A FOSSIL SKULL FRAGMENT OF A WALRUS FROM THE MOUTH OF THE RIVER SCHELDT (NETHERLANDS)

by

P. J. VAN DER FEEN [1])

§ 1. THE LOCALITY AND A PRELIMINARY CLASSIFICATION OF THE FOSSIL

In 1955 a party of palaeontologists aboard the fishing vessel ZZ8, under Captain B. Schot of Zierikzee, explored a tidal channel, between 5 and 10 m below l.l.w.s., called Put van Domburg, or Put van Oostkapelle by the fishermen (Urk on the official chart, fig. 1) off the coast of Walcheren. The dredging yielded several shells and internal moulds of *Arctica islandica* (L.) (syn. *Cyprina islandica* (L.)) (Pelecypoda). In the Antwerp region, roughly 100 km up the River Scheldt, this species is restricted to the Scaldisian and does not occur in the next younger formation, the Merxemian (GLIBERT, 1958, Pélécypodes No. 92).

[1]) Domburgseweg 6, Domburg (Netherlands).

In 1965 another fisherman, dredging at the same locality, brought up a mammal skull fragment. It belongs now to the collection of Mr. J. A. Trimpe Burger, Aardenburg (Netherlands), who kindly lent it to me for study. It was partly covered with living balanids and Polyzoa having lain on the sea bottom for at least a year or considerably longer. The colour of the bone is black. When tapped with a metal hammer it produces a sound markedly higher in tone than does fresh bone; and its specific weight is considerably higher than that of normal bone. In short, it is highly fossilized and belongs to the often discussed group of black mammal fossils from the Scheldt aestuary (SCHREUDER, 1944, 1945, 1949, 1950; HOOIJER, 1950, 1957).

The fossils belonging to this group are all in a broken and worn state. Apparently they come from a basal conglomerate. From the stratigraphical struc-

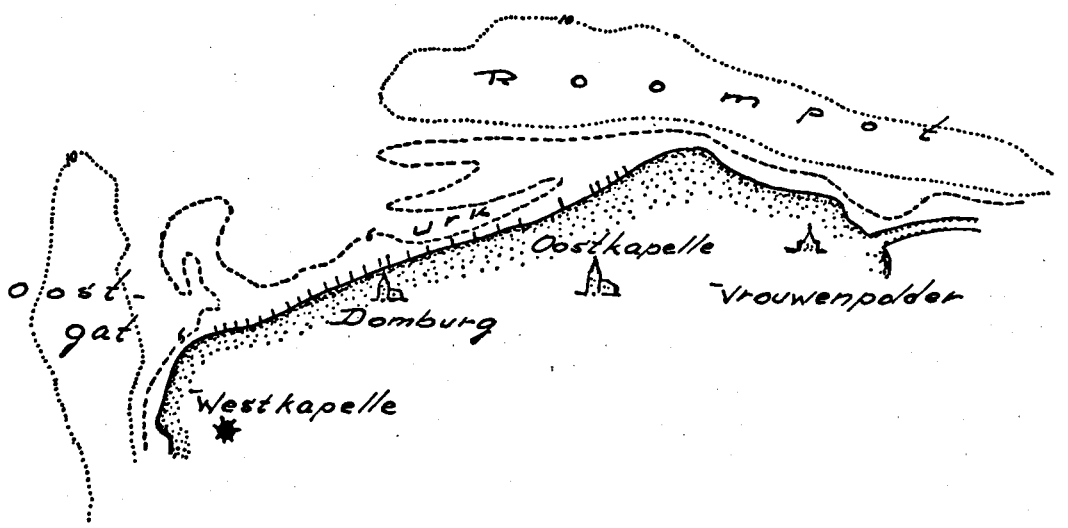

Fig. 1. The tidal channel "Urk" is, according to the available information, the locality where the fossil skull fragment was dredged.

ture of the region, as explained by VAN VOORTHUYSEN (1957, 1960) and VAN RUMMELEN (1965), I conclude that they probably belong to the basal conglomerate of the Halsteren deposit; this was laid down in a broad and locally deep E-W river existing during a large part of the Tiglian period. The locality where the fossil was dredged up is near the southern bank of that Pleistocene river, where it was never very deep. At the end of the Tiglian period the filling up of the river bed had begun already. Obviously the animals represented in the basal conglomerate lived before the Tiglian period.

The fossil is a damaged brain-case. Its right wall is rather well preserved. The foramen occipitale with both condyles is complete. When seen from the occipital side (Pl. I, fig. 1) its most conspicuous character is, on the right side, a heavy processus in latero-ventral direction, slightly abraded at the ventral end, but still 10 cm long, measured from the base near the condyle, and nearly 10 cm broad as well. In living mammals a processus of these dimensions, in this region of the skull, occurs only in some Otariidae (TURNER, p. 171; VAN KAMPEN, 1904, p. 213; 1905, p. 543) and in the walrus (WEBER, p. 350, fig. 214; WINGE, 1941, II p. 245). The Otariidae have a Pacific distribution and their fossil occurrence in the North Sea is not very likely. Several species of fossil walruses, however, were recorded from the lower Scheldt region, including Antwerp, and from East Anglia. From the same locality where our fossil was dredged VAN DEINSE (1944, pp. 120-121) figured and described a walrus femur equally belonging to the "black fossils". We have, therefore, first to investigate whether our fossil belongs to one of these walrus species.

§ 2. NOMENCLATURE OF THE LIVING WALRUS

LINNAEUS (1758, p. 38) described the walrus under the name *Phoca Rosmarus*. In the same edition (p. 34) he mentioned the manatee (Sirenia) which he named *Trichechus Manatus*. In the 12th edition (1766, p. 49), however, the walrus is mentioned as *Trichechus Rosmarus*, and this name was in general use during the next century and a half. BRISSON, in 1762 (p. 30), had already published the generic name *Odobenus* for the walrus, which name has priority and is valid according to the Rules of Zoological Nomenclature. The valid name of the Atlantic walrus is, therefore, *Odobenus rosmarus* (L., 1758). The northern Pacific walrus was named *Trichechus obesus* by ILLIGER (1815, p. 64). This specific name, though often used, is a nomen nudum according to ELLERMAN & MORRISON-SCOTT (p. 325) who concluded that *divergens* (ILLIGER, l.c., p. 68) is the valid (sub)specific name of the Pacific walrus. Modern authors disagree whether the Atlantic and the Pacific walrus are specifically (MOHR, p. 238; PEDERSEN, p. 20; KARDAS) or subspecifically (ELLERMAN & MORRISON-SCOTT; HALTENORTH & TRENSE, p. 368; KING, p. 37) distinct.

§ 3. STRATIGRAPHY AND NOMENCLATURE OF EARLY PLEISTOCENE WALRUS REMAINS IN EAST ANGLIA (ENGLAND)

KELLOGG (pp. 101-105) published a checklist of fossil walrus remains from Europe and North America.

LANKESTER (1865) described fossil walrus tusks (canine teeth) from "the base of the Red Crag" in Suffolk and named them *Trichecodon huxleyi* n.g.n. sp. This generic name had been suggested to the author, in a letter, by the Belgian zoologist Van Beneden who studied the mammal fossils from Antwerp. A diagnosis of the genus was not published by either of the two zoologists. (If only Lankester had dedicated his new species to Van Beneden many later discussions between the two colleagues surely would have been prevented.) LANKESTER (1870) stated that the tusks came from the bone bed underlying the Red Crag. LANKESTER (1882) described more of these tusks from the same stratum. Considering now that the tusks, although specifically distinct, do not justify the establishment of a new genus, Lankester withdrew the name *Trichecodon* and called the fossil tusks *Trichechus huxleyi* (Lankester). In full agreement with this opinion this name now (see § 2) has to be changed to *Odobenus huxleyi* (Lankester, 1865).

In 1865 geologists distinguished only one "Red Crag". Later investigations revealed the existence of three successive divisions of the Red Crag, each with its own basal conglomerate: (1) Waltonian (the oldest part); (2) Newbournian; and (3) Butleyan (being the youngest part). Lankester's syntypes (1865) had been collected, probably, near Woodbridge, Suffolk (cf. LANKESTER, 1882, p. 216) which is situated in the Newbournian district (CHATWIN, p. 42, map). There are records of similar tusks from the same bone bed below the Newbournian Red Crag at Felixstowe, Suffolk (WOODWARD & SHERBORN, p. 387), and at Fox Hall, Suffolk, 2 miles E of Ipswich (NEWTON, 1891, p. 18). This walrus lived during the Waltonian period or earlier.

Other specimens were found in somewhat younger strata. A walrus tusk from Holton near Halesworth,

Years Before Present	Continental Europe	Antwerp	East Anglia
	Saalian		
4.10^5			
	Cromerian		*Yoldia myalis* Bed Cromer Forest Bed
			Chillesford Beds
			Norwich Crag
	Tiglian		Red Crag: Butleyan
			Red Crag: Newbournian
		Merxemian	Red Crag: Waltonian
10^6		Scaldisian	

Stratigraphical terms used in this paper.
The exact synchronization of the East Anglian with the continental deposits is still highly problematic.

Suffolk, is in the Ipswich Museum and comes from the region of the Norwich Crag which also rests on a bone bed. A damaged walrus femur was recorded from the Chillesford Bed at Aldeby, Norfolk, 6 miles W of Lowestoft (Reid, p. 109; Newton, 1891, p. 18, pl. II fig. 3).

Similar tusks were recorded from the Forest Bed (Cromerian) near Cromer, Norfolk, (Newton, 1882, pp. 26-29, pl. V fig. 3) and from marine "laminated beds" directly following the Forest Bed (Gunn, p. 62). These laminated beds are most likely identical with the *Yoldia myalis* (syn. *Leda myalis*) Bed (Reid, pp. 191-194; Chatwin, p. 58).

The fossils mentioned in this paragraph may be dated roughly between one million and 400 000 years B.P. (Zagwijn, p. 175). We may suppose that the walrus lived at least during certain periods of this length of time.

§ 4. STRATIGRAPHY AND NOMENCLATURE OF EARLY PLEISTOCENE WALRUS REMAINS IN THE ANTWERP REGION (BELGIUM)

Du Bus (1867) described a fossil walrus mandible collected in 1863 from the upper part of the local crag in the Fort No. 1, between Wyneghem and Deurne, a few km E of Antwerp town (Stieler's Hand-Atlas, map 43) and named it *Alachtherium cretsii* n.g.n.sp. A diagnosis of the new genus is lacking.

Van Beneden (1871) based another fossil walrus species *Trichecodon koninckii* n.sp. on a very fragmentary tusk from the Antwerp crag. Rutten (1907) reported that the type specimen was lost, but a cast of it was in the Brussels Museum. The specimen was badly worn and still recognizable as part of a walrus canine, but hardly sufficient to identify specifically.

HASSE (1909), in this respect, agreed with Rutten and thought the tooth fragment to be "un faible point d'appui". In the present state of affairs it is hardly possible to identify satisfactorily other walrus remains as the species *Trichecodon koninckii* unless one of the limb bones, described under this name by VAN BENEDEN (1877), is designated as neotype.

More interesting is a damaged brain-case, described and figured by VAN BENEDEN (1876; 1877, pl. 1 fig. 1), together with several limb bones, as *Alachtherium cretsii* Du Bus, all collected from the red sand in Fort No. 1 near Wyneghem and in Fort No. 2 near Wommelghem. I could not ascertain in which of these two localities the brain-case was collected. Both are situated E of Antwerp town, only 2 km from each other, and less than 10 km from the River Scheldt. Other limb bones, classified by Van Beneden as the same species, came from Deurne near Fort No. 1. According to MOURLON (1877) the yellow-reddish sand in which *Alachtherium cretsii* was found, is the upper part of the "Pliocène scaldisien", the lower part of this formation being grey sand. Mainly on account of the molluscs present VINCENT (1889) distinguished the upper part of the Scaldisian as a separate formation which he named Poederlian. The term Scaldisian was now restricted to the lower part of Mourlon's Scaldisian.

RUTTEN (1907) studied the same brain-case. The engraving published by VAN BENEDEN (1877, pl. 1, fig. 1) is the inverse of Rutten's photograph. Rutten argued that the mandible, holotype of *A. cretsii* Du Bus, for anatomical reasons, could not belong to the same species as the brain-case. The latter, therefore, had to receive a new name. Seeing no sufficient reason to classify it in a genus other than that of the living walrus Rutten named the brain-case *Trichechus antverpiensis* n.sp. According to § 2 this has to be changed to *Odobenus antverpiensis* (Rutten).

HASSE (1909) checked again whether the mandible and the brain-case could belong to the same species and came to a negative conclusion as well. Wishing, however, to maintain the brain-case in the genus *Alachtherium* he called it *Alachtherium antverpiensis* Hasse, which, according to the Rules, should be *Alachtherium antverpiense* (Rutten).

In the same paper HASSE reported the discovery of a number of walrus bones belonging, probably, to four individuals of the same species, all collected from a distinct horizon, regarded as Poederlian, in a very restricted locality situated in the harbour district N of Antwerp town (No. 12 "bassins intercalaires", on map DE HEINZELIN, 1950, p. 6). Apparently these bones had not been reworked from older horizons, but belonged to stranded animals living contemporaneously with the molluscs of the same horizon. Hasse classified these bones in the same species as the brain-case just mentioned.

For several reasons the term Poederlian was abolished officially in 1929 in the geological map of Belgium, and was replaced, at least in the Antwerp region, by "Sands of Merxem" or Merxemian, so named after a locality near Antwerp, NE of the town. Most authors now regard the Merxemian as a separate formation, following directly after the Scaldisian (GLIBERT, 1958; VAN RUMMELEN, 1965). Others regard it as the upper part of the Scaldisian.

The exposure described by Hasse has now disappeared. According to DE HEINZELIN (II, p. 10), Hasse probably collected his remarkable walrus remains from the top of the Scaldisian, where already some molluscan species, to be soon abundant and typical in the Merxemian, had appeared.

With due reserve I conclude that *Odobenus antverpiensis* (Rutten) lived at about the end of the Scaldisian and the beginning of the Merxemian, that is at about the much discussed Plio-Pleistocene boundary. Only a revision of the material preserved in different collections can show whether or not more than one species of walrus lived during that time.

§ 5. PALAEO-OECOLOGY OF THE ODOBENIDAE

The living walrus is an Arctic animal both in the Atlantic and in the Pacific. It was a point of discussion (HOOIJER, 1950) whether "one walrus makes an ice-age" or, in other words, whether a walrus living about Lat. 52° N. during the transition Pliocene-Pleistocene, is an analogon (si parva licet componere magnis) of *Elphidiella arctica* (Foraminifera), proving the existence of a cooler climate, or of cold currents, or at least of a communication between the northern part of the Atlantic Ocean and the southern part of the North Sea.

The earliest representative of the Odobenidae, *Prorosmarus*, was found in the Upper Miocene of the Atlantic coast of Virginia (U.S.A.) Glacial conditions at the poles probably did not exist before the Mid-Pliocene (BARGHOORN, p. 244). Apparently the Odobenidae did not originate as an adaptation to glacial conditions.

Pleistocene walrus was recorded along the Atlantic coast of North America as far South as Florida and South Carolina (U.S.A.) (KING, p. 42).

The food of the living walrus consists principally of shellbearing molluscs, both Pelecypoda and Gas-

Fig. 1

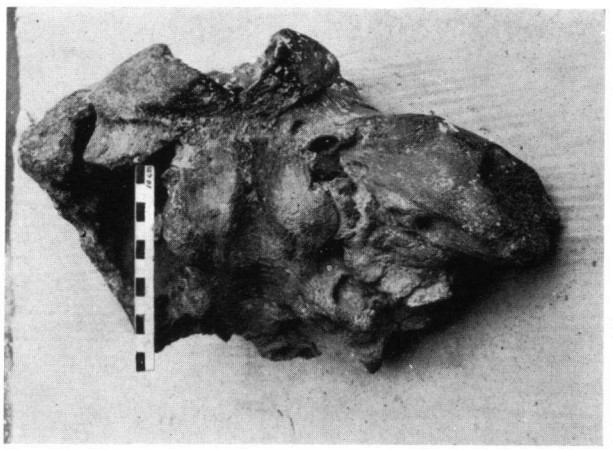

Fig. 2

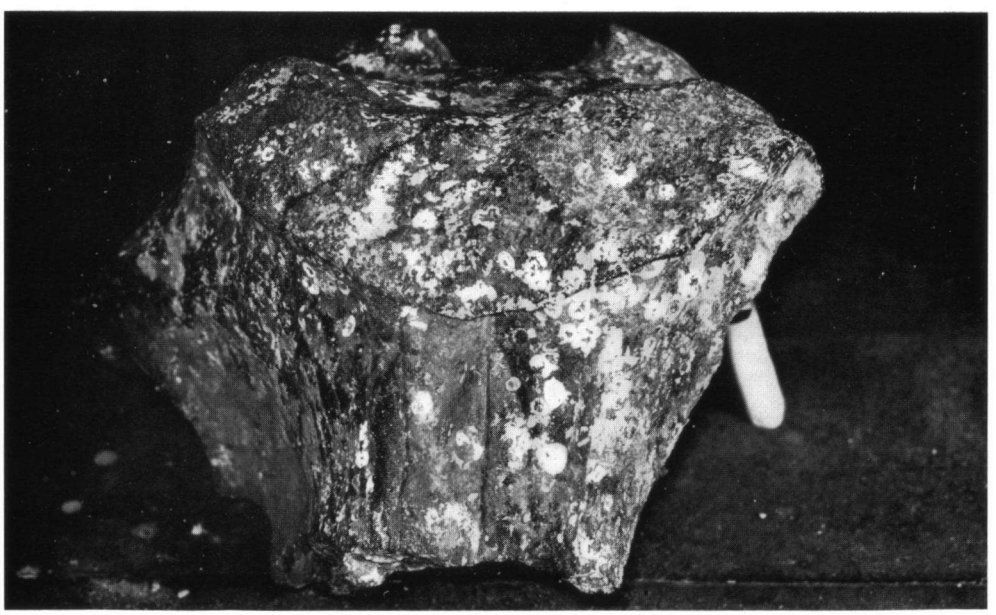

Fig. 3

Pl. I. Skull fragment of *Odobenus antverpiensis* (Rutten). Fig. 1. Occipital side. Fig. 2. Ventral side. Fig. 3. Dorsal side. The little measuring-rod is divided in cm.
Fig. 1 and 2 foto van der Feen; fig. 3 foto Kotvis.

tropoda, living in and on a sandy or muddy sea bottom at 20 to 100 m deep. Swimming backwards under water, and moving its head, the walrus ploughs the sea bottom with its tusks (PEDERSEN, p. 39; FREUCHEN cited from MOHR, pp. 249, 254; HAMILTON, p. 141; KING, p. 41; MANSFIELD, p. 25). To a lesser degree it is a praedator on Phocidae.

In the coastal waters in which the East Anglian and Antwerp crag was deposited the walrus must have found plenty of food. Perhaps already the earliest Odobenidae were an adaptation to the abundance of molluscs in coastal waters during the Miocene.

§ 6. LATE PLEISTOCENE WALRUS REMAINS

Another group of walrus remains from North-Western Europe, (RUTTEN; VAN DEINSE; and others) including France (GRATIOLET) and Denmark (NORDMANN, 1905, pp. 30, 41; 1944, pp. 35, 62) and from the Atlantic coast of North America (KELLOGG, pp. 104-105; KARDAS) differ from those mentioned in §3 and § 4 in being distinctly less fossilized. Their state of fossilization resembles that of the bones and teeth of the mammoth, *Mammuthus primigenius*. They were mostly obtained by dredging and hence in most cases no distinct horizon of origin could be indicated. Their date is probably post-Saalian. The adaptation of the walrus to Arctic conditions may have happened during or even after the Saalian period. This group of walrus fossils were mentioned by different authors under different names and should be revised.

§ 7. DESCRIPTION OF THE SKULL FRAGMENT

For comparison I used a series of *Odobenus rosmarus* in the Zoological Museum, Amsterdam, and two Late-Pleistocene calvaria No. V 24 (figured: VAN DEINSE, 1943, pp. 98-100; 1964, pl. XIII) and V 36 in the Zeeuws Museum, Middelburg (Netherlands).

In the occipito-parietal region of the skull of Carnivora we have to distinguish between three crests: (1) a sagittal crest in fronto-caudal direction on the sutura sagittalis between the left and the right parietal bone; (2) a transverse lambdoid crest near the sutura lambdoidea sive occipito-parietalis; and (3) an occipital crest on the median line of the squama ossis occipitalis, dorsal of the foramen occipitale. The presence or absence of these crests in Carnivora is strongly influenced by age and sex, more than by specific, let alone generic differentiation.

In our fossil the mastoid process is still more developed than in the Late-Pleistocene calvaria V24 and V36. The extremely strong development both of this process and of the lambdoid crest corresponds with an equal development of the muscles for the movement of the head, neck, and fore limbs (MURIE) "The powerful muscles holding up the head give the male a noticeable heaviness about the neck and shoulders." (MANSFIELD) Our specimen must have been a full-grown male; the sutures have largely disappeared.

According to VAN KAMPEN (1904, p. 215; 1905, p. 546) the strong mastoid process in the living walrus has associated probably a processus posttympanicus and certainly a processus paroccipitalis which sometimes can be distinguished on the occipital side. The latter tiny process is just visible in the photograph of a walrus skull the bones of which have been detached (Beauchène method) in Report Field Museum 1904 pl. L. In our fossil specimen a thin processus paroccipitalis, long 5 cm and broad 2 cm, is intimately united with the processus mastoideus.

Quite characteristic is the difference in form of the occiput: the dome-like outline of a Late-Pleistocene skull (RUTTEN, fig. 1; VAN DEINSE, 1943, p. 98 fig. 5; 1964, pl. XIII) and the more angular form, with a mid-dorsal depression, in the holotype of *O. antverpiensis* (RUTTEN, fig. 2). Our fossil is similar to the latter.

No less characteristic is the base of the skull seen from the outside (Pl. I, fig. 2). Following the occipital axis from the foramen occipitale in a forward direc-

	Late-Pleistocene skulls V24, V31	*O. antverpiensis*	fossil skull fragment
(1) sagittal suture	ridge	depressed	depressed in the form of a broad furrow
(2) lambdoid crest	narrow	broad and high	broad, strongly developed
(3) occipital crest	present	absent	absent

tion we see a distinct, smooth, median ridge bifurcating about the invisible suture of the basisphenoid with the basioccipitale. On each side the branch of the fork has grown out in a lateral direction into a massive, smooth tubercle about an inch in diameter. Apparently this is the tuberculum musculare (of veterinary anatomy) for the attachment of deep neck muscles lying on the ventral side of the vertebral column. RUTTEN described exactly the same configuration of the skull base in the holotype of *O. antverpiensis*. In the Late-Pleistocene calvaria V24 and V36 a trace of the same structures is visible but much less developed.

A steep-sided, narrow furrow separates the tuberculum musculare from the auditory-vestibular apparatus. The triangular bulla ossea is low, grooved and rough (not swollen), just as in Otariidae and in Ursidae (VAN KAMPEN, l.c.).

The broken state of the skull allows an easy inspection of the inside. The tentorium cerebelli osseum is conspicuous. The cerebellum was relatively large compared with the cerebrum. The fossa lateralis (Sylvii) of the cerebral hemisphere is clearly visible. A mould may reveal several details of the brain.

MEASUREMENTS

Distance from the median plane of the skull to the outside of the processus mastoideus, as far as the latter is present, 0.175 m; this is nearly the half maximum breadth of the complete skull.
Height basion – opisthocranion 0.183 m.
Distance opisthion – opisthocranion 0.144 m.
Greatest breadth occiput 0.217 m.
Breadth at the frontal edge of the fragment, 0.08 m in front of the crista lambdoidea, 0.105 m; this is only little more than the minimum breadth of the undamaged skull.
Processus mastoideus: breadth halfway 0.090 m; long, as far as present, from crista sagittalis 0.175 m, from condylus occipitalis 0.097 m.
Foramen occipitale, inner entry, high 0.045 m, broad 0.056 m.
Distance of condyli over the middle of the foramen occipitale 0.060 m.
Breadth over condyli 0.145 m. Left condylus long 0.085 m, broad 0.053 m.
Breadth of crista lambdoidea (damaged) 0.07 m in the sagittal plane, 0.037 m at the lateral sides.

The holotype of *O. antverpiensis* is exhibited in the Institut Royal des Sciences Naturelles de Belgique in Brussels with the name *Alachtherium cretsii* Du Bus. It has the same form and roughly the same dimensions as our fossil. Its colour is brown. Apparently it was fossilized in oxydizing surroundings whereas our specimen underwent a reducing process. For fossils of different origin a difference in colour needs not be an indication of different age (Brouwer in discussion, HOOIJER, 1950, p. 13).

The many points of conformity with the holotype of *Odobenus antverpiensis* (Rutten) lead to the conclusion that our fossil belongs to this species. The cranial characters of this species are dependent on a strong development of the muscles moving the head, neck, and fore limbs. In accordance with the general principle not to increase the number of taxonomical units beyond strict necessity, I quite agree with Rutten in considering the differences between the living walrus and this fossil species as specific, not as generic. Consequently I record the fossil described above as *Odobenus antverpiensis* (Rutten, 1907) (syn. *Trichechus antverpiensis* Rutten, syn. *Alachtherium antverpiense* (Rutten)).

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SUMMARY

An occipito-parietal skull fragment of a male specimen of *Odobenus antverpiensis* (Rutten, 1907), from the mouth of the River Scheldt (Netherlands) is described and figured. The animal lived probably about the transition Scaldisian-Merxemian (Pliocene-Pleistocene). It lived in coastal marine surroundings rich in shell-bearing molluscs and is not necessarily an indication of cool conditions.

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