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VALLEY COVERSAND RIDGE,
A NEW MORPHOLOGICAL ELEMENT IN THE GUELDERS VALLEY

Abstract

During geomorphological investigations made in part of the Guelders Valley for the geomorphological map of the Netherlands 1 : 50,000 the following forms were distinguished in the coversand part of the district: flat coversand area, coversand ridge, valley coversand ridge. Formerly all coversand ridges in this area were understood to be remnants of parabolic ridges formed during Early Dryas times.

The present author thinks that the narrow long ridges situated in or near the lower parts of the coversand area do not date from Early Dryas times, but were formed during the Upper-Pleniglacial. In view of their genesis they have been named: Valley coversand ridges.

The Geological Map of the Netherlands 1 : 50,000 (1929) gives most of the surface deposits in the Guelders Valley as "postglacial (post-Riss) valley fill or low-terrace deposits, in general, consisting of fine sands". Oosting (1936) was the first to deny the predominantly fluvial character of these sands. Edelman & Crommelin (1939) pointed to the partly eolian origin of the material, at the same time mentioning the peculiar features of the coversand relief. Maps drawn after this period by the Soil Survey Institute at Wageningen afford a good picture of this micro-relief (see Buringh, 1951, and others). In the Bennekom area a more or less regular pattern of coversand ridges was observed (Maarleveld, 1958), which gave rise to a reconstruction of the position of the original coversand ridges in the Guelders Valley (Maarleveld & v.d. Schans, 1961).

In 1966 the Soil Survey Institute at Wageningen and the State Geological Survey in Haarlem started the joint mapping for the geomorphological map of the Netherlands 1 : 50,000 under the direc-

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tion of Prof. Dr. G. C. Maarleveld. Figure 1 gives an idea of a part of the Guelders Valley, copied from the geomorphological map 1 : 50,000 and reduced to 1 : 100,000, and leaving out details.

The following forms are distinguishable in the coversand part of the Guelders Valley:

(1) flat coversand area (inclusive of river deposits),
(2) coversand ridge and complex of coversand ridges.
(3) valley coversand ridge.

FLAT COVERSAND AREA
(inclusive of brook deposits)

Flat coversand areas in the Guelders Valley are those areas which differ less than $^1/_2$ metre in height from the adjacent country.

The thickness of the coversand in these flat areas is often not more than $^1/_2$ to $1^1/_2$ metres. In consists of a not-loamy, moderately fine sand (Younger Coversand I) overlying an almost horizontal stratified sand with thin loamy to very fine sandy layers (Older Coversand II). The stratified loamy sand in the lowest part of this area is mostly very thin or locally absent. This Older Coversand overlies material of niveo-fluvial and eolian origin, characterized among other by coarse sandy layers and fine gravel. At some depth in these deposits peaty and gyttja-like layers have been found (see also Zagwijn, 1961). The lowest parts often contain brook deposits less than $^1/_2$ m thick and overlying the coversands.

In this connection Oosting (1937) drew the attention to the occurrence of bog ore in several places in the Guelders Valley, at the same time reporting that some of the brooks had been frequently diverted and improved, others neglected. This process continued until a few years ago. Now nearly all the brooks have been canalized. The old brooks and the forms created by them have been omitted for practical reasons in the geomorphological map 1 : 50,000.

COVERSAND RIDGE AND COMPLEX OF COVERSAND RIDGES

During our mapping it appeared that nearly all coversand ridges were less than $1^1/_2$ metre higher than their immediate surroundings. In this difference in height are included the old arable land, which

Table I

Stratigraphic table

(Holocene)		
Late Glacial	Late Dryas	Younger Coversand II
	Allerød	Peat or Usselo soil
	Early Dryas	Younger Coversand I
	Bølling	Peat or loam-band
Pleniglacial	Upper Pleniglacial	Older Coversand II
		Niveo-fluvial and eolian material. Desert pavement
	Middle Pleniglacial	Loamy beds and peat. Niveo-fluvial and eolian deposits
	Lower Pleniglacial	
Early Glacial		
(Eemian)		

is sometimes as much as 80 centimetres thick and overlies these ridges and the river deposits in the adjoining lower parts, which are locally 50 centimetres thick. The former layer was laid by man and the latter was deposited, after the formation of the coversand relief. The ridges vary a good deal in length and width; often it is not possible to recognize a ridge, when we were probably dealing with a complex of coversand ridges. In such cases the width may be more than one kilometre. In several places the ridges resemble a parabola. This confirms the view which led to the reconstruction of the coversand ridges in the Guelders Valley by M a a r l e v e l d & v.d. S c h a n s (1961). O t t o (1959) showed that the slopes of the coversand ridges are slight. Of the area surveyed by him 80% appears to have slopes of less than 1°, while only 2% of the ridges had slopes of between 3° and 6°, and hardly any slope was steeper than 6°.

The ridges consist of more or less horizontal stratified moderately fine sand. The upper part of this stratification has disappeared by the action of roots, etc. Loamy layers are totally absent. P a p e (1963) describes a 1.80 m high coversand ridge near Veenendaal

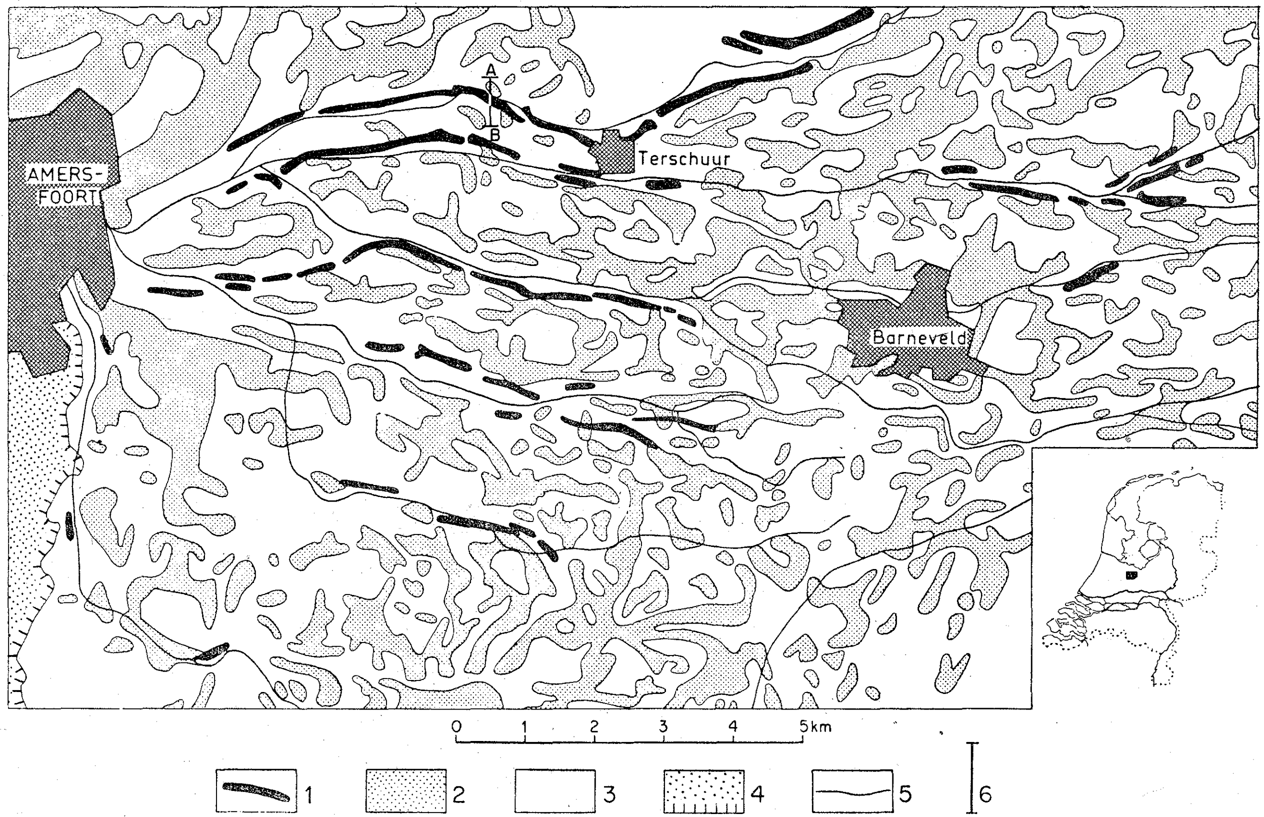

Fig. 1. Geomorphological map of a part of the Guelders Valley

1. valley coversand ridge; 2. coversand ridge; 3. flat coversand area; 4. high coversand region; 5. brook; 6. profile A—B (see fig. 2a)

(Guelders Valley). The lower part of the ridge consists of sand with thin loamy layers (Older Coversand II); the greater part, however, is Younger Coversand I from the Early Dryas Age. This sand is overlain by some decimetres of Younger Coversand II from the Late Dryas Age.

In general we can say that coversand ridges in this map (fig. 1) consist of Younger Coversand I and were, therefore, formed in Early Dryas times. Only in some places of rare occurrence, with ridges higher than $1^1/_2$ m, may the upper part contain Younger Coversand II. In that case the slopes of the ridges are steeper compared with ridges without coversand from Late Dryas times.

VALLEY COVERSAND RIDGE

In a summary of coversand forms in the Netherlands Maarleveld (1965) draws the attention to the fact that very narrow, but long ridges occur in many coversand areas in the east of the Netherlands, probably connected with brooks. During the geomorphological mapping of the Guelders Valley such ridges were also found in this area. The ridges are from 50 to 100 metres wide and often a few kilometres long. Of these ridges a much larger number is higher than $1^1/_2$ m compared with the other coversand ridges. Heights exceeding $2^1/_2$ m have never been found. From our observations in the field it appears that in this area the percentage of slopes of between 3° and 6° is considerably higher than with the other coversand ridges. These long ridges are associated with the lower parts of the coversand area and have the same orientation.

Figure 2b gives a transverse profile through such a ridge situated northwest of Terschuur. The ridge has a nucleus about one metre thick, consisting of stratified sand with thin loamy to fine sandy layers. The slopes of these layers vary from 5° to 15°, with a maximum of 25° to the north to north-northeast. Moderately fine sand, some decimetres thick, overlie this stratified coversand, which in its turn is overlain by arable land, locally 1 m thick.

From its situation in the field and from other phenomena it appears that the coversand with loamy layers belongs to the Older Coversand II and lies on top of niveo-fluvial and eolian material. Data from borings clearly reveal the fluvial character by the occurrence of channels filled in with coarse sand. Such a channel was found about 500 m south of the long ridge. Here the deepest peat-

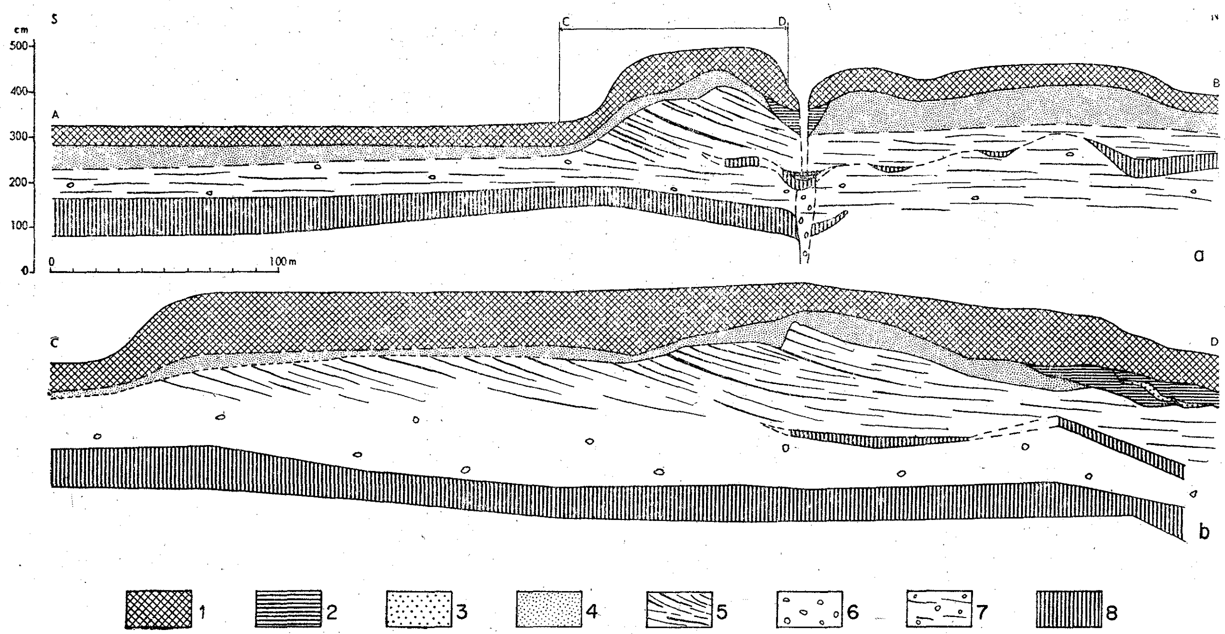

Fig. 2. Cross-section of a coversand area (A—B in fig. 1) b — Detail of fig. 2 (C—D)

1. old arable land and humus-soil profile; 2. brook deposits (sandy loam); 3. brook deposits (coarse sand); 4. Younger Coversand I; 5. Older Coversand II; 6. coarse sand and fine gravel; 7. niveo-fluvial and eolian material; 8. peat and gyttja

layer (fig. 2a) had disappeared almost entirely. The same phenomenon was observed near the present-day brook, just north of the long ridge. Here, too, the deepest peat-layer had disappeared and coarse sand was found in it. Both peat-layers in the profile (fig. 2a) were examined for their botanical content.

The lower contains 93% non-arboreal pollen and the upper one 90%. The tree-pollen is mainly from *Betula*, *Pinus* and *Salix*.

In an exposure occuring in a narrow long ridge west of Terschuur stratified sand with loamy and very fine sandy layers was found, also rather high in the ridge.

The coversand ridge north of the present-day brook (fig. 2a) consists of a moderately fine sand, in which loamy layers are lacking. This ridge of Younger Coversand I overlies sand with loamy layers, which is in agreement with v.d. H a m m e n (1951).

Coversand without loamy layers from part of the Guelders Valley was examined in the laboratory. The provisional results are:

(1) An increase was found in the selection of sand (peak in 105 to 210 microns) from the coversand ridges to the narrow long ridges. In the latter the fraction $>$ 420 microns is greater, the fraction $<$ 105 microns lower on an average.

(2) In the sand we found an increase in white and coloured grains in the same sequence. This investigation was made by means of the sello-tape method (M a a r l e v e l d, 1964b). Sand free or freed from iron and humus was taken from each fraction (two or three) and sprinkled on sello-tape. The tape was turned to remove the loose grains, and fastened to a slide. Then the black and white grains were counted per 5,000 particles for the fractions of 75 to 105 and 150 to 210 microns, and per 2500 particles for the fraction of 300 to 420 microns.

The above mentioned facts lead us to conceive the formation of the narrow long ridges as follows:

During part of the Pleniglacial, in which the deposits mentioned above accumulated, a considerable discharge of snow-meltwater was taking place. In view of the vast extension of niveo-fluvial deposits in the Guelders Valley, this must have taken place in many places. At the end of the Upper Pleniglacial some areas will probably have seen the greatest discharge. The greatly varying quantities suggest a braided system of channels. These relatively moist areas had a somewhat richer vegetation than other parts of the valley, as is for instance shown by the presence of *Salix*. Some erosion will have been caused by the strong discharge of water. At last the adjoining area developed another system of water-management and became dry. So it was possible for the wind to get hold of the sand. Favoured by strong winds the sand came to be transported. The transportation of sand stopped as soon as contact was made with undergrowth. Here, by continuous transportation, accumulation of material took place, and as the area of discharge may have been surrounded by luxuriant vegetation, this fact may have favoured the formation of the rather low long ridges.

The occurrence of thin loamy layers in the sand may be connected with the presence of much dust in the air at the time. Accumulation of this dust could take place during times of decreasing wind. It was possible for the loamy layers to survive new storms, probably by the relatively great absorption of moist, which may have prevented erosion. The northerly dip of the sandy and loamy layers (0° to 30°) is suggestive of north to north-northeasterly winds at the end of the Pleniglacial.

In the Early Dryas Age the quantity of dust in the air will have decreased strongly due to changing conditions, such as higher temperatures, a greater discharge of water into the rivers, higher sea level, winds changing to west-northwest (M a a r l e v e l d, 1964a), etc. In consequence mainly sand was accumulated by the wind. The above mentioned size-frequency distribution research shows a better selection of the sand in the narrow long ridges above the nucleus of sand with loamy layers than is found in the sand of the coversand ridges. The sand also contains more white and dark grains than the other coversand ridges. These two facts may indicate that during Early Dryas times the sand was blown away from channels which dried up at periodic intervals, and was transported only over short distances.

There is nothing to indicate that sand was blown out of the channels during Late Dryas times.

The fact that the long ridges are higher than the coversand ridges may be explained by the occurrence of a nucleus of Old Coversand, which may also account for the steeper slope as a result of the loamy layers being more resistant to erosion by wind. The occurrence of erosion is seen in fig. 2b, where loamy and sandy layers are discordantly overlain by Younger Coversand I. Due to the lack of considerable vegetation during Early and Late Dryas times the long ridges are not much higher than the coversand ridges.

During the Holocene the existing lower parts of the coversand area served as draining channels. A pollen-analytical examination of a humic layer in brook deposits (fig. 2a) shows: 54% *Alnus*, 25% *Quercus*, 10% *Tilia*, 2% *Ulmus*, 0.6% *Fagus*, etc. A Subboreal age of the layer is therefore very likely.

The genesis of the narrow long ridges has induced us to call them: Valley coversand ridges.

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