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## Some remarkable Weichselian elephant remains

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Three dental fragments and an incomplete first caudal vertebra are shortly described. They were collected from an artificially formed lake, formed by a suction-dredger, from a depth of some 20 m, in sand and gravel deposits of the Weichselian Kreftenheye Formation. One molar fragment is identified as *Elephas antiquus*; its age is 32.500 yBP, a remarkably late dating. The caudal vertebra may also belong to the same species.

Keywords: *Elephas antiquus*, *Mammuthus primigenius*, eastern Netherlands, 14C dating, Pleistocene

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### INTRODUCTION

During the past three years an exploitation of sand and gravel by suction-dredging has been in operation directed by the firm of Reko at a locality known as the Hooge Broek, directly to the north of Raalte (province of Overijssel) in the Netherlands (Fig. 1). The material, used for the making of concrete, is sucked up from a depth of maximally 40 m below the local groundwater-table, in a field of roughly 70 ha in size. At a depth of some 20 m below the surface a layer, or a series of lenses, consisting of tough grey-blue fluvial clay has been encountered between the sands and gravels of the Kreftenheye Formation, the locally occurring Upper Pleistocene lithostratigraphical unit which has its upper limit at about 5 m below the surface. This clay contains numerous cobbles and stones, plant remains and fossil animal bones.

The stones indicate an almost exclusive provenance from the Rhine region: fragments of basalt, Devonian sandstones with brachiopods such as *Spirifer* (from the Eiffel area), jasper

from the Lahn area, greywacke from the Siebengebirge, etc. Macroscopic plant remains are still being studied and contain many pieces of different kinds of wood and fructifications (such as horse chestnuts and pine and fir-cones), but also pieces of heather and twigs of diverse herbs. Included in the clay one may also encounter pieces of yellowish brown loam and dark brown peat. The loam is frequently accompanied by weathered complete and incomplete marine shells of Pliocene and Miocene age, such as *Anadara diluvii* (LAMARCK, 1805), *Glycymeris* sp., *Laevicardium decorticatum* (WOOD, 1849) and *Pygocardium rustica* (SOWERBY, 1818). These Tertiary molluscs also occur in the deposits of a mixed-moraine at Miste near Winterswijk (province of Gelderland), not very far from the Raalte locality in a straight line (Faber 1933, pp. 142, 358). We are much indebted to dr R.G. Moolenbeek (Zoological Museum, University of Amsterdam) for their identification. Their occurrence at the Hooge Broek locality is

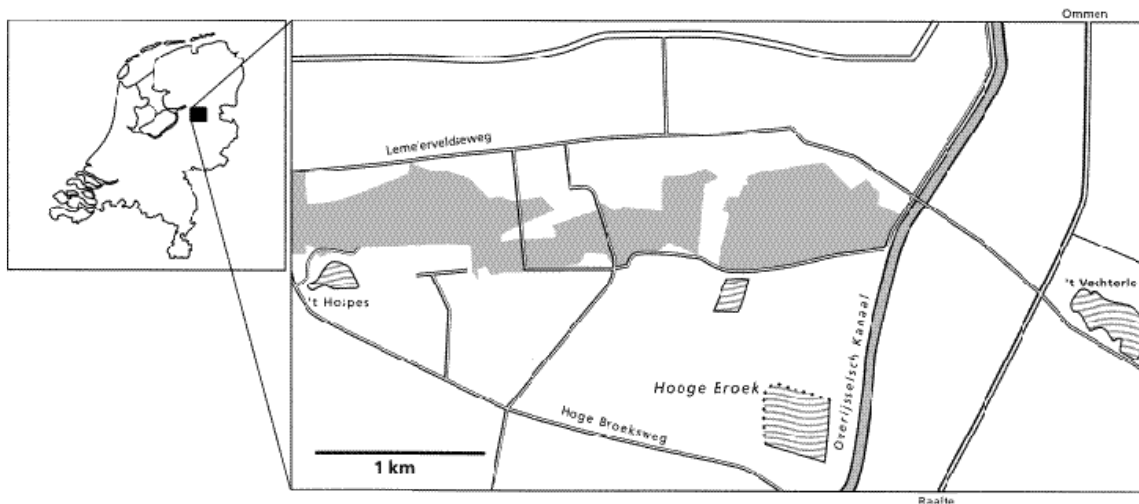


Figure 1 The Hooge Broek locality (in the centre) next to the Overijsselsch Kanaal to the North of Raalte. As the lake made by the dredger is continually changing in outline, two of its sides are dotted.

quite in accordance with the observation made above on the presence of lithic material carried there by the Pleistocene Rhine. The many flint cobbles and pebbles also included may well have been derived from that same mixed-moraine, having a Cretaceous origin from somewhere in northern Germany or the Baltic and brought hither by the earlier Saalian glacier; but accidental transport by the Pleistocene Meuse cannot entirely be ruled out. The Miste mixed-moraine consists of local Tertiary material in combination with Saalian boulderclay and other pre-Saalian surface material.

The grey-blue fluvial clay of the Hooge Broek regularly contains a large amount of fossil vertebrate bones and bone fragments. Up till now about twenty different animal species have been recognized with certainty. Most frequent are the remains of red deer; reindeer and giant deer also occur rather often, while fallow deer and elk (*Alces*) are not infrequent either. The aurochs is common as well, together with a large, heavy, and a more slender type of horse; the bison and the wild boar occur too, while some rarer remains have been collected of musk oxen, roe deer, woolly rhinoceros and carnivores such as the cave bear, the cave lion, the cave

hyaena and the wolf. Elephant bones and fragments of molars and tusks can sometimes be found, and a few of these form the reason for the present short communication.

#### DESCRIPTION AND IDENTIFICATION

Three dental fragments (Fig. 2) and an incomplete vertebra (Fig. 3), collected in 1999 at the Hooge Broek locality and inscribed as numbers HB 65, HB 66, HB 67 and HB 123 in the Brewer collection, shall be shortly described.

HB 65 (Fig. 2 a,b) is an anterior part of a first lower molar of the right side still containing seven and a half enamel grinding plates within a total occlusal distance of 97 millimetres. The width of the intralamellar cementum on the grinding surface varies from 7 to 4 mm, while the horizontal thickness of each enamel plate shows a variation of 1.8 to 2.5 mm. The greatest width of the molar, in a vestibulo-lingual direction, somewhere between the second and third enamel plate from in front, is 57 mm. The maximum height of the molar fragment, at the sixth enamel plate from in front, is 108 mm. According to the revised Munsell colour scale by Oyama *et al.* (1967), the colour and hue of the dentine and cementum on the sides

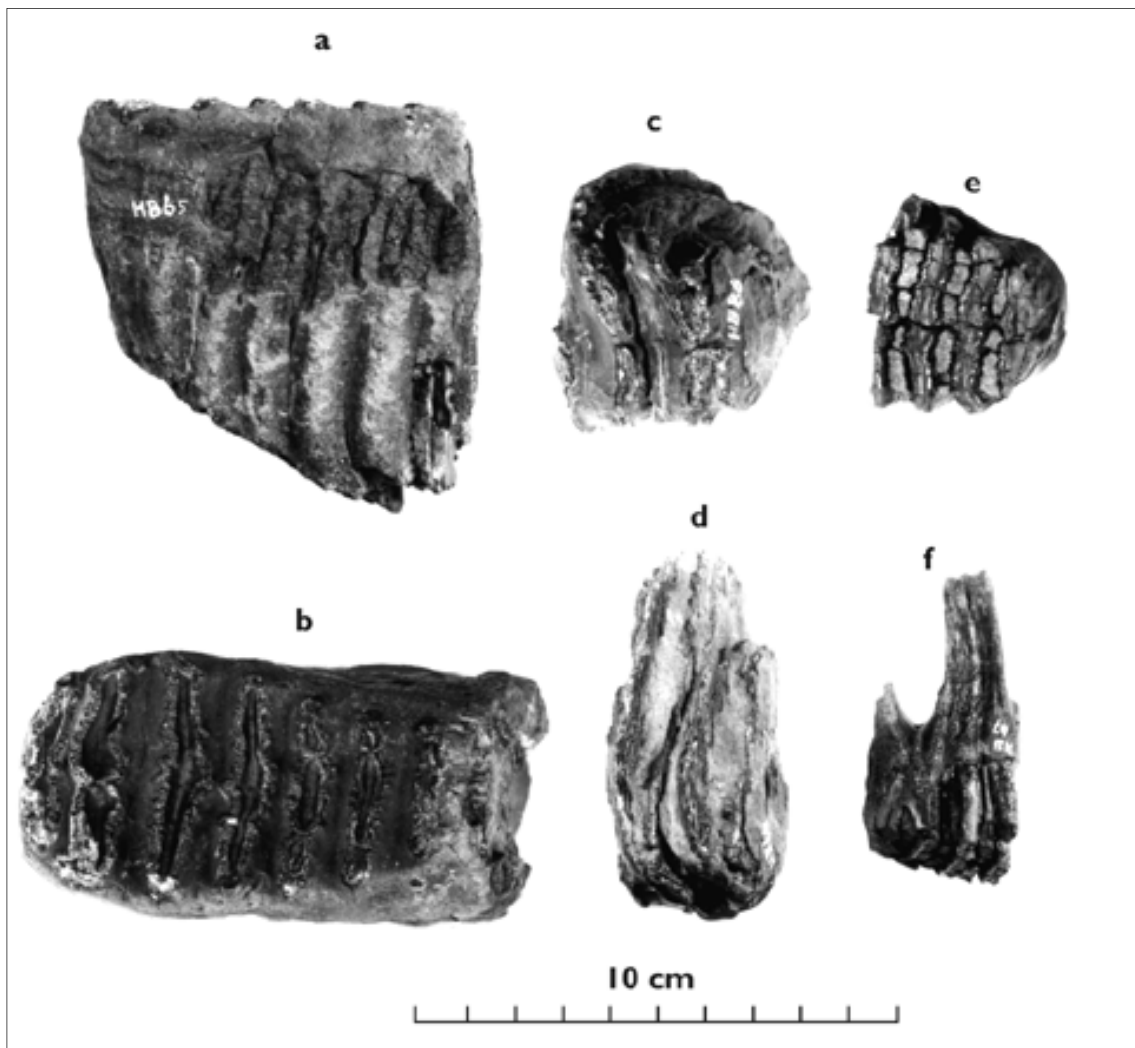


Figure 2 Anterior part of right first lower molar HB 65: **a** lingual aspect, **b** occlusal aspect; small fragments of upper (?) molars of the right side HB 66 (**c,d**) and HB 67 (**e,f**), **c** and **e** are occlusal aspects, **d** and **f** are lingual views.

of the tooth are 5YR 3/3 (dark reddish brown), and those of the enamel on the occlusal surface 10BG 3/1 (dark blueish grey).

The configuration and form of the grinding surface (with indications of a beginning central lozenge or diamond-like formation in each enamel ridge-plate) of this heavy, relatively long and narrow molar fragment (Osborn 1910, p. 398) indicate that it should be identified, without the slightest doubt, as belonging to the straight-tusked or forest elephant,

*Elephas antiquus* FALCONER ET CAUTLEY, 1868, or, if it should be preferred to stress a presumed relationship with the recent African elephant, *Palaeoloxodon antiquus*.

HB 66 and HB 67 (Fig. 2 c,d and e,f) are small fragments of, in all probability, upper molars of the right side (with barely discernible convex occlusal surfaces), each containing only parts of not more than three enamel plates. The maximum height of HB 66 is 102 mm, its maximum width 55 mm, while the



Figure 3 Incomplete first caudal vertebra B 123: **a** frontal view, **b** oblique view from behind.

partial three enamel plates occupy 41 mm of mesiodistal space on the grinding surface. The maximum height of HB 67 attains 86 mm, its maximum width 42 mm, and its three plates are spaced apart on 40 mm of its grinding surface, accounting for a lamellar frequency, almost equal to that of HB 66, namely approximately 7.5. The thickness of the enamel in each plate, in the two molar fragments, varies from 1.2 to 2.4 mm and the width of the intralamellar cementum does not exceed 5 mm, being mostly about 4 mm. This, and the parallel structure of the plates on the grinding surface, forms a sufficient indication for an identification of these two fragments as belonging to the 'true' mammoth, *Mammuthus primigenius* (BLUMENBACH, 1799). In each of the two fossils the colour and hue of the cementum are 7.5YR 5/8 (bright brown), those of the enamel being 5BG 2/1 (blueish black).

The incomplete vertebra, evidently having suffered much damage while in the transport-tube of the suction-dredger (Fig. 3 a,b), is a very large first caudal one. Its left transverse process has broken off at the junction with the corpus vertebrae, while, at right, a stretch of some 60 mm has remained intact. However, the recent break at its extremity there shows that, originally, the transverse processes must have been appreciably longer and larger. Its sagittal width, at the point of breaking, is still 55 mm. The vertebral corpus has a sagittal length of 70 mm in its centre, with an anterior width of 70 mm and a posterior one of 65 mm, and heights of 40 mm in front and 37 mm behind. The neural canal, with a rounded-triangular vertical section, has a width of 48 mm at its base (in front and behind), a maximum height of about 40 mm and a length of 60 mm. What is left of the vertebra still has a height of approximately 110 mm; the spina has broken off just at its base. It is perhaps noteworthy to state that the beginning of the spinal axis, when seen from aside, forms an angle of roughly 60 degrees

with the sagittal line through the corpus. Colour and hue of this specimen are a uniform 10YR 5/3 (dull yellowish brown). Mainly because of its very large size, but perhaps also because of the wide angle between the longitudinal axis through its corpus and the spinal axis, which approaches the perpendicular (according to Cornwall 1956, p. 114, a typical character of the main vertebrae of *Elephas antiquus*), we are in favour of an identification of this piece as either belonging to *Elephas antiquus* or else as an extremely large *Mammuthus primigenius*.

#### FINAL REMARKS

Collagen taken from small samples of the roots of HB 65 and HB 66 were used for a 14C age determination, carried out at the R.J. Van de Graaff Laboratory of Utrecht University (sample numbers UtC 9307 and 9308, respectively). The 14C age of HB 65 was determined as being 32.500 +/- 500 yBP, and that of HB 66 as 39.000 +/- 1000 yBP. A previously made 14C age determination, of a sample taken from the root of a third upper molar of a *M. primigenius* dredged up nearby at 't Vechterlo (Fig. 1; see Bosscha Erdbrink 1999), resulted in an age of 31.900 +/- 400 yBP. Samples taken from a fossil antler of a red deer, and from a piece of fossil wood, both collected at the Hooze Broek itself and evidently having been embedded in a layer, or lenses, of the earlier mentioned tough grey clay, had already produced ages of, respectively, 51.000 +/- 5000 and >55.000 yBP.

It is therefore clear that the fossil material brought up by the suction-dredger from, at most, 20 m below the groundwater surface, consists of remains of different age and, presumably, different stratigraphical levels. The Kreftenheye Formation as a whole is roughly considered to be of Weichselian (= Devensian) stratigraphical age. Van Andel & Tzedakis (1996, fig. 1, pp. 482, 494) place the several different age moments mentioned for our Hooze Broek and Vechterlo samples all

within the Oxygen Isotope Stage 3. The two oldest Hooge Broek samples may well be correlated with the two earliest Upper Weichselian warm interstadials, the Oerel and the Glinde (Moershoofd) interstadials (Van Andel & Tzedakis 1996, fig. 11, p. 492). The HB 66 sample could then be placed in the Hengelo interstadial, while the Vechterlo sample, and HB 65, nicely fit in the still younger Denekamp interstadial.

This last observation constitutes an interesting addition to the remarks regarding *Elephas antiquus* made by Mol *et al.* (1999, pp. 128-129). Arguments are summed up which indicate that the straight-tusked or forest elephant occurred in our country, and through most of Europe, from the Middle Pleistocene up to and during the Late Pleistocene. The locality of De Haerst, also in the province of Overijssel, is not very far distant from the Hooge Broek. The remains of *E. antiquus* recorded from there (Mol *et al.* 1999, p. 128) are thought to be of Eemian age. HB 65 constitutes proof that this giant elephant still existed at a later time; also that it lived almost side by side with the 'true' Mammoth, as is attested by the find from 't Vechterlo; as, indeed, it already did during Eemian (= Ipswichian) times (Stuart 1982, p. 169).

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