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A deer (*Cervus rhenanus*) from the Early Pliocene of Langenboom, Noord-Brabant (The Netherlands)

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A molar of a deer was recovered *in situ* by a scuba diver from a fossil site near Langenboom (The Netherlands). The molar, here identified as *Cervus rhenanus* Dubois, 1904, stems from the Oosterhout Formation, from an interval that is dated to the middle to late Zanclean (Early Pliocene), considerably extending the stratigraphic range of the species. The recovery of this molar suggests fossil terrestrial mammals found *ex-situ* from the Langenboom may originate from these Early Pliocene layers as well.

KEY WORDS: *Cervus rhenanus*, Pliocene, Langenboom.

Introduction

In recent years, the artificial lake "de Kuilen" near Langenboom (Noord Brabant, The Netherlands) developed into one of the most important fossil sites for Miocene and Pliocene fossils in The Netherlands. Fossils are numerous and are generally of marine origin. Incidentally, the remains of terrestrial mammals are reported. Ahrens (2003, 2004) indicates the presence of *Anancus arvernensis* (mastodont), *Dicerorhinus (= Stephanorhinus) etruscus* (rhinoceros), *Sus strozzi* (wild boar), *Ursus* cf. *etruscus* (bear), *Cervus rhenanus* (deer) and *Equus* sp. (horse). All these fossils were found *ex-situ* and were tentatively attributed to the 'Early Pleistocene' (Gelasian) by earlier authors that use the Pliocene-Pleistocene boundary following Gibbard *et al.* (2005). A single molar of a deer was recovered by a diver in 2003 in the walls of the lake. The in-situ recovery sheds light on the possible stratigraphical origin of the other, *ex-situ,* terrestrial mammals from Langenboom. In this paper we describe and discuss the molar.

Site description and stratigraphy

In "de Kuilen" glauconitic sands are mined from c. 7 to 20 m depth using a suction dredger. The compact sediments are loosened with the aid of a water jet attached to the suction inlet of a dredger. This regularly leads to partial collapse of sand walls in the lake. The sands are subsequently sucked up from the lake bottom and deposited in depots at the lake side from where collectors have recovered the vast quantities of fossils. The collapsing sediments leave steep vertical walls with outcrops that are readily inspected by scuba divers. The molar described here was found at a depth of 14 metres below the surface in a layer of fine sands with dispersed mollusks. This was one metre above an easily recognizable fossiliferous shell bed that is generally found at 15 metres throughout the lake.

Currently, stratigraphic investigations of the subaquous section are under way. Claims made here concerning the age and depositional environment are inferred from lithological observations (T.J. Bor, pers. comm.) and provenance of specific dinoflagellate cysts (D.K. Munsterman and H. Brinkhuis, pers. comm.) and molluscs (F.P. Wesselingh, pers. comm.). These claims result from the study of sediment samples, collected *in-situ* by scuba divers. The sands at 14 metres below the water surface are attributed to the Oosterhout Formation (Ebbing & de Lang, 2003) and are of middle to late Zanclean age. Based on lithology and molluscs, the depositional setting during deposition of the 14 m layer are interpreted as a sand bottom in full marine conditions in water depths of at least 15-20 m.

Material and methods

The molar is held in the collections of the Oertijdmuseum "de Groene Poort" (Boxtel, The Netherlands) under number MAB 4275. Measurements were taken with a vernier caliper. Nomenclature and measurements given are in concordance with Heintz (1970) (see also figure 1).

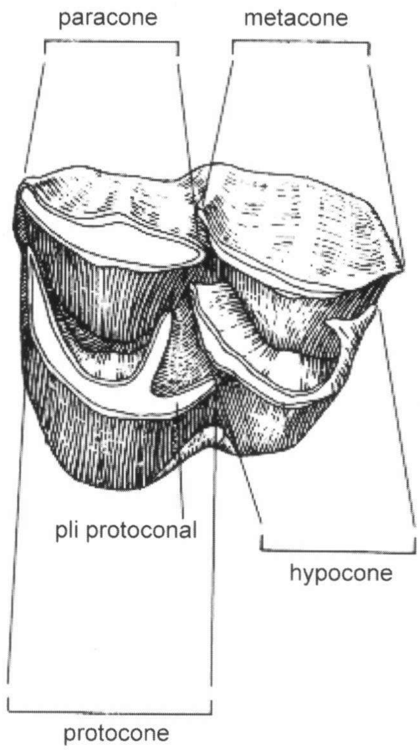

Figure 1. Morphological terminology of cervid molar, adopted from Heintz (1970).

Epoch and Stage definitions follow Gradstein *et al.* (2004).

Description and identification

The upper molar dexter from the cervid is pictured in figure 2. The anterior-posterior diameter (DAP) measures 16.3 mm and the transverse diameter (DT) measures 18.1 mm. The molar is brachydont. A wearing facet is only present on the anterior side and lacking on the posterior side and furthermore the lingual-buccal diameter of the protocone/paracone (17.3 mm) exceeds the lingual-buccal diameter of the hypocone/metacone (16.1 mm) indicating that it concerns an M^3. In the $M^{1,2}$ these diameters are more or less of similar size. The presence of a pli protoconal is a distinctive character for Villafranchian cervids (Heintz, 1970). It reduces over time and lacks in modern species. The molar agrees in most aspects with Villafranchian cervids with the exception of a very tiny cingulum on the anterior side. As the occlusal surface is only little worn, it concerns the molar of a young adult.

Because the morphology of Villafranchian cervids is more or less similar, we resort to size for specific attribution. In table 1, the size range for several Villafranchian cervids is denoted.

The Langenboom molar is larger than those of adult *Cervus cusanus* and slightly larger than *Croizetoceros ramosus*. It is smaller than *Eucladoceros senezensis*, *E. tegulensis* (both assigned to *E. ctenoides* by de Vos *et al.*, 1995), *Cervus perrieri* and *Arvernoceros ardei*.

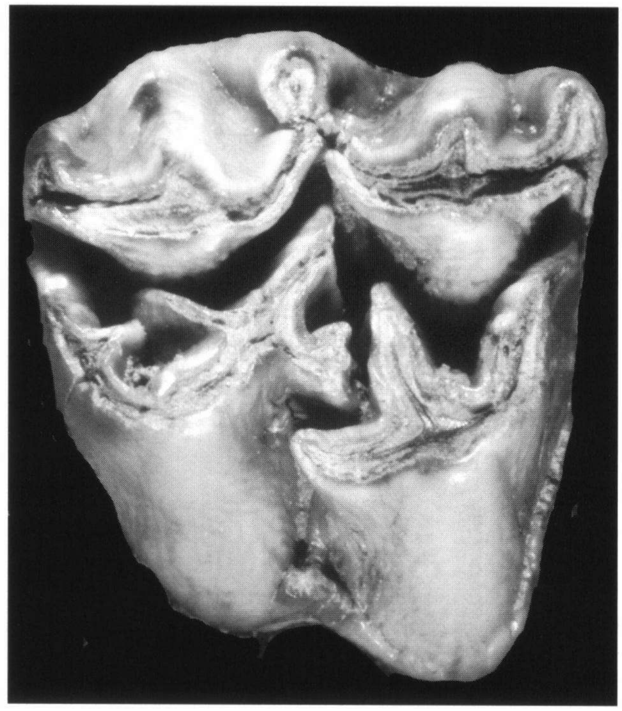

Figure 2. *Cervus rhenanus* from Langenboom (coll. Oertijdmuseum, Boxtel). Third upper molar dexter (M^3). Length 16.3 mm.

The molar fits the size range given for *Cervus perolensis*, *C. philisi*, *C. pardinensis* and *C. rhenanus*. *Cervus philisi* Schaub, 1941, and *C. perolensis* Bout & Azzaroli, 1952, are considered as junior synonyms of *C. rhenanus* Dubois, 1904 (de Vos *et al.*, 1995). These authors considered *C. pardinensis* Croizet & Jobert, 1828, a valid species that is differentiated from *C. rhenanus* by large cingula on the upper molars. As noted above, this feature is absent in the molar from Langenboom, that is therefore attributed to *Cervus rhenanus* Dubois, 1904.

Discussion

Heintz (1970) documents the stratigraphic distribution of *Cervus philisi* (= *C. rhenanus*) to range from about 2.6 Ma to less than 1.9 Ma. Sardella *et al.* (1998) report the presence of *Pseudodama lyra* (= *C. rhenanus sensu* de Vos *et al.* (1995)) from 3.3 Ma to about 1.8 Ma. This limits the known range for *C. rhenanus* to the Late Pliocene (Piacenzian-Gelasian). Though a precise minimum age can not be given, the Langenboom molar extends the known range of the species into the Early Pliocene (middle to late Zanclean).

Cervus rhenanus is part of faunas occupying continental ecosystems that ranged from western to eastern Europe. Other *ex-situ* terrestrial mammals from Langenboom, such as *Anancus arvernensis*, *Dicerorhinus etruscus* and *Sus strozzi* were likely to be part of the same faunas. However, *Sus strozzi* has never been mentioned from deposits predating 2.2 Ma (Gliozzi *et al.*, 1997). Though this find can not provide certainty concerning the stratigraphical origin of the *ex-situ* terrestrial mammals from Langenboom, the possibility exists that the stratigraphic range of the latter species may be extendable downward into the Early Pliocene. A Gelasian age for the terrestrial mammals from Langenboom (Ahrens, 2004) is too young for at least *C. rhenanus*, and possibly for the other terrestrial mammals as well.

The molar was found in marine sediments deposited in a sea of at least 15-20 metres deep which may seem surprising. However, the presence of (large amounts of) terrestrial mammals in marine deposits is frequent in the Dutch Neogene deposits. Peters *et al.* (2004) reported the presence of green sands cemented to *Anancus* molars dredged from Neogene deposits near Liessel, Brabant (The Netherlands), indicating they originated from marine sediments. Peters (2004) indicated green sands present in the spinal canal of vertebrae of a small deer (probably *Cervus rhenanus*) and a rhinoceros from the same site. Pleistocene mammal remains are also commonly found on the bottom of the modern North Sea. Whether the molar from Langenboom is reworked from older deposits or resulted from a carcass floating out to sea remains uncertain, but the beautiful preservation of the molar might support the latter option.

Acknowledgements

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	N		DAP M³		N		DT M³	
		min	mean	max		min	mean	max
Cervus from Langenboom	1		16.3				18.1	
C. cusanus (Etouaires)[1]	9	11.5	12.3	13.5	9	13	13.8	14.5
Croizetoceros ramosus (St. Vallier)[2]	28	14	15.0	16	28	15.5	16.2	18
Cervus perolensis (various localities)[3]	7	15.5	17.4	18.5	7	17	17.6	18
C. philisi (St. Vallier)[3]	26	15.5	17.0	19	26	16.5	17.5	19.5
C. pardinensis (Vialette)[3]	34	14.5	n.a.	19.5	36	16.5	21.5	23
C. rhenanus (Tegelen)[4]	16	16	17.3	18	15	16	17.9	19.5
Eucladoceros senezensis (Seneze)[5]	32	23	25.4	28.5	32	21	24.1	26.5
E. tegulensis (Tegelen)[6]	6	23.5	26,0	28	6	24	25.6	26.5
C. perrieri (Etouaires)[7]	24	21	23.4	26	22	20	22.5	24
Arvernoceros ardei (Etouaires)[8]	17	20	21.9	24.5	17	21.5	23.3	25.5

Table 1. Size variation of several species of Villafranchian cervids. DAP: anterior-posterior diameter; DT: transverse diameter. Data from : [1]Heintz, 1970, table 3; [2]Heintz, 1970, table 11; [3]Heintz, 1970, table 45; [4]Heintz, 1970, table 32; [5]Heintz, 1970, table 81; [6]Spaan, 1992, table 12; [7]Heintz, 1970, table 111; [8]Heintz, 1970, table 118.