A NOTE ON VENTIFACTS AND THE SHAPE, ANGULARITY AND SURFACE POLISH OF LYDITES IN FLUVIATILE DEPOSITS AND IN STONE PAVEMENTS[1]

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ABSTRACT

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Possible differences in shape, angularity of edges, and surface polish in lydites sampled from fluviatile deposits (Urk Formation) and the stone pavements have been investigated. Lydites from the Hattem Layer have been included in this research in connection with the question whether they orginate form stone pavements.

INTRODUCTION

In those areas where winds significantly influence the earth surface because of a lack of vegetation, not only eolian deposits are found, but also features that are the result of wind abrasion, deflation and erosion. An extensive literature exists on this subject (see e.g. COKE & WARREN, 1973; SCHÖNHAGE, 1973; TEDROW, 1977; WASHBURN, 1979).

Traces of wind-activity can also be found on stones. The measure to which they are affected is especially influenced by:

a. Shape. The strongest affection is found in those parts that are oriented favourably to the wind.
b. Size. Increase in affection coincides with increasing size, according to NITZ (1965) and SCHÖNHAGE (1969).
c. Hardness. Quartz and lydite for instance are much less affected than porphyry (NITZ, 1965).

Equally important to the affection of the stones are:

d. Windspeed.
e. The size of wind-transported material. VIERHUFF (1967) found that more wind-affected stones occur in stone pavements underlying sand than in pavements underlying sand containing loess.
f. Hardness and angularity of wind-transported material. In this context it is important that snow plays a considerable role under cold conditions and silt-sized ice particles with hardness 2-3.5 (Mohs' scale) at –10° to –25° C have been reported to abrade stones as hard as 5.5 at only moderate wind velocities (DIETRICH, 1977; quoted in WASHBURN, 1979).

The above-mentioned affection of stones can result in the formation of ventifacts and their etching. As mentioned in the American Geological Institutes' Glossary of Geology, the term 'ventifact' was introduced by EVANS (1911). It is defined as a stone, shaped, worn, faceted or polished by the abrasive action of windblown sand, silt or ice particles. As to its shape a ventifact is a stone, of which the basal face changes, via a curved part, into one or more almost flat facets, which are bounded by sharp edges and best developed towards the highest part of the stone. Depending on the number of facets, ventifacts are known as dreikanter, etc. Roof-shaped forms with two dominant facets (zweikanter), as well as triquetrous pyramids (dreikanter) are the dominant forms. From various quarters the significance of the original shape of a stone for the definitive shape of the ventifact has been pointed out. It has also been pointed out that the dreikanter must be regarded as the final form and that the roof-shaped form only represents an intermediate stage of development.

This research was done in consequence of the find of several lydites as zweikanter and dreikanter in the surroundings of Elspeet and Ede. As lydites in fluviatile deposits mainly occur as tablet-shaped stones, the question arose whether the affection by wind could be so strong that the above-mentioned stones with 2 and 3 facets could have developed from stones with 1 facet, or that lydites with another shape have been supplied by rivers. The zweikanter and dreikanter that were found possess a strong polish and for that reason it seemed to be of interest to trace in how far this polish is typical for ventifacts.

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In this investigation fluviatile deposits (Urk Formation) at Bennekom and Woeste Hoeve (Veluwe) were sampled. Lydites were also sampled from stone pavements at Ede and Elspeet, in which ventifacts also occur. Lydites were also sampled at Hattem (Enschede Formation, mainly Hattem Layer).

METHODS

The number of lydites per sample was more than 200, in the fraction 2 - 5 cm. Of each stone the maximal length and width of the basal face were measured as well as those of the top face. The shape index as used in this note is found by addition of the quotients of the lengths and widths thus found. In case both lengths and widths of a stone are equal, the result is 2. A zweikanter will approximate a value of 1 and a dreikanter a value of less than 0.1.

Visually the maximal angularity of each stone's edges was determined. By means of comparison the results were divided into 4 classes:

1. stones with at least a very angular edge
2. stones with an angular edge
3. stones with a subangular and a rounded edge
4. stones with a rounded and a well rounded edge

Finally it was established by comparison whether a lydite shows a) a dull, b) a weakly polished, or c) a strongly polished part. A lydite ventifact typically possesses a strongly polished surface (group c in Fig. 1).

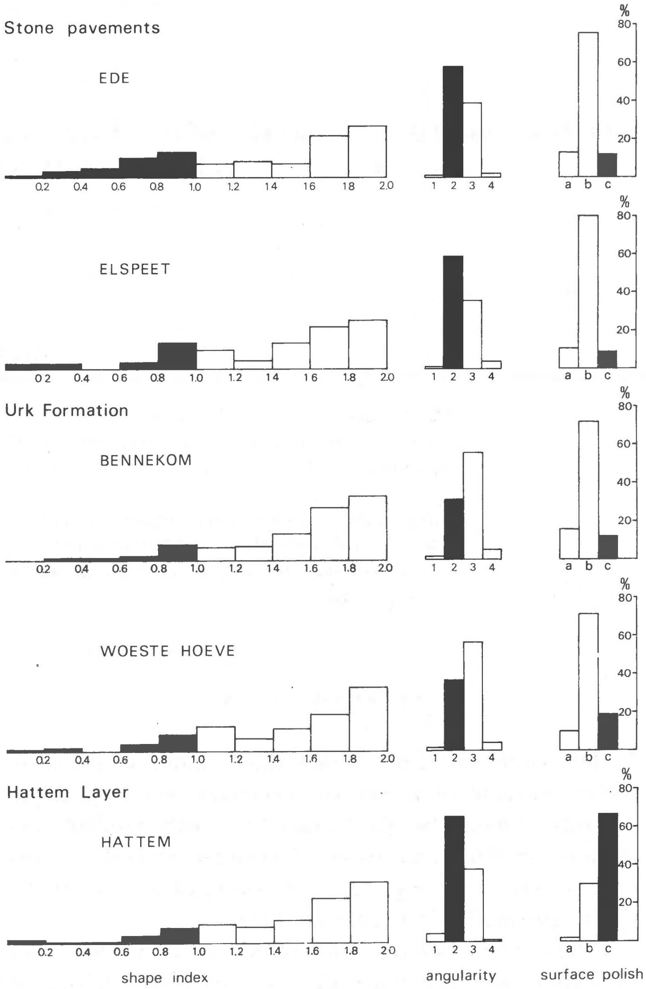

Fig. 1
Shape index, angularity of the edges, and surface polish of lydites from the stone pavements, the Urk Formation and the Hattem Layer. For explanation of shape index, etc. see text. Values typical for ventifacts are presented in black.

RESULTS

The results of the measurements are presented in figure 1. The data on shape index show minor differences. If we regard the values of 1.8-2, in which class those stones occur that come closest to the tablet-shape, then we find the highest percentages in the Urk Formation and the Hattem Layer (resp. 33 and 32%). Lydites from the stone pavements have at average 25.5% in this range. Because of the small number of samples, the number of stones measured in each sample (at least 100), and the possible errors in measuring, the differences found are too small to draw conclusions. The differences are clearer when we regard the stones from the stone pavements and the fluviatile deposits having an index value of less than 1. (The values which any zweikanter and dreikanter should possess) Stones from the stone pavements show an average percentage of 27.5, those from the Urk Formation 13.5% and those from the Hattem Layer 12%.

The results of the determination of the angularity of the edges show that stones with angular edges from the stone pavements make up, at average, 58.5% and those from the Urk Formation 34%. This difference may be called significant. It is striking that these stones make up 66% in the Hattem Layer, which is the highest value found. Higher even than in the stone pavements. It has been noticed before that ventifacts are characterised by this type of edges.

As far as the surface polish is concerned it can only be noticed that there is a remarkable difference between the lydites from the Hattem Layer and those from the other groups. The number of strongly polished lydites reaches 67% in the Hattem Layer, while it stays below 20% in the other samples. (Urk Formation at average 15.5%, stone pavements 10.5%).

CONCLUSIONS

From the data mentioned above one can only cautiously and with reservation draw conclusions. Comparison of the lydites from the Urk Formation with those from the stone pavements points to a slight change in shape for the stones from the stone pavements. This is especially expressed by the sharper edges of the stones from the stone pavements. This change in shape most probably occurred through wind affection.

It is striking that stones from the stone pavements do not show stronger polish than those from the Urk Formation. A sample from a stone pavement collected on the sandur at Schaarsbergen (Veluwe) also showed only a small number of strongly polished stones (8%). The same applies to lydites from the Enschede Formation at Sibculo, with 16% strongly polished stones and 58% stones with angular edges. This implies that hardly any conclusions on eolisation can be drawn by means of surface polishing alone. In this connection it has to be mentioned that strongly polished stones have been found by the author in a river-bed (Vaal River, South Africa). It is also interesting that KUENEN (1947) noted the occurrence of facetted stones in Indonesia and in the Alps. These stones supposedly were shaped by the abrasive action of sand, transported by running water. Although there are similarities in lithological compositions and the angularity of stone's edges between material from the Hattem Layer and from the stone pavements on top of the Mid-Pleistocene deposits in The Netherlands, it is not possible to pass sentence on the genesis by means of the data presented here.

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