specialization.

It will be noted that the often used category of technical capacity (development) is not included as a factor. This is because the assemblages used in this study are all within a limited chronological period and it is assumed that a common technological expertise existed for the groups producing the assemblages under study. Under this assumption the presence or absence of technical specialities can be related to (a) the kind of raw material, or to (b) the kind of tools needed, or to (c) commonly shared preferences which are considered to be an aspect of style.[1]

Table 1 illustrates a model of how the factors, which produce regularities in the flint material, are expected to be expressed at the highest level.

Factor a, raw material, is introduced in the scheme as a raw material index (see section 11.1.), and, theoretically could vary from assemblage to assemblage. But clearly, given the other factors involved, it would be better to hold this factor constant (at least for the first trial), if possible.

Factor b, environment, is simplified by having only two categories, wet and dry, and by selecting assemblages from one region, *i.e.*, the Northern Netherlands, in order to avoid interregional variations, such as greater or lesser degree of continentality. In order to include both the synchronic and diachronic dimensions of style, factor c, at least three of the matrix cells of the model must contain assemblages which are chronologically appropriate.

Minimal conditions required for producing an assemblage usable for analysis are the collection of all flint material from the whole site or at least a representative part, sufficient stratigraphic control ensuring that the material comes from a single time period, and the sieving of the excavated earth so that smaller pieces of flint are present in the assemblage.[2]

The 'filling' of the categories in the model with archaeological assemblages is not entirely satisfactory because of the lack of well-excavated sites dated to the Neolithic in the Netherlands. At the beginning of this project the only assemblages available fulfilling the above conditions were those of the 'Swifterbant' Culture (Deckers, 1979; 1982).

Table 1. Model for factors related to flint material.

b. Factor	'Wet' environment	'Dry' environment
c. Factor	Assemblage A x raw material index	Assemblage B x raw material index
Time		
	Assemblage C x raw material index	Assemblage D x raw material index

Taking as a starting point the Swifterbant assemblages (assemblage A in table 1), the only contemporaneous assemblages from a dry environment and spatially not too far away were to be found in Michelsberg context of the southern part of the Lower Rhine Basin (Louwe Kooijmans, 1974). Some of the raw material in these assemblages, however, come from the flint mines in the neighbourhood making them incomparable with the Swifterbant assemblages, whose raw material is erratic flint. Furthermore, there were difficulties in obtaining access to the Michelsberg archaeological material.

This meant that it was necessary to find two assemblages at a later period than Swifterbant which were roughly contemporaneous with each other. The TRB is the first culture occurring, although with a time lag, after the Swifterbant complex and is found in a dry environment.[3] The assemblages from the Vlaardingen culture group are roughly contemporaneous with the later phases of the TRB and are found in a wet environment (Lanting & Mook, 1977). A problem with the TRB and Vlaardingen assemblages is that most come from partially excavated sites or have been mixed with material from other periods. Moreover, in most cases there has been no sieving during the excavation. Although the material from several TRB assemblages (Appendix E) was available and analysed, the only (TRB) assemblage satisfying our requirements was Laren (Bakker, 1961).

Along with TRB material from settlements, material from some megalith graves was also included in cell D to get a better insight into the variation of material from the TRB and to collect information for a problem for future study: the relation between flint material coming from settlements and that from graves within one culture.

The site of Kolhorn, which belongs to the Protruding Foot Beaker Culture (SVB) and the subsequent early AOO (All Over Ornamented) phase, was excavated using the methods and experiences of the Swifterbant excavations. Roughly contemporaneous to the Vlaardingen Culture and located in a wet environment, Kolhorn was selected for cell C (table 1) rather than one of the suboptimal Vlaardingen assemblages. Although Kolhorn belonged along with Swifterbant to the northern sphere of influence in the Netherlands, in contrast to the Vlaardingen assemblages, its environment is less similar to that of Swifterbant than it is to the Vlaar-

Table 2. Assemblages studied in relation to the model in table 1.

b. Factor	'Wet' environment	'Dry' environment
c. Factor	Swifterbant	
Time		
	Kolhorn	TRB Assemblage

dingen environment (Clason, pers. comm.). The assemblages selected for the model are shown in table 2.

The application and evaluation of the model are to be presented in five parts. This publication is part 1. In parts 2, 3, and 4 a description and analysis of the assemblages of the cells will be given. In part 5, 'Comparing Neolithic flint assemblages, evaluation and further goals and questions', the model will be refined and the conclusions of the study will be published.

Part 1 up to section 10 describes the code list developed for analysing the flint material. Where other authors have found different solutions for approaching the attributes used here, these will be mentioned along with the reason(s) why their solutions were rejected. The attention to alternative solutions is sometimes rather extensive, but not as extensive as it could be if the intention here were to rewrite Brézillon's *La dénomination des objets de pierre taillée*, which it is not. Section 10 is a discussion of pre-existing tool typologies and a comparison of their types with the tool types that can be constructed with the code list presented here. In the remaining sections (11-18) the decisions made for the code list construction are linked to the broader categories of the model.

2. FRAMEWORK FOR RESEARCH

2.1. Setting the limits or defining conditions

Three rules guided the course of this study:

1. Restriction of observational data to macromorphological attributes wherever possible.
2. Definition of terms used.
3. Collection of interval-level, rather than ordinal-level, data for measurements whenever possible.

It was thought that adherence to these rules would help minimize inconsistencies and inaccuracies that normally arise in studies of this type. Because all the measuring of the material was done by me, one possible source of inaccuracy in the measuring process was avoided (Fish, 1975). It would have been ideal to measure the material at one time, but this could not be done because of the enormous quantity of material.

In order to evaluate the possibility that my measuring methods changed during the analysis, the assemblages treated in the beginning period of the research were rechecked. Differences did not exceed 1 percent.

2.2. Building the framework

In this study any piece of flint removed from its geological context by human action is considered to be an artefact. Each artefact can be object of further treatment. The different ways of treating the artefact are combined in the model illustrated in table 3. In this model processual 'stages' of tool production and use are linked to 'levels', methodological approaches to analysing flints on the basis of morphology. The first stage is finding and selecting the flint material. In this stage there are NO alterations of the flint material. In the second stage the flint material is altered to produce the final form for its intended function(s). In traditional typologies this stage is divided into two substages: substage a in which the flint artefact results in a core, flake, blade, or residual category and substage b in which the general shape is refined by retouching. The third stage is the use of the artefact. This stage is divided into two substages in order to link it with levels 3 and 4. This was necessary because in level 4, which falls outside the scope of traditional archaeology, completely different approaches and methods have been developed. The model is a simple one which will need expansion when applied to particular assemblages, for example, to categorize those artefacts that are mined but not yet changed into a core, flake, *etc.* Although the numbering of the stages follows the 'normal' sequence of a flint tool cycle, it is not meant to imply that all stages are obligatory. Raw material could be directly used and stages 2a and 2b skipped, for example.

This (simplified) model is used in all traditional flint studies, but it is a processual model. The stages of this model had to be translated into corresponding morphological levels in order to be useful for analysis.

The morphological definition corresponding to level 1 (raw material) is flint material completely covered by cortex or patina with no indications of use wear. The presence of raw material on a site will

Table 3. Stages in flintworking.

Stage	Material	Level
–		
1	Raw material	1
2a	Core blade flake other material (O.M.)	2
2b	Retouch	3
3a	Use usewear (macroscopic)	3
3b	Microwear	4

Table 4. Model for different levels of patterning.

Level 1	Level 2	Level 3	Level 4
Side			
Side	Artifact		
		Assemblage	
Side			
Side	Artifact		
			Group of assemblages
Side			
Side	Artifact		
		Assemblage	
Side			
Side	Artifact		

mean that, except for the few pieces which were lost before they could be used or modified, a portion of the assemblage was abandoned at the first stage of the flint working process. From this stage, one may reasonably infer that the intended use of the raw material was abandoned as well (section 11.1.). The morphological definition of level 2 corresponding to substage 2a is discussed in sections 3.9. and 11.3.

Substage 2b in the processual model cannot always be differentiated from substage 3a by morphological characteristics. Although retouch and use wear as extremes in a continuum can usually be distinguished, it is frequently difficult to distinguish between intentional retouch and use retouch in intermediate cases. Because the distribution of characteristics within each assemblage could be of importance, artefacts with retouch, use retouch and use wear are analysed at the same level (level 3). In section 6.5. this topic is discussed at length. Substage 3b is linked to level 4, microwear analysis, which is not yet integrated into the code list, but which is considered important for evaluating functional interpretations of assemblages.

2.3. The basic units, concepts

In this study the basic unit of analysis is the artefact side considered from a two-dimensional perspective (for details see section 6.1.). The primary data level in the code list comprises all variables connected with the side. Variables pertaining to the artefact as a whole are found at a higher level of information in the code list (for example, variable 26 which encodes artefact form). The hierarchical structure of the code list reflects the author's preferred methodology for defining tool types and for ultimately comparing assemblages. Patterns should be found first within the basic unit, the side, followed by a search for patterns on the next higher level, the complete artefact (the sum of the sides). Then patterns within one assemblage can be identified, and when this is accomplished, the patterning in the different assemblages can be compared in order to group the different assemblages (table 4).

The present study will be mainly concerned with levels 1 and 2.

2.4. Model and morphology

In order to apply the approach sketched above and to move from identifying regularities on the side to identifying those between assemblages, several well-known typologies (most of which were designed for particular time periods) were studied to learn about and to select among morphological attributes present in them.

Special attention was given to Neolithic and Mesolithic typologies to anticipate differences between Neolithic and Mesolithic assemblages resulting from different analytic approaches of the scholars concerned and from my selection of attributes used in these typologies. Furthermore, by taking into account both Mesolithic and Neolithic typologies, transitional tool types were more easily recognized and separated from new tool types created for new tasks (*e.g.* Neolithic sickles for harvesting grain).

Some attributes considered as primary discriminating ones in existing typologies will not be found in the code list presented here. Generally the excluded attributes have been directly related to a technological factor or to a supposed function, which contradicts the aim to first establish morphological regularities and to interpret them later.

This does not mean that I am unaware that morphological attributes can be related to and justifiably selected for underlying interpretations. The sharp division between morphology and interpretation used here is an attempt to avoid observation and interpretation from becoming two sides of the same coin. One of the most common examples of this mixture of morphology and interpretation is the definition of a core as the (mostly larger) piece of flint from which smaller pieces are detached, which is a processual definition, not a morphological definition. In excavations, pieces of flint with morphological attributes are found, not processes. The processes are an interpretation of morphological attributes and have yet to be proven. The interpretation should not automatically replace the observation. Therefore I have avoided those variables that could not be defined using only morphological attributes.

The variables selected are in the data bases called VBV (flint basic file), KVF (core file), and WVF (tool file). Variables recorded for all artefacts are in the VBV file. Additional variables measured for cores are in the KVF file and for tools in the WVF file. The information for stage 1 (raw material) and stage 2a (cores, *etc.*) is located in the VBV file.

3. FILE VBV (flint basic file)

The variables constituting the VBV file are:
variable 10: length
variable 11: width
variable 12: thickness (height)
variable 13: weight
variable 14: colour
variable 15: degree of burning
variable 17: quantity of cortex or patina
variable 18: part present
variable 19: direction of negatives
variable 20: kind of platform
variable 21: primary grouping (*e.g.*, cores, flakes)
variable 22: additional information
variable 23: further file reference
variable 24: length/width index
variable 25: width/height index
variables 1, 9, 16: site number
variable 2: north-south coordinate (field data)
variable 3: east-west coordinate (field data)
variable 4: height coordinate (field data)
variable 5: feature number (field data)
variable 6: layer (field data)
variable 7: dip (field data)
variable 8: orientation of artefact (field data)

3.1. Variables 10, 11 and 12: length, width, thickness

Variables 10, 11 and 12, length, width, and thickness, respectively, were all measured in millimeters. To take measurements a pronounced straight side much longer than the width (*e.g.* as found on whole blades) was preferred for positioning the artefact. When no straight side was present and the artefact had a straight striking platform, the platform side was chosen as the line of reference (fig. 1). The length was measured from the platform to the distal end and the width measured perpendicular to the length.[4]

When neither a straight side nor a straight platform was available, the artefact was situated so that both the platform and the left side touched the measuring lines. The artefact was always oriented dorsal side up (in contrast to figure 1 where the ventral side is illustrated to show the platform location). The first side measured always refers to the length direction.

For pieces having no platform or where the position of the platform was unclear (*i.e.*, all artefacts except flakes and blades), the longest side was the base side for orientation and measuring (taking the largest measurement possible for the length).

After working with some material, it became evident to me that the orientation for the length and width measurements was less complicated than

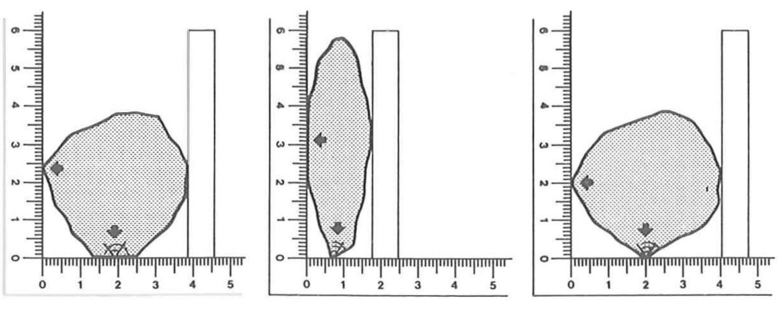

Fig. 1. The measuring of length, width and thickness.

might be concluded from the description above. The variable thickness is just the largest measurement which can be taken when the arfefact is laid on the ventral side. Therefore this variable could also be named height.

An alternative for measuring the length would be to measure the axis of percussion as proposed by Ohel (1979: p. 688). But since a good 'morphological' definition for the axis of percussion was lacking this alternative was not used.

Another alternative is Uerpmann's method (1976: p. 54) where the striking platform is positioned nearest to the zero measuring point (fig. 2) and then the smallest width is measured. This method was not chosen, because it could not provide the length of the sides which was needed for the morphological description. Uerpmann's measuring method (1976: p. 64) correlates better with weight (volume) than mine, but this would only be important when volume and weight are being related to other considerations or factors.

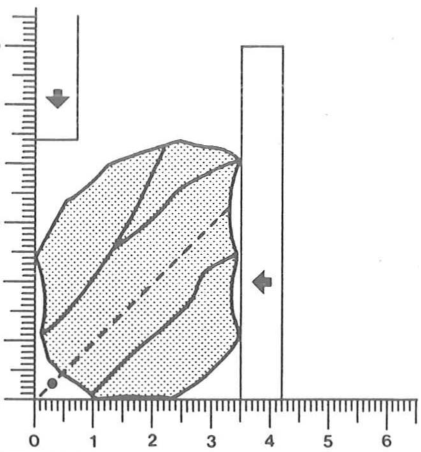

Fig. 2. The measuring of length and width according to Uerpmann (1967).

3.2. Variable 13: weight

Weight was measured in centigrams and rounded to the nearest even number.

3.3. Variable 14: colour

Colour was measured according to the Rock Color Chart. Only the most prominent colour was measured; no attention was given to specks and spots of different colours.

The following codes were used for the different colours as recorded from the Rock Color Chart.

The colour determination was found to be rather time-consuming and therefore only done for the Swifterbant sites s-2, s-4 and part of s-3. The main reason for recording the colour variable was to facilitate fitting together the flint material in order to provide one type of evidence for investigating intrasite spatial relationships. It soon became clear, however, that the abundance of material would prevent sufficient refitting within a reasonable time span. Thus the major reason for determining the colour was gone. In other situations a reason to record colour is to help source the raw material. But since most of the flint raw material in the assemblages under study was collected from glacial deposits the ability to source its original location would serve no archaeological function.

colour number	recoding	subcolour	subcolour recoding				
n9	119	5 b9/1	50291	n8	118	5yr8/1	58981
		5 y8/1	50881				
		5gy8/1	54981				
		5 g8/1	50481	n7	117	5 b7/1	50271
n6	116	5yr6/1	58961				
		5 y6/1	50861				
		5gy6/1	54961				
		5 g6/1	50461	n4	114	5yr4/1	58941
		5 y4/1	50841				
		5gy4/1	54941				
		5 g4/1	50441	n3	113	5yr3/1	58931*
n2	112	5yr2/1	58921				
		5 y2/1	50821				
		5gy2/1	54921				
		5 g2/1	50421	n1	111		

* This colour is not in the Rock Color Chart, but is devised by the author.

3.4. Variable 15: degree of burning

Variable 15 indicates whether or not the piece of flint is burned. The codes are based on distinctions made by Chappel (Price, Whallon & Chappel, 1974: p. 42) thought to indicate the degree of burning:

0. No traces of burning or fire.
1. Colouration, gloss on areas made in period of use of flint.
2. Potlidding and cracking.
3. Structural change, usually resulting in white opacity and a porcelain looking surface.

3.5. Variable 17: amount of cortex or patina

Variable 17 refers to the amount of cortex and/or patina, if present, and its location. Patina refers to all the patina which differs from the worked surfaces, which was formed presumably before the piece was utilized.

No distinction was made between cortex and patina because the purpose of this variable is to indicate how much of the original surface was removed by the worker. The following codes were used:

1. Completely covered by cortex or patina.
2. Dorsal side completely covered by cortex/patina.
3. Dorsal side partially covered by patina/cortex.
4. Patina/cortex present on both the ventral and dorsal sides.
5. Ventral side partially covered by cortex/patina.
6. When dorsal and ventral sides cannot be distinguished, more than 50% of the surface is covered by cortex or patina.
7. No cortex or patina on the artefact.
8. When dorsal and ventral sides cannot be distinguished, less than 50% of the surface is covered by cortex or patina.

Cortex on the platform was considered to belong to the dorsal side in order to avoid coding pieces having cortex only on the platform as 7, which would be inaccurate.

In this study code 2 is considered a 'primary' flake. This differs from, for example, Sirakov (1983) who defines a primary flake as one having 50% or more cortex and who also measures the amount of cortex more precisely and gives its exact location. The use of the term 'primary' also differs from that of Clark (1960: p. 214), who uses it to refer to all flakes that have no retouch or traces of use. For him the term 'primary' has no relation to the amount of cortex.

3.6. Variable 18: parts available

Variable 18 refers to the condition of the artefact and the parts present and is mainly used for blades and flakes:

1. Distal part present.
2. Medial part present.
3. Basal (proximal) part present.
4. Complete artefact.
5. Broken along length axis, running from platform to distal end.

3.7. Variable 19: direction of negatives

Variable 19 refers to the orientation of flake scar negatives on the dorsal side of blades and flakes. The negatives are coded in relation to the length axis of the artefact as indicated by the positive scar on the ventral side of the artefact:

1. Parallel to length axis.
2. Oblique to length axis.
3. Irregular.
4. Parallel to length axis, bulb negative near platform.
5. Parallel to length axis, bulb negative near distal end.
6. Oblique to length axis, negatives bidirectional with the bulb on the left as well as on the right side.
7. Oblique to length axis, negatives unidirectional.

In the course of this research variable 19 has been subjected to several changes. Originally it was used to indicate how many millimeters of the edge had been taken away by retouch or use (Swifterbant S-2, S-3, S-4, S-51). In most cases, however, this variable could not be reconstructed, and the variable was later recoded as above. Initially only the first three codes were used, but now all seven codes are used. Generally, those flakes with negatives running oblique to the length axis are called core rejuvenation flakes or blades.

Following Kozłowski (1982: p. 84), codes 4-7 relate to the kind of cores from which the flakes/-blades were detached. For example, flakes/blades with code 4 were detached from cores having one platform, whereas those coded 5 come from cores having two opposite platforms. The same subject is also treated by Radovanic (1981).

3.8. Variable 20: kind of platform

The following codes were used for platforms in general conformity with distinctions made by Brézillon (1968: p. 72):

1. Cortical: the platform is covered by cortex.
2. Formed: the platform is formed by a complete negative of a flake.
3. *Dièdre*: the platform shows the remains of two negatives, whose intersection forms a ridge.
4. *Facetté*: the platform is made by perpendicular retouching.
5. *Facetté convexe*: the platform is made by perpendicular retouching and also forms a ridge.
6. Edged: the platform is not wider than 2 mm and its length is longer than 2 mm.
7. *Punctiforme*: the length and width of the platform is smaller than 2 mm.
8. Normal: the platform has none of the foregoing attributes.
9. The platform cannot be coded according to the foregoing codes.

When no platform was available no coding was entered. The small dimensions of the platforms under study and the even smaller differences (less than 1 mm) among them prevented the creation of separate variables giving the measurements of the platforms. Thus, only codes 6 and 7 refer to measurements. If one wished to measure platforms, codes 6 and 7 could be eliminated and one could use Uerpmann's method (Uerpmann, 1976, p. 55; fig. 3).

3.9. Variable 21: primary groups (cores, flakes)

The following primary groups are distinguished in the code list:
1. Cores.
2. Flakes.
3. Blades.
4. Other flint material (OM).

In working with flint material it is almost impossible to avoid problems related to making distinctions between flakes and blades. Blades are usually considered as being a special type of flake.

For example, Cullberg & Parsmar (1968) define flakes as chips from flint blocks and cores and blades as flakes with more or less parallel sides and with a definite proportion between length and width. Other definitions are:

A blade is a specialised elongated flake with parallel to subparallel lateral edges; its length equal to at least twice its width. The cross or transverse section may be either plano-convex, triangular, subtriangular, rectangular, often trapezoidal and the blade has on the dorsal face one or more longitudinal crests or ridges. On the dorsal side of the blade there should be two or more scars of previously removed blades with force lines and compression rings indicating that force was applied in the same direction as blade detachment
(Bordes & Crabtree, 1969: p. 1)

A blade is a flake of which the length is at least double the width and the width at least double the height (thickness). The length should be longer than 5 cm and the width 1.2 cm. When the last two conditions are not met flakes with length more than twice width and height larger than 4 mm are called short blades
(Rozoy, 1967a: p. 212)

More simply, a blade is a flake with its length equal to or more than twice its width (Uerpmann, 1976; Laplace, 1956: p. 279). The above definitions have two elements in common: a) a length-width index between 1.5 and 2, and b) parallelism of the sides.

Some authors use the presence of negatives of previously detached blades on the dorsal side to distinguish 'true' blades from decortication flakes having a blade length/width criterion. Others merely define blades as flakes which are twice as long as wide, and some do not use the blade category at all.

The older English tradition of not using the term blade but referring to blades as 'long flakes' (*e.g.* Amstrong, 1919-1922: p. 278; for an exception see Peake, 1919-1922) is intriguing, because no reason for the rejection of the term blade, as is generally used on the continent, is given. When related to tools, the division into ¼, ½ and ¾ flakes (the length-width classes) is collapsed into a division between long and short tools (greater than ½, less than ½), *e.g.*, scrapers are distinguished as long and short scrapers (Clark, 1960).

The rejection of the blade/flake division is commonly found in studies which take a particular interest in unretouched flakes and which use metrical attributes. This use of metrical attributes makes the older blade/flake distinction irrelevant. For example, Cullberg & Parsmar (1968), in addition to measuring (maximum) length and width, take many other measurements from flakes, most

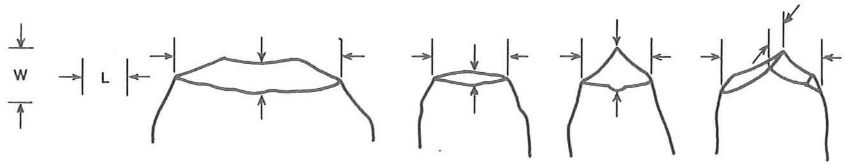

Fig. 3. The measuring of length and width of the platform.

of which are related to the negatives on the dorsal side of the flake. I could not evaluate the merits of this approach because of the incomparability between their measuring system and the one used here. Cullberg & Parsmar also use measurements to describe the morphology of the total flake. Among other attributes, the degree of parallelism of the long sides is described by measuring the difference between the width at the base and at the top. The positions for taking these measurements are referenced to the place of the negatives on the dorsal side, an attribute not coded for this study. For a possible integration of the variable parallelism, see section 3.13.

In this study blades are considered to be flakes with special qualities, and the common definition, *i.e.*, that based on the length-width ratio, is not used. Rather, since the side is used as the basic analytical unit, a blade is defined in terms of the attributes of its sides: the sides should be straight and run parallel to the length axis. If a flake has a width longer than its length, it would be difficult to determine whether or not it is a blade using the straightness of the side as the only attribute, since the observation of straightness of a side when the length is smaller than the width is distorted by the form, which is not covered by the length/width condition.

Although a blade/flake division is used in my analysis of the different assemblages based on the above attributes, it will be necessary to establish for each assemblage whether or not the blade/flake division is relevant by first seeing if a bimodal distribution is present in the length and in the length/width index data for the complete items in the assemblage. This method may not elicit the blade component, however, if blade frequencies are very small, for example, when blades are only used for certain tool categories. Thus, one should first check if the percentage of tools on blades is much higher than that on flakes and if blades were used for manufacturing a special kind of tool. When the flint material has been sieved, a great quantity of very small flakes, essentially unsuited to be used as tools, may be recovered; data from these flakes may 'mask' a bimodal distribution, if present. To avoid this problem it is necessary to exclude flakes under certain dimensions from the analysis of the blade/-flake component. Rather than measuring small flakes to determine those to be omitted from the analysis, one could use their weights (see *e.g.* Uerpmann, 1976, who singled out flakes lighter than 0.5 gr and called them chips).

A second reason for not using the length/width ratio as the sole definition of blades is that this measurement cannot be used for incomplete flint artefacts. To classify these artefacts it is necessary to first analyse a sample of the assemblage to estimate the blade/flake ratio. If a blade component is clearly found, incomplete and uncertain or intermediary artefacts can be coded as blades. When no clear blade component is available, intermediary artefacts can be coded as flakes. For example, the assemblages of the 'Swifterbant Culture' (Deckers, 1979) have a clear blade component, and consequently, the more uncertain, incomplete artefacts were classified as blades. In contrast, the dubious or uncertain blade or flake parts of artefacts in the Funnel Beaker Culture were coded as flakes because in this case no clear blade component, or blades with a special form related to certain tools, were found. Although this method dichotomizes the distinction between 'flake and blade cultures', this distinction is irrelevant within the context of the larger framework of this study.

The criteria for establishing the blade/flake distinction in this study cover some classes of blades that are commonly treated separately. For example, Rozoy defines bladelets as those blades not exceeding 5 cm in length and 1.2 cm in width and not having a height greater than 4 mm. Movius (1968: p. 5) makes a division between regular and irregular blades, which is related more or less to the parallelism of the sides. Movius also distinguishes trimming blades/flakes from the others. The trimming blades and flakes consist of core rejuvenation pieces and primary blades and flakes, which represent the waste part of the production resulting from the fabrication of blades and flakes fitted for tools. None of these subclasses are distinguished here.

The definition of a core used here is a piece of flint which has no positive scars showing that it was detached from another piece of flint, such as positive bulb, *etc.*, but which shows at least one negative of a piece of flint intentionally struck off.

This definition deviates from that of some writers, who demand a more positive indication of the intention to use the piece of raw material for the detachment of flakes or blades by requiring either that more than one negative (Uerpmann, 1976) be present or that at least a small portion of cortex/patina remains on the core.

Intermediate stages between raw material and 'real cores' are relevant when they can be linked to steps in manufacturing and exchange, as is possible to do with the products of flint mining. But with the type of material (moraine flint) under study here the results of this approach cannot be linked to a spatial component and would yield little information. A pebble struck in two pieces will, in accordance with the definition used here, produce both a core and a flake simultaneously. A solution to this problem would be to introduce groups, such as precores, *etc.* This was not done because no corresponding morphological level could be devised.

In principle, the distinction between flake negatives and retouch negatives should be established on the basis of a bimodal distribution of their dimensions. This being too time consuming, I used 5 mm as largest measurement for retouch, which, except for surface retouch seemed to separate the two kinds of negatives in our material well. I also had difficulties in separating very small cores from flakes which show traces of bipolar technique (Deckers, 1979: p. 148).

Other flint material (OM) is a residual category which includes all material that cannot be classified as a flake, blade or core, *i.e.*, all material which does not have a positive indication of intentional detaching in the form of a platform, characteristic bulb, *etc.* There is a tendency among some archaeologists to classify artefacts that lack the aforementioned characteristics, but that have certain length and width dimensions and are not too thick as flakes or blades. Such an approach inflates the proportions of flakes and/or blades in an assemblage.

The OM group consists of several subgroups. One of these subgroups is pieces of flint that were formed as result of heating (thermal 'flakes'), which are easy to identify by using variable 15, traces of burning. The number of artefacts that had lost all positive indications of intentional detaching because of fire (heating) and were therefore classified as OM formed less than 1 percent of the total OM group in the assemblages under study. This group of 'burned OM' and those artefacts which are completely covered by cortex and patina, also grouped under OM, will be treated as a special subgroup.

3.10. Variable 22: additional information

This variable was introduced to facilitate the study of groups of artefacts that require special attention (codes 1, 2, 6, 8 and 9 below), to introduce information that could not be included in the 'normal' variables (codes 3 and 5 below), or to identify artefacts that are considered as separate tool types but are not yet defined in the tool type list (section 8: codes 5 and 7):

1. Mechanical. The only fractures visible on the artefact are the result of mechanical influence, for example, burning, movement by ice, *etc.* This means that there are no clear flake or blade negatives on the artefact, such as bulbs, ripples, and the like, clearly caused by intentional striking.
2. Raw material. The artefact is completely covered by cortex/patina and is referred to as 'raw material' (section 2.2.). Such pieces are analysed further (section 11.1.).
3. Polished. The artefact shows traces of polishing. Polished axes of the cultures considered in the present context have been studied by various authors, and, since several typologies of flint axes have been devised, flint axes have been left out of the study for the time being. It is assumed that flakes, blades, cores, and other waste products (and the tools made on them) showing traces of polishing were made from polished flint axes, *i.e.*, that polished axes were used as 'raw material' for detaching flakes and for tools that could not be made from the normal available raw material, such as blades used for special tool types.
4. Burin spall. Many assemblages include artefacts which look like burin spalls, although no burins were found; these 'pseudoburin' spalls are included in this category.
5. Hammer stone. The artefact shows traces of pecking/bruising.
6. Bipolar. The artefact shows traces of bipolar technique.
7. Striker. The artefact is a core with a triangular section perpendicular to the longest side (also called strike-a-light).
8. Rejuvenation. The artefact is a core rejuvenation piece. It can be a flake which looks as if it has been retouched on all edges on the dorsal side. If the so-called retouch is analysed, however, one sees that the negatives are not complete but, instead, are truncated on the ventral side. Rejuvenation flakes show flake negatives on the dorsal side which run perpendicular to the length axis.
9. Disc. The flake is more or less round and has a diameter greater than 4 cm.

3.11. Variable 23: reference to other files

This variable was made to indicate the next file to which the condensed information of file VBV (field basic file) should be sent. In principle three other files are available:

1. KVF file (core file). All the information required for analysis of cores will be stored in this file.

This means that file KVF will include all the information from the VBV file as well as additional variables. Although a variable list for the KVF was made (section 4.), the data are not yet computerised. The number of cores is so small that counting by hand was more efficient.

2. BVF file (burin file). This file is reserved for the results of analysis of burins. Because no burins occurred in the sites used in this study, the file has yet to be structured. It will have the same structure as file WVF, possibly with a few minor alterations.

3. WVF (tool file). This file contains all data pertaining to 'tools', defined as such by the presence of macroscopically visible retouch or use wear. The presence of retouch as a part of this definition conforms to the traditional definition of a tool. Although retouch is not necessarily related to the working edge of the item, its presence indicates an intention to work with the artefact. Resharpening flakes are also included in this file even though they are no longer tools themselves. They are separated from tools proper at a later stage in the analysis.

The inclusion of those artefacts which show use wear in the tool file deviates from the traditional approach. No reason could be found, however, for including a blade with clear use wear traces and a little retouch near the platform for or from hafting and excluding the same type of blade with clear use wear traces but which lacks the minimal 'hafting' retouch. Instead of speaking of the presence of retouch and/or use wear, one could speak about the presence of an 'altered' edge as White does (1969: p. 23).

Although only three codes are necessary to reference the three files, a much larger reference coding system has been incorporated for checking purposes:

1. Cores	KVF
2. Flakes, no tools	--
3. Flakes, tools	WVF
4. Blades, no tools	--
5. Blades, tools	WVF
6. OM, tools	WVF
7. Cores, tools	KVF and WVF
8. Burins, on flake, blade, core or other flint material	BVF
9. *Grobgeräte*	KVF

The difference between 'tool on core' (7) and *Grobgeräte* (9) (core tool) is that 'tool on core' is a primary core with secondary retouch or use wear, whereas a *Grobgeräte* has been shaped to serve primarily as a tool (for example, pics).

3.12. Variables 24, 25: (length/width, width/height indices)

These variables are not measured directly but are constructed by the computer. Both variable 24, the length/width ratio, and variable 25, the width/height ratio, are multiplied by 10 to create length/width and width/height indices, respectively.

3.13. Proposals for improvement of or addition to variables in file VBV

In using the side as the basic unit of analysis, the total morphology of the (non retouched) material does not get optimal attention. For example, the variable 'parallelism' could be introduced into the VBV with the following codes: 1. Parallel flake, sides run parallel from base to top; 2. Contracting flake, sides from base to top converge; 3. Expanding flake, the distance between the sides from base to top expands.

If necessary a more precise measurement for parallelism can be obtained by following Cullberg & Parsmar's method (1968) (section 3.9) or by using the system that Movius *et al.* (1968: p. 15) devised for scrapers. Movius' measuring system, which requires that the artefact is placed with the platform on the right hand, can be used for all artefacts (fig. 4).

Attributes that were not coded are usually related to technology. For example, some authors collect information concerning the type of break (fracture) at the distal end, such as feathered, hinged *etc.*

Hinge fracture. A fracture at the distal end of blade or flake, which prevents detachment of the flake at its proposed terminal point. A hinge fracture terminates the flake at right angles to the longitudinal axis and the break is usually rounded or blunt

(Crabtree, 1972: p. 68; also sections 13.3. and 6.12.)

All kinds of platform 'angles', partly related to different methods of detaching, are also measured by

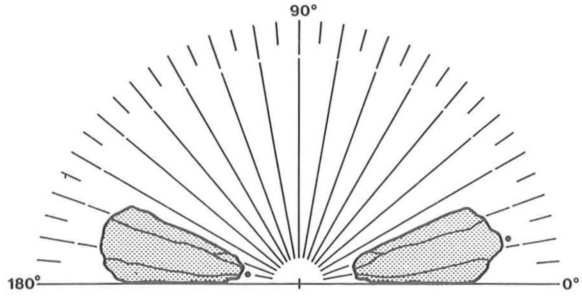

Fig. 4. The measuring of parallelity according to Movius (1968).

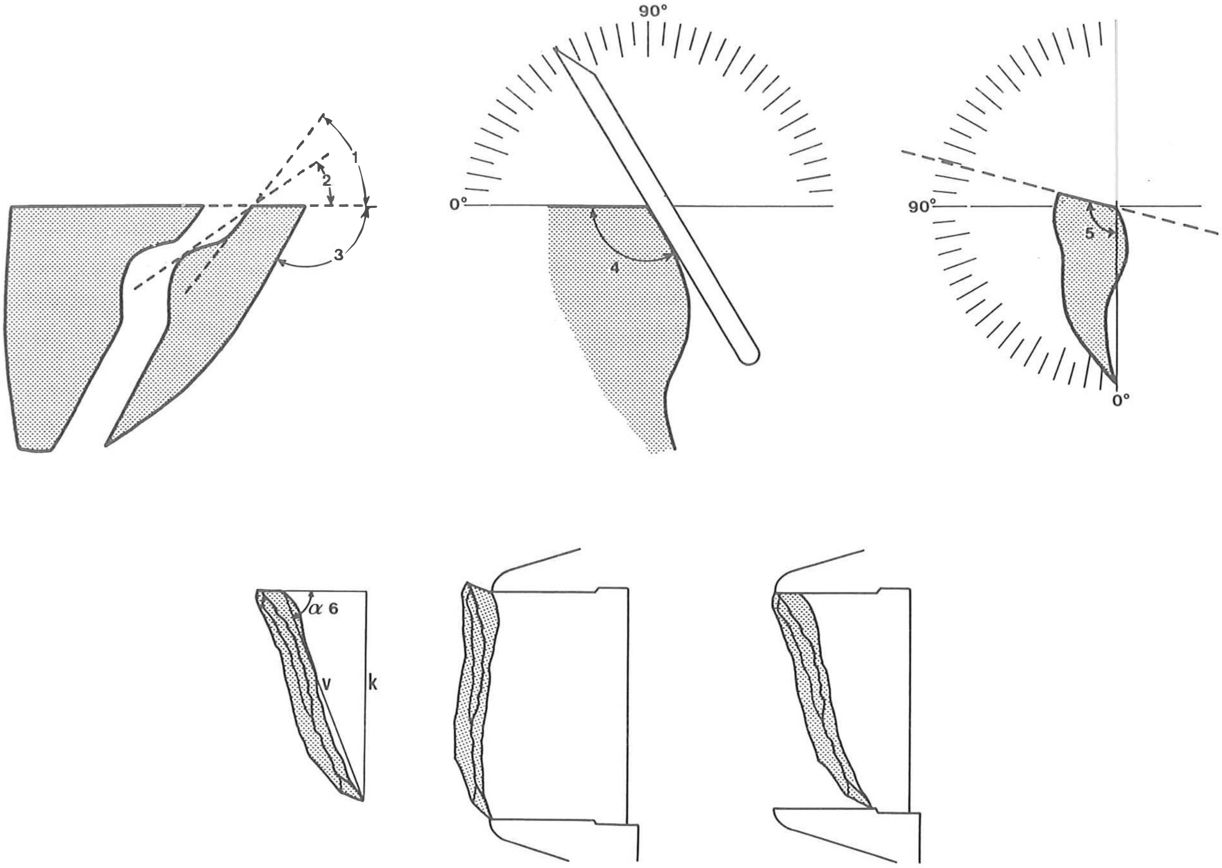

Fig. 5. The measuring of different kind of angles related to detaching, according to Barnes & Chernier (1935: pp. 1-3), Ohel (1978: pp. 4-5), and Uerpmann (1976: p. 6).

various authors (fig. 5). For example, Barnes & Cheynier distinguish three different angles: *l'angle d'incidence ou frappé; l'angle du cul;* and *l'angle de chasse.* Ohel (1978) distinguishes a flang (flaking detachment angle) from an inclination, the latter being comparable to Uerpmann'ns (1976: p. 56) *Abbau* angle.

The rather complicated way of measuring by Uerpmann (fig. 5: no. 6) certainly improves measurement accuracy and should be preferred to other methods. The *Abbau* angle, henceforward termed 'inclination' here, was one of the main variables in her study and distinguished between assemblages belonging to different time periods. It was not possible, however, to use her measuring technique for the assemblages under study here which have a large blade component. The Swifterbant items, for example, have many edged and *punctiforme* platforms. The Uerpmann measuring method would be appropriate, therefore, for only a portion of some of the assemblages under study. When amenable assemblages are encountered, however, this method will be introduced into the coding system.

The angles mentioned above are usually related to different detaching techniques. The same is true of another variable, the development of the bulb, measured as the height which the bulb attains. Although it is technically feasible to measure the height of the bulb (Ohel, 1977; Partel & Ohel, 1981), this variable was not incorporated because most of the artefacts had no bulb or a very small one (height smaller than 0.5 mm).

Barnes & Chenier (1935) have proposed that, especially for assemblages with a prominent blade component, measuring blade thickness at both distal and basal (or proximal) ends gives more information about technical ability or available raw material. In the future these measurements will be taken on a sample of assemblages with a clear blade component in order to see if there is a relation between blades with a thick basal end and distinctly formed bulbs and the inverse (smaller basal ends and diffuse bulbs) and the different stages of core reduction. This would allow me to evaluate the hypothesis that the former group of blades is the product of the final stage of core reduction.

4. FILE KVF (core file)

File KVF contains information for further classification of the cores. Designing a computer program to establish the core typology, as was done for the tools, seemed unnecessary and inefficient at this stage of research because there are only a small number of cores in the collections and almost none of the classic core types, such as pyramidal cores, polyhedrical cores, *etc.* (Ulrix-Closset & Rousselle, 1982) occur. In contrast to current definitions of a core, I include artefacts with only one negative in the category of cores. In the future a program will be designed, but for the present a simple matrix appeared to be satisfactory.
The following variables were coded in file KFV (fig. 6):

Variable 26: the number of platforms, whereby 9 means more than four platforms.

Variable 27: the placement of the platforms with the codes: 1. long core, flaked from opposite sides; 2. long core, flaked from adjacent sides; 3. long core, flaked from opposite sides and one adjacent side; 4. short core, with at least two platforms which form a thin edge, comparable to bifacial retouch; 5. short core, with rotating platforms. Meaning that a platform is situated at the distal ends of the negatives struck off from a previous platform; 9. core with flakes or/and blades detached randomly.

Variable 28: the number of flake negatives.

Variable 29: the number of blade negatives.

Variables 30, 31: length and width of largest intact negative.

Variable 32: indicates if variables 30-31 refer to a flake (2) or blade (1) negative.

Variables 33, 34: length and width of smallest intact negative.

Variable 35: indicates if variables 33-34 refer to a flake (2) or blade (1) negative.
Variables 30-35 were excluded in the matrix. Cores having only one platform, of course, could not be coded for variable 27, but these were the only cores

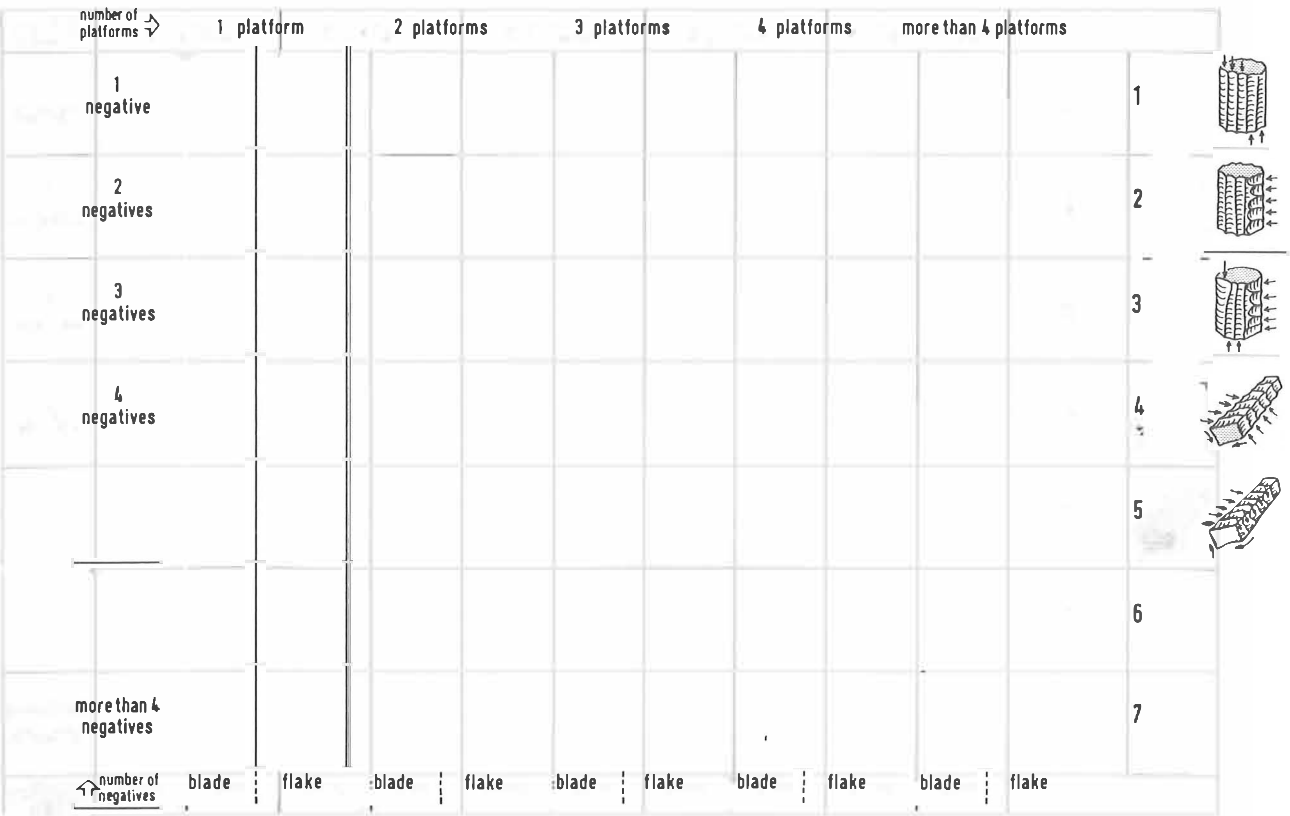

Fig. 6. Matrix for core types.

coded for the number of negatives on the core, variables 28-29.

The core typology developed by Clark (1960) is used by many authors who study British Neolithic flint material. Clark distinguishes 5 classes, A-E. A has one platform, B two, and C more than two. E and D are keeled cores with flakes struck from two directions (D) or with one or more platforms (E). Class A is further subdivided into two groups according to the amount of cortex. Group A-1 has flakes removed all around and therefore no cortex in contrast to group A-2. Class B cores are divided according to the location of the two platforms with respect to each other: parallel platforms; platforms at adjacent sides, oblique angle; platforms at adjacent sides at right angles.

An earlier publication (Clark & Rankine, 1939) illustrates types A, B, and C. Clark's type A includes those cores having one platform from which all flakes/blades were detached, but apparently does not include those cores classified here as cores with many platforms, type 9. Type 9 would probably be classified as irregular by Clark. Clark's type B1 should be the same as type 1 here, but it was difficult to ascertain the difference between his classes B2 and B3.

From the publication of Smith (1965: fig. 37), however, I surmised that types B2 and B3 are equivalent to type 2 whereby the first group of negatives that form the platform for the second group are situated on the short side of the core for type B2, and B3 includes all others that do not fulfil this condition. This interpretation may be incorrect, and an alternative one may be that the oblique or right angle refers to the angle between one platform and the negatives formed from the second platform. Whether an angle is an oblique or a right one is related to a technical factor. Cores with a right platform angle are certainly exhausted cores because it is hard to detach further flakes from them. Clark's types D and E could perhaps be equivalent to types 4 (short bifacial type) and 5 (short core with rotating platform), respectively.

The core typology here does not include cores and flakes showing bipolar technique (Radovanic, 1981: p. 101), although these are probably present in the assemblages. I had problems in recognizing the bipolar technique in the assemblages under study (Deckers, 1979: p. 148). More attention will be given in forthcoming publications to the relation between detachment and core types, *e.g.*, the relation between the axis and the negatives on the dorsal side of flakes and blades (Uerpmann, 1976: p. 73).

5. TOOL TYPOLOGIES

As stated in the introduction, I consider the differences in the flint material of prehistoric societies to primarily reflect differences in economic activities. But prehistorians have defined successive Palaeolithic and Mesolithic groups in terms of flint tool types, grouped into typologies. Generally speaking, the Late Palaeolithic typologists assume that certain tool types are characteristic for different chronological periods[5], whereas the Mesolithic typologists assume that proportions of tool types within the assemblages are diagnostic for different periods. For those concerned with the Neolithic, neither the individual tool type nor the proportion of tool types within the assemblage have been used for the purpose of making chronological determinations.

That a systematic approach to Neolithic flint material, comparable to those for Late Palaeolithic and Mesolithic flint was never developed is because pottery provided a suitable, and usually better, alternative for chronological determination. Thus, tool types as recognized in the Palaeolithic or Mesolithic were no longer recognized in Neolithic assemblages. In my opinion, the shifts in methodological approach are due to real changes in tool types and assemblages and reflect changes in economic activities: from specialized hunting in the Late Palaeolithic to broad spectrum hunting and gathering in the Mesolithic to farming in the Neolithic.

The only Neolithic flint material that has been studied rather extensively is that of the Linear *Bandkeramik* (LBK) (for example Bohmers & Bruijn, 1958/59). Following his studies of the Palaeolithic and Mesolithic flint material, Bohmers published his study of the LBK flint material as the next chronological step. Then, however, his work was interrupted, and it is not clear whether or not he intended to publish studies of the flint material of the Middle and Late Neolithic as well. It is certain that the impetus for the study of the LBK material was its presence in the more recent and more important excavations. Other writers (Newell, 1970; Zimmerman, 1982) have thought that the possible role of the Mesolithic element in Early Neolithic Culture was sufficiently intriguing to study the LBK flint material.

In general, the Neolithic flint material receives more attention in British excavation reports than it does in continental excavation reports. This unsatisfactory state of affairs stimulated this study. When I began analysing the Neolithic flint material the common opinion was that flint tool types are virtually absent in Neolithic assemblages. Because no 'classic' tool types were available, it was necessary to develop a system to allow tool types to be defined on a lower level of analysis than had been done for tool types in the Late Palaeolithic and Mesolithic.

The decision to choose the side as the basic unit analysis was based on the system used in microwear analysis (*i.e.*, Odell, unpubl.) who, in fact, used segments and not sides) and the availability of computers, which made the analysis of extensive data banks possible. After having made this decision, I was gratified to discover that my solution had also been adopted independently by White.

White (1969; 1972), while studying the flint material of New Guinea in both archaeological and ethnographical contexts, noted that tools which were difficult to classify into well-defined 'good' types were either neglected or assigned to vaguely defined 'intuitive' types by archaeologists. On the basis of his ethnographic observations, White decided to tackle the problem by taking the side of the flint artefact as the basic analytical unit.

The approach allows all the tools in assemblages, rather than a minor subset (the 'good' types) of them, to be studied. Moreover, the validity of the approach is supported by the view of contemporary flint tool makers and users who see a tool as: "a record of a series of discrete processes, which have acted on it" (side) (White, 1969: p. 22) and not as an attempt to create a specific formal type.

Although some problems have been solved by this approach, the ethnographic approach is only one way to stablish a typology and certainly not always the way. Furthermore, we have to realize that this approach to flint material and its interpretation is not a *panacea* for solving all problems in the study of flint material. This cannot be emphasized better than by the fact that in most cases we study a biased sample, the waste products and discards of the flint material, but give this aspect little attention.

6. FILE WVF (tool file)

As stated in the introduction the Neolithic flint materials will be interpreted with respect to their possible functional significance because other factors (style and the development of manufacturing techniques) are less evident morphologically than in materials from other periods. The side of the tool is used as the basic analytical unit in order to relate morphology to the functional component, as described in this section.

The WVF file contains the variables pertaining to retouch and macroscopic use wear for a side and the variables specifying how the sides are related. Each retouch or use wear variable is measured for a maximum of five sides per artefact (section 6.1.). In the list below the first variable number refers to the measurement or discrete code obtained for side 1, the second to side 2, *etc*. The structure of the code list is presented in appendix A:

Variables 29, 37, 45, 53, 61: form of side (obligatory).

Variables 31, 39, 47, 55, 63, 86: form of retouch/use wear.

Variables 32, 40, 48, 56, 64, 87: location of retouch/use wear.

Variables 33, 41, 49, 57, 65, 88: length (depth) of retouch (*ampleur*).

Variables 34, 42, 50, 58, 66, 89: extension of retouch.

Variables 35, 43, 51, 59, 67, 90: direction of retouch.

Variables 36, 44, 52, 60, 68, 91: radius of arc (depth of curvature).

Variables 70-77: side number and length of curvature of retouching.

Variables 80-83: side complete or broken.

For an explanation of how the radius of arc variables (36, *etc*.) and variables 70-77 are used, see section 10.5. Variables in file WVF which give information about the mutual relationships of the sides are: Variable 26: form of artefact. Variable 27: location of platform. Variable 28: number of sides. Variable 69: tool type. Variables 78,79: left and right base angle. Variable 92: additional information. Variables 95, 96, 97: type coding according to computer program.

6.1. Variable 26: form of artefact

This variable refers to the geometric relationships among the sides, the positioning of the total artefact, and the order in which the sides are described. The contour of a side itself (straight, convex, *etc*.) is covered by another variable (section 6.3.).

Unless the artefact is a point or a trapeze (see below) the longest side (which may or may not include the platform side) is used as the 'base' or baseline for measuring variable 26 ('base' should not be confused with the term 'basis' which refers to the side where the platform is, or, in the case of broken blades, was, or the proximal end of the blade).

One method of defining the form or outline of a tool is to record the coordinates of points on the outline. Many difficult decisions are needed to register such an outline, such as how many points should be taken on the tool outline, where they should be taken, *etc.*

Furthermore, these decisions must be made individually for many cases because it is difficult to determine *a priori* which points to choose and how many should be chosen, particularly when it is not known if a type relevant in one assemblage is also relevant in another assemblage. Another method is to record the form of the artefact using digital image processing. Unfortunately, the author did not have access to the equipment required for this procedure.

Given this situation it was decided to find or develop a system that would combine the following advantages:

1. There would be no need to decide where and how many points to take from the artefact outline.
2. The outline forms would be universal ones, rather than existing tool type forms.
3. The forms in the system would be related to each other in such a way that the measurements of the different forms would approximate interval-level measurments (as stated in section 2.1. as one of the basic rules).

The method selected was conceived by N.J.M Commandeur (pers.comm.), who proposed starting from a imaginary rubber band representing the form outline. This imaginary rubber band is taken in the middle and gradually pulled up. The result is a changing isosceles triangle, whose change can be measured in degree classes indicating the base angle, or range of base angles. After applying this method to existing typologies, it was decided to code the form as isosceles triangles with their corresponding base angles (see table 5; fig. 7).

Because of the difficulties of control in working with flint, a deviance of 3 degrees for the top angle isoscelity and for the codes 30, 700 and 50 in relation to the top angle were allowed.

Initially, a code for isosceles triangles with a 90 degrees top angle was not needed during the analysis of the Neolithic material, but was later introduced as code 700. Code 60, 'base angle larger than 60 degrees' was created for points which are isosceles triangles with base angles larger than 60 degrees and whose distinctive feature is that they are isosceles, rather than scalene, triangles. If the longest side had been used as a baseline for these tools, the degree of isoscelity could not have been determined by the measuring device without undergoing complicated changes (see also four-sided forms, trapezes).

For scalene triangles the same system can be used, but rather than pulling the rubber band at the centre point, it was decided to pull it up at two points, one on the first third and the second on the second third of the band (table 6).

In this system four-sided forms can be considered as truncated triangles (in the geometrical sense). Where the triangle is truncated can be established with the help of length/width index, thus obviating the need to code the location of the truncation.

The direction of the truncation is coded as follows: the truncation runs parallel to the base; the right side of the truncation is nearer to the base; the left side of the truncation is nearer to the base.

These codes were incorporated into the form code for four-sided forms by changing the last figure of the code for three-sided forms from zero to a number greater than zero, *i.e.* 1, 2, 3, for four-sided forms. Since truncation of a triangle interrupts the regular relationship between the length of the longest side and its opposite angle, the method of measuring four-sided forms requires triangles whose base angle sum is more than 120 degrees.

Table 5. Form codes for isosceles triangles.

Code	
10	Line ('two-sided forms'; section 6.3.)
20	Isosceles triangle base angle 1-29°
30	Isosceles triangle base angle 30°
40	Isosceles triangle base angle 31-44°
700	Isosceles triangle base angle 45°
40	Isosceles triangle base angle 46-59°
50	Equilateral triangle base angle 60°
60	Isosceles triangle base angle > 60°

Table 6. Form codes of scalene triangles.

Top angle	Left base angle > right	Right base angle > left
> 90°		
90°		
< 90°	Code 70	Code 80
	Code 90	Code 100
	Code 110	Code 120

Table 7. Form codes for four-sided forms.

Left base angle	Right base angle	Form code
90°	< 45°	141 142 143
90°	> 45°	811 812 813
> 90°	< 45°	191 192 193/201 202 203
> 90°	> 45°	831 832 833
< 45°	90°	131 132 133
> 45°	90°	801 802 803.
< 45°	> 90°	181 182 183/231 232 233
> 45°	> 90°	231 232 233
90°	90°	(151) 152 (153)

Therefore codes for triangles where the sum of the base angles is larger than 120 degrees were introduced, even though the triangles themselves, *e.g.* scalene triangles with one straight base angle and triangles with an obtuse base angle, are never used. The triangles with a straight or obtuse base angle are subdivided into groups according to whether the other base angle equals, is smaller than, or is larger than 45 degrees. The form codes for four-sided forms are shown in table 7.

Four-sided forms which cannot be derived from a triangle, for example parallelograms and rectangles that have two 90 degree angles, are coded 151 (161), 152 (162), 53 (163). The codes between parentheses were used in the first version of the code list, but are no longer valid. The codes for parallelograms are 201 (211, 221, 231, 241, 251), 202 (212, 222, 232, 242, 252), 203 (213, 223, 233, 243, 253), 821 (833), 822 (832) and 823 (831).

The description of trapezes presents another exception to the longest side rule for describing four-sided forms are trapezes. A good definition for trapezes is an artefact with four sides, with a restricted length/width index, with two opposing retouched sides (neither more nor less; see also 10.2.). The longest unretouched side of the trapeze is called the base (or length) and the measurement perpendicular to this base the width. It is commonly assumed that the length/width ratio of trapezes has chronological significance. To investigate this assumption it was decided always to measure and describe them in the same manner and not to reverse the terms length and width in cases where a retouched side is longer than an unretouched side.

It appears to be a happy circumstance that the trapezes studied here have their supposed platform on one of the retouched sides; therefore, they conform to the definition of length as given in section 3. Five-, six- or perhaps even more-sided forms are reduced to a four-sided form by using code 6 (bend) in variables 29, 37, 45, 53 or 61, except in those cases where the chief characteristic of the tool type is five or more sides.

A measure for delimiting sides (White, 1969: p. 24) is a change in the direction of the edge of at least

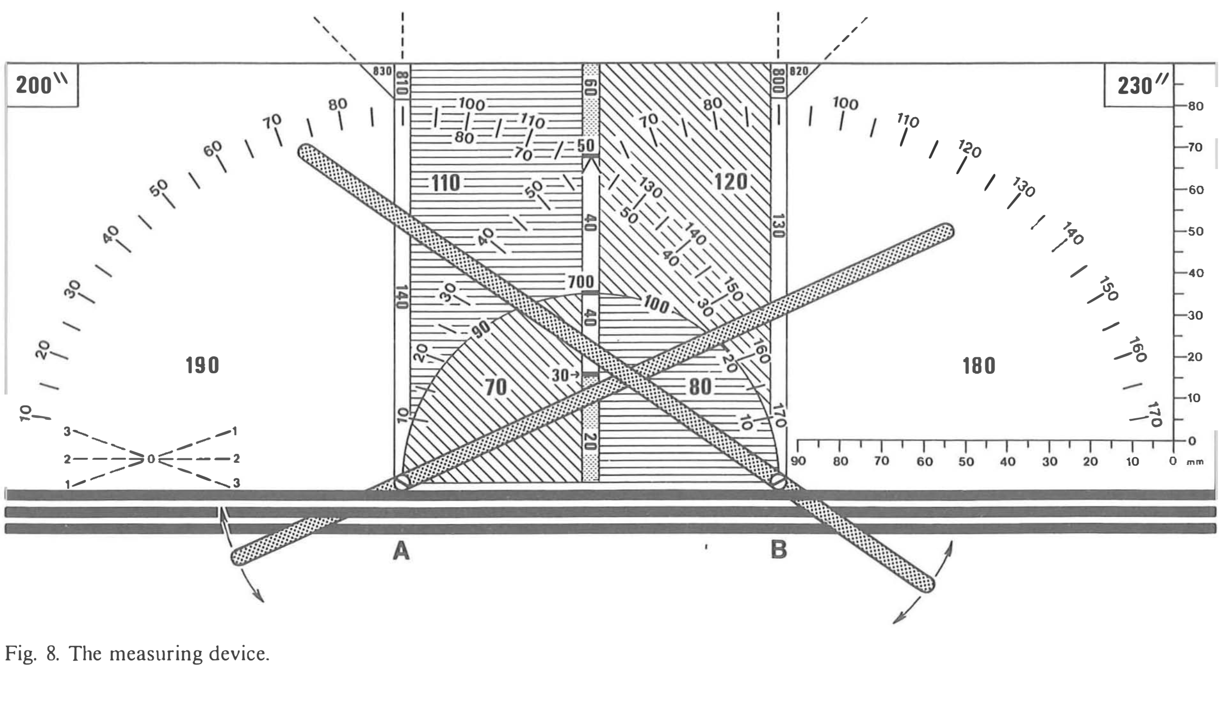

Fig. 8. The measuring device.

40 degrees within a distance of less than 1 mm. This measure was used here, without its accompanying criteria, such as the discontinuity of retouch or wear, except for those cases where a multi-sided form was reduced in the code to a four-sided form. For these cases I used code 6 in variable 29, *etc.* (section 6.3.). For those five-sided forms whose five sidedness is a distinctive feature codes 344, 352-354, 362-364, 400 can be used.

A measuring device, developed by J.N.M. Commandeur, was constructed to facilitate the form coding of three- and four-sided forms and is also useful for measuring other variables (fig. 8). It is a three-layer instrument. On the bottom layer, made of brass, are drawn coloured areas which stand for a form coding of a triangle (thick number). The two layers above are made of plexiglass; each contains a gradient for central points A and B, respectively, that serves as a pivot for the indicators with which the base angles are measured. The indicators are situated between the lower and the middle and the middle and top layer. At the base immediately underneath points A and B a plexiglass strip is glued with a right angle in the right lower corner of the device to measure the variables length, width, and height (10, 11, 12, respectively).

To measure the form, the artefact is laid ventral side down with the baseline line positioned between points A and B. The angle of both adjacent sides are measured with indicators A (left adjacent side) and B (right adjacent side). The coloured area where both indicators meet bears the code for the form of the triangle. For four-sided forms, the 0 of the form code is replaced by 1, 2 or 3, as mentioned before. The indicators can also be used for measuring the variables 30, 38, *etc.* (angle of retouch/use wear). With this device almost all variables (with the exception of weight and colour) can be recorded.

6.2. Variables 27, 28: location of platform and number of sides

The location of the platform in relation to other attributes can be of importance for determining a tool type. Since the baseline, which is the reference line for our system, is defined independently of the side on which the platform is situated, the platform can be found on any side. Therefore, it is necessary to code its location with respect to the baseline (black point in tables 9 and 10, and in fig. 13).

In case of four-sided forms, the following codes are used:

1. Platform on right side perpendicular to baseline.
2. Platform on left side perpendicular to baseline.
3. Platform on baseline.
4. Platform on side opposite baseline.
5. Platform on side perpendicular to baseline, for cases in which right and left cannot be decided.
6. Platform on side opposite to or on baseline, for cases in which the upper or lower side cannot be decided.

For other forms it is, in conformity with the codes used for four-sided forms, the direction which is coded. Variable 28, number of sides, was introduced because it is needed in some programs where the number of sides rather than the specific form is required. The number of sides refers to the number used in the form code and not necessarily to the actual number of sides (see 6.1.).

The variables described in sections 6.3.-6.12. are coded for each side, using a separate code for the variable according to the side referenced with a maximum of five sides per artefact. When two codes for one side within one variable are needed (for example, two different kinds of retouch or retouch and gloss on the same side), the extra information is stored in variables 84-91. Variable 84 indicates to which side the additional information refers, and variables 85-91 are used for this additional information (it is not necessary to code form of side, because this is done with variables in section 6.3.). The sides are numbered in relation to the form (variable 26). The side which is the baseline is always side number 1, and the numbering continues counterclockwise.

6.3. Variables: 29, 37, 45, 53, 61: form of side

Side 1 is related to variable 29, side 2 to variable 37, *etc.* To describe the side contour, the side is divided into three parts, and each part, going in a counterclockwise direction, receives one of the following codes:

1. Convex.
2. Straight. 3. Concave.
4. Notch, shoulder, hafting.
5. Burin spall.
6. Bend.
7. Very irregular side.

Together these three codes give the outline of the side from the bottom to the top of the side. For example, variable 37 coded 312 means that side 2 (the right adjacent side) is concave at the bottom, convex in the middle, and straight at the top.

Because code 3 can indicate that a notch is on the side, (*i.e.*, code 232 means a straight side with a notch in the middle), it is necessary in some cases to use code 4 rather than code 3. For example, a concave side that begins with a retouched notch is coded as 433 rather than 333. If instead the side code 333 were used, then when combined with code 1 for the extension of retouch variable (section 6.8.), it would indicate that the retouch occurs at the beginning part of the concave side but not that the concave side has a retouched notch at the beginning. In other words, code 4 is used when code 3 has already been used for describing the outline of the same side.

Code 6, bend, is used mainly to combine sides of a multi-sided form (variable 26) in order to make a three- or four-sided form. For two-sided forms, such as segments and double points, variable 26, artefact form, is coded as 10, line, and the form of the side variables give the curve of the line. For example, a segment could be coded 10 for artefact form with 222 for side one and 111 for side 2, which are, respectively, the lower and the upper sides of the same baseline, which are theoretically interchangeable.

In setting up the code list it was necessary to be prepared for all possibilities, but in using it it was found that side forms are, with a few exceptions, limited to a small number of combinations. The most common side forms are 333, 323, 232, 222, 212, 121, and 111. These codes indicate more than the sum of the parts, they describe the side as a whole (fig. 9): 222 represents a completely straight side that deviates only 1-2 mm along the side of the ruler; 111 indicates that the side is round like a half circle; 121 and 212 refer to intermediary cases in which 212 indicates a somewhat convex side and 121 a convex, but not circular round side.

Similarly, the codes from 222 to 333 describe a continuum from a straight to a semicircular concave side. For more information see Deckers, 1980-81.

6.4. Variables 30, 38, 46, 54, 62 and 85: angle of retouch, macroscopic use wear

Variable 30 refers to side 1, 38 to side 2, *etc.* Variable 85 gives the angle of retouch or macroscopic use wear for a second score of the variable on the same side (see 6.2.). The angle of retouch/use wear refers to the angle between the retouch and the edge this retouch is struck from, or, in case of bifacial retouch, the angle between retouch on one edge and that on the other. There are several problems normally encountered when measuring edge angles (and angles in general) of flint material (Patterson, 1980). The edge angle is defined as the intersection of the dorsal and ventral surfaces of the artefact and one of the problems is that the 'sides' of the edges are usually not straight.

Another problem is where to measure on the side. For convex and concave sides, and other sides when possible, the angle of retouch should be measured at the point of maximal expression of the curve. When this point is not obvious (for example, with completely straight sides) one should measure a point in the middle.

There are two ways of taking edge angle measurements (A and B in fig. 10). I preferred to measure angle A in the figure, which reflects the effects of use at the edge, rather than angle B, which better defines the original shape of the edge angle before use.

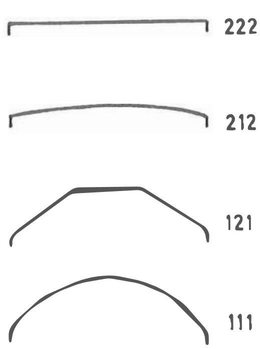

Fig. 9. Side forms and codings.

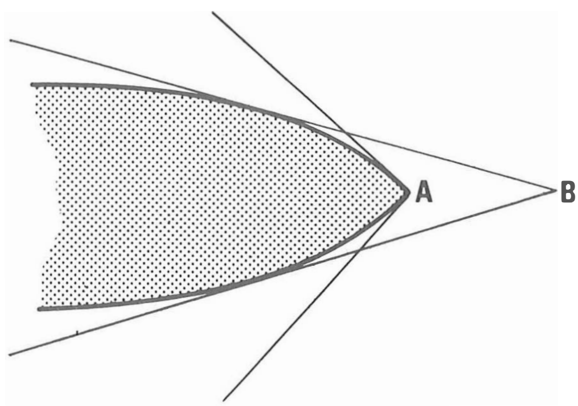

Fig. 10. Edge angle measurements.

But in some cases, wear or nibbling were so minute that the angle between the dorsal and ventral sides of the tool had to be measured (angle B).

The angle of retouch is often condensed into broader classes. For example: Movius *et al.*, 1968 (p. 14):

25	degr.:	very acute
26-50	degr.:	acute
51-75	degr.:	medium
76-85	degr.:	steep
85	degr.:	perpendicular

Leroi-Gourhan, 1966 (p. 252):

10	degr.:	*rasante*
20-30	degr.:	*très obliqué*
45	degr.:	*oblique*
90	degr.:	*verticale*

For this study, actual measurements were recorded, which can later be grouped into classes if there is some reason to do so (see 13.1.).

6.5. Variables 31, 39, 47, 55, 63 and 86: form of retouch, use wear

The following kinds of retouch/use wear are coded:

1. *Retouche sommaire* (no longer used).
2. *Retouche laminaire.*
3. *Retouche scaliforme.*
4. Visible rounding of edge by polishing or grinding.
5. General use wear.
6. Irregular retouch.
7. Gloss and retouch, both at the same location.
8. Use retouch.
9. Gloss.

Retouche sommaire (Brézillon, 1968), which is defined in relation to the angle of retouch, was eventually omitted because it combines two variables used in the code list. As the name implies *retouche laminaire*, code 2, has the same morphology as does a blade; it is distinguished by blade negatives below a certain size. (For the difficulties in distinguishing between negatives on cores and retouch see 3.9.) *Retouche scaliforme*, code 3, has the form of a half-moon or fish scale. Code 5 is the general code for use wear visible to the naked eye; subclasses of use wear are gloss (code 9) and polishing or grinding (code 4).

It is sometimes difficult to distinguish between certain types of intentional retouch and use retouch. An attribute used by other authors is retouch size with all small retouch considered as use retouch. Another criterion often used is regularity, with irregular retouch being considered use retouch.

Three definitions of use retouch are used in the code list: all retouch negatives are smaller than certain measurements; irregular retouch; and a combination of these two. When the first definition applied it is not necessary to code use retouch (code 8) at all because this has already been done in coding variable 33 (length of retouch, section 6.7.). When the second definition applies code 8 is the same as code 6. When the third definition applies code 8 is the same as 6 with the difference that 8 is below certain dimensions.

For the Swifterbant assemblages the third definition applied. But were this definition applied to the TRB and PFB assemblages, there would be no use retouch recorded at all. Still, most archaeologists would probably find use retouch on a number of artefacts from the TRB and PFB assemblages in the form of a regular, small retouch. Thus, it is clear that all definitions are required to code use retouch.

Rozoy (1967a: p. 212) defines a retouch named *parage*:

> *Retouche courte ou très courte, atteignant rarement un millimetre, semi abrupte ou abrupte, très régulière, n'entamant jamais notablement le bord qu'elle intéresse, debutant et se terminant progressivement, généralement inverse et située sur un bord non retouché d'un microlithe, parfois isolée sur des lamelles et dans ce cas indifféremment inverse ou directe*

which describes exactly use retouch in TRB and PFB assemblages (be it not on microliths). Another approach to categorizing retouch is to view it morphologically as a negative of a small flake (Uerpmann, 1976: p. 83 ff.). In this approach all the measurements, such as length, width, thickness, *etc.*, are taken for each retouch negative the same as they are recorded for blades and flakes. Such measurements may well facilitate the finding of associations among similar or dissimilar retouch forms and their associations with a part of a side or sides in order to form classes of retouch. Interpretations for associations found could then be made, and the research could go to the second phase, namely analysing the spatial distribution of the different groups of retouch on the same artefact. For this study the large number of artefacts and the lack of appropriate equipment precluded measuring every retouch negative.

Eventually, however, the task could be accomplished by sampling negatives representing the groups identified after determining representative patterns from a series of measurements of individual retouch negatives from different assemblages. It should be noted that retouch coded as 'normal' on the basis of its size and regularity can be the result of use (Rozọy, 1967a: fig. 1). Retouch can even result from detaching blades, called 'spontaneous retouch' by Newcomer (1975). Spontaneous retouch usually occurs at the distal end and is abrupt (90 degrees), but it can also be at the basal end and be less abrupt. For the present the solution adopted is to code use retouch not on the basis of global criteria, but in relation to its association with other variables, such as angle of retouch, form of side, length of retouch, *etc.*, in individual assemblages.

The validation of functional interpretations of the differing morphological characteristics of use wear is through microwear analysis.

In the code list for retouch types 'surface retouch', or 'flat retouch', is missing mainly because no reasonable definition could be found in the literature. At least two variables seem to play a role: A) the rather large (length) dimension(s) of the negative, an absolute measurement, which eventually could be replaced by a relative measurement (as done by Uerpmann, 1976) using the ratio between the retouched and unretouched surface of the tool; and B) the angle of retouch, which should not be too steep. Because variables A and B are recorded individually, a separate code for 'surface retouch' would be redundant in this system. Rather than arbitrarily setting a limit to the steepness of the edge angle it was decided to exclude 'surface retouch' until sufficient data are available to make a reasonable decision. Until now the only additional variable for distinguishing 'surface retouch' has been size. Tools with retouch negatives greater than or equal to 9 mm and perpendicular to the edge are provisionally considered to have surface retouch (see also section 6.7.).

6.6. Variables 32, 40, 48, 56, 64 and 87: location of retouch, macroscopic use wear

For these variables there are the following codes: 1. Dorsal; 2. Ventral; 3. Ventral/dorsal; 4. Dorsal/-ventral; 5. Ventral/dorsal/ventral; 6. Dorsal and ventral; 7. Dorsal/ventral/dorsal; 8. Middle not edge; 9. Middle and edge.

Codes 1-7 refer to the surface on which the retouch (negatives) or use wear is situated, rather than to the surface where the platform for the retouch is located: *e.g.*, code 1 indicates that the platform edge for the retouch is on the ventral surface, *etc.* Codes 3-5 and 7 indicate that the retouch/use wear occurs on both dorsal and ventral surfaces along the same side, but not at the same place along the edge of the side. Code 6 is used when the retouch occurs at the same place on the side. The location on the side is coded counterclockwise like the form of side variable (section 6.4.), but codes 3-5 and 7 only indicate the order of appearance of the retouch and are not to be directly associated with each 1/3 of the side as is specified for coding the form of side variable. 'Middle' in codes 8 and 9 refers to retouch/use wear on the middle of the ventral or dorsal surface, rather than on the middle of the side as viewed two-dimensionally.

6.7. Variables 33, 41, 49, 57, 65, 88: length of retouch (*ampleur*)

Length of retouch refers to the extension of the retouch negative perpendicular away from the edge, rather than to the extension of the retouch along the edge (see 6.8.). If there are successive layers of retouch, the total distance from the edge to the farthest retouch is measured. If the two layers of retouch are of a different type (as coded by variable 6.5), the variables 33, 41, 49, 57 or 65 refer to the retouch nearest to the edge and the other retouch must be coded under additional information (variable 88). This separately coded information is useful for studying use retouch superimposed on 'intentional' retouch. In the code list the maximum length is 8 mm (1 column) because code 9 is reserved for 'surface retouch' (see also 6.5.).

6.8. Variables 34, 42, 50, 58, 66 and 89: extension of retouching/macrowear

These variables refer to the location of retouch *etc.* on the side and have the following codes:

continuous retouch:	80: whole edge
	1: first part
	2: first and middle part
	3: middle part
	4: middle and last part
	5: last part
	6: first and last part
discontinuous retouch:	81: whole edge
	8: first part
	9: first and middle part
	10: middle part
	7: middle and last part
	11: last part
denticulated, round top, continuous:	82: whole edge
	12: first part
	13: first and middle part
	14: middle part
	15: middle and last part
	16: last part

denticulated, pointed top, continuous:	83: whole edge
	17: first part
	18: first and middle part
	19: middle part
	20: middle and last part
	21: last part
denticulated, discontinuous:	84: whole edge
	22: first part
	23: first and middle part
	24: middle part
	25: middle and last part
	26: last part
nibbling:	28: whole edge
nibbling,strong, eventually with notches:	29: whole edge
saw like edge:	30: whole edge

Nibbling means damage to the edge in the form of minute fractures (like mice biting the edge). It mainly occurs on blade sides parallel to the axis, where the edge is thin. Code 30, 'saw like edge', refers to those edges with very regular and deep notches, which often occur with gloss. Edges coded 30 were quite visually distinct from those coded 82 and 83.

6.9. Variables 35, 43, 51, 59, 67 and 90: direction of retouch/use wear

These variables describe the direction which the length axis of the retouch (from basal to distal end of the negatives) has in relation to the artefact on which the retouch is situated:

1. Perpendicular to the edge.
2. In the direction of the distal end.
3. In the direction of the basal end.
4. Centralizing. Centralizing is equivalent to the term convergent/semi-convergent (Movius *et al.*, 1968: p. 15). The use of code 4 is restricted to scrapers.

6.10. Variables 36, 44, 52, 60, 68 and 91: radius of arc; variables 70/71, 72/73, 74/75, 76/77: length of retouching and side number

The variable radius of arc and length of retouching were also used by Bohmers (1956). I took both measurements in mm, as did Bohmers. An alternative way of measuring proposed by Movius *et al.* (1968; fig. 12) is to measure length of retouching in mm and radius of arc in degrees. The variable radius of arc, length of retouch, and side number are all interrelated, and, although they can be used for many or all tool types, they have been used only for the different kinds of scrapers so far. During the study of De Wijert-zuid, site number 815 (Deckers, 1980-81), tools visually coded for the form of side variable with codes 222, 212, 121, 111 were checked by introducing the radius of arc and length of retouching (fig. 11: 1 and 2 resp.) variables. For the assemblage it was established that visual coding of the form of side variable was reliable.

In coding straight to fully curved scraper sides there seemed to be overlaps only between adjacent groups (for example 222 and 212). By introducing the radius of arc and length of retouch variable to check the accuracy of codes for variable 29 and related variables, it was found that these additional variables should be introduced permanently because they facilitated the analysis of the relation between scraper edges with regard to edge of retouch, form of retouch, *etc.* For example, a clear bimodal distribution of the angle of retouch variable and different kinds of retouch variable, independent of the form of side variable, was found for the scrapers of site 815 (de Wijert-zuid).

The 'radius of arc' variable replaces the 'influence of retouch/use wear on edge' variable in an earlier version of the code list. The old variable measured in mm the part removed by retouch or macrowear from the original edge. However, in most cases the original edge could not be reconstructed and so this variable was not used often. Most of the Swifterbant assemblages were coded according the old code list, whereas the TRB and PFB assemblages were coded using the new variables.

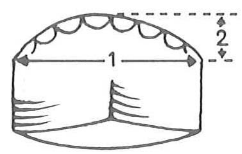

Fig. 11. Measuring scraper sides.

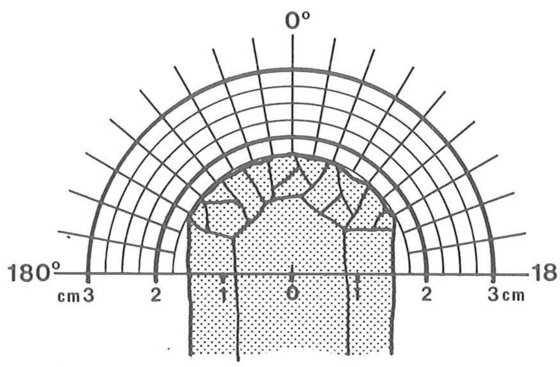

Fig. 12. Measuring scraper sides according to Movius.

The length of retouching variables (71, 73, 75, 77) could not be introduced into the code list without renumbering all the variables (appendix A) and completely changing the program for establishing tool types (appendices C, D, E). Instead, side number variables (70, 72, 74 and 76) were introduced to indicate the side on which the length of retouching was measured (71, 73, 75, 77). This redundant information also facilitates certain programming.

6.11. Variables 78, 79: base angles in degrees

The base angle is measured in degrees for only trapezes and points and is then related to the form of artefact variable (see 6.1.) in order to have better control over possible small differences which might be of significance for trapezes and points.

6.12. Variables 80, 81, 82, 83: condition of side

Only two codes were used for most artefacts to indicate the condition of the side:

1. The side is the result of a fracture.

0. All other cases. Code 1 is only used when the original fracture is still visible. Even in those cases where the side could only be the result of a fracture, but the fracture surface is not longer visible, *i.e.* when the side has been retouched, code 0 was used. More recently two additional codes have been introduced:

2. Feathered.

3. Hinged. These codes have only been used for a selection from the more recently analysed artefacts.

7. FILE WVF AND TOOL TYPOLOGY

The WVF files of the different assemblages were originally intended to form the base for the tool typology within an assemblage. The model used is the one given in section 2.3. in which the term artefact is replaced by the more specific term tool.

To apply the model, first, regularities confined to individual sides should be established, *i.e.* relations between form of side, retouch angles, kind of retouch, *etc*. Next, it must be established whether or not some of these patterns can be related to other patterns at the level of the total tool. After regularities at the side level and tool level and the relations between the two levels have been determined for one assemblage, then one investigates whether or not the patterns (on both levels) also appear in other assemblages. Finally, one can begin to interpret differences and similarities in these patterns among the various assemblages in chronological, spatial, or economic terms.

Tool descriptions of the assemblages published so far (Deckers, 1979; 1980-81) have had little to do with the proposed analysis. For programing (section 19), editorial, and analytical reasons the tools of the sites published have been analysed using an intermediary tool type list (and tool type defining program) which is described in this section.

After setting up the model for analysis information was needed concerning: 1) the attributes used to distinguish tool types; 2) whether or not these attributes are morphological, or could be expressed as morphological attributes; and 3) the underlying system for these attributes and how they are related in the different tool types. To get this information existing lists of tool type were analysed for the attributes used. In most typologies the description was insufficient or completely lacking, or attributes were related to a supposed function without proof or with no reference to a relationship between function and morphology. Underlying systems of attributes were difficult to extract because types, if defined, were defined without comparison with other tool types from the typology. In those 'excellent' cases where good morphological attributes were present, combinations of attributes were confined to a special group of tools within the total tool typology.

It was necessary, therefore, to set up an intermediary type list in which all the tool types coming from the traditional tool typologies were integrated in such a way that they could be defined with morphological attributes and distinguished from all other types of the type list. This list of tool types can be found in appendix B, and the definition of these tool types in terms of morphological attributes is in appendices C, D, E (the tool defining program). In testing the tool defining program with the Swifterbant material available 96% of the tools could be defined.

When the program was tested with the TRB material, only 56% of those TRB tools could be classified using the same type list. Frequently, tool types defined as the same for both the Neolithic and the Mesolithic typologies are very different in their range of variation.

Here again, the usefulness, or validity, of an attribute must be established within the level it is used. One should establish within each individual assemblage if one is dealing with real, separate tool types, or with an arbitrarily dissected variability of one type. For example, the study of the TRB assemblages to be published in part three resulted in a large number of trapeze types. However, when the distribution of attributes for all TRB trapezes (for example, the different measurements) is plotted, it becomes clear that they form one large group and that, rather than there being many different trapeze types, it appears that a much wider range of variability was accepted within the TRB context.

Almost 95% of the TRB trapezes come from graves and very few from settlements. Nevertheless, it is notable that trapezes coming from settlements are smaller in size. In part three I will suggest that trapezes were used as status indicators in graves and as tools in settlements.

Although the necessity to check the 'reality' of the tool types distinguished may seem self-evident, many archaeologists using tool type lists, for example, people using Sonneville-Bordes' typology, seem to underestimate this problem. Even in Sonneville-Bordes' typology the tools are forced into the limited standard tool type list, and the sophisticated use of indices, *etc.*, does not improve the problem.[6]

Although the method developed here to define tools as described in the previous sections avoids the problems which traditional typologies present and a new program has been developed (section 19.) parallel to the analysis of tools as described, the intermediary type list and the tool defining programs are still useful and needed for several reasons. First, the intermediary type list enables one to describe the material under study here in terms of the 'traditional' tool types of various authors. Second, the intermediate tool-defining programs are from a programing point of view, more suitable for defining new tool types and for introducing tool types from other typologies than are the programs designed to analyse tool types using side analysis (section 19). And, finally, the type list within this framework has been transformed from a 'key' to tool types into a list of hypotheses to be evaluated with the side analysis program. The 'existence' of every type is to be verified with attributes found significant within the assemblage where the type is found.

The tool typology made from the existing Neolithic and Mesolithic typologies was sufficiently comprehensive to include almost all Western European Neolithic and Mesolithic types. Most of the possible combinations of attributes defined here have been recognized and named as a type by one or more traditional typologists.

8. LIST OF CODED TOOL TYPES

The intermediate tool type list is presented in appendix B. Many of the tool types have three codes, with the first and the third codes being used to designate a special condition. The first code, if present, means that the tool is not thicker than 4 mm, the condition for a microlith as defined by Bohmers & Wouters (1956). Rozoy's (1978a) additional condition that the length of a microlith should not exceed 5 centimeterswas ignored. The presence of a third code for a tool type means that the retouch is 'surface retouch' (6.5.).

A tool type followed by one asterisk (*) indicates that in the description of the type (and the related variables) the symmetry of the tool type or the type itself (trapezes) overrules the stipulation that the longest side for the form description is the baseline (see 6.1.). Where there may be doubt as to which side should be considered the baseline, a double asterisk (**) indicates that the longest side rule is baseline applies. All tool types in the code list are illustrated in figures 13-15.

9. MAIN PUBLICATIONS USED FOR THE CODE LIST OF TOOL TYPES

9.1. Bohmers and Wouters, 1956

Statistics and graphs in the study of flint assemblages (Bohmers & Wouters, 1956: pp. 1-26).

Characteristics of tool types introduced by Bohmers *et al.* that are vaguely defined are only used *ad hoc* to separate types and have not been incorporated into the code list. Bohmers (1956) does not define the terms length and width in relation to the platform location, but rather according to the type of tool. In most cases, there are no differences between definition of length and width used here and Bohmers' definition. Where exceptions occur, *e.g.* the different tool groups in section 10., the differences will be noted. Although few archaeologists have adopted Bohmers' methods (for a recent exception see Beisert, 1981) his articles are widely known for introducing (1) a method to treat stone tools as measurable objects and integrating the method in a new, more general approach to flint material, and (2) the graphics in which the metrical information was displayed. The purpose of Bohmers' graphics was to present characteristics of total assemblages and thus essentially differs from the approach used here, where the total assemblage is the result of analysis of several underlying levels in the flint material. For this reason his way of presentation will not be used.

More relevant for the type list presented here are Bohmers' typologies for the Mesolithic, Late Upper Palaeolithic, and Neolithic periods of our region. In this section, a selection of Bohmers' types for each of these periods is discussed.

9.1.1. *Mesolithic: part III (Bohmers & Wouters, 1956: pp. 27-38)*

According to Bohmers and Wouters (1956), lanceolate and needle shaped points have a length that is equal to or larger than 5 times the width and 'steep' retouch. For both types the base can be either retouched or unretouched; the lanceolate point has one retouched side, whereas the needle shaped point has two sides with complete retouch or retouch near the top. Type 10 from our code list is analogous to these types, with the restriction that only three-sided points are coded and that no attention has been given to the steepness of retouch.

Bohmers' double points and the double point with surface retouch are similar to our types 20 and 22, respectively. Bohmers mentioned neither a length/width ratio nor the form of the sides, but in our system points with two convex sides are considered analogous to these types, while a double point with a straight and convex side is typed as a crescent.

Some of Bohmers' leaf-shaped points are covered by our code list as type 30, although type 30 has a much wider definition than Bohmers' leaf-shaped points. Leaf-shaped points with a retouched base are not coded as 30 but as 135-039, which also covers a broader class of types.

A-points are found in our code-list with the codes 40-41, 50-51, 60-62, 63-65 and 70-72, but are restricted to three-sided A-points.

B-points are found in our code-list with the codes 73-75, 76-78, 80-81, 90-91, 100-102. Codes 106-108 and 103-105, whereby the last group are A-points, have not been included in the type defining program (appendices C-E) because their definition is so general that many other tools would be coded under this type by the computer program. The B-points coded are also restricted to three-sided points.

Bohmers and Wouters state that a four-sided B-point with right and acute base angles and with the longest side perpendicular to the axis entirely retouched (our type 80-81) can be distinguished from a short truncated blade (our type 450) because it lacks a thick bulb. (A thick bulb prevents hafting.) Apart from the problem that Bohmers did not give a metrical definition of bulb thickness, our system does not record bulb thickness, and this distinction cannot be made. The distinction between a truncated blade and an uncomplete trapeze (or B-point if you want) is considered more important in the assemblages analysed (Deckers, 1979: p. 152).

C-points or Tardenoisien points are, according to Bohmers, microlithic (thickness smaller than 4 mm) three-sided points that have a straight or somewhat concave retouched base. These types are coded in our system as 110, 113, 115, 117, 119, 120, 123, 139, 140, 143, 145, 147, 150, 153, 155, 157, 900, 903, 912-922. It is not clear how similar points with a convex retouched base are typed by Bohmers, but here they are included with the C-points coded as 125, 127, 129, 130, 133, 135, 137. Our requirement that C-points must have a completely retouched base is made on the basis of the G.E.E.M. typology (section 9.3.), which also requires that C-points be symmetrical. Although Bohmers stated that C-points are more or less symmetrical, he also stated that scalene triangles are difficult to distinguish from C-points with a top angle of 90 degrees, which implies his acceptance of an asymmetrical C-point. The difference in thickness among the side, which is critical for the distinction between C-points and scalene triangles, cannot be extracted from our variable list, because thickness is recorded for the tool as a whole and not for the individual sides. Therefore, we consider C-points to be symmetrical.

Triangles can be symmetrical (isosceles) or asymmetrical (scalene). The difference between points and triangles is that the base of a symmetrical point is situated where the basis (section 6.1.) is on the opposite side, whereas the base of a triangle is always perpendicular to the basis (section 10.1.). The direction of symmetry of a triangle is perpendicular to the direction of symmetry of a point.

While now in agreement with Bohmers and Wouters to avoid the term trapeze and use the term trapezoid for trapezes and related forms, I have retained the term trapeze here in order to be consistent with my earlier publications. Bohmers differentiates trapezes that are longer than wide from those wider than long (his terminology is 'width' for length and 'height' for width). The first class (longer than 'wide) is divided into trapezes with two acute base angles, with one right and one acute base angle, and with one obtuse and one acute base angle. The same division is used in our code list.

In contrast to Bohmers the distinctions among acute, right, and obtuse base angles are considered a primary variable and the length/width relation a secondary variable. Therefore, the division of trapezes into those with acute, straight, and obtuse base angles is also used for trapezes where the length is shorter than the width.

Borers were not differentiated by Bohmers (type 300-308).

The code list follows the Bohmers & Wouters subdivision of scrapers into long (400-402), short (405-407-420), and double scrapers (425). Bohmers' class of short scrapers probably includes short blade scrapers and scrapers made on flakes or OM. For the Mesolithic period Bohmers also includes a type called microscrapers, which are circular and have a length shorter than 17 mm (408-413). The last condition is not included in the code-list for all codes, but it is included in some versions within a code (408/1-4, 410/1-4, 412/1). It is questionable that microscrapers are, in fact, confined to the Mesolithic period because some occur in the Neolithic assemblages under study here. The rest of the types for the Mesolithic show too little differentiation to be treated individually in our coding system.

9.1.2. *Palaeolithic: part II (Bohmers, 1956b: pp. 7-26)*

The Late Palaeolithic points are not yet included in the code list because they were not present in the material studied. Bohmers (1956b) makes a clear differentiation between borers and *Zinken*. Since Bohmers' classification of *Zinken* depends on variables which I consider characteristic for borers in general, *Zinken* cannot be distinguished from borers by the code list. For the scrapers see section 9.1.1.

Bohmers' category of retouched blades does not conform to the division in the code list (550-551) where blades with retouched ends are subsumed under straight blade scrapers (433-434), concave blade scrapers (430-431, 435-438), truncated blades (450-451), blades with notches (570-580), *etc.* (see also section 10.6.). Therefore, blades with retouch on the long side fall into a residual category.

9.1.3. *Neolithic: Linear Bandkeramik Culture: Part IV (Bohmers & Bruijn, 1958/59: pp. 183-213)*

In Bohmers and Bruijn (1958-1959) the following types of armaments are defined:

1. Asymmetric points: this includes the subtype 'classical *Bandkeramik* point' which has an obtuse angle between the short and the long side. Because little information was given by Bohmers for the different point types, illustrations of points from the assemblages in question where analysed. Of the nine points (*ibid.*: Abb. 113, p. 186), four would be coded 170, 857, 860, and two would be coded 860-874, and one would be coded 190. The atypical point, type 190, as well as the other armament types treated in this section, can be coded more precisely with the tool type list, as can the Mesolithic types defined by Bohmers. In coding Bohmers' illustrations with our code list it became evident that differences among chronologically related cultures, as defined by Bohmers, are a product of using different typologies for different periods.

Bohmers himself remarked that the atypical point shows a certain resemblance with Mesolithic triangles, but he did not indicate how the points could be differentiated. Here, it is assumed that the difference is that most Linear *Bandkeramik* points are thicker than 4 mm, whereas microlithic points are 4 mm or thinner.

2. Symmetrical points: the four different points in this class can be coded as types 70-110 (2x) and 120.

3. Four-angled or four-sided points: these all fit into the more precisely defined types in our code list.

4. Atypical points: a visual inspection of the figure (*ibid.*: Abb. 113) shows that one of the points can be considered as a symmetric point with one side entirely retouched (40-41) and another as a stemmed point. The rest of the types mentioned are defined in such general terms that the code list defines most of the types more precisely.

Bohmers and Wouters (1958/59: p. 196) also make a distinction in the class of scrapers between *Kratzer* and *Schaber*, with the *Schaber* having an extension of retouch more than 40 mm (also section 10.5.).

9.2. Bandi, 1963b

Birsmatten-Basisgrotte: V. Die archäologischen Funde, a: das lithische Material (Bandi & von Graffenried, in: Bandi, 1963b).

When a typology designed by one archaeologist is used by another who was not involved in the setting up of that typology, but who has the opportunity to discuss weak points and unclear definitions with the designer of the typology as well as to request solutions to problems, the result is optimal. This situation happened when Bandi used Bohmers' system to study an archaeological assemblage (Bandi, 1963b: p. 129, note 1).

In the course of their discussions Bohmers advised Bandi to decrease the number of types: *i.e.*, lanceolate points were no longer to be distinguished from the other points; isosceles triangles were not to be separated from scalene triangles; and the number of backed blades types were to be limited to two. Bandi, however, decided to distinguish three types, A, B, and C, a decision followed here by assigning two codes for each: type A (250-251), type B (240-241), and type C (230-231). The first code for each type indicates that it is a bladelet (thickness less than 4 mm), and the second refers to the form of the artefact with no size restriction.

As stated previously, the distinction between blade and bladelet is not considered valid until demonstrated as such within individual assemblages. The separate codes, therefore, are to be used only to compare our material with assemblages published by others. The difficulty of separating backed blades from other types is treated in section 10.6.

Bandi also introduced a new type of point, point with surface retouch, with surface retouch being a primary characteristic. In the code list surface retouch is a characteristic which may be recorded for every tool type, but is not a criterion for a separate tool type.

In addition to the convex scraper types mentioned by Bohmers, Bandi introduces *eingekerbte* and *gezahnte* scrapers. The former are related to our types 430-431 (scraper with a notch on scraper side) and the latter to 435-436 (denticulated scrapers). Bandi's knives are analogous to type 550, a blade on which one of the sides parallel to the axis is completely retouched.

9.3. Publications of the G.E.E.M. (*Groupe d'étude de l'épipaléolithique-mésolithique*)

Épipaléolithique-mésolithique, les microlithes géometriques (Barrière *et al.*, 1969: pp. 355-366).

The 1969 article concentrates on two groups of points, triangles and crescents, and on trapezes.

Table 8. G.E.E.M. triangles.

Attribute 1 Scalène isoscèle	Attribute 5 Relation retouched à non retouche side(s)	Attribute 2 Form of retouched sides	Attribute 3 Relation of length & width	Attr. 4 See text	Attr. 6 See text	Type name Triangle
	LR > NRS	LR & SR: convex				de Chateauneuf: 870-871
						de Fer: 866-868
		SR: convex				scalène à petite troncature concave: 860-862, 863-865
			L > 4W			de Muge allongée: 873-875
Scalène	LR < NRS	LR & SR: concave				de Muge: 176-178
		LR & SR: irreg.				scalène irregulier: 163-164
			L > 4W	+	+	de Monclus: -
				+		scalène allongé à petite troncature courte: -
						scalène allongé: 850-850
			L > 4W			isoscèle allongé: 173-174
Isoscèle			L > 4W			de Muge allongé: 873-875
		LR & SR: concave				
						de Muge: 176-178

Abbreviations: LNR = long not retouched side; SNR = short not retouched side; L = length; W = width; LR = longest retouched side; SR = shortest retouched side.

Table 9. G.E.E.M. crescent: attributes for segments.

Attribute 1 Scalène/isoscèle	Attribute 2 Form of retouched sides	Attribute 3 Relation of length and width	Type name
Scalène	LR SR: convex		segment de cercle asymétrique No. 180-182
		L > 3W	segment de cercle symétrique, large No. 183-185
Isoscèle	LR SR: convex		segment de cercle symétrique

For abbreviations, see table 8.

The focus of this section is on the combination of attributes used to structure the groups, while the types themselves will be treated in sections 10.1. (points) and 10.2. (trapezes).

The article, written from the point of view of a Mesolithic typologist concerned with geometric microliths, states that valid types are made on bladelets, which are defined as having a length shorter than 5 cm and a width of 12 mm or less. Although the condition that valid types be restricted to bladelets is ignored here, it is important that the definition of length and width of a flake/blade coincides with ours: the length (defined in relation to the platform) corresponds to the original long side of the bladelet.

A triangle is defined as:

Armature microlithique ayant la silhouette d'un triangle avec trois angles bien marqués, obtenu par la combination de deux troncatures. Le troisième côté, parfois retouché, est toujours sensiblement rectiligne

(Barrière *et al.*, 1969: p. 356)

The different types of triangles are distinguished by using the following attributes:

1. Scalinity or isoscelity, a division also used in the code list.

2. The form of the retouched sides (the non retouched being more or less straight (see definition); this is covered by the form of the non-retouched sides in the code list.

3. The length/width relation, a measurement not different from that used here.

4. The relation between the length of both retouched sides, this is used only for scalene triangles (LR:SR) in the code list.

5. The relation between the length of the longest retouched side (LR) and the non-retouched side (NRS).

6. The presence or absence of retouch on the third side.

For greater clarity a schematic of the possible relationships among attributes is presented in table 8 together with the correspondences with the tool types and the codes used in our system in parentheses.

The G.E.E.M. system makes use of attributes which are not directly related to each other and which are only used in small parts of the scheme. Therefore it was decided not to use the system as a whole but to select only those attributes that could be used in a more uniform scheme. In general, attributes 4 and 5, which give the relation between two sides for a three (four) sided form, will not be found in our variable list. Attributes 4 and 5 are above the level of the side, but cannot be transformed into our variable form. For the further differentiation among asymmetrical points that are not triangles, see section 10.1.

A crescent (*segment de circle*), another subgroup of points, is defined as a:

Microlithe ayant la silhouette d'un segment de circle. L'arc est obtenu par des retouches abruptes (bord abbatu ou troncatures convexes réunies), la corde est une portion de tranchant sensiblement rectiligne, brut de débitage ou à retouches semi abruptes partielles, plus rarement totales

(Barrière *et al.*, 1969: p. 360)

The authors see a strong relationship between crescents and triangles. Therefore, our system considers crescents as triangles with LR & SR convex (attribute 2).

Our type list does not distinguish between symmetrical triangles and crescents, but they can eventually be separated by using the subtypes.

A trapeze is defined as a:

Table 10. G.E.E.M. trapezes.

Attribute 1 Symmetric or asymmetric, etc.	Attribute 2 Form of retouched sides	Attribute 7 Relation of short and long non retouched sides	Attribute 8 Relation of short non-retouched sides and with	Attribute 9 Or other	Type name of Trapèze
	LR & SR concave				symétrique à troncatures concaves: 721-723, 880-882
	LR & SR:	2 * SNR < LNR			symétrique à troncatures très obliques:
Trapèze	rectiligne	2 * SNR = LNR	SNR < W		symétrique court: -
symétrique	(220-222	2 * SNR > LNR	SNR< W		symétrique long: -
	LR & SR:			> 45*	asymétrique à grande troncature courte:
	rectiligne			< 45°	asymétrique à grande troncature longue:
Trapèze asymétrique	LR &SR: concave				de Téviec: 718-720, 883-885
	LR & SR:			> 45°	rectangle à grande troncature courte: 709-711
	rectiligne			< 45°	rectangle à grande troncature longue vieille: 200-202, 730-732
Trapèze rectangle	LR: concave; SR: rectiligne	LNR: courte			du Martinet: 715-717, 840-842
				L < 1.5 W (attribute 3)	de Monclus court: 843-845
	LR & SR: concave	LNR: courte		L > 1.5 W (attribute 3)	de Monclus long: 712-714, 843-845
				> 45°	à bases décalées et grande troncature courte 210-212, 700-701
	LR: rectiligne				
				<45°	à bases décalées et grande troncature longue 223-225, 836-838
Trapèze a base décalée	LR & SR: concave	LNR: courte		L < 1.5W (attribute 3)	de Monclus court: -
				L > 1.5 W	de Monclus long: -

For abbreviations, see table 8

Microlithe géometrique determiné par deux troncatures lassant subsister deux parties approximativement parallèles des bords de lame ou de lamelle

(Barrière *et al.*, 1969: p. 360)

The following attributes are used (the numbering follows that used for points):

1. Shape: symmetric, asymmetric, rectangular, obtuse.
2. Form of the retouched sides.
3. Length/width relation.
6. The presence of retouch on the two 'non-retouched sides'.
7. Relation between the long non-retouched side (LNR) and the short non-retouched side (SNR).
8. Relation between SNR and length (L).
9. The restrictions for the largest base angle.

Attributes 4 and 5 are used for points, but not for trapezes, and three new attributes have been added to distinguish the different types of trapezes (table 10). G.E.E.M defined *lamelles bitronquées* as four-sided pieces having a length more than 2 times the width which are identical with type 925 blades/flakes having two opposite truncations and a length more than twice the width. This type is not coded in the type defining program because its existence as a separate type in our assemblages has yet to be established.

In table 10 attributes 9 and 3 are combined in one column.

9.4. Other authors (Rozoy, Daniel, Tixier)

Typologie de l'épipaléolithique franco-belge (Rozoy, 1979b).

Rozoy distinguish two kinds of points, Tardenoisian points with basal retouch and points with surface retouch.

a) *Les pointes Tardenoisiennes à base retouchée* As in the previous section the Rozoy and Daniel typology is restricted to the Mesolithic (Rozoy is a member of G.E.E.M.), meaning that some conditions, such as the basic form on which the tools are made, are of little importance to us. Rozoy's publications treat the whole range of Mesolithic types, but this discussion is restricted to those types important for the type list, *i.e.*, to symmetrical points with a retouched base.

A point is defined as:

Un microlithe pointu (l'angle de pointe étant en France inférieur à 45°), présentant une bonne symétrie soit par sa constitution, soit par la présence d'une base intentionnellement adaptée, l'axe de symétrie passant par la pointe

(Rozoy, 1976b: p. 228)

The following attributes are used by Rozoy:

1. L/W relation. L is more than twice the W, L is less than or equal to twice the W.

2. Form of the sides (excluding the base). Convex sides = original form; straight sides = triangular form.

3. Form of the base (concave or straight). Convex bases are not mentioned by Rozoy, therefore they are classified here as straight.

4. a) Form of retouch on base (inverse, direct, or both); b) Angle of this retouch (abrupt *etc.*).

5. The location of the 'bord abbatu', the steepest retouch, on either the right or the left side. Attributes 1-3 are included in the typology here (fig. 13), as are attributes 4 and 5 (the side location of retouch and the angle of retouch variables). Rozoy uses this latter attribute (angle of retouch) only for the subgroup of points with a retouched base. Because I do not agree with an *a priori* division of the edge angle into groups, such as abrupt, steep, *etc.*, I decided not to use this attribute. Therefore, a further analysis of the types of points would be redundant.

Code numbers for the types differentiated by Rozoy, irrespective of attribute 5, are:

Pointe du Tardenois: this point has convex sides and a length longer than two times the width. The other criteria that the point should be made on a bladelet and should have abrupt retouch on one side are ignored by the type list (120-121, 150-152 and 135-136).

Pointe ogivale courte: this point is the same as *Pointe du Tardenois*, but the length is shorter than or equal to two times the width (123-124-025, 137-138-039, 153-154-055).

Pointe triangulaire longue: this point differs from *Pointe du Tardenois* in having two straight sides. In this type are also included points with concave sides (115-116-017, 130-132, 145-146-047).

Pointe triangulaire courte: this point differs from the *Pointe triangulaire longue* by having a length equal to or smaller than two times the width. It is coded: 113-114-015, 127-128-029, 143-144-045 for straight sides and 117-118-019, 133-134-035, 147-148-049 for concave sides.

Pointe de Sonchamps: this point is a variation of the *Pointe triangulaire courte* in that it has also retouch on the ventral side of the base which is said to be longer than the retouch on the dorsal side. This retouch resembles surface retouch. One could use the attribute length of retouch negatives (variable 33, *etc.*) for both ventral and dorsal sides to define this type. This was not done because, firstly, this would be the only type requiring the length of retouch variable and, secondly, the relationship between the retouch on the dorsal and ventral side is given in relative terms in Rozoy's definition.

b) *Les pointes à retouches couvrantes* (points with surface retouch)

In our type list the presence of surface retouch does not warrant the designation of a separate type, but is indicated with a subnumber (the third, see section 8.). Rozoy's *feuille de gui* would be coded as 22, a Sauveterrien point with surface retouch. Under Rozoy's scheme this terminological designation would be unacceptable because a Sauveterrien point and a *feuille de gui* have no demonstrable genetical or chronological relationship (p. 244). Even accepting that the two types are separated in time and (possibly) space, prohibiting the placement of them in the same group because of a possible chronological separation is, in our view, unacceptable, because I emphasize the use of morphological attributes and a morphological typology.

Ideas about chronological gaps and spatially different distributions should be re-evaluated every time new material becomes available, and new material should not be forced into a pre-existing chronological typology. This is especially true for materials coming from periods (as Rozoy emphasizes himself in *Les derniers chasseurs*) in which flint types are the only chronological indicators.

Although it is difficult to extract precise definitions for attributes used for the different types from the article by Daniel & Rozoy (1966: pp. 251-261), they make two important remarks. First, it is their opinion, like that of Bohmers, that a pronounced bulb prevents hafting and therefore cannot be present on points. Second, in their system points whose base is not preserved should not be classified, since it cannot be established whether or not the base was retouched, which is a criterion for Tardenoisien points.

Tixier (1963) only refers to particular tool types or to very limited groups of tools. Insofar as his types are relevant for our list of tools, reference to these types is made in the sections dealing with the types.

10. INTRODUCTION TO TOOL TYPES

The tool types listed in appendix B and treated extensively in this section should not convey the impression that this typology is the goal of this study. Ultimately the tool typology is to be redefined in terms of clustering of attributes each time information about a new tool (as defined by having retouch or use retouch or macroscopic use wear) is introduced. This redefinition affects all the analytic levels, the side, the total artefact, the assemblage, and the group of assemblages. New types will be added whenever there is reasonable evidence that they are separate types and not merely a portion of the range of variability of one tool type. Additions necessitate changes in the type defining programs (see section 19.).

In this section types 'made' by other archaeologists are related to the types as presently used for this study. Thus, the section serves as a kind of conversion table.

10.1. Points

Most points are three-sided. Three-sided points are divided into three main groups: symmetrical points, asymmetrical points, and triangles. This division seemingly contradicts Rozoy, for whom points are always symmetrical; the definition of symmetry, however, is much stricter in this publication than in Rozoy's publication. The three groups can be related to the typologies of Rozoy for the symmetrical points (section 9.4.), of the G.E.E.M for triangles (section 9.3.), and of Bohmers for the asymmetrical points (section 9.1.1.).

These three groups of points have all been originally defined within the context of Mesolithic assemblages where these points are made on bladelets. Depictions of the point types given by the above typologists show that the platform placement may determine the type. For example, for symmetrical triangles the platform must be situated on the side perpendicular to the axis of symmetry, whereas for symmetrical points the platform must be situated on the axis of symmetry.

Within the group of asymmetrical points, the subgroup triangles is differentiated by having retouch on the shortest side perpendicular to the base (as defined here). Thus, type 10-12 of the code list may be a symmetrical point, an asymmetrical point, or a triangle. The difference between a symmetrical point and a symmetrical triangle is determined by the angle opposite the base. If the angle is smaller than or equal to 90 degrees, the tool is a symmetrical point; if the angle is larger, it is a symmetrical triangle. In figure 13 the three groups are represented by the three big blocks.

My attempt to define tool types outside the context of particular cultures or assemblages makes the definition of certain tool types more complicated or impossible, *e.g.*, defining points as distinct from backed blades (section 10.6.). The grouping of points in the category of backed blades, as is done by Tixier (1963), fits the particular assemblages studied by him and may even be true for the entire Mesolithic period. However, in our system where points are not always made on bladelets, it meets unexpected difficulties. Our general approach also results in rejecting certain systems of analysis. For example, Uerpmann's system (1976) is an example of precise measuring, but cannot be used, because it is only applicable to the very limited number of types of points appearing in her assemblages.

10.2. Trapezes

The term 'trapeze' (trapezoids in Bohmers' terminology) is used for all four-sided points which have two retouched opposite sides and the other two sides unretouched. The most common situation is

Table 11. Structure of trapeze types in relation to the main variables.

			Form of unretouched side	Form of retouched side
Symmetrical	Acute	ret 1.1/2	+	+
		ret 2 sides	+	+
	Straight	ret 1.1/2	+	+
		ret 2 sides	+	+
	Obtuse	ret 2 sides	+	+
Asymmetrical	Acute	ret 1.1/2	+	+
		ret 2 sides	+	+
	Straight	ret 1.1/2	+	+
		ret 2 1-45°	+	+
		ret 2 46-89°	+	+
	Obtuse	ret 1.1/2	+	+
		ret 2 1-45°	+	+
		ret 2 46-89°	+	+

that the platform is or was on one of the retouched sides; but since it is not a necessary condition, it is not mentioned in the tool type list. Rather the assumed position of the platform is shown by the black point in figures 13-15. The inclusion of an attribute for platform location would have required a parallel set of types for trapezes having the platform on an unretouched side. Since this situation occurs but infrequently, it would unnecessarily enlarge both the tool code list and the tool type list. For the infrequent cases where the platform is on the unretouched side there is a code in the type defining list (see appendices B-E) but not in the tool type list.

To extend the tool type list and the tool code list to accommodate the infrequent trapeze 'types' one must: add a code for indicating that the platform is on a retouched or unretouched side; change 'length is longer than width' to 'length is shorter than width' and the reverse; add to the existing definition of types the condition that the platform should be situated on the retouched side.

The G.E.E.M. (section 9.3.) trapeze typology was used to structure the tool type list. Additional data were collected to evaluate two hypotheses about differences between Mesolithic and Neolithic trapezes.

The first hypothesis is that Dutch Mesolithic trapezes are normally made on blades and have a length equal to or longer than width, whereas Neolithic trapezes are mostly made on flakes and have a length shorter than width. In order to test this hypothesis all types of trapezes were divided into subtypes having either a length equal to or longer than the width or having a length shorter than the width.

The second hypothesis is based on Taute's (1973-1974) statement that trapezes with a length equal to or longer than the width but with retouch on the ventral side or bifacial retouch should be dated to the Neolithic and are therefore an exception to hypothesis 1. Therefore, trapezes with the condition covered by hypothesis 2 were singled out as separate types and not further subdivided. Having worked with the code system for some time, I have come to the conclusion that this separation of trapezes with retouch on the ventral side or with bifacial retouch has no meaning for Dutch assemblages. Therefore, further investigation of this hypothesis has been dropped, and the type defining programs have been rewritten to omit types 193-198 and to make an additional note when trapezes have bifacial retouch or retouch on the ventral side.

All types of trapezes are shown in figure 14. In the figure there is first a division into symmetrical and asymmetrical trapezes, and these groups are further divided according to whether the base angles are both acute or one is acute and the other right or obtuse. The resulting groups are further subdivided according to how much of the side is retouched (two entire sides or one entire side and one partial side). In some of these subgroups a further division is made into trapezes having an acute base angle either between 1-45 degrees or between 46-89 degrees. These groups are further differentiated according to the form of the unretouched sides. Each of the resulting groups form one column in figure 14. Within the column types can be separated by row when one or more of the retouched sides according to the form of the side (straight, convex, concave). The types (their codes) in the bottom row stand for the whole column, with the exception of those types already singled out by row.

10.3. Borers

By building on the use of the more general term borers used in the older English literature (Peake, 1919-1922: p. 506), certain authors (Clark, 1960: p. 223; Smith, 1965: p. 93) make a useful distinction between awls and piercers. Awls are made for drilling or circular movements and therefore have dorsal and ventral retouch at the point, whereas piercers are made for pushing movements, usually through soft material, and have retouch on one side. In our assemblages awls can usually be distinguished from other tools by having bifacial retouch on the working point. Piercers, however, cannot necessarily be distinguished from points.

Borers are divided according to the waste type on which they appear: cores, flakes, blades, discs (borers on OM are usually classified as on flakes) and their length. Borers, according to most Mesolithic typologies, must 1) be pointed (variable 26, form of artefact), 2) have bifacial retouch (variable 32) or polish wear (variable 31), and 3) have a retouched shoulder or shoulders (variable 29).

In the Early Neolithic Swifterbant assemblages, where points are not expected, a small number of borers may have been coded as points because they do not conform to the three conditions listed above. That some borers could be morphologically coded as points implies that the borer-point distinction in the Mesolithic typology should be reconsidered (ultimately the problem will have to be solved by microwear analysis). The borers could be further differentiated according to, for example, the way the borer end is formed, whether it has one or two shoulders, *etc.*

10.4. Burins

Because only one burin was present in the assemblages under study, no code list was developed for burins. The future code list for burins (BVF) will be structured like the WVF list, but variables will be added to code the form of the burin edge itself, taking into consideration studies by Otte (1978), Rigaud (1972), Onoratini (1980), Rigaud (1972; 1982), and Movius *et al.* (1968).

The study by Gunn (1975) of Upper Palaeolithic burins, which integrates use wear analysis with morphological attributes is unfortunately limited to burins on blades, and in the analysis the axis of the blade (functional axis) plays an important role, preventing a more general application to, for example, burins on flakes.

The main variables of the BVF will be the location of the burin edge, on the left or right side or in the middle of the side, and how the two sides which form the burin edge are constructed, either by a combination of retouch and a spall or by a combination of two spalls (Bandi, 1963a).

10.5. Scrapers

Rozoy's definition of a scraper is:

> *Une pièce présentant une série de retouches continues non abruptes (sauf en cas de réavivage), constituant un front plus ou moins arrondi, ce front occupant une partie notable du pourtour de la pièce: au moins un sixième ou toute une extrémité, et présentant une courbure importante: le quart (ou plus) d'une circonférence*
> (Rozoy, 1967a: p. 343)

The definition of scrapers in our system is broader than that used by other authors, such as Rozoy, who are chiefly concerned with Mesolithic material. The reasons for the broader definition are several, but they are all related to the fact that our assemblages are Neolithic.

The conditions regarding the quantity of retouched edge and convexity of side in Rozoy's definition above present no problems for scrapers made on blades and blade fragments, such as are found in the Swifterbant assemblages. But these conditions can rarely be met by scrapers found in Middle Neolithic assemblages with few or no blades. In the later assemblages under study (*e.g.*, the Vlaardingen assemblages) scrapers on flakes with straight sides are the most frequent. In a study of TRB material (Deckers, 1980-81), I observed that the convexity or straightness of a side has no relationship to the kind of retouch, edge angle, or length of the retouch (delineation). A positive relationship between a greater proportion of scrapers with straight sides and a more intensive use of the scrapers could not be found in the material.

Rozoy distinguishes the following types of (convex) scrapers many of which are found in the type list:

1. Long blade scraper, convex (type 400).
2. Short blade scraper, convex (type 405).
3. Shortened scraper, which is a scraper on the end of a broken blade. Type 3 was excluded from the type list, because it did not seem reasonable to use a condition (breakage) to distinguish a separate

type. The variable list, however, will allow sorting scrapers according to such conditions if necessary without much difficulty.

4. Scraper on flake (type 406).

5. Scraper on retouched flake (type 407). Types 406 and 407 have been extended to scrapers on OM because many authors ignore OM as a primary group and classify much of the OM group as flakes.

6. Circular scraper. This type, which stipulates that all sides are retouched, is more or less identical to our types 411 and 412. The other circular types distinguished in our list, 408-409 and 410-411, would, according to Rozoy, be classified as a scraper on a retouched flake. How much of the outline of the piece should be retouched, which has a role in the definition of types 5 and 6, was not incorporated, because the basic unit of analysis is the side, rather than the total outline of a artefact.

7. *Grattoir unguiforme*. This scraper, which has a length smaller than 3 cm and is made on a flat flake (no metrical definition is given for 'flatness'), is currently not differentiated, but could be by using the 'Mesolithic code' (section 8).

For the other groups:

8. Different types of scrapers, and

9. Keeled scrapers, scraper on a core, and *rabot*, better definitions than those given by Rozoy are available or can be devised.

In Upper Palaeolithic and Mesolithic typologies, the only type of scraper on a blade is the convex scraper, and blades with straight retouched ends are classed as other tool types not related to scrapers. In the case of flakes, however, the distinction between 'straight' and 'convex' retouched sides is never made: all flakes retouched over a certain length are simply classified as scrapers. The differential importance attributed to tool types made on blades and those made on flakes is a consequence of the purely chronological function of the typologies in which tools on blades are considered to be chronological indicators, a role that tools on flakes never seem to play.

This way of 'analysing' flint material is inconsistent from a functional perspective because functional names are used for types which are considered chronologically important (tools on blades) but not applied to types which are considered chronologically unimportant (tools on flakes). Flint artefacts (tools) are the most important and sometimes the only indicator of functional aspects of the prehistoric subsistence system. Artefacts recovered from excavations represent the end product of activities within the subsistence system and, therefore, the best approach to the flint material is a classification of end products to provide the basis for explaining earlier stages of the process that resulted in the end products. Generally, the artefact is the result of the use of the tool which was shaped to perform a task, within which the variations are determined by raw material, the technical knowledge, and the tradition in working with flint.

In this study, the concern with the relationship between morphology and function resulted in the following distinctions among scrapers: short and long blade scrapers, both either straight (type 434-433), with a notch or concave (430-431), nosed (437-436), or denticulated (445-446). In most cases the retouched side is on the distal end perpendicular to the length axis of the blade. Therefore, no conditions for the angle between the retouched side and the axis of the blade were formulated, since it was expected that those artefacts with an angle smaller than 45 degrees would be classed as points or other types. An exception was made for the types that have a straight retouched perpendicular side, which are separated into those with an angle around 90 degrees (straight scrapers) and those smaller than 90 degrees (truncated blades) in order to discern the relationship among straight blade scrapers (430-431), truncated blades (450-451), and incomplete trapezes, all with only one retouched side (Deckers, 1979: p. 153; section 10.7.). These types correspond to Rozoy's (1978a: p. 353) *lame à troncature transversal*, with an angle around 90 degrees, and *lame à troncature oblique*, with an angle between 90 and 45 degrees.

From an article by Gouletquer (1965) describing Neolithic scrapers, mainly made on flakes, I have concluded that an additional set of length and width variables should be introduced for certain groups of tools. The length/width measurements in variables 10 and 11 were designed to designate the primary form (blades, flakes, *etc.*) used for tools and to find out if preferences of primary form existed for the various tool groups.

For some tools, mainly those made on flakes, where the form of the sides and their relation to each other is more important than where the platform is situated, it is preferable to take the length/-width measurement with reference to the retouched side (fig. 16: L2, W2) rather than to the platform or a straight side (section 3.1.). For assemblages where this additional set of length and wide measurements are of importance the variables L2 and W2 were introduced, even though they do not appear in the list presented here.

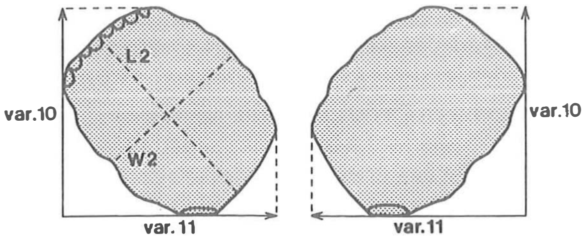

Fig. 16. The secondary length and width measurements of scrapers.

In French and French-oriented publications a difference is made between *grattoirs* and *racloirs* (in German, the terms are *Kratzer* and *Schaber*, respectively). The *racloir* can be related to type 440, side scraper (Ulrix-Closset, 1982: p. 21). The *racloirs* depicted in Ulrix-Closset's publication seem to show that there may be size conditions as well (a *racloir* being larger than other scraper types). For Bohmers' differentiation of the two types see section 9.1.

10.6. Retouched blades

Retouched blades can be divided into three main groups: a) those blades having the 'type' determining retouch situated on the short sides that are perpendicular to the axis that runs from the platform to the distal end; b) those blades having retouch on the long sides as well as on the short sides; and c) those blades having retouch only on the long sides.

Blades of group a) having retouch on a convex, concave, or notched side are considered blade scrapers and were treated in section 10.5. Morphologically, group b) is a combination of groups a) and c) and is grouped with backed blades (fig. 15), and, along with group c) will be discussed in this section.

From the morphological viewpoint, points and trapezes are closely related to group b), and in certain cases the computer program cannot differentiate between points or retouched blades. In functional terms, however, a distinction can be made between these tool types having retouch on the side to prevent damage to the hand or to the shaft in which the blades are mounted, backed blades or blades *à dos abbatu*, and those having the retouched edge on the working edge.

un bord est dit abattu quand la retouche continue, régulière qui l'intéresse a supprimé le tranchant brut de débitage et est assez abrupte pour ne pas créer un nouveau bord coupant

(Tixier, 1963, p. 26)

Tixier's functional criteria for backed blades, however, are not in line with our morphological criteria. The usual morphological characteristics of the backing on backed blades are a steep angle of retouch and regular retouch. While regularity of retouch is a rather subjective criterion, steep retouch can be identified by first establishing if within the assemblage there are different edge angle groups present, one of which is steep. Then one can see if the steep angles appear in combination with particular tool types or particular types of sides and, if so, from there make inferences about functions (see also Brézillon, 1971: p. 116).

'Protective' retouch can, of course, also occur on tool types other than retouched blades, such as points, *etc.* Blades with retouch on the long parallel side(s), group c, were divided into:

Type 570: blade with notch.

Type 580: blade with denticulation.

Type 603: blade with gloss and 'hafting'.

Type 606: blade with retouch, gloss and 'hafting'.

Type 605: blade with gloss and retouch on the same side and at the same location.

Type 604: blade with gloss and retouch on the same side and at another location.

Type 550: blade with retouch on part of the long side.

Type 551: blade with retouch along the entire length of the long side.

Type 617: blade with one side parallel to axis entirely or partially retouched and a second side, parallel to the first side having gloss, use wear or use retouch, or a combination of these.

The term 'hafting' used for types 603 and 606 does not refer to a function but to the presence of a different kind of retouch near the basal end, sometimes in the form of a notch. Type 550 has subcodes for distinguishing blades with partly retouched side(s) from blades with completely retouched side(s).

In some publications the term 'knife' (or *couteau* in French) is used. Ideally (Rozoy, 1967a: p. 214), a knife has one long, somewhat convex, 'backed' side (*dos*), and the other long side shows traces of use in the form of use retouch or gloss. Apart from the problem mentioned before that retouch is not easily related to a special function, there seems to be little agreement as to what the term 'knife' refers. Rozoy, for example, also includes both those blades with a partly retouched side and those with no retouched side at all, so that a blade with only use wear is considered a knife (here types 600-613). Thus, the general term 'knives' is not very useful. Nevertheless, it may be important to distinguish those blades having one long side with retouch and another side with use wear from the more general category of blade with retouch. Therefore, type 617 was introduced to the list with version 17 of the program (section 19), but was not available for the assemblages studied before that version was implemented.

The *poignard* or dagger (*e.g.* Patte, 1971) is a readily distinguishable type of knife, although some overlap with points may exist. In the Netherlands a number of daggers, usually called G.P. (Grand Pressigny) daggers or pseudo G.P. daggers occur. Their definition is based on a number of attributes: the Grand Pressigny raw material, a plano-convex cross section, surface retouch, and polishing of (part of) the dorsal side. They are similar to the daggers illustrated by Patte, except that they are generally smaller and in most cases the retouch covers a smaller portion of the surface. They resemble, but can be easily separated from blades having retouch on two sides on the basis of size (Deckers, 1980-1981: fig. 24:3). There is some information available about techniques used in fabrication of G.P. blades (Bordes, 1947: p. 27; Hundt, 1951), and Strahm (1961-62) and Thevenot (1976) have constructed dagger typologies.

Another group of tools that are also called knives, or more specifically 'Bell Beaker knives', are found in the assemblages under study. Lanting (1973), without using the term 'Bell Beaker knives', notes that this type seems to play a role in the burial deposits of the Late Neolithic and Early Bronze Age, although he does not restrict the type to these periods, as do other authors. In the assemblages studied the Bell Beaker knives exhibit a wide range of variation and a precise definition of them has not yet been made.

Furthermore, tools morphologically closer to the 'ideal' Bell Beaker knife than some of those found in the Bell Beaker graves were found in TRB assemblages. In general, the type is in many ways similar to the plano-convex knives illustrated in some English publications. In view of the possible chronological significance of this type of 'knife' it will be treated in a special publication.

10.7. Retouched flakes

The Neolithic assemblages under study generally have retouched flakes rather than retouched blades and, consequently, are not amenable to existing typologies. There is, however, no functional reason to suppose that most types recognized on blades should not be found on flakes. Those types requiring a long straight side as an attribute will be restricted to blades, whereas tools requiring a 'long' convex side will usually be restricted to flakes (or cores).

Some authors restrict retouched flakes to those flakes having 1/4 or more of the circumference retouched (Movius *et al.*, 1968: p. 8). This restriction was not used here. Retouched flakes is a residual tool type category for flakes with retouch that do not fall into the tool types discussed above, *i.e.*, point, borers, trapezes and scrapers, and are analysed the same way (as types) as 'traditional' tool types. This category is further divided into types parallel to those used for blades, in which the form is also a determinant, *i.e.*, type 485, 487, 492, and types which are defined by attributes on a side, just as with blade tools, *i.e.*, 490-521. These are all types normally not found in other typologies with the exception of the flake with a notch (type 510-511).

10.8. Tools with use retouch

In section 6.5. a provisional solution was given for making the distinction between retouch and use retouch by defining each within the assemblage. To avoid limiting the analysis of flint artefacts to the level of the assemblage it was decided to introduce a set of types having use retouch parallel to tool types having (normal) retouch; points, trapezes, and borers, for which this distinction is irrelevant were not included in the parallel set. Although artefacts with use retouch are not usually considered tools, the large number of artefacts with only use retouch in some assemblages has resulted in their introduction, with temporal and morphological restrictions, as tools in some typologies.

According to Bocquet, a microdenticulate is:

> *un outil sur éclat ou lame de forme et de dimension variées, caractérisé par une denticulation formée de très petites coches obtenues par enlèvement unique et disposées régulièrement ou non sur une longueur variable d'une arête d'éclatement. Ces coches, toujours inférieures à 1 mm de profondeur et de large, disposées en séries contigues ou non, constituent la constante des outils 'microdenticulés'. De nombreux autres paramètres varient*
>
> (Boquet, 1980: p. 77)

Thus, a microdenticulate is defined as a tool with retouch whose length does not exceed 1 mm and with every retouch 'flake' forming a notch. The condition that the retouch should be intentional and not be retouch resulting from use (without giving a method how to differentiate the two) is a good example of how observation and interpretation are confused.

Irrespective of Bocquet's criterion, retouch not exceeding 1 mm is coded in our system, in conformity with the definitions given in section 6.5., as use retouch. In our assemblages normally more than one retouch 'flake' forms a notch of a denticulation. Bocquet's denticulation seems more similar to what is here called 'nibbling', which consists of small half moon shaped fractures along the edge that do not appear to be the result of intentional retouch. Therefore, the microdenticulate is not coded as a separate tool type, but is covered by the following variables:

Variables 29, 37, *etc.*: form of side.

Variables 34, 42, *etc.* extension of use retouch (*ampleur*).

Variables 32, 40, *etc.* location on side (ventral/-dorsal *etc.*).

Some British typologies make a difference between serrated flakes and utilized flakes (Clark, 1960: p. 217). Serrated flakes have been finely denticulated to form a serrated edge along one or, more rarely, two sides. In a number of instances a thin well-defined band of lustre, extending slightly further from the edge than do the notches between the teeth, is visible. Thus, the type is closely related to the microdenticulate but is sometimes accompanied by lustre (gloss). Utilized flakes are subdivided by I. Smith into class A flakes that have regular retouch along the entire edge parallel to the axis and class B flakes that have irregular retouch on a part of the side. She relates type B flakes with cutting or sawing and type A flakes with lateral scraping along a hard, rounded object like bone (Smith, 1965: p. 93). These types were not used here because the morphological attributes were not adequately defined; furthermore, 'proof' for her functional interpretation was inadequate.

10.9. Combination tools

The reader will note that combination tools are missing in the code list. There are two reasons for this. The first is that when the type defining program was set up, possibilities for interactive programs were limited. Originally, the data for the tools were entered as one batch into the program for type determination (section 19). The program was later restructured to perform in an interactive mode so that the data are read for one tool at a time, and when a determination is found, the program records this and then continues to search for a second group of tool types which could occur in combination with the first identified tool type.

Since the purpose of this study is to relate morphology and function, it is of no importance whether functions are combined in one tool or not. The recurrent combination of different functions on one tool, however, could indicate that these functions are more closely related to each other than to other functions. After hypothesizing the relationship between morphology and function, one could begin to relate different combinations to rather specific activities. In the assemblages under study none of the 'classic' combination tools occur, but this does not mean that 'significant' functional combinations on single artefacts do not occur.

10.10. Core tool/tool on a core

In most publications core tools do not get the same attention as the tool types discussed above. This is due in part to the small number of core tools found in the different assemblages and in part to the difficulty of separating the morphological attributes which are related to the item's function as a core from those related to its use as a tool. Wherever this problem was encountered in our assemblages, the item was classed as a tool on a core. If the core technique was used solely to obtain a form to be used as a tool, then the item was classed as a core tool. The differentiation between both types is only possible when the entire assemblage, in particular the 'normal' cores, is taken into consideration.

The classes of core tool and tool on a core allow differentiation between those tools whose attributes can be described two-dimensionally (as the other tool types are described)–tool on core–and those that must be described three-dimensionally–core tool. A tool on a cores is analysed like the flakes by using the variables form of edge and kind of retouch or use wear on this edge. Another program, CTF (Core Tool File), will be developed to analyse core tools when enough material comes available. In some Neolithic cultures, such as the Campignien, most tools are core tools. But in our assemblages core tools are too few and the definitions of core tools in other typologies, *i.e.* the tranchets (section 10.11.) and the *Grobgeräte* (see below), are too inadequate to be used to set up a CTF file.

A core tool mentioned under different names, *pièce sculptée* (Ulrix-Closset, 1982: p. 21), pic or axe inset (Newell, 1970: p. 157), *mehrkantige Geräte* (Farruggia, 1973: p. 124), *Grobgeräte* (Bohmers, 1956-58: p. 157) and *outils multiforme* (Cahen & van

Table 12. Matrix for tranchets.

	0	1	2	3
0	-	i	ii	iii
1	-	iv	vi	vii
2	-	-	v	viii
3	-	-	-	ix

Berg, 1979: p. 29), is a long core with a triangular or quadrangular transection. This 'type' is also infrequently found in our assemblages and shows considerable morphological variability.

Tool type 653, 655, which is a tool on a core, is also described by I. Smith (1965). She suggests that the notches serve to secure the bindings which attached the tool to a shaft, but since she has no idea about the function of the hafted tool, she calls it a wasted core tool.

The tranchet is a core tool. Although it was not found in the assemblages under study, the description by Angelroth was good enough to plan how the CTF file should be composed. His definition of a tranchet is:

a) le tranchet est un outil de forme triangulaire ou quadrilateral a arête vive resultant de la rencontre d'un biseau avec l'une des faces ou de la rencontre de deux biseaux. Lorsque le tranchet possede deux arêtes opposées, engendrées par l'un de ces procédés il est double;

b) un biseau est un bord taillé obliquement part rapport à une autre surface determinée c'est donc un plan (Angelroth, 1957: tranchet d'Hastedon)

c) l'arête-ligne d'intersection de deux biseaux, ou taillée, terminée par un plan plat

A biseau is a beveled edge. Table 12 shows the possible combinations of biseaux that may be found on core tools. The arabic numeral indicates type of biseaux (table 12: i-iii) and the roman numeral is the type number resulting from the combination of one or two different kinds of biseaux. Types iv-ix are tranchet double (with two biseaux).

11. STATEMENTS

In the following sections some of the topics that I hope to address using the variables defined are discussed. The topics are presented in the form of statements and are divided into two groups according to the criteria for their verification.

In the first group statements are considered to be true under given conditions, where certain scores for variables, seen as representative for the statement, are attained (statistical proof).

In the second group statements are 'proven' when my results are comparable with the results from techniques, methods, and experiments by other authors in different, but related research areas (comparative proof). Statements of the first group can be evaluated with data internal to this study and those in the second with data external to it. First group statements are in sections 11-13. Second group statements are in section 14, the experiment, section 15, the ethnographical parallel, and section 16, use wear.

11.1. Raw material: the limiting factor

The many factors which result in a tool can be grouped into four major influences: function, style, technical knowledge, and raw material. In this section the influence of raw material is considered.

The first statement to be discussed is that the size of the raw material constrains the size of the tools. In comparing assemblages size may play an essential role, and, therefore, it is necessary to know the size of the available raw material. It is not sufficient to know what the maximum size is; rather, one must determine the size frequency distribution of the raw material. The best way to obtain this information is to measure the raw material at its source. For example, for the Swifterbant flint material (part 2) it would be necessary to measure the size of the nodules available in the boulder clay.

In some cases, however, the largest nodules were culled in prehistoric times so that only a biased sample of raw material remains, such as in an exhausted mining site (*e.g.*, Rijckholt, Middle Neolithic). One should be aware that the present conditions of 'visibility' of raw material can differ from those of the past. For example, the raw material that can be collected on a field today is thought to be more visible than it was in a Mesolithic woodland (Beuker, 1981: p. 101; Collins, 1975: pp. 1-9).

In many instances the flint 'collecting' or 'mining' area will be not available for study. The most common reason for this is that the origin of the material is unknown or cannot be differentiated from other material. Another reason is that the collecting area has been dispersed or buried as a result of geological processes, such as flooding. Therefore a method to reconstruct the raw material from the available flint material at a site would be helpful. We propose the following strategies.

If we assume that the raw material on the settlement site itself is rejected material, then the raw material from a site represents the minimum size which was considered workable by the user (strategy 1a). This assumption can be checked by comparing the size of the raw material with the cores, which also gives an indication for the minimum workable size (strategy 1b). Another way of establishing the sizes of raw material is by refitting (section 17.), although this method is not always possible nor desirable (because it is time intensive).

Another approach to the problem is to assume that whole flakes and blades covered by cortex and patina on the dorsal side (primary blades and flakes) give a good indication of the size of the original nodules. The removal of the cortex from the nodule by detaching a few large flakes along the length of the nodule would seem to be the quickest way to prepare the core for the detachment of the blades/-flakes wanted. However, this approach, while logical in many cases, did not seem to be practical for the assemblages under study here because of another factor, scarcity of raw material. When material is scarce this way of preparation may be too wasteful, and, indeed, it is apparent with our assemblages that in core preparation, small, rather than large primary flakes were detached. It is conceivable therefore, that raw material scarcity selects for this technique. Removal of large primary flakes/blades is also especially wasteful of irregular nodules. These considerations lead to another strategy (2): the greater the size difference between the complete primary flakes and blades (being smaller) and the other complete flakes and blades the more scarce the raw material must have been prehistorically. If the primary blades and flakes are larger, they can be used for the reconstruction of the nodules.

In reconstructing the size of the nodules the largest of the two groups, the primary flakes and blades and the complete flakes and blades not completely covered by cortex on the dorsal side, should be used. If the primary flakes and blades are not the largest in size, this indicates scarcity and irregular shape of raw material (strategy 3). When special types appear that have little or no cortex and that don't fit in the size distribution the possibility that the tool was imported should be considered.

Another indicator for the size of the flint nodules is the number of primary flakes and blades detached from the nodules. Assuming other factors constant, the smaller the nodules, the greater the proportion of primary flakes and blades relative to the rest of the flakes and blades. The problem arising here is that the size of the detached flakes influences their number. From the same nodules, smaller detached blades and flakes will be more numerous than larger primary flakes/blades. Therefore, it is better to compare the total surface of primary flakes and blades with the rest of the flakes and the blades rather than just the number (strategy 4). Obviously, this strategy requires fairly accurate measurements of the surface area of the items.

A study which takes into account all the above mentioned measurements should result in the reconstruction of the nodule sizes. The sizes themselves are less important than the task of comparing the size differences among the assemblages.

In the assemblages under study the raw material is erratic flint which is internally fractured. When struck, internally fractured material will fall apart into chunks, which means that the nodule cannot represent the maximum size of the available material. Therefore, in many assemblages the basic material to work from will be the broken parts of the nodule. If the nodule does not fall apart into chunks along the internal fracture lines, the desired length and shape of subsequent pieces cannot be attained because the remaining internal fractures will hinder the user's control of the material.

A standardized production system for flint plays an important role in the Neolithic in other parts of the Netherlands. This system operated in a context completely different from the one assumed for the assemblages under study. For our assemblages it is assumed that the working (production) of flint took place within the smallest economic unit (one person, family, extended family) where the producer and the consumer are within this small group. In a production system, on the other hand, the processing of flint is in the hands of a specialized economic unit, which produces for consumers who are not in the same group. In this case the producing group has its subsistence base wholly or partly in the production of flint artefacts. The mining industry in the Middle, and possibly the Early Neolithic in the south of the Netherlands is an example of such a production system. The mining industry processed the flint into cores and standard blades. Some of the cores, in turn, were made into mining tools, and the rest of the cores were fashioned into polished flint axes; the blades were almost exclusively made for 'export' to other consumer groups.

In relation to the mining industry in particular, but also in a wider context, there is a potential for spatial entities to represent the production process. The 'term 'site' then refers to a spatially localized unit, a number of which could occur in the same settlement: a) a site where flint was mined, b) a site where the mined flint was worked into unfinished products or preforms, for 'export', c) a site where the products of b were reworked to tools, and d) a site where the tools were used. Sites a) and b) belong to the producers' side of the production system, and sites c) and d) to the consumers' side (Balcer, 1981). Use of a tool should therefore never be seen as a phase in production as some authors do (Beuker, 1981: p. 104). Production can refer to the making of a tool as well as to part of a standardized production process with specialized production groups.

Between the two extremes of having a variety of flint material in the assemblages whose source is unknown, and flint material coming from a well-known flint mine, there are many other possibilities. In those cases where the raw material within the assemblage seems to come from a few distinctive sources it is useful to divide the material into subgroups according to the 'original' raw materials and then to try to reconstruct the dimensions for every group separately. For this one could code attributes such as those used by Uerpmann (1976: p. 24): *Körnigkeit*, *Lichtdurchlässigkeit*, colour, and colour patterns like spotted, *etc.*

11.2. Statements related to blades and flakes

Based on his analysis of the Corbiac material, E. Gibson (1982) draws a conclusion which is evaluated logically here and then used as one of the statements.

Some of the variables Gibson measured are the same or similar to ones used for this study: quantity of cortex, facetting (comparable to the form of platform variable used here), and a 'body' variable (comparable to our thickness variable, but for which he sometimes uses the cross-section of a flake or blade). In addition, he measured the trimming of the platform, the condition of the bulb, the flake/-blade outline, the ventral longitudinal section, and the platform angle, and he also noted the presence/absence of a lip on the bulb-platform interface. He found that 78% of the pieces had no cortex at all, that a lip was present in 77% of the cases, that 87,5% of the pieces had a straight ventral longitudinal section, and that 70.5 % had a platform angle of 90 degrees. He then stated that these high proportions of the variables, which were not necessarily correlated with each other, show that the production of flakes and blades in Corbiac was done by two or three individuals.

Gibson's statement is clearly invalid on the basis of his analysis. Alternative and usually simpler explanations, none of which Gibson considers, are available for all the variables showing little variability.

Furthermore, there are more general considerations to be taken into account, such as the limited way flint can be worked, the common cultural matrix in which flint working takes place, and the high probability that knowledge of and experience in flintworking was common to most members of the group.

By way of analogy with modern society, consider the spatial arrangements of furniture in Dutch houses, for example, where we would find uniformity in the placement of the dining table, the sofa, chairs, and television set. The possibilities are limited by some 'technical factors', such as the antenna connection and the size and shape of the space in which the furniture serving the culturally necessary functions have to be placed to be most efficient. It would be incorrect to conclude that uniformity in arrangements is due to 'specialist arrangers' rather than to technical and cultural factors. The idea that variables measured on blades and flakes can give indications for the possible existence of specialists cannot be rejected, but better evidence would be subgroups of blades/flakes that can be separated from the entire group of blades and flakes because they show little variance for a number of attributes. Even then it would be necessary to check whether or not other alternatives, such as the need of a special form of blade or flake for a certain tool type, could provide an explanation. That this special tool could only be made by a specialist would be hard to establish because the skills and knowledge common to every member of that society in relation to flint-working is unknown.

Comparison with results from present flintworking experiments can shed no light on this basic lack of knowledge because no experimental flint-worker has been working with flint from his childhood, like, for example, he has been eating with a fork and a knife, and furthermore, he lacks the 'cultural' context in which flintworking is basic and/or common knowledge.

Thus, for our purposes Gibson's statement is modified to say that the existence of an uniform group of flakes and blades within the flake and blade population can be one of the indications for specialist work, if it is not related to the function of the tool.

Patterson (1979: p. 3) sums up the advantages and disadvantages of a blade technology with particular attention to that producing prismatic cores. The advantages are that this technique is an economical way to produce blades with long lateral edges and that the blades are easily modified with light retouch for hafting or for insertion into a shaft. The disadvantages are that the prismatic blade usually has prominent ridges on the dorsal side at the ends so that frequently only middle parts of the blades can be used, and, therefore, the length becomes rather limited. Furthermore, the blades break easily during manufacture (shock breakage) and use. These blades are also difficult to retouch bifacially. The disadvantages make clear, as Patterson remarks, that a shift from a blade culture to a flake culture does not necessarily represent a technical or cultural step backwards, but can often be explained from the disadvantages of blades for certain purposes, such as the difficulty of using blades as the basic form for making bifacially retouched points.

In a study of French Neolithic flint material Phillips (1972), stimulated by an article by Prufer (Prufer *et al.*, 1965), compared the sizes between retouched and non-retouched blades. Although the sample for this study was very small and the data and their statistical description too meagre, there were some interesting results from the analysis.

One unexpected and unexplained result was that the length of the retouched blades is longer than that of the non-retouched blades. One might expect that since retouched blades are modified primary blades, they should be the same size or smaller than non-retouched blades. But given the results it would seem reasonable to suggest that the non-retouched blades are a group of rejected blades not large enough to be fashioned into tools. But since there were no clear cut size groups in the blade measurements the author concludes that the mobility of the flint makers must have been greater than that of the pottery makers because the pots can be separated into three groups, which are then interpreted to be indicative for matrilocality (the women being the potmakers), a rather bold conclusion seeing the material studied.

11.3. Statements related to cores

Statements related to cores are mainly additional to statements for other material groups. They relate core variables to the original 'raw material' (section 11.1.), to blades and flakes (section 11.3.), to technological practices (especially detachment techniques 14.1.), and to the smallest unmodified flakes and blades considered useful.

In addition to statements relating core size and negative size to such topics, statements regarding the proportion of cores in the assemblage can be generated. For example, the absence of cores may mean that the first steps of the technological process were done elsewhere, at another site or at another location in the same site. The absence of cores may also mean that exhausted cores were reshaped in such a way that they are not recognisable as cores. It is suspected (Deckers, 1982) that this latter possibility is the case in the Neolithic Swifterbant assemblages and that the absence of cores does not indicate that the detachment of flakes and blades was not done at Swifterbant (Beuker, 1981: p. 103).

12. MICRO*DÉBITAGE*

Fladmark (1982) has drawn attention to the possibilities of studying waste material smaller than 1 mm, or micro*débitage*, and has carried out some controlled experiments. Although this kind of research is in too preliminary a stage to incorporate as part of the total study of flint here, his suggestions and results are sufficiently interesting to propose that excavators take samples of earth from both the site and the adjacent non-culturally influenced area and store them for future research.

Fladmark suggests that if one has reason to believe a site is present at a location but cannot be verified by normal means, *i.e.*, no surface material is present and test pits cannot be dug because the site is situated underneath thick geological layers or other coverage, sifting the soils from a series of borings may reveal the presence of micro*débitage*.

The author also suggests that the distribution of micro*débitage* across the site may help one to establish the direction of the prevailing wind, and eventually the location of windbreaks on the site.

The study of micro*débitage* may also help resolve problems related to primary material. For example, the author experimented with three kinds of flaking technique (hard hammer, soft hammer, and punch) and examined different ratios in the macro/micro-*débitage* produced. But his results could also been obtained by studying the macro*débitage* only, which is less costly and time consuming.

Fladmark's initial study was done on ideal material (obsidian) in an ideal situation (a pit constructed for flint experiments) and that a subsequent study on material from an excavation showed than there were problems in separating cultural from non-cultural (*i.e.* geological) material in the micro-*débitage*. This problem is only ostensibly resolved by selecting those pieces which show characteristics of flakes and placing all others in an 'interminate' category, a problem that also is unresolved in analyses of macro*débitage*. In this stage of research the study of micro*débitage* (like micro-wear) is still too related to personal experience.

13. FACTORS RELEVANT TO THE INTERPRETATION OF TOOL TYPES

13.1. Tool types and their functions

As stated in section 2, microwear analysis provides the best 'proof' for statements relating the tool type function to morphological variables. Usually such statements are restricted to one tool type or to a tool type group or are offered only as a passing comment when total flint assemblages are analysed and discussed. There are, however, some exceptions. Thomas (1974 as mentioned in Duvall & Venner, 1979), for example, has suggested that blades with edge angles under 45 degrees are best suited for whittling wood or for fine slicing of meat and hides. Edge angles between 45 and 60 degrees are best suited for skinning large animals, for scraping hides prior to tanning, and for cutting wood and shredding fibrous plants. Edge angles larger than 60 degrees are best for chopping heavy wood or for cutting extremely fibrous materials.

Using these suggestions, Tainter (1979) has made a similar scheme with somewhat finer categories:

Smaller than 20 degrees, whittling wood (Thomas, 1971).

Smaller than 26-35 degrees, cutting (Wilmsen, 1970). Smaller than 46-55 degrees, skinning, hide scraping, sinew and plant fiber shredding, heavy cutting of wood, bone, or horn, and tool back blunting (Wilmsen, 1970). Smaller than 66-75 degrees, wood working, bone working, heavy shredding and skin softening (Wilmsen, 1970).

Using this scheme Tainter builds a more general model which is discussed in section 18. Tainter remarks that the form of the side (convex, straight, *etc.*) can say little about the tool's function because a tool is used in multiple ways and therefore not shaped according to a specific function. The same, however, can be said for an edge angle formed by retouch to which he attaches so much importance. Somewhat contradictorily, Tainter further mentions some preferences for the form of the side in relation to particular functions; for example, corners and straight to convex sides are preferred for butchering, and concave sides for woodworking.

Curwen (1935: p. 65) initially maintained that denticulation and lustre are indicative for wood cutting, but then later (Curwen in: Stone & Young, 1948) changed his opinion and stated that lustre and denticulation are related to trimming the edges of rushes or osiers used for mats or baskets. Smith (1965: p. 93) divides serrated flakes into two groups, those having regular retouch along the entire edge parallel to the axis, which were used for lateral scraping along a hard rounded object, such as bone (class A), and those having irregular retouch on part of the side, which were used for cutting and sawing (class B).

In section 10.5. the relationship between the groups of convex and straight scrapers in our assemblages and their functions was discussed and in section 16 standards for the evaluation of tool type function with microwear studies will be suggested.

13.2. Tooltypes and style; style and tradition

In section 1 style was given as one of the factors determining tool morphology along with raw material, function, and knowledge of available technology. Style was the most difficult factor to define because style is an instrument in the social system and does not necessarily have any relationship to utilitarian tasks. In the rest of this section the term function is spelled with a lower case f to indicate use of the tool in the technical sense (used as a knife, borer, scraper, *etc.*) and is spelled with a capital F to refer to its use in the social system.

The determination of the function of a tool meets problems on three levels: 1) the selection of a flint tool for a role in the social system can imply the selection of a completely different set of morphological attributes; 2) the relevance of these (flint material) attributes is defined in relation with the attributes of materials outside the flint material itself; and 3) the frame of reference for the levels in 1 and 2 is the sociological system, a conceptual entity, which is hard for archaeologists to grasp.

What is the function of style? Style is used to signal membership of an individual to either her/his group, to a different group, or to both simultaneously. Although these Functions seem to be complementary and can use the same signs, whether the emphasis is on group membership (or internal group communication) or on external communication (I belong to them and not to you) can have or imply different morphological attributes.

If the emphasis is on internal communication, signs to express membership may not be recognized by non-members (secret signs). One of the ways of expressing this is by using ordinary (common) signs whose special meaning consists of the order in which they are conveyed to group members only. On the other hand, when one wishes to express external communication, one can use these same common signs in a noticebly different order, in a context in which these common signs normally are not used, or by using signs not common in the society.

The problem for archaeologists especially, but also for other social scientists, is how signs of internal and external communication can be detected. The use of special signs or the use of signs in a different context seems most easy to detect, whereas the use of signs in a different order is more difficult, and the use of secret signs is normally impossible.

The best way to signal group membership to a different group is to use signs which are not common in the normal structure. Since raw material and function leave little or no room to add distinctive attributes, flint tools may not be good signs, and therefore not or infrequently used as such. It is therefore understandable that some archaeologists (Newell *et al.*, in press) believe that little or no stylistic (as defined here) importance can be attributed to flint material.

Yet the restrictions set by raw material and function themselves offer an opportunity to use flint tools as group signs: a) one may choose raw material that has distinctive attributes, such as a specific kind of colour, which is rare in that society because, for example, it is only available in small quantities or has to be imported; b) one may design a flint tool to be distinctive but to be inadequate as a tool since it's function is considered of no importance. In this context fall most of the flint material described as 'ceremonial'.

To identify potential candidates for expressing style among archaeological flint material it is common to search for one attribute or a group of attributes that is easily distinguishable from other attributes but cannot be explained by differences in the available raw material or by differences in environment that require tools for different tasks. Rather it may possibly be explained as a status symbol or token related to office chosen to express group membership, either between societies or within a society, and correspond to Wiessner's definition of style:

formal variation in material culture, that transmits information about personal and social identity

(Wiessner, 1983: p. 256)

formal variation in material culture, that has a distinct referent and transmits a clear message to a target population about conscious affiliation or identity

(Wiessner, 1983: p. 257; Wobst, 1977)

How does this work out in archaeological practice?

Most archaeologists using tool types to make distinctions between cultures don't ask why these differences occur. They simply find them and use them. Clark (1960: p. 219), for example, uses measurements on scrapers to compare the cultural bias between different cultures. Smith (1965: p. 95), in treating the material from Windmill Hill and other sites, uses metric characteristics of edge angles on scrapers to distinguish cultural groups, which is astonishing since she recognizes that edge angles are related to use. In general it can be said that most archaeologists seem to attribute style to a context different from that used by cultural (social) anthropologists. It is remarkable that archaeologists use style almost exclusively to chronologically order archaeological assemblages.

When cultural anthropologists consider the process of change, they are interested in the rate of change and not the length of time involved. Archaeologists, in contrast, are interested in particular cases of change, and for them time is a determinant. It is highly questionable if the term 'style' as used in cultural anthropology can be used by archaeologists at all, the more so when it is used to replace the old term tradition. Therefore, it is useful now to consider the term tradition:

1) the action of handling over, 2) delivery/oral delivery, 3) that which is handed down (the Oxford English Dictionary XI, 1961: p. 225);
an archaeological tradition is a (primarily) temporal continuity represented by persistent configurations in single technologies or other systems of related forms

(Willey & Phillips, 1958: p. 37)

tradition or stylistic variability: a demonstrable continuity through time in the formal properties of locally manufactured crafts items, this continuity being seen in the secondary functional variability only

(Binford, 1965-66: p. 108; note 4)

These three definitions relate tradition to other aspects of culture. The first definition, which is the common everyday usage of the term, refers to the passing of information through time, but does not relate tradition directly to material culture. The definition of Willey and Phillips is too broad to do more than indicate what is usually meant by archaeological culture. Binford's definition is more usable because it relates style and tradition. He uses the term secondary functional variability (directly related to the social matrix of production and use), and contrasts it to primary functional variability (the specific material use made of it), a distinction comparable to the function-Function one made in the beginning of this section. Most of the uses of 'style' in lithic studies follow the definitions of Binford and Willey in focussing on a distinct, persistent pattern of attributes through time; the social matrix of this continuity is neglected. Archaeologists usually are dealing with a persistent pattern through time, which is best defined by the old notion of tradition, as done by Childe (McNairn, 1980).

The term 'style' should only be used to denote social groups and to imply that these groups are found in the same space and time. The notion of style should certainly not be used in relation to factors related to material and function (as is done by Clark and Smith, for instance).

If the condition of occurrence in the same space and time this neglected, the definition of Binford and Davis could be used, but only in connection with secondary functional variability. Even so, a more comprehensive definition of style would be the conscious expression of differences within or between social groups, for which the evidence may or may not be found in archaeological material. The best archaeologists can do is to isolate all characteristics which are not determined by function and/or raw material and assume that these characteristics represent such an expression, as Davis does in his definitions of style:

> *formal similarities among artefacts that can be related to factors other than raw material availability or mechanical efficiency*
> (Davis, 1983: p. 55)

> *in principle considered as a residual category, composed of formal variability, when the functional variability is defined*
> (Chang, 1967: pp. 112-144; Dunnell, 1978: pp. 199-200; Davis, 1983: p. 55)

This last solution is used by Close (1979) in a paper entitled 'The identification of style in lithic artefacts' (although she does not use assemblages closely related in space and time). She concludes that the side on which the backing of the backed blade is made was stylistically determined because the side chosen formed specific patterns for the different assemblages, but could not be related to the function of the tool or to the proportion of left or right handedness as found in normal populations.[7, 8]

13.3. Technomorphology

The fourth determinant of a flint artefact, technomorphology, is the 'best' and most studied of the four determinants, as is clear from the number of publications on the subject. Only some general aspects of methodological interest will be discussed here. Technomorphological attributes are those attributes which are directly related to the mechanics of applying force on a body (a piece of flint) and the results this has, taking into consideration the shape and structure of the flint or other stone material used for tool making.

Whether or not the selection of a certain technique rests primarily on physical mechanical considerations or that other factors, such as style or raw material, also play a role is not necessarily self-evident and should be considered from assemblage to assemblage.

In fact, many aspects in the study of flint may have been unjustly categorized as purely technomorphological. For example, two common subjects in the literature on the technomorphological aspects of flintworking are 1) percussion techniques, and 2) fractures.

That archaeologists still refrain from describing the morphological attributes other than those related to technical factors, a step needed to get to the other factors, is for two reasons, both resulting from the situation that most authors seem to be so mesmerized by techniques (and the experiments with flint material) that they forget to search for other explanations.

1) Although they do not state it outright (or deny it), experimenters have a common opinion that morphological attributes resulting from the percussion technique are discrete attributes. Many archaeologists state that hard hammer percussion, for example, always produces a pronounced bulb, ripples, *etc.*, or that the presence of these attributes indicates that the hard hammer percussion was used. As emphasized previously, attributes should be interpreted after they have been defined in the context of an assemblage and not on the basis of the morphological attributes of an individual artefact (Speth, 1975).

2) Some attributes considered to be of a purely 'technological' character fail to have a technological explanation on closer inspection. A good example is hinged fractures which are often attributed to inadequate control in working with flint, which is then generally interpreted as having been done by novices or inexperienced flintknappers. Sheet (1975), for example, relates the index of hin-

ged fractures in the total assemblage to occupational specialization (or the complexity of the society): the more complex the society, the fewer hinge fractures should be produced.

Experiments (Nichols & Allstadt, 1978) have shown that while there are differences in the number of hinge fractures produced by more professional and beginning flintknappers, the variation among more professional workers is larger than that among the novices. Differences are probably more influenced by the tool being made than by the flintknapper's experience. In the experiments the percentages of hinge fractures produced by the novices were even smaller than found in some prehistoric assemblages.

Uerpmann (1976: p. 73), noticing that the number of hinge fractures was rather high in one of her assemblages, argued that they were made on purpose. She suggested that the hinge on certain tool types served as an alternative for 'backing' to eliminate sharp edges which could damage the hand or the handle in which the tool was to be mounted.

Furthermore, we note that in studies dealing with older time periods, in which the proportions of techniques used is assumed to be more important and sometimes even directly related to a style factor (*cf.* for example, the Binford-Bordes' arguments), it would be better if 'whole' assemblages, rather than selected artefacts which are frequently used to support a theory, were studied. Such studies have been done by, for example, Ohell (1978; 1979) who concludes that the industries (or complexes) *Acheuléen* and *Clactonien*, which have been traditionally distinguished on the basis of basically different techniques, are both components of the same technique whose differentiation is the result of selective collecting.

'Purely technological' attributes (see section 1) were excluded from the code list, because they did not seem relevant for the limited period of our study. But now the conclusions is it is not even longer possible to accept the 'proven' technological attributes as such. Recent publications (Ohnuma, 1982) make us believe that in the near future the subject can be more adequately treated.[9]

14. THE EXPERIMENT

The experiment and the use of ethnographical analogy (section 15.) are two approaches used to interpret statistically significant associations found in the archaeological material (see section 1.). Although the approaches are different, both stimulate new directions in archaeological research or suggest alternative interpretations of the archaeological material. The experiment offers the opportunity to isolate and investigate the relationship between or among a limited number of variables. The ethnographical record, on the other hand, provides the only opportunity for studying flintmaking in its social context of stone tool production and use.

Most experiments entail 1) the reconstruction of tool types and types of primary products, such as blades, flakes and core types, and 2) the application of different techniques to discover how they can be recognized.

But experiments are generally limited to technical problems. They ignore that by studying the archaeological material and the environment existing at a designated time in prehistory, one can formulate those activities which could or would have to be done using flint tools. One should study how these activities could have been performed and the type of morphological alterations resulting from the activities. The correlates to the activities can then be searched for in the archaeological flint material.

The limited scope of most experiments tends to seduce some scholars into believing that there is a one-to-one correspondence between the morphological attributes produced in the past and the way they were produced in the experiment. In most experiments alternative production techniques are not attempted, and, therefore, the conclusion that certain morphological characteristics can only be the result of conditions similar to those in the experiment may be unfounded.

Although it is fortunate that the study of flint material is increasing and becoming more sophisticated (particularly in experiments), some studies seem to suffer from the same fault found in the earlier days of archaeology in treating the study of flint only by its technological aspects. In many cases, however, this is not the fault of the experimenters, but of the users of the published results. For example, I feel uneasy in reading part one of the book *Préhistoire de la pierre taillée* (Tixier *et al.*, 1980) which is centred around the opening definition:

La technologie est l'étude de l'ensemble des procédés employés pour produire un outil ou un arme

It is not so much the subject itself which is disturbing, but that another book on flint technology has appeared in which aspects other than technology are not considered.

15. ETHNOGRAPHIC ANALOGY

The merit of the ethnographic record is that it provides insight into the complexity of whole systems. For archaeologists it is the order of complexity which is essential to grasp, and it is premature for models of the ethnographic society to be devised and used for interpretations of archaeological data.[10]

One of the earliest uses of ethnographic analogy was the functional interpretation of prehistoric flint tools through comparison with tools in ethnographic collections. Lartet & Christy (1865-1875), for example, devote two chapters (IV and V), "remarks on the similarity of some flint implements found in the caves of the Dordogne compared with North American Indian tools", to this topic, and in the rest of the book are numerous references to ethnographic parallels in order to interpret the use of objects.

The recent studies by White (1969; 1972) also interpret flint material by using ethnographic information, but his approach is quite different from that used by Lartet & Christy.

First, spatial variability is kept as small as possible by using archaeological and ethnographic material from the same geographical area.

Second, White distinguishes different stratigraphic levels in a site and compares their flint material. He first reconstructs a typology of the flint material now in use on the basis of the groups as made by the present makers and translates this typology into morphological attributes; these attributes are used to compare the typology of today's flint worker with the typologies of other scientists working with the archaeological material from the same area and with his own excavated material. This results in an edge typology and not in a tool typology. Quite remarkably the assemblages from the same site and different levels are more similar than assemblages from different sites and the same period.

An article by Gallagher (1977) makes use of ethnographic data collected in Ethiopia. Although the article gives more information regarding the social context of the flint tool makers, the condensed form in which the attributes are published and the particular situation of the group make it difficult to use the information in a different context.

16. USE WEAR

The results of microwear analysis were originally intended to be incorporated into the code list and stored in a file called UWF (Use Wear File) which would become the third data level for the study. The structure of the file would be analogous to and include information from the WVF file. The edge angle, form of side, and other variables would have the same value in relation to microwear as they do to retouch. Only the type of retouch and extension of retouch variables would be changed, and variables 78-83 and 92 would be left out.

In trying to combine and structure the information about microwear, however, it was discovered that publications offer many different methods of research for different kinds of microwear and often treat only special categories of tools, for which special functions are related to entirely different kinds of use traces. Remarkably enough, the number of supposed functions is extremely small and limited to a few actions on a few types of material, such as scraping soft and hard material, *etc.*

The decision about which method of microwear analysis to apply to our material was made when Mrs Bienenfeld (Bienenfeld, in prep.) contacted us (1981-1982) with the request to study part of the Swifterbant material using Keeley's method.

Although microwear analysis has already contributed greatly to our ability to master the functional component of the flint material, even though the different studies are limited and often not comparable, its development has begun to show limitations similar to those found in the study of flint technology.

Use wear studies, being an intensive and time consuming enterprise (especially when experiments, as in the better studies, are done), allow little time to place results in the larger structure of a study of interpreting differences among flint assemblages, as this study attempts. But there is a need to study the microwear of whole assemblages (or samples chosen without regard to special groups in the assemblage) and to relate it to the morphology of macroscopically visible attributes in order to gain some insight into how the macroscopic attributes are related to functional aspects of assemblages. This type of analysis could save time in future microwear studies. Studies of microwear on selected groups of tools, such as scrapers (Jensen, 1982), are interesting but contribute little to a more global approach to flint studies at this moment.

By combining macroscopic attribute and microwear analyses Hope (1981) confirmed (table 14) the relation between function and edge angle mentioned in section 13.1., but this study, like Jensen's, used too few artefacts to be totally convincing.

Table 13. The relation of edge angle and use (after Hope, 1981: fig. 1).

Category	Less than 55°		55°-65°		66°-72°		More than 72°	
Scraping	4	1 soft 1 medium 2 hard	8	1 soft 3 medium 4 hard	7	7 hard	39	9 soft 10 medium 22 hard
Cutting	4	2 soft 2 medium	5	1 soft 1 medium 2 hard	1	1 soft	4	1 soft 4 hard
Whittling	-		-		-		1	1 medium
Rotational	2	2 hard	-		-		9	3 soft 6 hard
Rubbing	-		-		-		4	1 medium 3 hard
Total	7		10		7		50	

N.B. Multiple use and re-use courses discripancies in the totals.

It must be stressed that it is not the limited number of tool groups studied in microwear that is criticized, but rather the use of different variables for different tool groups. What is needed is an approach in which the same variables can be used for all tool types.

17. REFITTING

Refitting is a potentially rewarding method for solving a number of problems related to the interpretation of flints. Sometimes refitting is not possible, and once this is determined it can be considered a result requiring explanation. P. Bienenfeld (1983a; 1983b), who is doing the microwear analysis of the Swifterbant assemblages, has also tried to refit material from site S-2 with no success, notwithstanding that an *in situ* situation is rather certain and sieving was part of the excavation, which are optimal conditions for refitting.

Nevertheless, refitting is very time consuming, and because of the large number of flint artefacts in our assemblages, it was decided to postpone refitting as a standard procedure until a method can be developed, using videocamera and computer, to reduce the amount of time involved. It would be worthwile to examine how the flaking diagrams proposed by Moir (1915-18) could be useful for writing computer programs which help refitting and describe the detachment method. Refitted nodules not only allow more specific determination of the detachment process, but also how the raw material is shaped. Furthermore, the reshaping of tools in different functions can also be studied.

Refitting has also been used as an additional method for establishing whether or not an assemblage is *in situ* (Hofman, 1981), and is an excellent tool for reconstructing the spatial relationships within a site (Cahen *et al.*, 1979c; 1980).

18. STATEMENTS RELATED TO TOOLS

From the scheme described in section 13.1. Tainter (Tainter; 1979: p. 465) constructs the following functional settlement model:

1. Hunting camps: predominance of edge angles in the 26-35° range; edge shapes ranging from convex to straight, presence of fractures and blunting; low frequency of retouched edges and of concave sides; presence of projectile points; and a high density of tools.

2. Vegetal food-gathering/processing camp: predominance of edge angles larger than 45°; absence of projectile points; and presence of pounding and grinding implements

3. Tool preparation: for the preparation of stone tools, a high frequency of unutilized *débitage* and indications for complex tool production, such as platform preparation; for wooden tool preparation, a high frequency of concave edges on stone tools.

This model was tested by Tainter with positive results. The amount of material used, however, was small, and therefore it should be tested further. Although the model allocates these different functions to different sites, which is more probable in hunter-gatherer contexts, it could be modified to incorporate those contexts where most functions are done at the same site.

19. PROGRAMS DEVELOPED FOR THE ANALYSIS OF FLINT MATERIAL

Until now this publication has mainly been concerned with the theoretical background of the analytical system and only incidentally with the computer programs used to implement it. Because the analysis itself is complex it was thought best to avoid referring to actions or decisions in the analysis which are influenced or necessitated by the computer programs. It should be noted that the foregoing analysis, together with the large amount of data, combination possibilities, and information output is not manageable without a computer. In constructing the analysis system, computer programs were developed parallel to the theoretical development of the different levels of analysis (table 4) in order to avoid discrepancies between the proposed analysis and the potentials of the available computer programs. In this section are presented some examples of the output of these programs and a brief description of what the programs (table 14) do, although the programs themselves will not be described (with the exception of the intermediate tool-defining programs) because they would offer little which is understandable to readers who are not programers themselves.

In table 14 the text in the blocks indicates the different programs and their names. The letter S indicates that cases are selected in the preceding program to be routed to the next program for further analysis. All programs are connected and interactive, which means that new programs are started

Table 14. Programs for the analysis of flint material.

File VBF (veld basis file)		File with field data used during excavation	
V			
---		Selection of flint material from file VBF	
S			

V			
File VBV (vuursteen basis verwerking file		File with data from levels 1 and 2	
S		Selection of cores	
V			
V	File KVF	File with further data	
V	(kernverwerking file)	for cores and core typology	
V			
S		Selection of tools	
File BVF (burin 'verwerking' file)	File KVF (core tool file)	File WVF (werktuigver- werking file)	Files for data from level 3 and 4
V		V	
Level 1 and 2 analysis		Tool defining program, part 1*	
V			
Level 3 analysis part a		V	
V		Tool defining program, part 2*	
Level 3 analysis part a		V	
V		Tool defining program, part 3*	
Level 3 analysis part c		* appendices c, d, e programs in WESP	

by the preceding program. All data programs (VBF-WVF) and level 1 and 2 programs are written in Dbase II and in IBM-Pascal. Level 3a, 3b, and 3c programs are written in IBM-Pascal (MDOS/Z-DOS).

The VBF file, which is associated with other programs not depicted here, is used for storing information collected during excavation. The data stored in file VBV and WVF can be found in appendix A (the numbering of the variables is slightly different for Dbase II and Pascal programs) where the structure of the data for a WESP (*Waarlijk Eenvoudig Statistisch Paket*: State University of Groningen) program can also be found. The output of these programs (program: level 1 and 2 analysis) in the form of tables and figures has been published previously (Deckers, 1979; 1980-81) with the exception of a core type list which is also included in this program.

The program for the level 3a analysis produces the following output: artefact number; category (flake, blade, core, *etc.*); description of each side which has retouch or use wear; relation of sides described; and tool type (see intermediary tool type defining list). For example: 121; flake with convex side, completely retouched; flake with straight side; use retouch on part of side; sides opposite; convex scraper.

Table 15 gives an example of the output of the level 3b analysis. The 'side' columns show the number of artefacts having retouch, use retouch or other microwear characteristics on 1-4 sides. The total column gives the total number of these sides (3*9+2*40+45 = 152). 0 sides is the number of those tool types which do not appear in file WVF, but do appear in the BVF (burins) or CTF files (for example a tranchet). In this program the number of different tool types (appendix B) also are counted.

The program for the level 3c analysis counts the number of possible combinations of attributes per side and the distribution of the edge angle belonging to these combinations (see table 16).

Table 16 can be made for all sides or for tools with one side, with two sides (opposite or adjacent), with three sides or with four sides retouched and for every tool type wanted.

Although the intermediate tool-defining programs in WESP have been replaced by the level 3a analysis Pascal program, they are published here (appendices C, D, E) because the WESP programs are easier to read and show better how the tool types are defined as clusters of attributes. The tool types presented in appendix B, however, have been

Table 15. Example of output of the Level 3^b analysis.

4 sides	0
3 sides	9 = 27
2 sides	40 = 80
1 side	45 = 45
0 side	1
Total number	152

Table 16. Example of output of the Level 3^c analysis.

	Convex		Straight		Concave		Nosed		All others	
	T.	P.	T.	P.	T.	P.	T.	P.	T.	P.
Retouch	x	x	x	x	x	x	x	x	x	x
Use-retouch	x	x	x	x	x	x	x	x	x	x
Macro-wear	x	x	x	x	x	x	x	x	x	x
Gloss	x	x	x	x	x	x	x	x	x	x
Gloss and retouch	x	x	x	x	x	x	x	x	x	x
Total	x	x	x	x	x	x	x	x	x	x

all defined by the Pascal program.

For those unfamiliar with expressions used in computer languages, but interested in how the tool types are defined, a few definitions will allow appendices C, D and E to be read. Between the IF ... THEN phrase the conditions are given which result in the tool type code which is found between THEN ... ELSE phrase.

The last number of the code in the THEN ... ELSE phrase should be ignored, *e.g.*, code 121, 122, *etc.* is tool type 12 in appendix B.

The number in front of the = sign indicates the variable number (see appendix A) and the number after the = sign is the value code for that variable, *e.g.* 26=10 is variable 26 (form) with the score 10 (which is a line).

The IF ... THEN conditions can be related by A ('and') or V ('or'), and if the conditions are between brackets they are executed first, as in mathematical formulas. The computer starts with the first IF ... THEN condition and goes on to the next IF ... THEN until it finds the set of conditions which are appropriate for the tool type. The use of WESP has the disadvantage that the more specific types must be placed in the program before more generally defined types so that when a tool type code for a tool is found it not only means that the tool fulfils the conditions between that specific IF ... THEN, but also that it does not fulfil any of the other IF ... THEN statements specified earlier in the program. The tool defining list (appendices C-E) provides a good illustration of how the tool types are defined, but because it is not the latest version, it does not give the up-to-date definition of the tool types.

20. NOTES

1. The categorical exclusion of the technical factor in this thesis is due to my opinion that the technical aspect has already received much attention with rather limited results, while other factors, which are just as important, have been neglected. A similar development seems to be happening in microwear studies (see also section 13.3.).
2. The sieving of the excavated earth is essential because it influences the proportions of the flakes, blades, *etc*, which are recovered and, consequently, the analysis of the assemblages.
3. The recent excavations of Heveskesklooster and Borger, which are TRB sites in wet areas, mean that the characterization of the TRB culture as one occurring only in dry environments will be questioned. This is of no direct importance to our study because the TRB assemblages used for this study all come from dry environment contexts.
4. For the definition of distal and proximal ends see Crabtree, 1972: p. 22, and for dorsal and ventral sides see Crabtree, 1972: p. 44.
5. Even if there are changes in the attitude of the researchers and in how style is used, we note that Schild (1984) in the description of the Late Palaeolithic flint material uses the different kinds of percussion techniques (hard hammer, punch, *etc*.) to separate stylistic groups. As the reader will notice further in our article this approach is questionable.
6. According to Rozoy (1967a: p. 211) the type list of Sonneville-Bordes should be preferred to the more refined type lists from Bandi (1963b), Bohmers (1956a; 1956b), and Laplace (1956; 1957; 1966), because her types are more comprehensive and therefore less dependent on time and space. However, none of the these authors forbid the inclusion of their types within a more comprehensive typological structure if need be, even within the Sonneville-Bordes typology, which for the types defined by Bandi and Bohmers should not be complicated. Furthermore, if desired, their graphics could be translated into the cumulative graphs of Sonneville-Bordes. One should not assume, however, that such exercises would inform functional interpretations. Sonneville-Bordes made her groups of tool types impressionistically at a time when use wear analysis and environmental data were not yet available for verifying functional interpretations of her groups.
7. Style: highly specific and characteristic manner of doing something which by its very nature is peculiar for a specific time and place (Sackett, 1982: p. 62).
8. The meaning of the terms style and tradition used by art historians is not taken into consideration here, although clearly this is the meaning used by some archaeologists.
9. Ohnuma, 1982: p. 163: Beyond these general guidelines no one has provided a foolproof method for linking hammer hardness to flake features.
10. A discussion of terms like system, model, *etc.* which are used rather vaguely or even in a contradictory manner in many publications, is of no relevance to the topic here.

21. REFERENCES

AMSTRONG, A.L., 1919-1922. The evidence of S. York's surface implements relative to classification and dating. *Proceedings of the Prehistoric Society of East Anglia* 3, pp. 277-289.

ANGELROTH, H., 1957. Tranchet d'Hastedon, considerations generales sur les tranchets. *Bulletin de la Société Royale Belge d'Anthropologie et de Préhistoire* 68, p. 11.

BAKKER, J.A., 1961. Een nederzetting van de trechterbekercultuur te Laren (N.H.). In: *In het voetspoor van A.E. van Giffen*. Groningen, pp. 27-32.

BALCER, B., 1981. Ökonomische Aspekte der Feuersteinbearbeitung in der Trichterbecherkultur. *Jahresschrift der Mitteldeutschen Vorgeschichte* 63, pp. 143-148.

BANDI, H.G., 1963a. The burins in the eskimo area. *Anthropological papers of the University of Alaska* 10 (2), pp. 19-28.

BANDI, H.G. (ed.), 1963b. *Birsmatten, Basisgrotte* (= Acta Bernensia I). Bern.

BARNES, A.S., 1929. The dimensions of flint implements. *Proceedings of the Prehistoric Society of East Anglia* 6, pp. 117-130.

BARNES, A.S. & Cheynier, A., 1935. Étude sur les techniques de débitage du silex et en particulier des nuclei prismatiques. *Bulletin de Société Préhistorique Française* 32, pp. 288-299.

BARNES, A.S. & Kidder, H.-H., 1936. Différentes techniques de débitage à La Ferrassie. *Bulletin de la Société Préhistorique Française* 33, pp. 272-288.

BARRIÈRE, Cl., R. DANIEL, H. DELPORTE, M. ESCALON DE FONTON, R. PARENT, J. ROCHE, J.-G. ROZOY, J. TIXIER, E. VIGNARD (G.E.E.M.), 1969. Épipaléolithique-Mésolithique. Les microlithes géométriques. *Bulletin de la Société Préhistorique Française* 66, pp. 355-366.

BARTA, I., 1980. Das Mesolithikum im nordwestlichen Teil des Karpatenbeckens *Veröffentlichungen des Museums für Ur- und Frühgeschichte Potsdam* 14/15, pp. 295-300.

BEISERT, W., 1981. Ein statistisch-graphischer Vergleich des Silexmaterials der bandkeramischen Siedlungen Diemarden und Gladebeck in Südniedersachsen *Neue Ausgrabungen und Forschungen in Niedersachsen* 14, pp. 67-71.

BEUKER, J.R., 1981. Een vindplaats met primair bewerkt vuursteenmateriaal bij Uffelte, gem. Havelte. *Nieuwe Drentse Volksalmanak* 98, pp. 99-111.

BEUKER, J.R., 1983. *Vakmanschap in vuursteen* (= Museumfonds Publicatie Nr. 8). Assen.

BIENENFELD, P., 1983a. Preliminary results from a lithic use wear study of the Swifterbant sites, S-2, S-4 and S-51. Draft copy.

BIENENFELD, P., 1983b. Patterns of stone tool use at some Dutch Neolithic settlements. Paper presented at the forty-eight annual meeting of the Society for American Archaeology. Pittsburg, Pennsylvania. April 30th, 1983.

BINFORD, L.R., 1965-66. Archaeological systematics and the study of culture process. *American Antiquity* 31, pp. 203-210.

BINFORD, L.R., 1983. *In pursuit of the past, decoding the archaeological record*. London.

BLANCHET, J.C. & M. PETIT, 1972. l'Habitat néolithique de Jonquières (Oise), Premiers résultats. *Bulletin de la Société Préhistorique Française* 69, pp. 389-407.

BOCQUET, A., 1980. Le microdenticulé, un outil mal connu. *Bulletin de la Société Préhistorique Française* 77, pp. 76-85.

BOHMERS, A., 1956a. Statistics and graphs in the study of flint assemblages. I. Introduction. *Palaeohistoria* 5, pp. 1-6.

BOHMERS, A., 1956b. Statistics and graphs in the study of flint assemblages. II. A preliminary report on the statistical analysis of the Younger Paleolithic in Northwestern Europe. *Palaeohistoria* 5, pp. 7-26.

BOHMERS, A. & A. WOUTERS, 1956. Statistics and graphs in the study of flint assemblages. III. A preliminary report on the statistical analysis of the Mesolithic in Northwestern Europe. *Palaeohistoria* 5, pp. 27-38.

BOHMERS, A. & A. BRUIJN, 1958/59. Statistische und graphische Methoden zur Untersuchung von Flintkomplexen. IV. Das lithische Material aus den bandkeramischen Siedlungen in den Niederlanden. *Palaeohistoria* 6-7, pp. 183-211.

BORDES, F., 1947. Étude comparative des différentes techniques de taille du silex et des roches dures. *l'Anthropologie* 51, pp. 1-29.

BORDES, F., 1967. Considérations sur la typologie et les techniques dans le paléolithique. *Quartär* 18, pp. 25-55.

BORDES, F. & D. CRABTREE, 1969. The Corbiac blade technique and other expériments. *Tebiwa* 12-2, pp. 1-21.

BOUTIN, P., B. TALLUR & A. CHOLLET, 1977. Essai d'application des techniques de l'analyse des données aux pointes à dos des niveaux aziliens de Rochereil. *Bulletin de la Société Préhistorique Française* 74, pp. 362-375.

BRÈZILLON, M.N., 1968. *La dénomination des objects de pierre taillée. Matériaux pour un vocabulaire des préhistoriens de langue française* (= Suppl. Gallia Préhistoire 4). Paris.

BRÉZILLON, M.N., 1971. Les Tarterets II. Site paléolithique de plein air à Corbeil-Essonnes (Essonnes). *Gallia Préhistoire* 14, pp. 3-40.

CAHEN, D. & P.-L. VAN BERG, 1979. *Un habitat danubien à Blicquy. I. Structures et industrie lithique* (= Archaeologia Belgica 221). Bruxelles.

CAHEN, D., L.H. KEELEY & F.L. VAN NOTEN, 1979c. Stone tools, toolkits, and human behavior in prehistory. *Current Anthropology* 20, pp. 661-683.

CAHEN, D., C. KARLIN, L.H. KEELEY & F. VAN NOTEN, 1980. Méthodes d'analyse technique, spatiale et fonctionnelle d'ensembles lithiques. *Helinium* 20, pp. 209-259.

CHANG, K.C., 1967. Major aspects of the interrelationship of archaeology and ethnology. *Current Anthropology* 8, pp. 227-243.

CLARK, J.G.D. & W.F. RANKINE, 1939. Excavations at Farnham, Surrey (1937-38): The Horsham culture and the question of Mesolithic dwellings. *Proceedings of the Prehistoric Society* 5, pp. 61-118.

CLARK, J.G.D., 1960. Excavations at the Neolithic site at Hurst Fen, Mildenhall, Suffolk. *Proceedings of the Prehistoric Society* 26, pp. 202-245.

CLOSE, A.E., 1979. The identification of style in lithic artefacts. *World Archaeology* 10, pp. 223-237.

COLLINS, M.B., 1975. Lithic technology as a means of processual inference. In: E. Swanson (ed.), *Lithic technology. Making and using stone tools.* Den Haag, pp. 15-34.

CRABTREE, D.E., 1972. *An introduction to flintworking* (= Occasional papers of the Idaho State University Museum 28). Pocatello.

CULLBERG, C. & T. PARSMAR, 1968. A theoretical and statistical approach to some flake measuring problems. *Norwegian Archeological Review* 1, pp. 57-75.

CURWEN, E.C., 1935. Agriculture and the flint sickle in Palestine. *Antiquity* 9, pp. 62-66.

DANIEL, R. & J.-G. ROZOY, 1966, Divers types d'armatures tardenoisiennes à base non retouchée. *Bulletin de la Société Préhistorique Française* 63, pp. 251-261.

DAVIS, D.D., 1983. Investigating the diffusion of stylistic innovations. *Advances in archaeological method and theory* 6, pp. 53-89.

DECKERS, P.H., 1979. The flint material from Swifterbant, earlier Neolithic of the northern Netherlands. I. Sites S-2, S-4 and S-51 (= Final reports on Swifterbant II). *Palaeohistoria* 21, pp. 143-180.

DECKERS, P.H., 1980-81. Het neolithisch vuursteenmateriaal uit Groningen-De Weijert-Zuid. *Groningse Volksalmanak*, pp. 178-201

DECKERS, P.H., 1982. Preliminary notes on the Neolithic flint material from Swifterbant (= Swifterbant contribution 13). *Helinium* 22, pp. 33-39.

DECKERS, P.H., unpubl. The flint material from the Funnel Beaker Culture. Manuscript.

DOLUKHANOV, P.M., J.K. KOZŁOWSKI & S.K. KOZŁOWSKI, 1980. *Multivariate analysis of Upper Palaeolithic and Mesolithic stone assemblages.* Warszawa-Krakow.

DUNNELL, R.C., 1978. Style and function: a fundamental dichotomy. *American Antiquity* 43, pp. 92-202.

DUVALL, J.G. & W.T. VENNER, 1979. A statistical analysis of the lithics from the Calico site (SBCM 1500A), California. *Journal of Field Archaeology* 6, pp. 455-462.

FARRUGGIA, J.-P., 1973. Steinmaterial. In: J.-P. Farrugia, R. Kuper, J. Lüning & P. Stehli, *Der bandkeramische Siedlungsplatz Langweiler 2, Gemeinde Aldenhoven, Kreis Düren* (= Rheinische Ausgrabungen 13). Bonn, pp. 106-133.

*FISH, P.R., 1975. Replication studies in classification: The implications for statistical analysis. Paper presented at the 40th annual meeting of the Society for American Antiquity.

FLADMARK, K.R., 1982. Micro*débitage* analysis: initial considerations. *Journal of Archaeological Science* 9, pp. 205-220.

GALLAGHER, J.P., 1977. Contemporary stone tools in Ethiopia: Implications for archaeology. *Journal of Field Archaeology* 4, pp. 407-414.

GIBSON, E.C., 1982. Upper Paleolithic flintknapping specialists? The evidence from Corbiac, France. *Lithic Technology* 11, p. 41-49.

*GOULD, R.A., D.A. KOSTER & A.H.L. SONTZ, 1971. The lithic assemblage of the western desert aborigines of Australia. *American Antiquity* 36, pp. 149-169.

GOULETQUER, P.L., 1965. Etude morphologique de grattoirs néolithiques de la Pointe Saint-Gildas. *Annales de Bretagne* 72, pp. 42-47.

GUNN, J., 1975. Dynamic typology: A model for functional typing of stone tools with an application to French Paleolithic burins. *Lithic Technology*, 4, pp. 9-17.

HODDER, I., 1982. *Symbols in action: ethnoarchaeological studies of material culture.* Cambridge.

HOFMAN, J.L., 1981. The refitting of chipped-stone artifacts as an analytical and interpretive tool. *Current Anthropology* 22, pp. 691-693.

HOPE, R., 1981. Aspects of microwear analysis of stone tools. In: *Early technology in North Britain* (= Scottish archeological forum 11). Edinburgh, pp. 25-35.

HUNDT, H.-J., 1951. Eine neue jungneolitische Gruppe im östlichen Bayern (Chamer Gruppe). *Germania* 29, pp. 5-17.

JENSEN, H.J., 1983. A preliminary analysis of blade scrapers from Ringkloster, a Danish Late Mesolithic site.

KOZLOWSKI, J.K. (ed.), 1982. *Excavation in the Bacho Kiro cave (Bulgaria). Final report.* Warszawa.

LANTING, J.N., 1973. Laat-Neolithicum en vroege Bronstijd in Nederland en N.W.-Duitsland: continue ontwikkelingen. *Palaeohistoria* 15, pp. 216-313. to

LANTING, J.N. & W.G. MOOK, 1977. *The pre- and pro history of the Netherlands in terms of radiocarbon dates.* Groningen.

LAPLACE-JAURETCHE, C., 1956. Typologie statistique et évolution des complexes à lames et lamelles. *Bulletin de la Société Préhistorique Française* 53, pp. 271-290.

LAPLACE-JAURETCHE, C., 1957. Typologie analytique, application d'une nouvelle méthode d'étude des formes et des structures aux industries à lames et lamelles. *Quarternaria* 4, pp. 133-163.

LAPLACE-JAURETCHE, C., 1966. *Recherches sur l'origine et l'évolution des complexes leptilithiques.* Paris.

LARTET, E. & H. CHRISTY, 1865-1875. *Reliquiae Aquitanicae*; being contributions to the archaeology and palaeontology of Perigord and the adjoining provinces of southern France. London.

LEROI-GOURHAN, A., G. BAILLOUD, J. CHAVAILLON

& A. LAMING-EMPERAIRE, 1966. *La préhistoire*. Paris.

LOUWE KOOIJMANS, L.P., 1974. *The Rhine/Meuse delta: Four studies on its prehistoric occupation and Holoceen geology*. Diss. Leiden. (also *Analecta Praehistorica Leidensia* 7)

McNAIRN, B., 1980. *The method and theory of V. Gordon Childe*. Edinburgh.

MODDERMAN, P.J.R. & P.H. DECKERS, 1984. Verblijfssporen uit mesolithicum, neolithicum en bronstijd op de Keuperheide, gem. Helden (L). *Analecta Praehistorica Leidensia* 17, pp. 29-55.

MOIR, J. Reid, 1915-1918. The position of prehistoric research in England, *Proceedings of the Prehistoric Society of East Anglia* 2, pp. 381-391.

MOVIUS jr., H.L., N.C. DAVID, H.M. BRICKER & R.B. CLAY, 1968. *The analysis of certain major classes of Upper Palaeolithic tools* (= Peabody Museum, Harvard Univ. Bulletin 26). Cambridge.

NEWCOMER, M.H. 1975. Spontaneous retouch. *Second international symposium on flint* (= Staringia 3). Maastricht, pp. 62-64.

NEWELL, R.R., 1970. The Mesolithic affinities and typological relations of the Dutch Bandkeramik flint industry. Unpubl. Ph.D. Diss. London.

NEWELL, R.R., A.L. VAN GIJN, D. KIELMAN & W. VAN DER SANDEN, in prep. An inquiry into the ethnic resolution of Mesolithic regional groups: the study of Mesolithic decorative ornaments in time.

NICHOLS, J. & D.J. ALLSTADT, 1978. Hinge fracture rates of novice flintknappers. *Lithic Technology* 7, p. 1-2.

ODELL, G.H., unpubl. A system of computer codes for the functional analysis of archaeological data.

OHEL, M.Y., 1977. A device for measuring flake bulbs. *Lithic Technology* 6, pp. 6-7.

OHEL, M.Y., 1978. 'Clactonien flaking' and primary flaking: some initial observations. *Lithic Technology* 7, pp. 23-28.

OHEL, M.Y., 1979. The Clactonien: an independent complex or an integral part of the Acheulean? *Current Anthropology* 20, pp. 685-726.

OHNUMA, K. & C. BERGMAN, 1982. Experimental studies in the determination of flaking mode. *Bulletin of the Institute of Archaeology* 19, pp. 161-170.

ONORATINI, G., 1980. Essai d'analyse des burins simples. *Bulletin de la Société Préhistorique Française* 77, pp. 328-340.

OTTE, M., 1978. Analyse des burins de Spy. *Bulletin de la Société Royale Belge d'Anthropologie et de Préhistoire* 89, pp. 151-165.

PARTEL, Y. & M.Y. OHEL, 1981. Measuring the radius of flake bulbs by a spherometer. *Lithic Technology* 10, p. 28-30.

PATTE, E., 1971. Quelques sépultures du Poitou, du Mésolithique au Bronze Moyen. *Gallia Préhistoire* 14, pp. 139-244.

PATTERSON, L.W., 1979. Limitations in uses of large prismatic blades. *Lithic Technology* 8, p. 3-5.

PATTERSON, L.W., 1980. Measurement of stone artifact edge angles. *Flintknappers' Exchange* 3/2, p. 11.

PEAKE, H. 1919-1922. A flint factory at Thatcham, Berks. 1. Report of site and excavations. *Proceedings of the Prehistoric Society of East Anglia* 3, pp. 499-514.

PHILLIPS, P., 1972. Les charactères régionaux du Chasséen du Midi. *Bulletin de la Société Préhistorique Française* 69, pp. 538-553.

PRICE, T.D., R. WHALLON & S. CHAPPELL, 1974. Mesolithic sites near Havelte, province of Drenthe, Netherlands. *Palaeohistoria* 16, pp. 7-61.

*PRUFER, O.H. *et al.*, 1965. *The McGraw site: a study in Hopewellian dynamics* (= Scientific publications of the Cleveland Museum of Natural History N.S. 4, No. 1). Cleveland.

RADOVANOVIC, I., 1981. *Ranoholocenska kremena industrya sa lokaliteta Padina u Derdapu*. Beograd.

RIGAUD, A., 1972. La technologie du burin appliquée au matériel osseux de la Garenne (Indre). *Bulletin de la Société Préhistorique Française* 69, p. 104-108.

RIGAUD, A., 1982. Quelle importance doit-on accorder à l'arêté des burins dans une étude typologique. *Bulletin de la Société Préhistorique Française* 79, p. 38-40.

ROZOY, J.G., 1967a. Essai d'adaption des méthodes statistiques à l'Épipaléolithique ('Mésolithique'). Liste-type provisoire et premiers résultats. *Bulletin de la Société Préhistorique Française* 64, pp. 209-226.

ROZOY, J.G., 1967b. Typologie de l'Épipaleolithique franco-belge. *Bulletin de la Société Préhistorique Française* 64, pp. 227-260.

SCHILD, R., 1984. Terminal Paleolithic of the North European Plain. A review of lost chances, potential and hopes. *Advances in World Archaeology* 3, pp. 193-274.

SHEETS, P.D., 1975. Behavioral analysis and the structure of a prehistoric industry. *Current Anthropolgy* 16, pp. 369-391.

SIRAKOV, N., 1983. *Reconstruction of the Middle Palaeolitic flint assemblages from the Cave Samuilitsa II (Northern Bulgaria) and their taxonomical position seen against the Paleolitic of South-Eastern Europe* (= Folia Quarternaria 55). Krakow.

SMITH, I., 1965. *Windmill Hill and Avebury: Excavations by Alexander Keiller 1925-1939*. Oxford.

SONNEVILLE-BORDES, D. DE, 1966. l'Évolution du paléolithique supérieur en Europe Occidentale et sa signification. *Bulletin de la Société Préhistorique Française* 63, pp. 3-34.

SPAULDING, A.C., 1953. Statistical techniques for the discovery of artifact types. *American Antiquity* 18, pp. 305-313.

SPAULDING, A.C., 1960. Statistical description and comparison of artefact assemblages. In: *The application of quantitative methods in archaeology* (= Viking Fund publications in Anthropology 28). New York, pp. 60-92.

SPETH, J.D., 1975. Miscellaneous studies in hard-hammer percussion flaking. The effects of oblique impact. *American Antiquity* 40, pp. 203-207.

STONE, J.F.S. & W.E.V. YOUNG, 1948, Two pits of grooved ware date near Woodhenge. *Wiltshire Archaeological Magazine* 52, pp. 287-306.

STRAHM, Chr., 1961/62. Geschäftete Dolchklingen des Spätneolithikums. *Jahrbuch des Bernischen Historischen Museums* 41/42, pp. 447-477.

TAINTER, J.A., 1979. The mountainair lithic scatters: settlement patterns and significance evaluation of low density surface sites. *Journal of Field Archaeology* 6, pp. 463-469.

TAUTE, W., 1973-1974. Neolithische Mikrolithen und andere neolithische Silexartefakte aus Süddeutschland und Osterreich. *Archäologische Informationen* 2-3, pp. 71-125.

THEVENOT, J.-P., 1973. *Le village préhistorique d'Ouroux-sur-Saone* (= Travaux du Centre de Recherche de Solutré 1).

*THOMAS, D.H., 1971. Prehistoric subsistence-settlement patterns of the Reese River Valley, Central Nevada. Unpubl. Ph.D. diss. Univ. of California.

*THOMAS, D.H., 1974. *Predicting the past*. San Francisco.

TIXIER, J., 1963. *Typologie de l'Épipaléolithique du Maghreb* (= Mémoires du Centre de Recherches Anthropologiques, Préhistoriques et Ethnologiques 2). Alger/Paris.

TIXIER, J., M.L. INIZIEN & H. ROCHE, 1980. *Préhistoire de la pierre taillée. 1. Terminologie et technologie*. Antibes.

UERPMANN, M., 1976. *Zur Technologie und Typologie neolithischer Feuersteingeräte. Die Silices aus Yverdon im Vergleich zu denen anderer Fundorte*. Tübingen.

ULRIX-CLOSSET, M. & R. ROUSSELLE, 1982. *l'Industrie lithique du site rubané du Staberg à Rosmeer* (= Archaeologia Belgica 249). Bruxelles.

WHITE, J.P., 1969. Typologies for some prehistoric flaked stone artefacts in the Australian New Guinea Highlands. *Archaeology and Physical Anthropology in Oceania* 4, pp. 18-46.

WHITE, J.P. & D.H. THOMAS, 1972. What mean these stones? Ethno-taxonomic models and archaeological interpretations in the New Guinea Highlands. In: D.L. Clarke (ed.), *Models in archaeology*. London, pp. 275-308.

WIESSNER, P., 1983. Style and social information in Kalahari San projectile points. *American Antiquity* 48, pp. 253-276.
WILLEY, G.R. & P. PHILLIPS, 1958. *Method and theory in American archaeology*. Chicago.
WILMSEN, E.N., 1970. *Lithic analysis and cultural inference: a Paleo-Indian case* (= Anthropological Papers of the University of Arizona 16). Tucson.
WOBST, H.M., 1977. Stylistic behavior and information exchange. In: C.E. Cleland (ed.), *Papers for the director. Research essays in honor of James B. Griffin* (= Museum of Anthropology Univ. of Michigan, Anthropological Papers 61). Ann Arbor, pp. 317-342.
*ZIMMERMAN, A., 1982. Das Steinmaterial des bandkeramischen Siedlungsplatzes Langweiler 8. Diss. Tubingen.
ZIMMERMANN, W.H., 1980. Ein trichterbecherzeitlicher Hausgrundriss von Flogeln im Ortjen, Kr. Cuxhaven. In: H. Krüger & H.-G. Stephan (eds.), *Beiträge zur Archäologie Nordwestdeutschlands und Mitteleuropas* (= Materialhefte zur Ur- und Frühgeschichte Niedersachsens 16). Hildesheim, pp. 479-489.

Literature with an asterisk was not available for reading, but mentioned in other literature.

Figs. 7, 13, 14 and 15 can be found in the fold at the back of this volume.

Appendices A-F have been reproduced as microfiches in an envelope attached to the cover of this volume.