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FOSSIL CRANIAL WALRUS MATERIAL FROM THE NORTH SEA AND THE ESTUARY OF THE SCHELDE (MAMMALIA, CARNIVORA)

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ABSTRACT

Six cranial odobenid remains in a public collection, which have come to our notice since the publication of two earlier papers, are described and discussed. Identification of several specimens with *Odobenus antverpiensis* (Rutten, 1907) cannot be ruled out.

INTRODUCTION

Continuing our description (Bosscha Erdbrink & Van Bree, 1986, 1990) of fossil odobenid material from the North Sea bottom, present in Dutch public collections, we think that a further series of six cranial remains are sufficiently important to be recorded. These are registered in the collection of "Naturalis", the Nationaal Natuurhistorisch Museum at Leiden, and previously formed part of the palaeontological collection of the (suspended) Rijksmuseum van Geologie en Mineralogie.

There they were inscribed in a "stamboek", implying that each numbered item was preceded by the letters St.. Figure 1 is a sketch map indicating the locations whence the fossils have been recovered. As in our 1986 and 1990(b) papers, the accurate rendering of the colours and hues of each specimen has been attempted through the use of the revised Munsell colour charts by Oyama et al. (1967). Several measurements have been arranged in Table 1. The same measuring procedures as in our two previous publications were again used, enabling a comparison with the data published there.

DESCRIPTION

The first specimen described here (Fig. 2 A, B) is a complete, slightly eroded mandible, St. 172351. Its label, *Odobenus* sp., contains the information that it was bought for Dfl. 50.- from a Mr Jaco v.d. Bent from Katwijk-aan-Zee on

Table 1. Mandibular measurements (in mm).

	St. 118436	152995	172351
Max. length, left half mand. ramus	256	259	261
Max. length, right half mand. ramus	-	-	258
Height, horiz. left ramus at P3	74	77	69
Height, horiz. right ramus at P3	-	-	68.5
Height, vertic. left ramus	93	89	91
Height, vertic. right ramus	-	-	89
Vertic. height of symphysis in nat.position	49	58	62
Sagitt. width of symphysis in nat. position	106	81	107
Dist.centr.l.&r.proc. coronoidei from above	-	-	143
Ext.dist.l.&r.proc. condylares from above	-	-	223
Hor. x vert. dimensions left for.mentale	10.5x7.5	8x6	10.0x7
Hor. x vert. dimensions right for. mentale	-	-	11.5x7
Low.edge l.mand.-low.edge l.for.mentale	42	43	45
Low.edge r.mand.-low.edge r.for.mentale	-	-	44
Upp.edge l.for.mentale-edge alv. P2 sin.	25	29.5	± 22
Upp.edge r.for.mentale-edge alv. P2 dext.	-	-	24
Horiz.x vert.dimens.of for.mandibulae sin.	20x6.5	15x7	19x9
Horiz.x vert.dimens.of for.mandibulae dext.	-	-	19x11
Horiz. width of left condylus	52	48	57
Horiz. width of right condylus	-	-	57
Min. width left half horiz. mand. ramus	27	34	29
Min. width right half horiz. mand. ramus	-	-	28

Alveolar measurements of:	a.p.	tr.	a.p.	tr.	a.p.	tr.
M1 sin.	15	10.5	-	14.5	18.5	15
M1 dext.	-	-	-	-	14.5	13
P3 sin.	19.5	14	22	14	21	17
P3 dext.	-	-	-	-	21.5	16
P2 sin.	18	13	21	14.5	±22.5	±16
P2 dext.	-	-	-	-	21	16
P1 sin.	19.5	16.5	23	17.5	23	16
P1 dext.	-	-	22.5	16	22	17

November 22, 1976, and that it had been trawled from the North Sea bottom, probably near the Brown Ridge. Colour and hue of the rather heavily mineralized fossil vary from 7.5 YR 4/4 to 4/6 (brown), with some patches and areas of 6/3 (dull brown). In some places a thin surface layer has flaked off, disclosing much lighter coloured bone with some thin black wavy lines underneath, 7.5 YR 8/6 (light yellow orange). All dental elements have been lost, the canines and incisors evidently already during life, as is usual among older adult walrus individuals. The alveolar edges of the three premolars and the single molar on each half lower jaw are somewhat damaged, especially those on the left half. The medial posterior regions of each of the two condyli are damaged also, probably long ago. The angle between the left and right horizontal rami, seen from above, is approximately 48 degrees. This indicates the narrowness of the individual's palate in front, and, in consequence, a relatively short distance between the two tusks in the upper dentition. As postulated by Mohr (1942) it implies that the individual is female; in

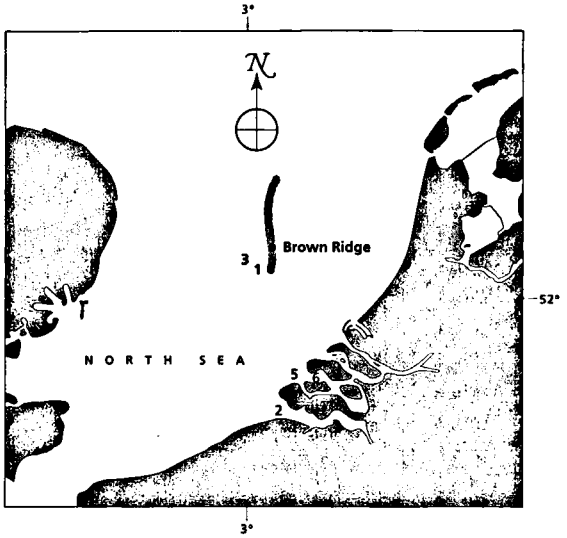

Fig. 1. Sketch map of southern part of the North Sea and the estuary of the Schelde, with localities of collection of the described specimens: 1, near the Brown Ridge (St.172351); 2, in front of Nieuwe Sluis, mouth of western Schelde (St.118436); 3, 52 °30'N/3°10'E (St.152995); 5, the Roompot, a gully in front of Domburg (St.20087); 6, gully in front of Wissenkerke (unnumbered specimen).

the present case it must have been rather robust in appearance. The dental alveoli are normal in outline. Right and left single mental foramina are comparatively large. Each possesses an internal vertical bone partition of the kind described by us in 1986 and 1990, thus proclaiming this feature as evidently typical for *Odobenus*. Small pin-point-sized foramina are present along the upper ('occlusal') edges of the remaining traces of the canine emplacements and, in front, near the symphyseal midline. The relatively small left and right mandibular foramina open horizontally backward almost straight below the highest points of the low and rounded coronoid processes and point in a direction between the angular and the condylar processes. The symphyseal region is extraordinary massive. The low vertical and horizontal mandibular rami form angles with values between 135 and 140 degrees when measured along the inner sides.

A second mandibular specimen, this time only a left half lower jaw (Fig. 2 D, F), is St. 118436. Its label, where it is mentioned as *Odobenus* sp., informs us that it was collected from the western Schelde in front of Nieuwe Sluis and acquired through the intermediary of Mr J. P. Jacobs. Its colour and hue are a uniform 10 YR 5/2, greyish yellow brown. Just as in St. 172351 all teeth are lost. The left canine and incisors have even left less traces of their presence, pointing to an individual age of the specimen which has probably surpassed that of St. 172351. The half-mandible, although complete, save for some slight damage along the alveolar edges and the entire lower rim of the condylar process, makes a rather worn and rolled impression. It may have lain uncovered on the bottom of the Schelde for a considerable time, while being subjected to the polishing action of passing sand and small stones. The heavy bone appears to have been strongly mineralized. The half-mandible has broken precisely along the symphyseal plane. The symphysis must have been heavy and robust. Except for the fact that the size of each alveolus indicates that the individual has had relatively small teeth in comparison to the earlier described specimens, no exceptional particulars can be observed. The single left foramen mentale is proportionately large and contains clear traces of the typical vertical bony partition mentioned in previous cases. A small foramen is present some 10 mm below the edge (on the external side) of the alveolus for P3, while another, similar foramen exists in front at 6 mm from the symphysis and 15 mm below the upper edge of the jaw. The mandibular foramen is relatively large and opens backward in the same way and at the same place as described in St. 172351. The inside angle between the horizontal and vertical rami is approximately 135 degrees, while a rough attempt at defining the angle between the original left and right halves of the mandible, seen from above, arrives at (2 x 22=) 44 degrees. This would indicate that this individual was female.

A third mandibular specimen, again a left half jaw (Fig. 2 C, E), bears the number St. 152995. It is booked as *Odobenus* spec. and has been trawled up from the North Sea bottom at a point defined as 52° 30'N, 3°10'E. It was acquired through the intermediary of the Central Fisheries Laboratory at IJmuiden on April 17, 1969. Its colour and hue are mainly 7.5 YR (dark brown) with numerous large patches and areas of 8/4 (light yellow orange). The specimen is heavily mineralized and rather eroded and rolled, so that it must have lain

Fig. 2. A, occlusal aspect, and B, slightly oblique left vestibular aspect of mandible St. 172351; C, occlusal, and E, left vestibular aspect of half-mandible St. 152995; D, occlusal, and F, left vestibular aspect of half-mandible St. 118436.

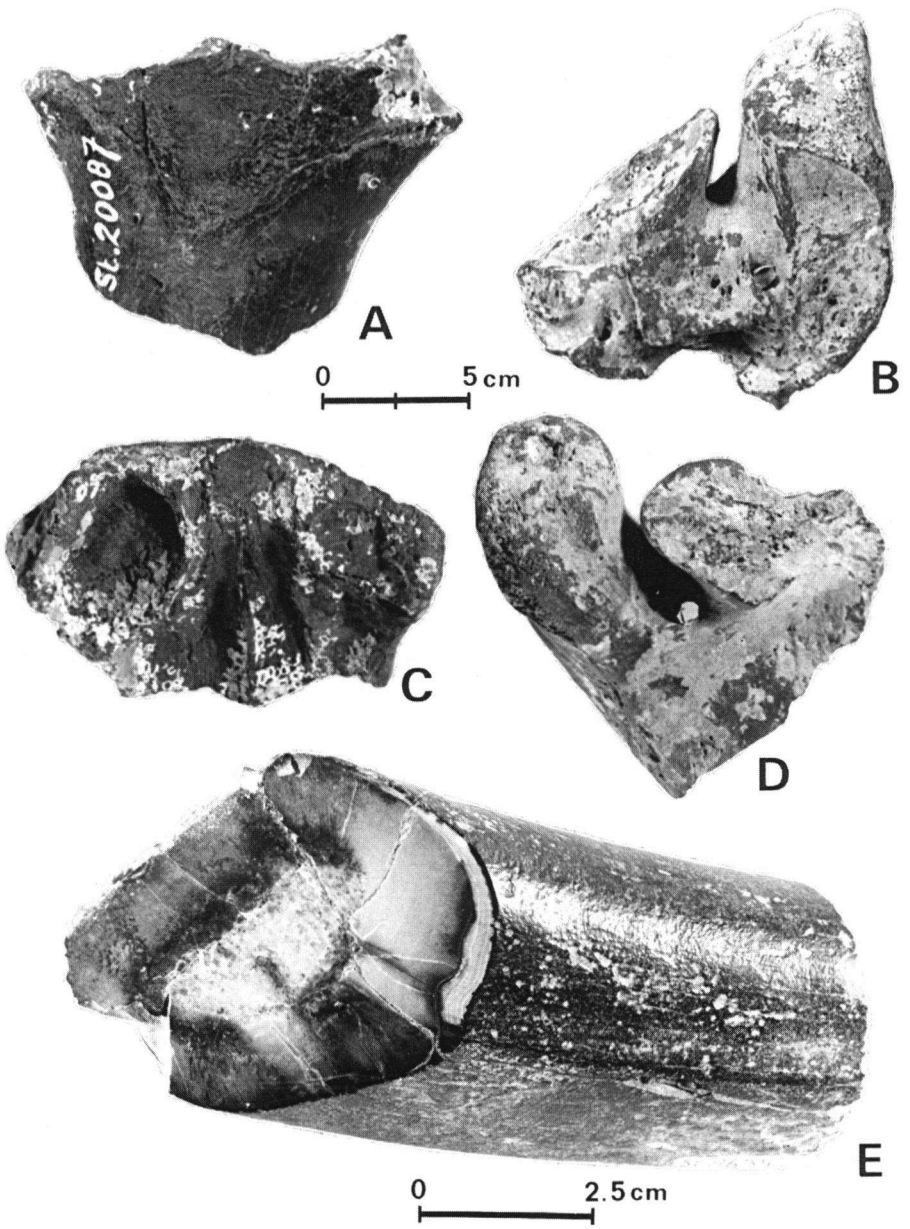

Fig. 3. A, aspect from above, and C, from below, of fragment with part of nasalia and frontalia St.20087; B, aspect from below, and D, from in front, of left temporal fragment, with processus mastoideus, of unnumbered specimen from Wissenkerke; E, posterior and somewhat oblique aspect (note globular vasodentine in centre of polished proximal plane, left) of right (?) tusk section St.86347.

uncovered on the bottom for a considerable time. A small medial part of the right half jaw is still present; this half-mandible has broken through vertically, right in the middle of the alveolus of P2. As in the former specimens, the symphyseal region is heavy and robust. The angle between the two rami, seen from above, has an approximate value of no more than 41°, indicating that this too is a female individual. It must have attained a considerable age, because nearly all traces of the former presence of lower canines and incisors are gone and synostosed. So is the alveolus for M1, evidently a tooth lost during life. Only its transverse width can be (approximately)

measured. All other teeth are lost; as in the two previous cases only alveolar measurements can be given. The single, large left mental foramen below P2 again displays its internal vertical bony partition. Four to five small foramina are present in front near and along the symphyseal plane at some 15 to 20 mm below the 'occlusal' surface. The mandibular foramen opens up to the back, is not proportionately large and is situated as in the two specimens previously described. No other foramina are observable. The inside angle between the left horizontal and vertical rami attains a value of some 140.

A fragment of a tusk, inscribed as St. 86347 (Fig. 3E), bears the additional information on its two labels that it has been collected by Dr. A. B. van Deinse from "the waters around Zeeland". It is identified as *Trichechus* spec. on one, and as *Alachtherium* sp. on the other label. The maximum length of the fragment is 102 mm. At its obliquely cut and polished distinctly ovaloid proximal end it measures 58 mm in an anteroposterior sense and 35 mm in a mediolateral sense, while its equally cut and polished ovaloid distal extremity has an anteroposterior dimension of 51.5 mm and a mediolateral one of 31.5 mm. In view of the circumstance that one of the two almost flat vertical sides of the fragment displays a rather outspoken vertical fluting while the other flat side bears a roughened vertical plane of wear (with a barely distinct shallow vertical fluting behind it), we assume, with some hesitation, that the tusk is one of the right side; the most strongly developed fluting appears to occur on the external vertical face of the tusk, as in the specimen K 8052 described in our 1990b paper (Bosscha Erdbrink & van Bree, 1990b: 87-89, Pl. 1C). The ivory of the tusk is completely silicified and very dark and heavy. Its external colour and hue are uniformly black (10 YR 1.7/1), while the ivory on the polished and cut surface has an internal colour and hue between 10 YR 5/3 (dull yellowish brown) and -4/4 (brown). The very typical walrus structure of globular vasodentine in the core of the tusk is clearly observable. This core, which measures 33 by 13 mm at its proximal end and 30 by 11 mm distally, is surrounded by solid dentine without visible traces of growth rings (Fay, 1982). The solid ivory has a thickness of approximately 11 to 12 mm at each extremity, which is not much different from the situation encountered in the recent walrus. The tusk fragment is not strongly curved; the tooth may therefore have been of a considerable length, perhaps indicating its male sex.

St. 20087 is a cranial fragment identified as *Odobenus* cf. *antverpiensis* (Rutten) on its label, which also contains the information that it was bought through the intermediary of the Zeeuwsch Genootschap at Middelburg and that it had been collected from a trough to the North of the isle of Walcheren, known as the Roompot, near Domburg, in 1934. The specimen (Fig. 3A-C), a flat piece of bone with a trapezohedral outline, having a base of 143 mm, a top of 98 mm and sloping sides of 90 and 75 mm, consists of the posterior portion of the nasalia (with numerous foramina on their external surface, no doubt related to the typical tactile vibrissae on the walrus snout), and an anterior part of the frontalia. The bone is very heavily mineralized and partly overgrown by Bryozoan colonies, which indicates that it has lain free on the bottom for a considerable time. Colour and hue are 10 YR 3/1 (brownish black) to -1.7/1 (black) on the upper (or external) side, and -4/1 (brownish grey) on the inner side. This side displays part of the surface of the nasal cavity together with (presumably) small areas of the extreme upper ends of the alveoli for the two tusks. These last features show a curious, finely wrinkled bony surface at their uppermost limits. When seen from aside, the nasal-frontal midline follows a flat, even slightly concave profile, which may well indicate that its identification as *antverpiensis* is correct.

A last cranial fragment, as yet without a number but also encountered among the material in the Leiden collection, is a large piece of a left temporal bone containing the complete mastoid process and the sheath for the styloid process, and much of the acoustic meatus (Fig. 3B-D). On the inner side a number of impressions above the internal acoustic meatus are visible, presumably representing the subarcuate fossa and the sulcus for the superior petrosal sinus. The label of the piece contains the information that it has been fished up by the fishing vessel Th 6 near Wissenkerke (on the island of Noord Beveland) and that it was donated by the Rijksmuseum van Oudheden at Leiden in August, 1972. It has

been identified as *Odobenus* spec.. The fragment is heavily encrusted with Bryozoan colonies and Balanidae, attesting that it must have lain free on the bottom for a considerable time. Colour and hue of the very strongly mineralized and heavy fossil are 10 YR 4/1 to 3/1 (brownish grey to brownish black) with -7/2 (dull yellow orange) for the encrustations. Size and morphology of the fossil are almost identical with the corresponding parts in recent male walrus skulls in the collection of the Zoological Museum at Amsterdam. It appears almost meaningless to take measurements from this irregular fragment of bone, apart from recording that the diameter of the acoustic meatus varies from 17 to 18 mm and that the mastoid process, having a rounded-rectangular outline, has a maximum antero-posterior length (in a horizontal sense) of 64 mm and a transverse width, at the same place, of 40 mm.

IDENTIFICATION AND DISCUSSION

St. 172351, the complete fossil female mandible without teeth from the Brown Ridge area, may be identified as *Odobenus rosmarus rosmarus* (Linnaeus, 1758), the Atlantic subspecies of the recent walrus, because the horizontal angle at the symphysis, formed by the two half-mandibles, is such that the two tusks in the upper jaw stood relatively close together. This indicates that the animal has been fully capable of producing the 'vacuum pump'-effect described by Fay (1982: 167-171) from the recent walrus, which we cited in our 1990(b) paper. The locality of collection indicates that the animal must have belonged to the Atlantic subspecies. It may possibly date back to Weichselian times, or somewhat younger.

St. 118436, the heavily fossilized half-mandible collected in front of Nieuwe Sluis at the mouth of the western Schelde, displays small alveoli of its missing teeth. This, together with its state of mineralization, may well point towards an *Odobenus cretsii* (Du Bus, 1867), but the relatively small horizontal symphyseal angle, perhaps indicative of the female sex, is not in accord with this supposition and favours an identification as *Odobenus rosmarus*. The most prudent solution, as long as sexual dimorphic features of *cretsii* remain unknown, is a determination as *Odobenus* species.

St. 152995, from a certain point in the North Sea (see Fig. 1), a heavily mineralized left half-mandible, possibly female, resembles its recent counterpart so much that we do not hesitate to identify it as such, but whether it already belongs to the Atlantic subspecies should remain an open question. Its heavy degree of fossilization may indicate a considerable stratigraphical age. Thus a determination as *Odobenus rosmarus* (Linnaeus, 1758), ssp., does appear warranted.

St. 86347, the very heavy silicified fossil section of a tusk of the (?) right side, constitutes an interesting problem. The flattened oval outline of its transverse section is in accordance with our observations (1990b: 89) regarding this feature in *O. antverpiensis*. If, as we think, *antverpiensis* is but a younger synonym (perhaps) for *huxleyi,* one should expect the outer layers of dentine and cementum around the core of globular vasodentine in the present tusk-fragment to be very thin, something like the 2.5 mm in the specimen 919R of the Sekeres collection described and figured by us in 1986 (Bosscha Erdbrink & van Bree, 1986: 17). As we stated there, this should be seen as a "valid differential feature" between the two forms, *huxleyi* and *rosmarus*. However, it is 11 to 12 mm in the presently described specimen! As long as the tusk of *O. antverpiensis* is not known, this observation may EITHER mean that *O. antverpiensis* and *O. huxleyi* (Lankester, 1865) are two separate, distinct species, in which *antverpiensis* has a thick dentine-cum-cementum covering of the globular vasodentine in the core of its tusk, comparable to the situation in the recent *O. rosmarus,* and *huxleyi* a thin covering; OR, that the present tusk-section belongs to a different species altogether, perhaps of a much older stratigraphical age (in view of the heavy state of fossilization), while *antverpiensis* and *huxleyi* are one and the same animal, with a thin covering of the globular vasodentine.

We rather favour this latter option, the more so because the "waters around Zeeland", especially around the mouth of the western Schelde (in front of Nieuwe Sluis, and in front of Westkappelle near Domburg on the island of Walcheren) are known to possess some particularly deep gullies and troughs where sediments of a much older, Miocene and Pliocene age occur quite near the surface of the irregularly shaped bottom. The local Miocene is represented by the Breda For-

mation, the local Pliocene (up to the Pretiglian) by the Brielle Ground Formation, as can be gathered from a recent Geological map (Rabsbank sheet, Geological Survey of the Netherlands; Ebbing et al., 1992). The upshot of this, regarding a correct iedentification of St. 86347, is that the fossil may represent an ancestral form such as *Prorosmarus,* the tusks of which are thus far unknown but which may well have had a thicker dentine-cum-cementum cover of the globular dentine core, comparable to that in the recent *O. rosmarus.* St. 86347 should be determined as *Odobenus* species, exactly as in the case of the Miocene fossil from the German island of Sylt described by us (1990a). We are not able to observe morphological differences between a tusk section of the recent *Odobenus* and this fossil; and indeed we question the validity of a generical distinction between *Odobenus* and *Prorosmarus,* only based upon a difference in stratigraphical age.

In the case of St. 20087, the cranial fragment consisting of part of the nasal and frontal bones, collected at the gully known as the Roompot (one of the localities where older sediments such as the Plio-Pleistocene Brielle Ground Formation lie near the surface of the bottom), we have already indicated our belief, based on the somewhat concave sagittal suture of the skull as far as this is present on the fragment (Bosscha Erdbrink & van Bree, 1990b: 90), that its provisional identification as *Odobenus* cf. *antverpiensis* (Rutten, 1907) is correct.

The unnumbered temporal fragment collected in front of Wissenkerke is atypical. Its heavily fossilized state pleads in favour of a rather early stratigraphical age, but as we have no other indications, the fossil may equally well be *O antverpiensis* as *O. rosmarus.* We therefore opt for an identification as *Odobenus* species.

The generical name *Alachtherium* has been mentioned in the present paper. This applies, more specifically, to *Alachtherium cretsii,* the form described by the Vicomte B. du Bus (1867: 566) from a half-mandible containing two peg-like incisors, a canine and four post-canine teeth of "smaller size than the canine, but having the same form", the whole of a size definitely (much) larger than a recent walrus, while the curvature of the os mandibularis exceeds that encountered in the recent animal. The fossil had been collected during the construction of a fortification at Wijneghem, a western suburb of Antwerpen, in 1863 by a Captain of Military Engineers, Crets. It is stated to have been extracted from the upper part of a "crag", i.e. probably a Pliocene or Early Pleistocene shell-bearing formation. The description of the fossil, not accompanied by a figure, is rather lacunary. However, its large size, the evidently curved (not plate-like flattened) teeth, and the peg-like incisors, together with its presumed stratigraphical age, strongly point to an identity with *Odobenus huxleyi* (Lankester, 1865) and also with *Odobenus antverpiensis* (Rutten, 1907). Of course Lankester's name has precedence when the three forms are indeed identical, which is subject to further research and to the finding of more material. Du Bus' generic name *Alachtherium* should, in any case, be relegated to the nomina relinquenda. In our view, Systematic Zoology has been invented in order to obtain a comprehensive oversight of all zoological forms; it should be kept as simple as possible so as not to obstruct that idea.

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