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A CONTRIBUTION TO THE STUDY OF DUNE DEPOSITS OF THE BELGIAN COASTAL PLAIN

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INTRODUCTION.

Since 1978 the dunes of the Belgian coastal plain are the subject of renewed research trying to unravel their geology and vegetational history. This research has led to new results (LEBBE & DE CEUNYNCK, 1980; DE CEUNYNCK & THOEN, 1981) concerning the dune area west of De Panne. The intention of the present article is to deal with some problems of the dune deposits regarding lithostratigraphy and chronology.

THE DUNE AREA WEST OF DE PANNE.

This area features a well developed secondary dune landscape with active parabolic dunes and a broad mostly uncovered wandering dune. These dunes are frequently designated by "Jonge Duinen" (= Younger Dunes; TAVERNIER & AMERIJCKX, 1970).

As already indicated earlier (MOORMAN, 1951), older dune sediments (1) are present below the northern zone of this dune area. The extension of these sediments has been studied by LEBBE & DE CEUNYNCK (1980) (fig. 1). Their age can be determined by means of carbon dating and archeological data. Carbon dating of a peaty layer containing Iron Age earthware yielded 1965 ±110 B.P. (Hv 9136) for the top and 2660 ±100 B.P. (Hv 9137) for the base (DE CEUNYNCK & THOEN, 1981). Archeological material was found ranging from Iron Age, Roman Period upto the beginning of the Early Middle Ages (2). These data suggest an age from about 2700 B.P. to 1100 B.P.. Dune formation possibly started earlier, since the earliest date, 2660 B.P., reflects only the beginning of a stabilisation phase of the dunes. Most probably different phases of eolian activity and dune stability have succeeded one another as is indicated by the various older dune surfaces, part of them formerly occupied by man. At this stage, however, it cannot yet be determined whether these phases are local or regional features and whether they are induced by human activity or not (cfr. DE CEUNYNCK & THOEN, 1981). Within the younger dune sediments humus-rich former land surfaces are frequently interstratified. Carbon dating of two of these surfaces yielded 1520 +75 A.D. for the youngest, and 1400 +75A.D. for the oldest surface (DEPUYDT, 1967). Renewed attempts to date some of those older surfaces failed; they all yielded modern dates, probably because of contamination with recent carbon. The oldest archaeological material found at the base of the younger dune sediments in this area dates from the 11th and 12th centuries (some finds of the 9th and 10th centuries reported by LOPPENS, 1932, are uncertain). This may indicate that the major formation of the "Younger Dunes" did not start much earlier in this region. Whether or not the different land surfaces found within these sediments represent regional eaolian phases or local disturbances remains a matter of doubt.

(1) The present author wishes to emphasize that the term "older dune sediments" is used here informally and that it does not refer to stratigraphical units such as Older Dune Deposits (ZAGWIJN & VAN STAALDUINEN, 1975) or to terms such as Older Dunes (TAVERNIER & AMERIJCKX, 1970).

(2) Archaeological time scale cfr. JELGERSMA *et al.*, 1970 or LEBBE & DE CEUNYNCK, 1980.

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As to vegetation history, preliminary results of the palynological analyses of different peaty and humic horizons undertaken by the present author reveal several successions from open herbaceous to shrub or even wood vegetation. However, as is pointed out earlier, it is not yet clear if these sequences should be interpretated as local or regional phenomena. In any case, the younger dune vegetation (1000-1800 A.D.) seems to be exclusively dominated by herbs and in a lesser degree by shrubs (with *Hippophae rhamnoïdes*, whereas trees being probably almost absent within the dune area itself. The vegetational sequences of the older dune sediments show that woody patches existed within the area, at least temporary. There is also no sign of the presence of Sea buckthorn (*Hippophae rhamnoïdes*) probably due to a less calcareous character of the dunes at that time. Human presence is revealed by pollen of ruderal plants and cereals although only in small percentages (DE CEUNYNCK & THOEN, 1981).

THE LITHOSTRATIGRAPHICAL POSITION OF DUNE DEPOSITS.

Two stratigraphical classifications incorporating the dune deposits have been widely used : one classification used during the soil mapping of the Belgian coastal plain, the other developed by the Geological Survey of the Netherlands. Within the first classification system, the various dune deposits and their characteristics have been described and mapped. An attempt was made to relate the different generations of dune ridges with the transgressive and regressive intervals of the Belgian coastal area (Fig. 2). However, this classification is not a lithostratigraphical subdivision in the sense of the principles and directions of the International Subcommission on Stratigraphic Classification (HEDBERG, 1976). This is not surprising since it was developed before. The classification used in the Netherlands (ZAGWIJN & VAN STAALDUINEN, 1975) on the contrary, is proposed as a lithostratigraphical subdivision (Fig. 3). Therefore, the present author initially intended to use this classification when interpretating the borings of Dr. L. LEBBE (LEBBE & DE CEUNYNCK, 1980). However, problems arose when an attempt was made to distinguish the deposits of the Calais and Dunkerque members as defined by ZAGWIJN & VAN STAALDUINEN (1975) because no distinct peat layer was present. Furthermore no chronological data were available to define the boundary, and the use of such data is not recommendable, as will be explained below. In our case the drawing of the boundary would have been totally arbitrary. Therefore an informal lithostratigraphical subdivision based on lithological homogeneity and lateral coherence of the units, both at the bed and member level was elaborated. Five members were distinguished (Fig. 4), some of them further divided into beds.

The subdivision into Calais and Dunkerque Members has recently been criticised om several grounds (3). One of them is the confusion that exists about the real meaning of the terms Calais and Dunkerque in stratigraphy. The main objection is that a lithostratigraphical subdivision which for identification has to rely heavily on radio-carbon datings of interstratified peat layers is questionable because it mixes chrono- and lithostratigraphy. Moreover there exist problems concerning the real meaning of those datings.

The present author believes that the remarks concerning the Calais-Dunkerque subdivision are essentially also valid for the Younger-Older Dune subdivision, on the following grounds :

1. Younger and Older Dune Deposits as lithostratigraphical units cannot always be lithologically differentiated in the field, especially when they occur on top of each other. One has to rely on absolute dating of interstratified peat or humic layers to establish where the boundary between both deposits should be drawn. In fact, this practice is comparable with the criticised practice through which the Dunkerque and Calais members are differentiated.

2. It is preferable not to use names with age implications for lithostratigraphical units. Neither should lithogenetic terms be used under these circumstances (HEDBERG, 1976).

The foregoing remarks are also valid concerning Younger and Older Beach Deposits, or, for that matter, "Middeloude duinzanden". Consequently if one accepts the arguments against the current Calais-Dunkerque subdivision and decides not to use this lithostratigraphical classification, one should also not adopt the terms Younger and Older Dune or Beach Deposits. This explains the choice made by LEBBE & DE CEUNYNCK (1980), when they worked out their informal local lithostratigraphy. However, one could argue that this practice leads to an increase of local lithostratigraphical classifications. BARCKHAUSEN and collaborators (1977) therefore proposes a new lithological system, also adopted by BAETEMAN, 1982 (4). Until now the application of this new system covers only tidal flat areas, marshes and coastal peatbogs. The inclusion of the barrier systems (coastal islands, beach and dune areas) would necessitate at least the introduction of two new facies units : dune and beach deposits. Whether this implies a major or a minor adaptation of the lithological system is not yet clear (BARCKHAUSEN *et al.*, 1977). It should also be stressed that the new system itself is not in accordance with the principles of lithostratigraphical classification. But it has the advantage not to lead to the undesirable intermixing of litho- and chronostratigraphy while its range of application can cover the coastal zone of the southern North Sea region.

The Younger-Older Dune terminology can, in the opinion of the present author, still be applied, but then in a strict chronological sense. For exemple to designate different phases of duneformation, as is done by JELGERSMA *et al.*, 1970.

(3) For an extensive review we refer to BARCKHAUSEN *et al.*, 1977, and BAETEMAN, 1981.

(4) For reasons of space limitation we refer to the authors mentioned under (3) for an explanation of the lithological system.

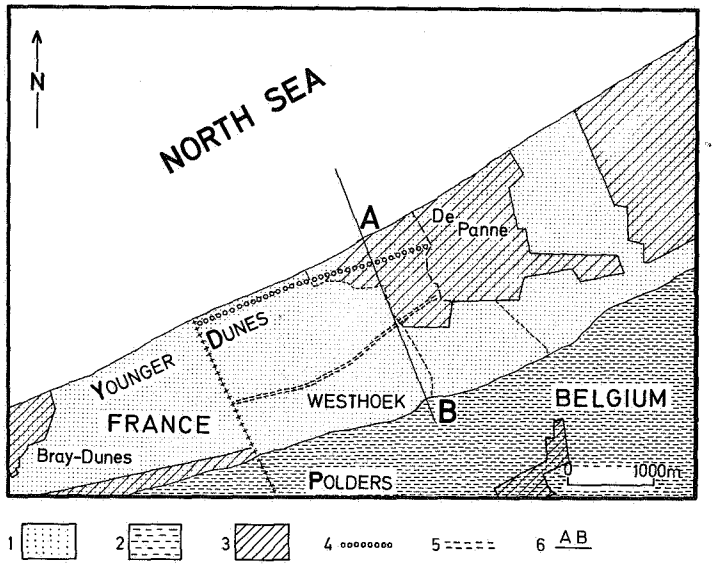

Fig.1. General outline map; 1: Younger Dunes; 2: polders; 3: urbanisation; 4: northern border of the older dune sediments; 5: southern border of the older dune sediments beneath the Younger Dunes; 6: section-line of fig.4.

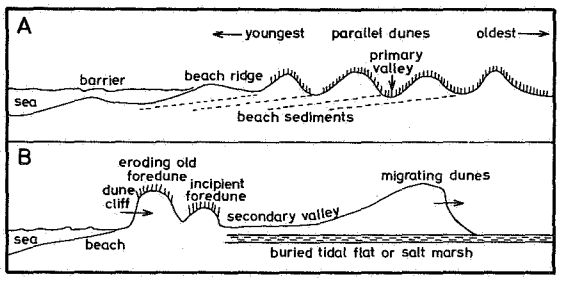

Fig.5.A. Primary dune system.
5.B. Secondary dune system.

STRATIGRAFIE	
BOVEN HOLOCEEN	Jonge duinzanden Sedimenten van de Duinkerke III-transgressie Jonge duinzanden Sedimenten van de Duinkerke II-transgressie Middeloude duinzanden Sedimenten van de Duinkerke I-transgressie
MIDDEN HOLOCEEN	Oppervlakteveen Oude duinzanden Sedimenten van de Assise van Kales
ONDER HOLOCEEN	Veen op grotere diepte

Fig.2. Stratigraphical subdivision used during Belgian soil mapping (MOORMAN, 1951; Soil Maps of Belgium DE HAAN 10W-BLANKENBERGE 10E-1953, HEIST 11W-1954, DE MOEREN 50W-1960, NIEUWPOORT 36W-1951)

LITHOSTRATIGRAPHY			AGE
WESTLAND FORMATION	DUNKIRK DEPOSITS	YOUNGER DUNE AND BEACH DEPOSITS	1200 A.D.
		OLDER DUNE AND BEACH DEPOSITS	1500 B.C.
	HOLLAND PEAT		2000 B.C.
	CALAIS DEPOSITS	(UNKNOWN)	
	ELBOW DEPOSITS		6000 B.C.

Fig.3. Lithostratigraphical subdivision of the Dutch coastal plain (ZAGWIJN & VAN STAALDUINEN, 1975).

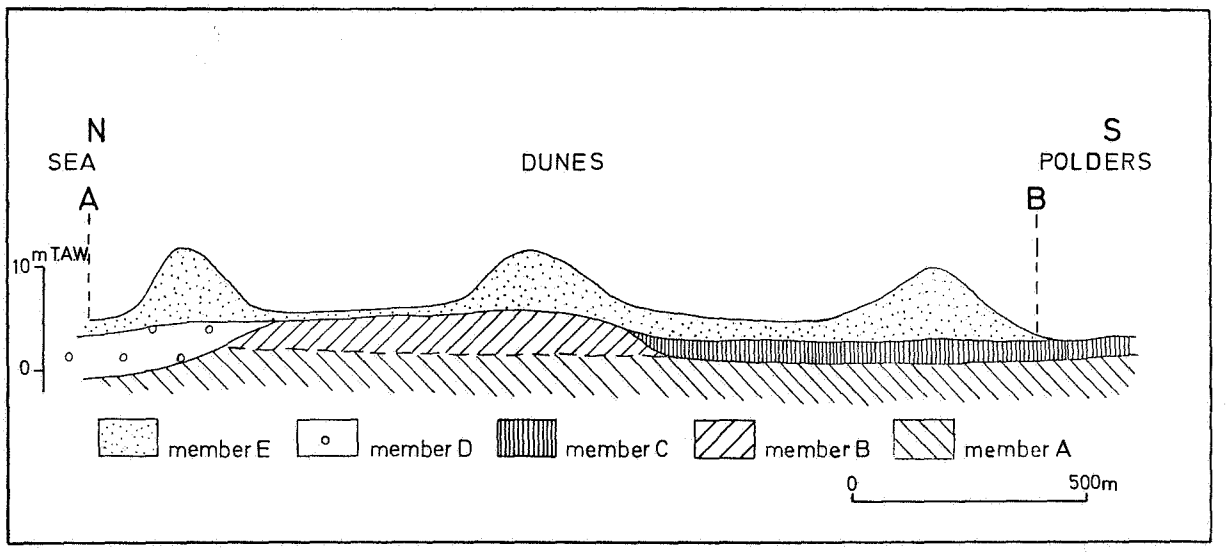

Fig. 4. Section through the dune area west of De Panne (position indicated on fig.1; LEBBE & DE CEUNYNCK, 1980). The whole of the sediments is attributed to the Westhoek formation. Within this formation following members are differentiated (informal subdivision):

MEMBER E: yellow sands with humic intercalations (younger dune sediments).
MEMBER D: yellow sands with large amounts of shells (beach sediments).
MEMBER C: clay, clayey sands (tidal - lagoonal sediments).
MEMBER B: gray sands with peaty layers (older dune sediments).
MEMBER A: gray sands with thin clayey intercalations or shells (undifferentiated marine sediments).

THE AGE DETERMINATION OF PHASES OF DUNE FORMATION.

In the literature one distinguishes primary and secundary dunelandscapes according to their genetic history (Fig. 5). Parallel dunes, stabilised where they were originally formed, are typical in the first case. In the second case the landscape consists of sequences of moving ridges and of slacks mostly bown out to groundwater level (RANWELL, 1972).

Age determination of phases of duneformation can be problematic especially when the dune deposits are formed in a secondary dune landscape as it is the case with the so-called "Younger Dunes" west of De Panne. The elements that can then lead to a chronological subdivision of phases of duneformation and stability are the buried former land surfaces (humic soils or peaty layers) and the geomorphology of the dunes. First of all it should be stressed that the former land surfaces within the dune deposits should be interpretated as **diachronous** levels. Moving dunes such as parabolic dunes are migrating at rates of several meters a year, progressively burying soil and vegetation cover and also habitation sites. In fact, the same dune can override different sites in the course of a few centuries. The dates of such events may be recorded in historical accounts, or deduced from the ceramics associated with the buried sites. It is clear that these dates do not indicate different eolian phases, but only brief moments of one and the same eolian phase. The use of carbon datings of buried soils to distinguish phases of duneformation can equaly lead to aberrant results.

Regarding geomorphology, a phase of duneformation in a secondary dune system starts with a (new) foredune growing on the backshore, followed by the subsequent eroding and landward movement of parabolic or other dunes and ends when these dunes are more or less stabilised. In the meantime, a new foredune may come into existence, erode, move landward, etc... This way different series of parabolic dunes are usually formed. How many series of parabolic dunes have succeeded each other in the area west of De Panne is not yet clear.

The direction of displacement of the parabolic dunes in this area differs little from the general direction of the coastline. This makes it much more difficult to identify separate phases on the basis of series of parabolic dunes as can be done in the coastal dunes near Haarlem (JELGERSMA *et al.*, 1970), where the coastline direction is more perpendicular to the axis of movement of the parabolic dunes.

CONCLUSIONS.

The assignment of particular dune deposits to a lithostratigraphic unit on chronological ground should be avoided. Furthermore names incorporating lithogenetic terms or age indications should equally be avoided.

With respect to the distinction of phases of duneformation, one should reconstruct the general morfogenetic history of the dunes (primary or secondary dune landscape or complex origin), before phases of duneformation are differentiated. All available data on the age of eolian sand movements should be carefully checked for their real significance.

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