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First record of *Trogontherium cuvieri* (Rodentia, Castoridae) from the Oosterschelde

Mayhew, D.F., de Vos, J. & van Veen, J.C., 2008 - The first record of *Trogontherium cuvieri* (Rodentia, Castoridae) from the Oosterschelde - DEINSEA 12: 17 - 20 [ISSN 0923-9308]. Published online 10 July 2008.

A fragment of right tibio-fibula from the bed of the Oosterschelde deep channel is identified as *Trogontherium cuvieri*, not recorded previously from this area. The bone is larger than other material from Late Pliocene/ Early Pleistocene deposits in the Netherlands and the UK and falls within the size range of Middle Pleistocene material. Various interpretations are possible: size variation through time, sexual dimorphism (not previously recorded) or else the mixing of Middle Pleistocene material with the fauna from the Oosterschelde deep channel.

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Keywords: Rodentia, Castoridae, *Trogontherium*, southwest Netherlands, Late Pliocene, Early Pleistocene

INTRODUCTION

During the trawling operations of the annual 'Kor en Bot' trip in 2001, a fragment of a right tibio-fibula of a beaver was recovered from a depth of 36m in the channel just off the coast of Schouwen-Duiveland near Zierikzee (province of Zeeland, The Netherlands). The degree of fusion of the tibio-fibula and the shape of the epiphysis demonstrate that this fragment is from the extinct species *Trogontherium cuvieri* FISCHER, the first record of the species from the Oosterschelde.

The genus *Trogontherium* was widely distributed in Europe during the Pliocene and Pleistocene. Schreuder (1929) described the *Trogontherium* remains from the Tegelen clay, which today still form the single most important reference sample available. The taxonomy of *Trogontherium* has been complicated unnecessarily in the past by proposal of

various different generic and specific names. The genus was reviewed by Mayhew (1978, see for synonymy and detailed references) with the conclusion that the genus was a single lineage, with an increase in body size through the Pliocene and Pleistocene followed by a size decrease before extinction in the Late Middle Pleistocene. An earlier smaller Pliocene form *T. minus* NEWTON (known by material from the Crag basement beds) was followed by the larger *T. cuvieri*. The latest reasonably well dated occurrences of *Trogontherium* are in the Late Middle Pleistocene (Netherlands: Neede; UK: Hoxne, Clacton, Copdock, Swanscombe). According to Schreve (2001) these UK localities should be dated as MIS stage 11. Later proposed occurrences of *Trogontherium* (?Eemian (=MIS 5?), von Koenigswald & Menger 1997) are not considered to be sufficiently substan-

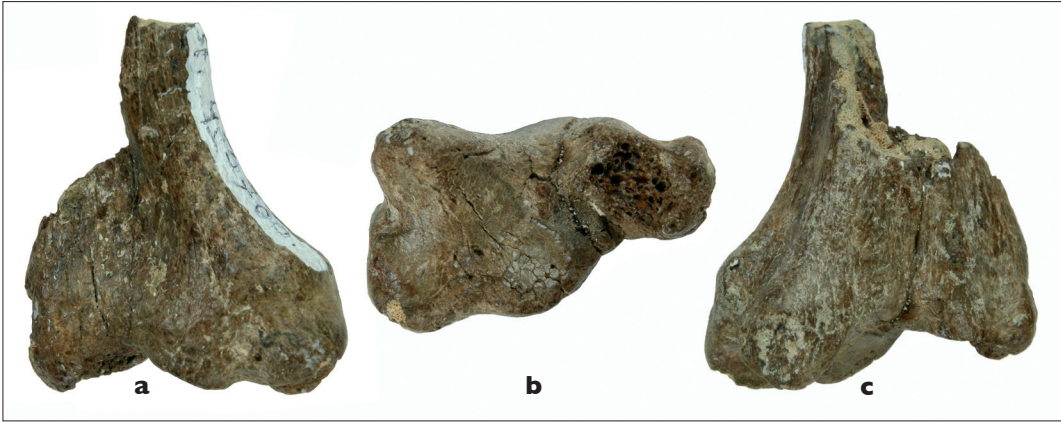


Figure 1 Tibio-fibula fragment of *Trogontherium cuvieri* from the Oosterschelde (collection Naturalis, RGM St.450760): **a** anterior, **b** distal and **c** posterior view. The maximal dimension is 40 mm. [photo's: A.A. Slupik]

tiated, as reworking from earlier sediments cannot be ruled out. The Middle Pleistocene specimens from Mosbach (BRD) and later localities differ from earlier material in having an additional enamel loop on the lower premolar, a slightly different cross-section ratio in the lower incisor, and a smaller maximum size (Mayhew 1978). The material from the Upper Freshwater Bed at West Runton UK (Middle Pleistocene, type Cromerian stage, considered to be geologically older than the Mosbach material) is the largest known.

In this article the Plio/Pleistocene boundary is taken (for convenience) to be that defined by the International Commission (GSSP: Vrica, MIS stage 65, dated at about 1.8 Ma.)

MATERIAL AND COMPARISON

The distal part of a right tibio-fibula of *Trogontherium cuvieri* (collection Naturalis, Leiden, RGM St.450760) recovered from the Oosterschelde is brown in colour, rolled and damaged (Fig. 1). The bone structure is dense and robust, indicating probably an old animal. The maximal dimension is 40 mm. The overall width of the epiphysis (which is quite damaged and lacks the malleoli) is 33.5 mm. The antero-postero dimension of the epiphysis is 19.3 mm (Table 1). This latter measurement is relatively unaffected by the damage to the bone and so can be used for comparison with remains from other localities. Comparison was made with

measurements from material in the following collections: Naturalis, Leiden (RGM); Teylers Museum, Haarlem (TM); The Natural History Museum, London (NHM); Geological Survey Museum, Keyworth (BGS); Norwich Castle Museum (NCM); Natural History Museum, Mainz; (MNHM); Geology Dept, University of Heidelberg (GUH).

Trogontherium from East Runton (Early Pleistocene or Late Pliocene, on faunal grounds approximately similar in age to fossil material from the clay pits at Tegelen) has values of 15.1 and 17.4mm, i.e. significantly smaller than the Oosterschelde specimen. Material from the Cromer Forest bed Series localities of Middle Pleistocene age (Paston, Mundesley, West Runton Upper Freshwater Bed) ranges in size from 16.3. to 20.9, i.e. has a range including the Oosterschelde specimen. The Tegelen material of *Trogontherium* yields the following measurements: mean =16.7, n=11, range =15.4 - 17.8. SD = 0.81. The bone from the Oosterschelde is significantly larger ($p < .01$) than the Tegelen material (Table 1).

DISCUSSION

Fossil remains of several mammal species including *Mammuthus meridionalis*, *Anancus arvernensis*, *Equus* sp., *Stephanorhinus* cf. *etruscus*, *Cervus rhenanus*, *Eucladoceros ctenoides*, *Leptobos* sp., *Homotherium* sp., cf. *Hyaena perrieri*, *Sus strozzi*, (De Vos et

Table 1 Antero-postero length (in mm) of the distal epiphysis in *Trogontherium cuvieri* from localities in The Netherlands, England and Germany.

locality	specimen (coll / cat. nr)	size (mm)	dating/comments
Oosterschelde	RGM St. 450760 dex.	19.3	
Tegelen	TM 15568b dex.	16.3	E. Pleist./L.Plioc.
Tegelen	TM 15588a sin.	15.4	
Tegelen	TM 16240.dex.	17.6	
Tegelen	TM 15568a sin.	15.8	
Tegelen	TM 15568c sin.	16.5	
Tegelen	RGM St.86704 sin.	16.1	
Tegelen	RGM St. 85590 dex.	17.6	
Tegelen	RGM St. 119929 dex.	16.9	
Tegelen	RGM St.T 45461 dex.	17.8	
Tegelen	RGM St.T 95397 dex.	16.3	
Tegelen	RGM St.T 52989 sin.	17.3	
East Runton	NHM M7022/1403	17.4	E. Pleist./L. Plioc.
East Runton	NHM M7020/818	15.1	
Paston	BGS GSM 659	16.3	E.Pleist./L.Plioc.
Mundesley	NHM M3573	17.5	M. Pleist.
Mundesley	NHM M7021/1193	17.9	
Mundesley	BGS GSM 7345 dex.	20.9	
West Runton UFB	NCM 329.368 dex.	20.1	type Cromerian
West Runton UFB	NCM 3536	18.3	type Cromerian
Jockgrim	GUH	15.5	post-Cromerian
Mosbach	MNHM 1959/84	17.8	post-Cromerian

al. 1998) *Mimomys pliocaenicus*, *Mimomys reidi*, *Mimomys tigliensis*, *Borsodia newtoni*, *Beremendia fissidens*, *Sorex (Drepanosorex) praeearaneus* and *Galemys kormosi* (Reumer *et al.* 1998, Reumer *et al.* 2005) have been recovered from the deep water channel of the Oosterschelde. These species are consistent with derivation from a fauna of Early Pleistocene or Late Pliocene age, corresponding to the age of continental and marine sediments known to exist at a depth of around 40 metres, the depth of the channel near Zierikzee/Schelphoek. However, the nature of the accumulation of bones on the bottom of a sea bed means that mixing of material from different periods cannot be ruled out.

The difference in size between the Oosterschelde specimen and Early Pleistocene/Late Pliocene material from the UK and from Tegelen is substantial and was rather unexpected. It could point to derivation of material from later sediments. Up to now the picture of size variation in *Trogontherium* is one of gradual size increase up to the Cromerian,

followed by a reduction in size (Mayhew 1978). However it cannot be ruled out that *Trogontherium* varied in size throughout its geographic range. Such variability in size with e.g. climate or longitude/latitude is known in recent and Pleistocene mammals, and is found in the living Eurasian and North American beavers *Castor fiber/Castor canadensis*. It is now clear that already during the Late Pliocene and Early Pleistocene there were regular climatic oscillations sufficient to influence Western European populations of mammals dependent on water and specific sorts of vegetation such as *Trogontherium*.

The deposits forming the base of the Oosterschelde channel were investigated by the Delta dienst Schelphoek borehole 42G4-11 sunk in 1963. Some information about this has been described by Van Rummelen (1970, as borehole number 42G22), and a more detailed review and study of the sediments has recently been made (Slupik *et al.* 2007). The Maassluis formation (marine) here is succeeded by the Waalre formation (continental/fluviatile) at a

depth of approximately 40 metres, close to the location where the bone was recovered. These sediments are considered to date from the Late Pliocene to Early Pleistocene.

ACKNOWLEDGEMENTS

We thank the curators of the respective collections for providing access to materials in their care. Ir A.A. Slupik supplied information concerning the Schelphoek borehole and made the photographs.

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Received 11 August 2006

Revised 27 July 2007

Accepted 13 August 2007