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Quaternary Marine Formations of Belgium

A brief review of the at present known quaternary marine deposits and their extension is given here. Many problems with regard to age and stratigraphical position remain unsolved. This is due to the fact that outcrops of these formations are scarce and also because paleontological data are often lacking. Furthermore, lithological differences between the formations may be so small that the stratigraphical succession may not be readily derived from borings.

1. PLEISTOCENE

Lower Pleistocene

According to R. Tavernier (1954), the Lower Pleistocene consists of deposits which show no direct affinity with the present fluvial system. At that time existed in the northern part of Belgium and in the Netherlands, a sedimentation basin of fluvial and marine deposits. The onset of this basin dates back from the Pliocene so that tertiary and quaternary deposits are found there in a rather continuous sequence. As a result of this, the Pliocene-Pleistocene boundary is not clear and differs greatly according to various authors. The most questionable formation is formed by the so-called Merksemian (Cochels et Van Den Broeck, 1877). It consists of two members: Kruisschans Sands (littoral) and Merksem sands (marine). These deposits much resemble the underlying Sands of Kallo (Scaldisian = Upper Pliocene) from which they are separated by a line of discordance along which the transgression took place. At this level a gravel deposit (De Heinzelin, 1956) containing remnants of mammals is often found in places (America Dock) while in others, littoral deposits occur which are then referred to as sands of Austruweel (De Heinzelin, 1956). This forms the level with *Melampus pyramidalis*. Within these deposits one may see the appearance of *Tellina (Macoma) praetenuis*, *Mya arenaria*, *Cardium parkinsoni*, *Corbulomya complanata*, *Lacuna suboperta*, *Littorina littorea*, *Spisula deaurata*. This fauna points to a warming up of the climate which is also indicated by the foraminifera association. Lateral extension of the Merksemian transgression towards the east is given by the Poederlian also

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of marine origin. Correlation between both formations is based on the presence of *Cardium parkinsoni*, *Corbulomya complanata* and *Mya arenaria* as well as on the existing geometrical relationship. The Poederlian overlies a special facies of the Diestian (Kasterlian). The former formation is overlaid by the Sands of Mol of continental origin (M. Gulinck, 1962). More eastwards the Poederlian disappears while westwards they continue to be found underneath the *Sands of Brasschaat* (M. Gulinck, 1962) which are a lateral facies of the Sands of Mol. The basis of the *Sands of Brasschaat* shows a slightly coarser texture and for this reason are designated separately as *Sands of Merksplas*. The latter sands rest immediately

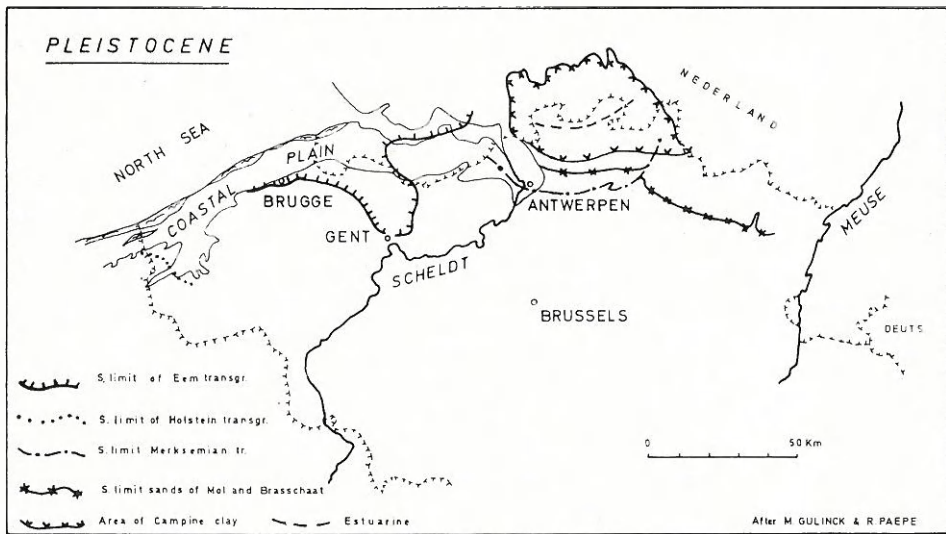


FIG. 1.

either on the Merksesian or on the Scaldisian. They are the last marine formation to be noted in the Lower Pleistocene, and may probably be correlated with the Icenian of Breda (The Netherlands).

The horizontal extension of the above described deposits is shown on the map (fig. 1). On the wedge formed by the Merksesian-Poederlian between Antwerp and Kasterlee, follows towards the north, the *Sands of Brasschaat* and finally the Campine Clay. Actually the latter formation is of equal age of the Brasschaat Sands and Sands of Mol. It differs only by its complexity as to composition: sands, silts and clay with sporadically lignite characterizing the continentality of the deposit. To the east, these clays also go over into the Sands of Mol.

Due to its stratigraphical position and floristical content (R. Vanhoorne, E. L. Dricot), the Campine sand can be dated as of Tiglian in age. Within the bulk of these clays and located nearby the Dutch border, an estuarine zone is found which is characterized by the presence of *Littorina sp.* (oral communication by M. Gulinck).

Middle Pleistocene

During the Middle Pleistocene the present fluvial system was already established. Deposits of this period refer mainly to the terraces (R. Tavernier, 1954).

Marine Middle Pleistocene deposits are scarcely developed and found only in the very southwestern part of Belgium, just outside the present coastal plain. They form a shell bank, essentially composed of *Cardium edule*, of 60 cm. thickness at small depth beneath the surface. The topographical record of the sites varies between 10 m and 0 m. Ostend Ordnance Datum. The poor faunistic assemblage points more to Holsteinian (Hoxnian) rather than Eemian in age (R. Tavernier and J. De Heinzelin, 1965). This assumption may be supported by the fact that the peat of Lo, occurring beneath this deposit is found to be Holsteinian (R. Vanhoorne, 1963) in age too.

Upper Pleistocene

After a period of maximum erosion, filling up of the present fluvial system by marine, estuarine and fluvial sediments followed during the Upper Pleistocene. Finally an important loess-cover mantles the whole.

The western part of Belgium, was largely affected by the Eemian transgression. It occupied the greatest part of the present coastal plain while north of Ghent, it pierced deeply into the inland along the so-called Flemish-valley (R. Tavernier, 1946). Sediments of this marine invasion were designated as "marine sands with *Corbicula fluminalis* of the Ostend stratum". The marine character of these sediments diminishes land inwards. However, *Corbicula fluminalis* is found in many places together with *Tapes senescens* var. *eemiensis* (R. Paepe, 1965) at a considerable distance from the present coastline. This permitted R. Paepe (1965) to trace the extension of the Eemian as a marine estuarine deposit, as far East as Lochristi, east of Ghent. The same author correlated on this basis, the sands of the stratum of Ostend with the "*Tapes Senescens* Sands" of Northern Germany.

The Eemian deposits generally start with outspoken gravels and coarse sands, 0.50 m. to 1.50 m. in thickness. *T. senescens* occurs rather abundantly. Upwards the coarse material is gradually replaced by finer sands within which shell bearing levels, containing *T. senescens*, may still occur. In the very upper part of these sands, clayey and vegetations horizons happen to appear also, thus pointing to a more estuarine sedimentation. Together with the two already mentioned Guide fossils, *Cardium edule*, *Hydrobia ulvae*, *Macoma balthica*, *Mactra*, *Nassa reticulata*, *Littorina littorea*, *Natica* and *Mytilus* are found.

The upper limit of this formation is difficult to establish since the overlying sands of the Calais stratum, are similar in outlook. It may be assumed that the level fluctuates between -6 m. and -8 m. Ostend Ordnance Datum. The lower boundary can usually, easily be determined since the Eemian layers rest, most often, on a tertiary substratum. But here, a larger variation with regard to its topographical position may be noticed: -10 m. to -17 m. Ostend Ordnance Datum.

2. HOLOCENE

After the Eemian transgression, a considerable drop in the sea-level is noticed again during the Last Glacial (Weichselian) period. It lasted until the Holocene before the first traces of new marine invasions are observed again in the present Belgian coastal plain. After the formation of the "peat at great depth" during the Boreal, sea-level rise starts at the beginning of the Atlanticum (+ 6500 y.B.P.). This is the so-called *Flandrian transgression* which coincides with the enlargement of the strait of Dover. The effect of this transgression results in the deposition of the *Stratum of Calais* (6500-4000 y.B.P.). These deposits, which may attain up to 10 m. in thickness, are generally composed of fine sands, but clay lenses may appear in the 1 or 2 m. topzone. Peaty layers, however point to the

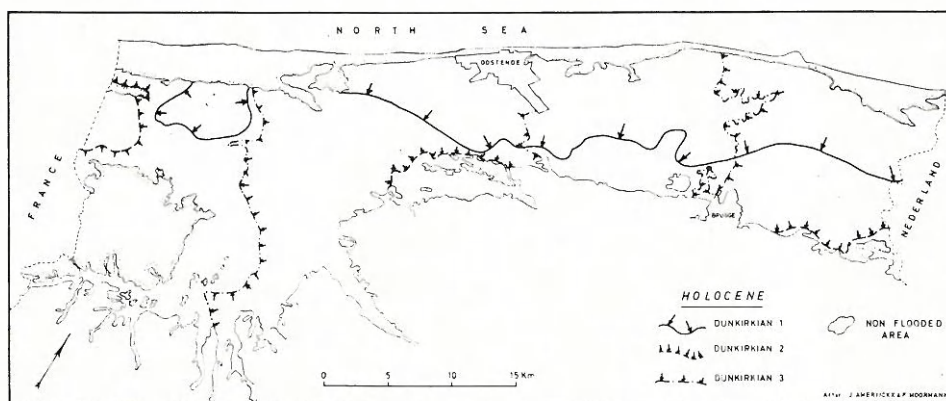


FIG. 2.

fact that the sea-level rise was not a continuous one. A wadden landscape is most probably to have existed.

About 4000 y.B.P. the so-called old dunes build up a coastal bar of which relicts are still found today, sometimes at more than 5 km inland. Within the thus protected coastal plain, the landscape changes again and instead of the atlantic wadden, peat development starts again. This "surface peat" or "Holland peat" never surpasses 1 m. and continues to develop throughout the Sub-boreal (4000 y.B.P. - 2200 y.B.P.).

The Sub-atlanticum then is characterized by a renewal of the sea-invasions in the coastal plain which are generally referred to as Dunkirkian transgression which start at about 200 y.B.C. It must be noticed that the Pre-roman transgression is only found in a small area along the Belgian-French border. On the contrary the Dunkirkian invasions influenced greatly the further evolution of the coastal plain. Three main phases are generally reported and it was also found that the area of main activity was not always the same (fig. 2).

The 1st Dunkirkian transgression (2nd Cent. B.C. - 1st Cent. A.D.) struck the old dune bar in the middle and western end of the Belgian coast. Sediments may be found up to 7 km. away from the present coast line. These deposits show

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a typical microstratification of sands and clays and resemble to the sediments of the preroman transgression of the Netherlands. Nowhere they are found to be outcropping but when present, they are reached at about 1 m. below the surface. Followed the roman regression (1st Cent. - 4th Cent. A.D.) as is proved by the presence of roman tools lying on the Dunkirkian 1 surface, which may partly be covered with peat as well. During this regression, a subrecent coastal (dune) bar formed.

Of greater importance for the Belgian coast was the 2nd Dunkirkian transgression (4th Cent. - 8th Cent. A.D.), which may also be called "Early mediaeval transgression". According to archeological findings, this invasion may have started at about 300 y.A.D. It invaded not only the peaty plain but even part of the pleistocene borderland was covered by it, up to the level of 4.5 m. in the N.E. and 5 m. in the S.W. As a result, both preroman and 1st dunkirkian deposits were entirely covered. Only a few islands such as the old and subrecent dunes, pleistocene hills and hills build up by Sphagnum peat, remained emerged. The effect of the tidal waves to which the flooded plain was submitted, resulted in a selectional sedimentation. In the tidal gullies, coarse thick sand bodies are laid down while between the gullies, where water movement was slower and even came periodically to a standstill, clay was deposited. Thus thickness of the deposits varies from a few centimetres up to several meters.

The Carolingian regression (8th - 11th Century A.D.) took place hereafter and lasted until the year 1000. First traces of settlement in the polders dates back from this period. Actually the coastal plain was then again protected by a newly built dune bar which corresponds with the present one.

The 3rd Dunkirkian transgression must be situated in the first half of the 11th Century. Even when its extension was more limited than the previous one, its effect was more catastrophical due to existing important settlement at that time. Two main areas of invasion are reported: the Yser estuaria in the West and the Zwin estuaria on the Belgian-Dutch border. From the latter, a second, even more important phase is located at about 1130 which gave later rise to Bruges (Damme) as a harbour in Mediaeval times. The relative small area of inundation mapped for sediments of this period can be explained by the intervention of man who had started broadscale dike-building.

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RIASSUNTO

L'A. presenta una sintesi delle attuali conoscenze sulle trasgressioni marine pleistoceniche ed oloceniche in Belgio. Le trasgressioni del Pleistocene inferiore sono documentate nella regione nord-orientale, quelle del Pleistocene medio in quella sud-occidentale, e quelle del Pleistocene superiore in quella nord-occidentale. Le tracce delle trasgressioni marine oloceniche sono limitate all'attuale pianura costiera.