ZOOLOGY

MAXILLARY TEETH IN SPECIMENS OF HYPEROODON ROSTRATUS (MÜLLER) AND MESOPLODON GRAYI VON HAAST STRANDED ON THE DUTCH COASTS

BY

H. BOSCHMA

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In various species of Ziphioid Whales there occur, besides the larger teeth found at the extremity or near the posterior end of the symphysis of the mandible, very small teeth, in the upper jaw as well as in the lower.

In *Hyperoodon rostratus* (Müller) these teeth have been recorded by several authors. LACÉPÈDE (1804) remarked that in this species there were small teeth, not only on the sides of the upper jaw, but also on the palate. It seems, however, that LACÉPÈDE erroneously regarded the rough papillae on the palate as teeth (BEDDARD, 1900, p. 222). Later ESCHRICHT (1845) found three small teeth projecting through the gum of the upper jaw and two similar teeth in the lower jaw of a specimen of *Hyperoodon*. Further research led to the discovery of a larger number of these teeth embedded in the gums of both jaws of this specimen. There were twelve to thirteen on the right side of the upper jaw, probably the same number on the left side; in the right half of the lower jaw there were eleven rudimentary teeth, for the left half the number was not noted before they were lost. The eleven small teeth in the right half of the lower jaw were figured (copied in text-figure 1*b* of the present paper). The rudimentary teeth described by ESCHRICHT were slightly curved, their length was 3.3 to 5.9 mm, their thickness up to 1.6 mm. In the specimen of *Hyperoodon* dissected by VROLIK (1848) there were six rudimentary teeth in the foremost part of the left lower jaw, completely hidden in the gum. VROLIK's figure of these teeth has been copied in text-figure 1*c* of the present paper. The teeth are smaller than those described by ESCHRICHT, their length varying from 1.37 to 2.75 mm. Various other authors have drawn attention to these small teeth in *Hyperoodon*.

Repeatedly similar small teeth have been observed in the upper as well as in the lower jaw of *Ziphius cavirostris* Cuvier. As a rule these were of very small size, but a fairly large rudimentary tooth was described and figured by TRUE (1910). This tooth had a length of 16 mm and a thickness of 2 mm. Generally in *Ziphius cavirostris* these teeth are extremely small; large rows of such minute teeth have been recorded by FRASER (1936). In one specimen there were fourteen vestigial teeth

on the right and twelve on the left side of the lower jaw, the largest tooth of the series measuring 8.5 mm. In a second specimen there were one vestigial tooth and seven follicles without calcified remains in the left lower jaw; the right lower jaw was not available. In the left upper jaw of the same specimen there were eight vestigial teeth and six or seven additional follicles, and in the right upper seven teeth and the same number of additional follicles. In a third specimen, of which one ramus of the lower jaw was available for dissection, there were twenty-eight vestigial teeth, the longest of which was 3.9 mm. Various other authors have mentioned the occurrence of similar teeth in *Ziphius cavirostris*, as a rule in much smaller numbers. On the other hand FRASER remarks that BURMEISTER in the Buenos Aires specimen of *Ziphius* found twenty-five teeth in each upper and thirty to thirty-two in each lower jaw.

VAN BENEDEN (1888) and BEDDARD (1900) state that rudimentary teeth of the same size and structure as those of other Ziphioid Whales not unfrequently occur in *Mesoplodon bidens* (Sowerby). Obviously this statement is based on the small functionless teeth described by GERVAIS (on page 402 in VAN BENEDEN and GERVAIS, 1880, figures 6 and 8 on plate XXVI). At a very short distance from the larger tooth in the lower jaw there were on one side four and on the other two teeth not longer than 5 mm; originally there may have been more of these teeth. In a specimen of *Mesoplodon bidens* stranded in the Shetland Islands HARMER (1927, p. 56) found six vestigial teeth concealed in the gum of the right ramus of the lower jaw, the row commencing 34 mm behind the large tooth; in the left ramus of the lower jaw one vestigial tooth was found.

In the rarer species of the genus *Mesoplodon* up to the present time no vestigial teeth similar to those dealt with above were found. On the other hand in *Mesoplodon grayi* von Haast, a species fairly common in New Zealand waters, the occurrence of a row of small teeth on each side of the upper jaw seems to be a constant character of the species. The peculiarities of these teeth are discussed below.

In the present paper the maxillary teeth of two specimens of Ziphioid Whales in the collection of the Leiden Museum are described in some detail.

Hyperoodon rostratus (Müller)

The specimen (Leiden Museum, reg. no. 7218) stranded on the Noorderleeg on the Frisian coast on October 19, 1946. It proved to be a male of a total length of 7.5 m. Mr. H. CORNET, technician of the Leiden Museum, who was in charge of the activities for roughly cleaning the skeleton on the spot, took care to preserve strips of the gum of each side of the upper jaw, each containing two or more small teeth, slightly projecting above the surface. In its lower jaw the specimen has one tooth of fairly large size in the left half, and in the right half two teeth of slightly smaller size, the one at some distance behind the other.

The preserved part of the gum of the right upper jaw showed ten distinct shallow pits in a slightly curved line, in the five hindmost of which the tip of a small tooth was visible (Pl. I fig. 1). The pits shown in Pl. I fig. 1 correspond with the numbers 5 to 14 in text-figure 1*a*. Dissection of the gum showed that before the first visible pit there were four small teeth completely embedded in the tissues, surrounded by a fibrous tooth-sac. The pits numbered 5, 6 and 7 (the uppermost in Pl. I fig. 1) proved to be empty follicles; undoubtedly here the teeth recently had fallen out. The pits numbered 8 and 9 each contained a small tooth. As remarked above the teeth in the pits numbered 10 to 14 were already visible before dissection. The last of the row (no. 15 in text-figure 1*a*, not visible in Pl. I fig. 1) again was a small tooth completely hidden in the gum. The accurate position of the teeth in the gum is given in text-figure 1*a*, the distance (in mm) of each of these teeth or tooth-pits from the tip of the lower jaw is:

1: 428	6: 500	11: 570
2: 446	7: 517	12: 585
3: 461	8: 531	13: 592
4: 475	9: 545	14: 599
5: 492	10: 560	15: 606

On the left side of the jaw there were two visible teeth, distinctly projecting through the gum, and no pits indicating the presence of other teeth. Dissection showed that behind these two teeth there were two more, entirely hidden in the gum. The first of these four teeth was situated as far from the tip of the jaw as the tenth tooth of the row on the right side. The accurate position of the teeth in the gum is given in text-figure 1*d*, the distance (in mm) of each of these teeth from the tip of the lower jaw is:

1: 560	3: 593
2: 578	4: 602

All the maxillary teeth of specimen no. 7218 are figured, 5 times enlarged, on Pl. II of the present paper. As far as the larger teeth are concerned the lingual surface is represented, for some of the smaller teeth the exact position in the photographs is not certain. As a rule the teeth are slightly curved, the concave side being turned posteriorly and ventrally, the convex side anteriorly and dorsally. The topmost parts of the teeth that protruded through the surface of the gum are comparatively smooth (the first two teeth of the upper row and the first four of the lower row of the plate). The smallest teeth on almost the whole of their surface are covered with an irregular layer of cement (middle row), the same is found on the roots of the larger teeth. In many of the larger teeth the roots are conspicuously enlarged by masses of cement (first tooth of the upper row, and four in the lower row of the

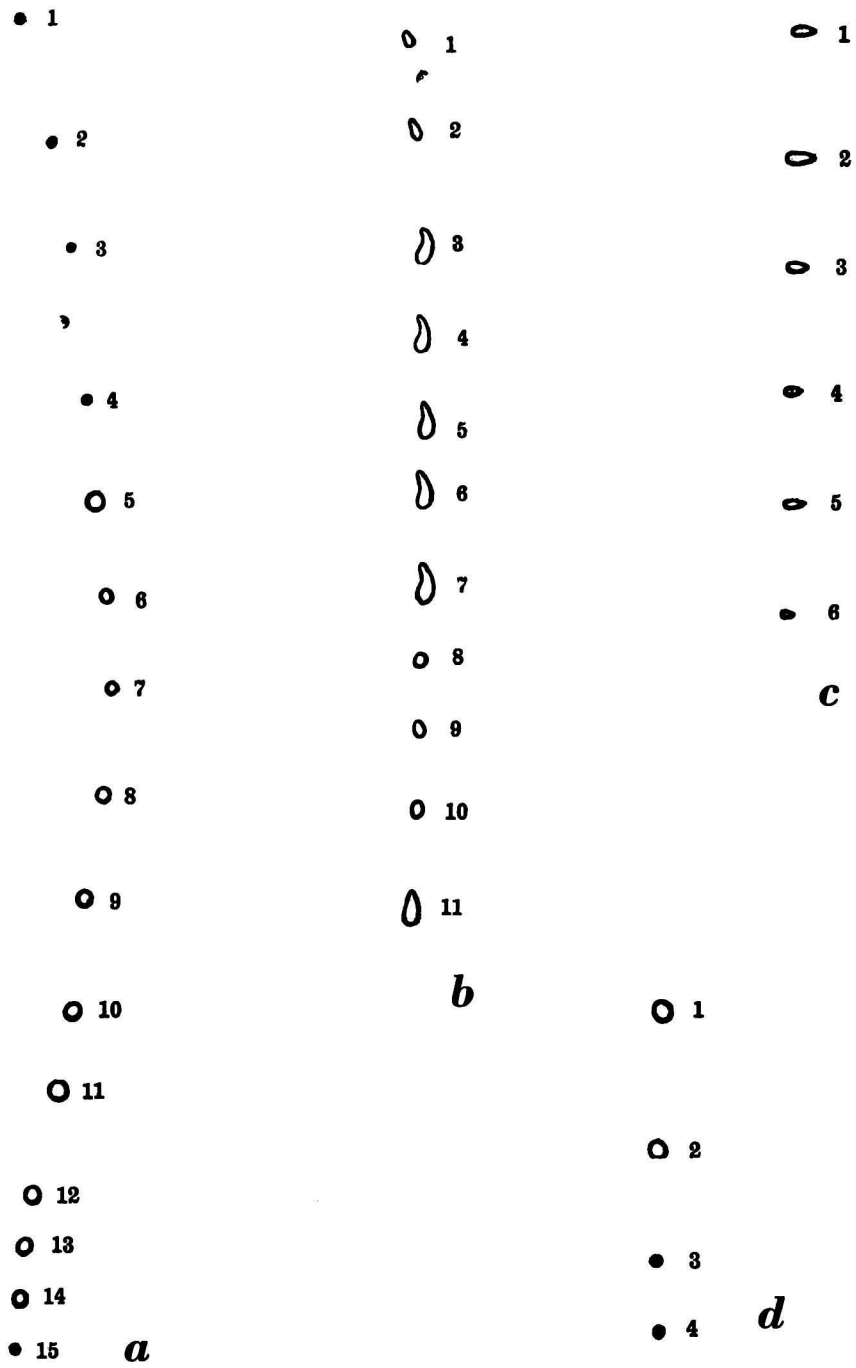


Fig. 1. *Hyperoodon rostratus* (Müller). *a*, Leiden Museum reg. no. 7218, right maxillary toothrow; *b*, right mandibular toothrow (except the large anterior tooth) after ESCHRICHT (1845, woodcut on page 338); *c*, left mandibular teeth (except the large anterior tooth) after VROLIK (1848, Pl. VIII fig. 14); *d*, Leiden Museum reg. no. 7218, left maxillary toothrow. Natural size.

plate). The roots of the teeth, even in the smallest, are completely closed. In the larger teeth that do not show the long projections of cement the roots are closed by a bulbous mass of tooth tissue (distinctly visible in two teeth of the upper row and in two of the lower row of the plate). The length of the teeth without the projecting masses of cement varies from 3 to 6 mm, the length including the irregular masses of cement may amount to 11 mm. The thickness of the teeth is from 1 to 2 mm.

With the exception of the masses of cement the larger mandibular teeth of the present specimen correspond in size and in shape with those described by ESCHRICHT (1845, cf. also text-figure 1*b*); the smaller teeth are similar in shape and in size to those described by VROLIK (1848, cf. also text-figure 1*c*). Undoubtedly they are entirely functionless; those of which the tips protruded above the surface were so loosely attached that they easily could be moved about in their alveoli, at their extreme lower ends only they were firmly attached to the surrounding tissue.

Mesoplodon grayi von Haast

The specimen (Leiden Museum, reg. no. 1638) stranded on December 11 or 12, 1927, near Kijkduin, Loosduinen (North Sea coast of the province South Holland). It has been mentioned by VAN OORT (1928) as an accession for the Leiden Museum, and later by VAN DEINSE (1931), who comments upon the fact that two rows of about twenty small maxillary teeth have been preserved on the skull. In the two cited publications the (female) specimen is named *Mesoplodon bidens* (Sowerby), its length is recorded as 4.6 m.

Just as in the three skulls on which the description of the species *Mesoplodon grayi* was based (VON HAAST, 1876*a*) our specimen shows, on both sides of the upper jaw, commencing in the region of the conspicuous tooth in the lower jaw, a row of small teeth (text-figures 2 and 3). On each side there are twenty-two of these teeth, the greater part of which for a distance of 2 or 3 mm protrude above the surface. The toothrows have a length of about 10 cm, the teeth themselves are placed at fairly equal distances from each other. In our specimen the part of the gum containing the teeth probably has shrunk by the process of drying, so that in the living animal the length of the toothrows may have been somewhat larger. The teeth at the beginning and at the end of each toothrow are slightly smaller than those in the middle region. The largest teeth have a length of about 12 mm, one third of which protrudes from the gum; their thickness is about 1 to 1.5 mm. The teeth are slightly curved, the concave side being turned inwards. Owing to the shrinking of the surrounding tissues the embedded parts of the teeth are faintly visible. The tips of some of the teeth have broken off, but this may have occurred during or after the mounting of the skeleton.

Eight of these small teeth (nos. 11 to 14 and nos. 7 to 10 of the left toothrow) are shown, 5 times enlarged, on Pl. I figs. 2 and 3. Their shape

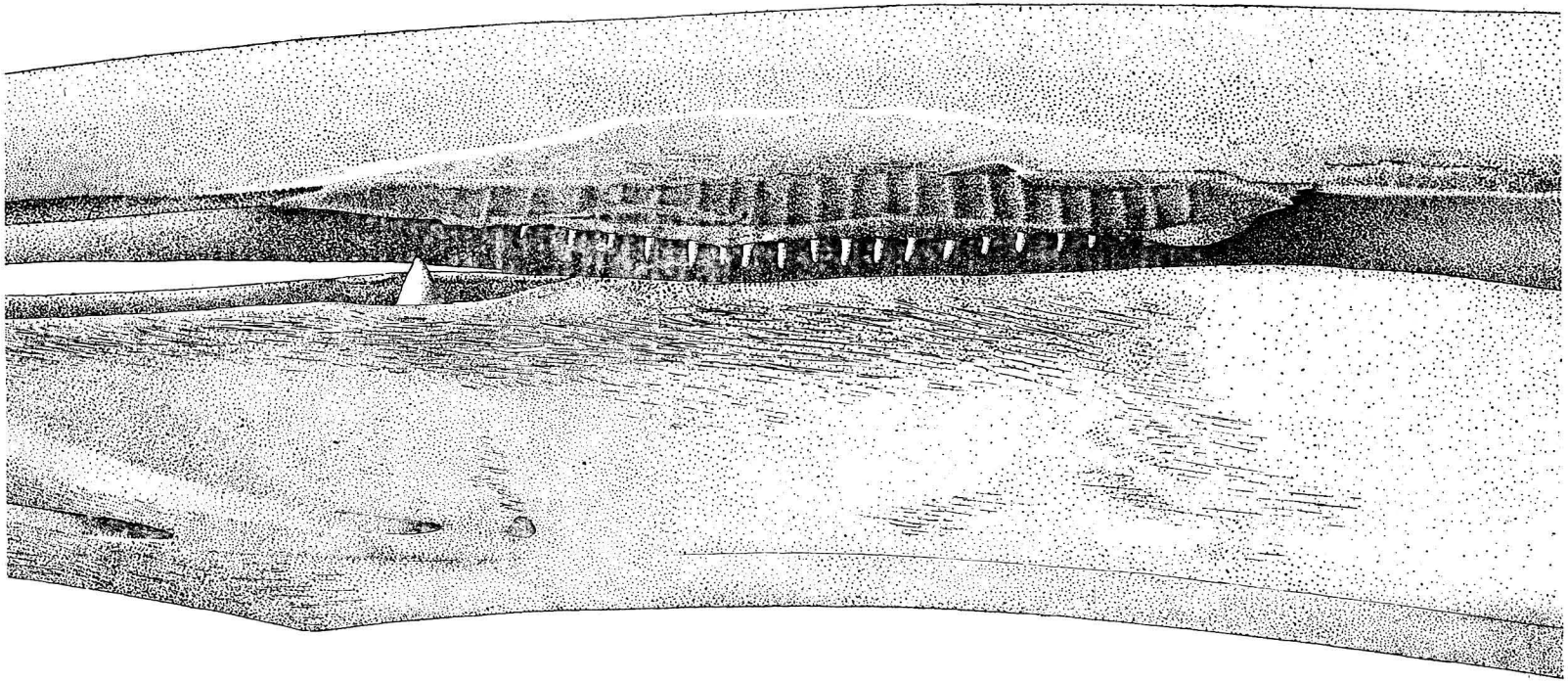


Fig. 2. *Mesoplodon grayi* von Haast, Leiden Museum reg. no. 1638, part of rostrum and lower jaw, left side. Natural size.

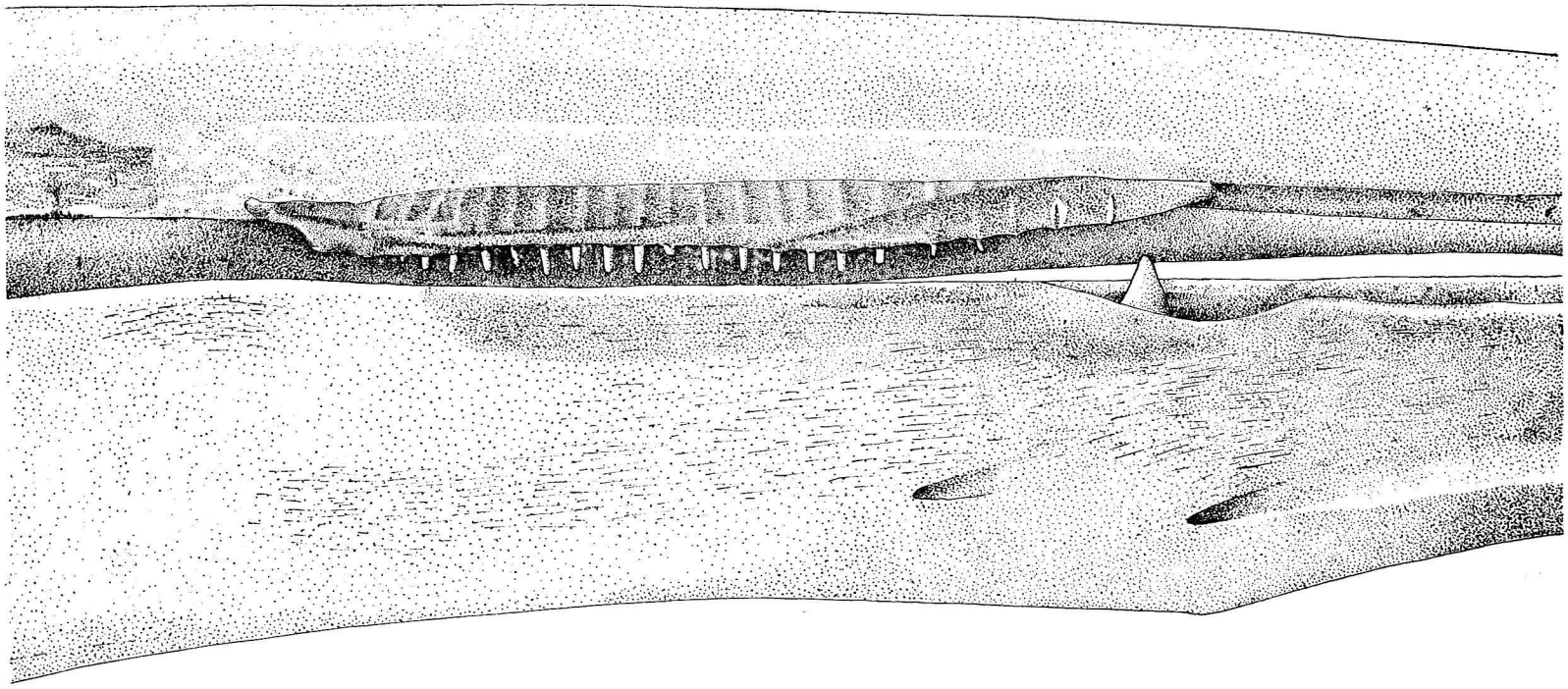


Fig. 3. *Mesoplodon grayi* von Haast, Leiden Museum reg. no. 1638, part of rostrum and lower jaw, right side. Natural size.

is very similar to that of the teeth of the Common Dolphin (*Delphinus delphis* Linnaeus). Many of these teeth have split lengthwise, a common occurrence in various Cetaceans when preserved as museum specimens.

In contradistinction to the minute teeth in *Hyperoodon* these teeth in *Mesoplodon grayi* do not give the impression of being rudimentary. It is true that they are not placed in distinct alveoli, but this is not exceptional in Toothed Whales. Even in the Sperm Whale (*Physeter macrocephalus* Linnaeus) the teeth of the lower jaw are so loosely set in the dental groove that it is difficult to regard their place of attachment as a real socket; the fastening of the teeth to the jaw is largely due to the hard and extremely fibrous gum. In the specimen of *Mesoplodon grayi* dealt with here the row of teeth on each side of the upper jaw was implanted in the lateral basirostral groove.

The minute teeth in the upper jaw of *Mesoplodon grayi* do not appear as being in a rudimentary state. They are, as remarked above, very similar to those of the Common Dolphin, and, as in the latter species, in all probability they have a definite function for capturing or holding the prey. This opinion is in full agreement with that of VON HAAST (1876*a*).

Moreover, VON HAAST (1876*a*) regarded the row of minute teeth as the distinctive specific character of the species. His three original skulls of *Mesoplodon grayi* showed nineteen, seventeen, and seventeen of these teeth respectively. In four specimens stranded at a later date there were from seventeen to nineteen teeth on both sides of the roof of the mouth (VON HAAST, 1876*b*). In the specimen from South Australia described by HALE (1932) on one side of the upper jaw there were fifteen small teeth (on the left side the soft parts had decayed when the specimen was collected). FLOWER (1879) examined a specimen of *Mesoplodon grayi* with eighteen maxillary teeth; VAN BENEDEN and GERVAIS described a specimen with eighteen maxillary teeth on the left side and seventeen on the right (GERVAIS, in VAN BENEDEN and GERVAIS, 1880, p. 518, Pl. LXII fig. 2*a*). The Leiden Museum specimen, with its rows of twenty-two maxillary teeth on each side of the jaw, therefore, has a slightly larger number than previously recorded.

In VON HAAST's drawing (1876*a*, figure on page 10) and in HALE's figure (1932, fig. 9) the minute teeth of *Mesoplodon grayi* appear even more strongly developed than in the Leiden Museum specimen, and in all these cases they give the impression of being functional. In VON HAAST's specimens these teeth had a length of 0.20 to 0.40 inch (5 to 10 mm), the largest tooth at its base was $\frac{1}{8}$ of an inch (3 mm) thick. In HALE's figure the small teeth appear to protrude from the gum for up to 8 mm, but this may be due to partial decay of the object. Here the teeth again have a thickness of 1 to 2 mm. It is interesting to note that in VON HAAST's figure *b* (1876*a*, page 10), showing four of the upper teeth with the whole of their roots exposed, the basal parts of the roots have an even contour, indicating that the teeth were still in full growth.

This again is an argument in favour of the opinion that the minute teeth in *Mesoplodon grayi* are functional.

The occurrence of well developed toothrows on each side of the rostrum formed an indication for the possible identity of the Leiden Museum specimen as *Mesoplodon grayi*. The skull was compared with that of three specimens undoubtedly belonging to *Mesoplodon bidens*, in various respects it proved to be distinctly different from these. A comparison of the skull with the figures of FLOWER (1879, pls. LXXI and LXXII), of VAN BENEDEN and GERVAIS (1880, pl. LXII), of FORBES (1893, pls. XII and XIII), of HALE (1932, figs. 2—4), and of BRAZENOR (1933, pl. VI) showed a close agreement in every respect. As in the specimens described and figured by the authors cited above the skull of the Leiden Museum specimen shows the narrow base of the rostrum and the conspicuous lateral basirostral groove which form the striking characters of the skull of *Mesoplodon grayi*. The peculiarities of the Leiden Museum specimen of *M. grayi* and its differences from *M. bidens* will be dealt with in more detail in a later paper.

Mesoplodon grayi seems to be of fairly common occurrence in New Zealand waters (VON HAAST, 1876*a*, *b*). OGILBY (1892) notes as habitat for the species New South Wales and New Zealand. WAITE (1922) records the species for South Australia, based on a lower jaw only; HALE (1932) obtained a complete specimen stranded on the South Australian coast. BRAZENOR (1933) figures a skull without lower jaw found on the beach in Victoria. OLIVER (1922) gives as range of distribution New Zealand and Patagonia. Finally LYDEKKER (1911) records the species for the South coast of South Africa. Up till now, therefore, *Mesoplodon grayi* was known to occur in the Southern hemisphere only; the specimen stranded on the Dutch coast in 1927 forms the first record of the occurrence of the species in the Northern hemisphere.

Immediately after it had been found on the beach the carcase of our specimen of *Mesoplodon grayi* was transported to the Leiden Museum in completely undamaged state. Here Mr. M. A. KOEKKOEK executed an excellent picture of the specimen based on accurate measurements of all the various parts. This oil painting is reproduced on Plate IV of the present paper; it appears to be the first complete figure of the species. The figures on Plate IV are so exact that accurate measurements may be taken from these.

Concerning the colour of *Mesoplodon grayi* VON HAAST (1876*b*, p. 458) states: "The colour of the back is black, getting a little lighter near the tail, where it assumes a dark slate tint; the lower side is reddish brown, near the tail assuming on both sides a more blackish hue". In our specimen (Plate IV) the colour of the back is black to dark slate grey, on the sides towards the ventral surface the colour gradually becomes lighter, the sides being of a brownish grey. The ventral surface is of a light grey with a brownish tinge, with the exception of a broad darker

median band gradually becoming mottled anteriorly and vanishing in the region of the flippers. The flippers and the tail-flukes on both sides are very dark grey to black, the edges of the flippers have a lighter border. The lower jaw and the throat are of a very light grey, in some parts even whitish. On the edges of the upper jaw, around the navel, the genital aperture and the anus there are whitish lines. On the sides of the body there are one white streak and several smaller white patches; possibly these are to be regarded as scars.

The figures distinctly show the two throat grooves which anteriorly nearly meet in the basal part of the lower jaw. In dorsal and ventral view the rostrum appears very narrow.

The existing figures of *Mesoplodon bidens* as a rule show the animal in lateral view, figures of specimens in dorsal or in ventral view seem to be extremely rare. Fortunately the Rijksmuseum van Natuurlijke Historie possesses a photograph of a female specimen of *Mesoplodon bidens* (reg. no. 2114), total length 4 m, stranded near Hoedekenskerke, province Zeeland, September 14, 1932, showing the not too badly damaged carcase in dorsal view (Pl. III, upper figure). The triangular outline of the head is markedly different from that of *Mesoplodon grayi* of Pl. IV; in the latter the sides of the triangle are decidedly more concave than in the specimen of Pl. III. These differences closely correspond with those found in the skulls of the two species, the basal parts of the maxillary in *M. bidens* expanding far more laterally than in *M. grayi*.

The lower figure of Pl. III shows the ventral side of the head of *Mesoplodon bidens* no. 2114, here especially the throat grooves are to be seen, which are of a similar configuration as those of *M. grayi* (Pl. IV, lower figure).

HARMER (1918) discovered a fairly reliable character for distinguishing the three Ziphioid Whales not uncommonly stranding on the British coasts, by reducing the distance of the tip of the beak to the blow-hole to a percentage of the total length. These percentages are 14.0—22.0 for *Hyperoodon rostratus*, 10.4—12.6 for *Ziphius cavirostris*, and 9.7—15.2 for *Mesoplodon bidens*. In our specimen of *Mesoplodon grayi* this percentage is 13.4 so that in this respect it corresponds with *M. bidens*; in the specimen of Pl. III the percentage is 12.3.

As far as concerns the colour of *Mesoplodon bidens* there seems to be a great deal of variation, some specimens being described as entirely black, others as having white ventral parts. The following data in regard to the colour are given by HARMER (1927, pp. 55, 56): "The coloration of Sowerby's Whale is not constant, but is mainly black, although some specimens have a considerable amount of white on the ventral surface (Report no. 4, p. 12). A pregnant female stranded on December 18, 1892, and described by Mr. Southwell and myself, was almost entirely of a uniform black colour, though it was stated that when quite fresh a bluish

PLATE I

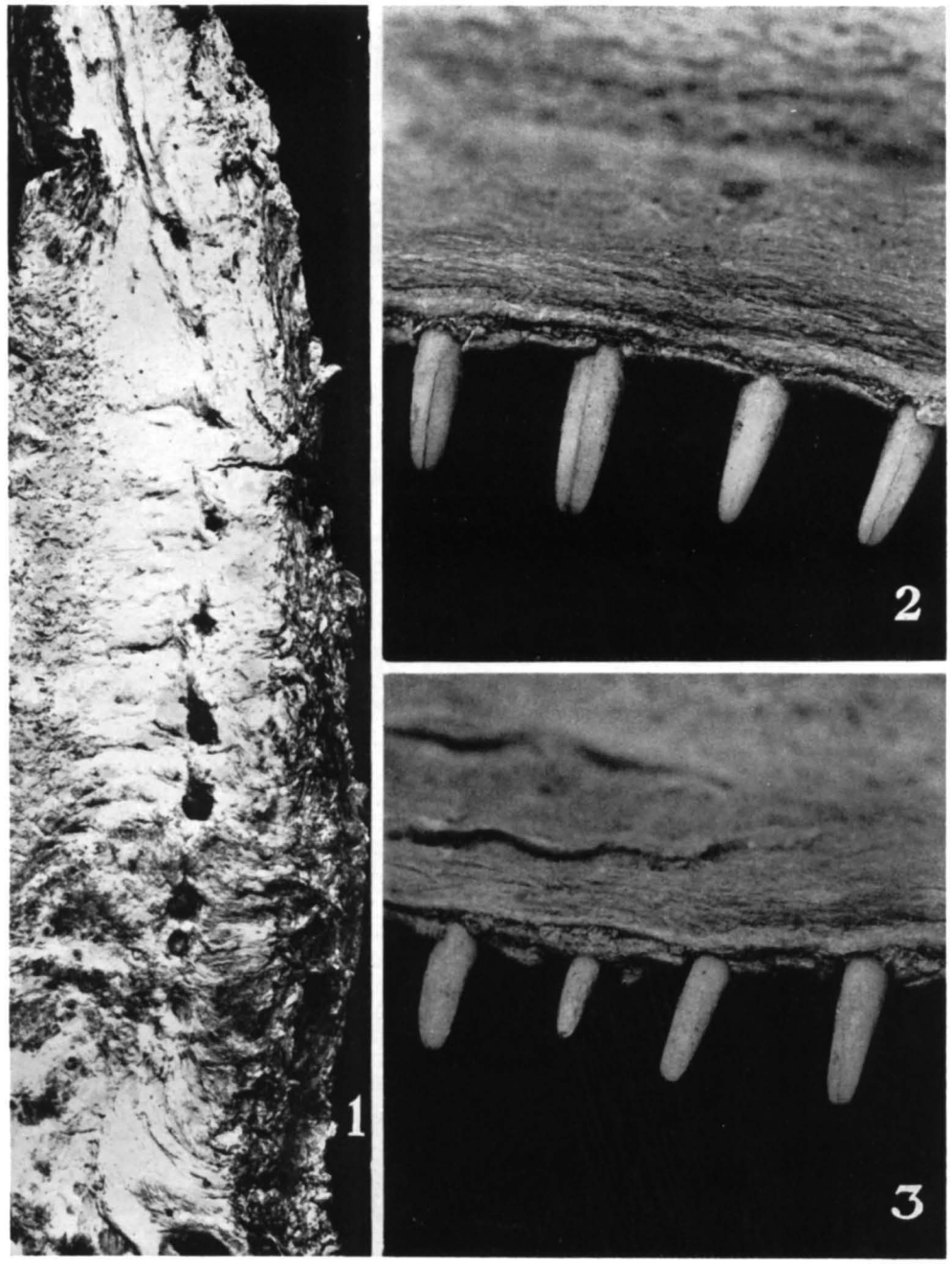
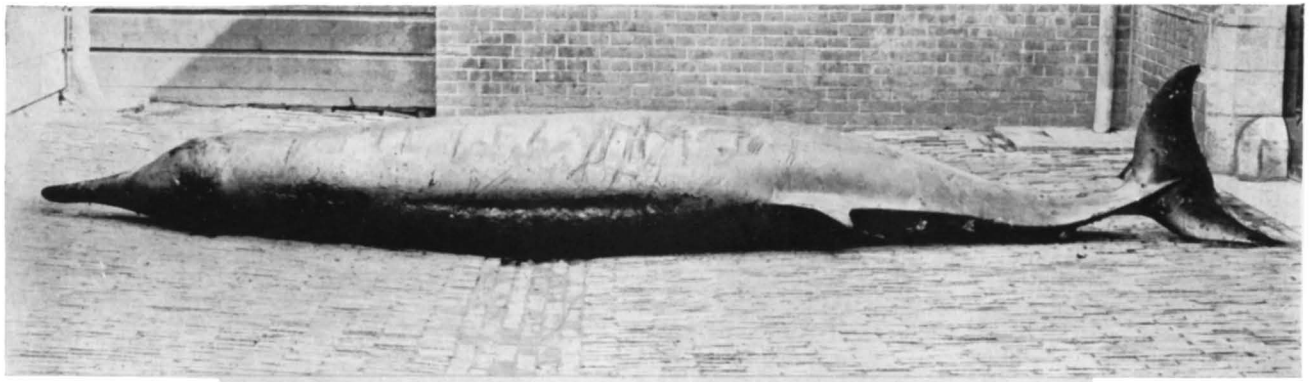
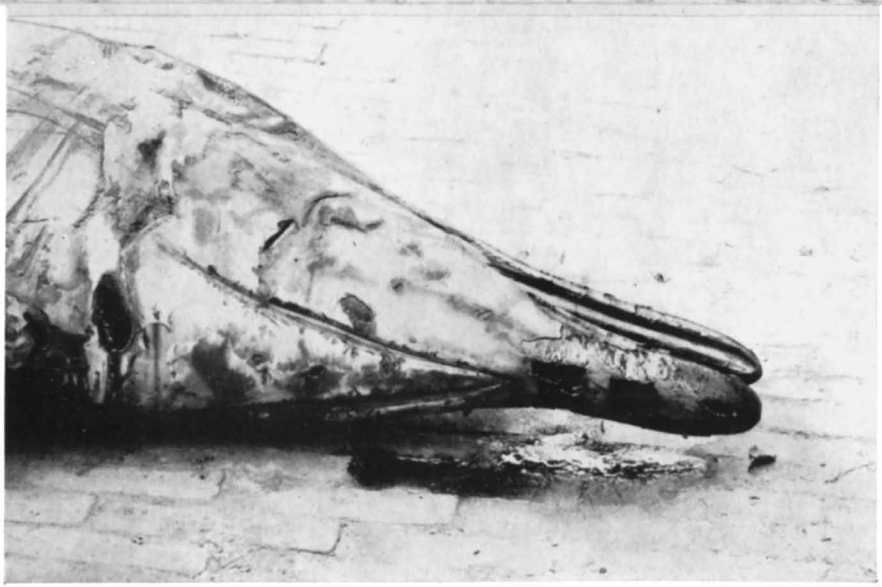


Fig. 1. *Hyperoodon rostratus* (Müller), Leiden Museum reg. no. 7218, part of the gum showing right maxillary toothrow. Natural size.
Fig. 2. *Mesoplodon grayi* von Haast, Leiden Museum reg. no. 1638, eleventh to fourteenth maxillary teeth of left side. × 5.
Fig. 3. Same specimen, seventh to tenth maxillary teeth of left side. × 5.

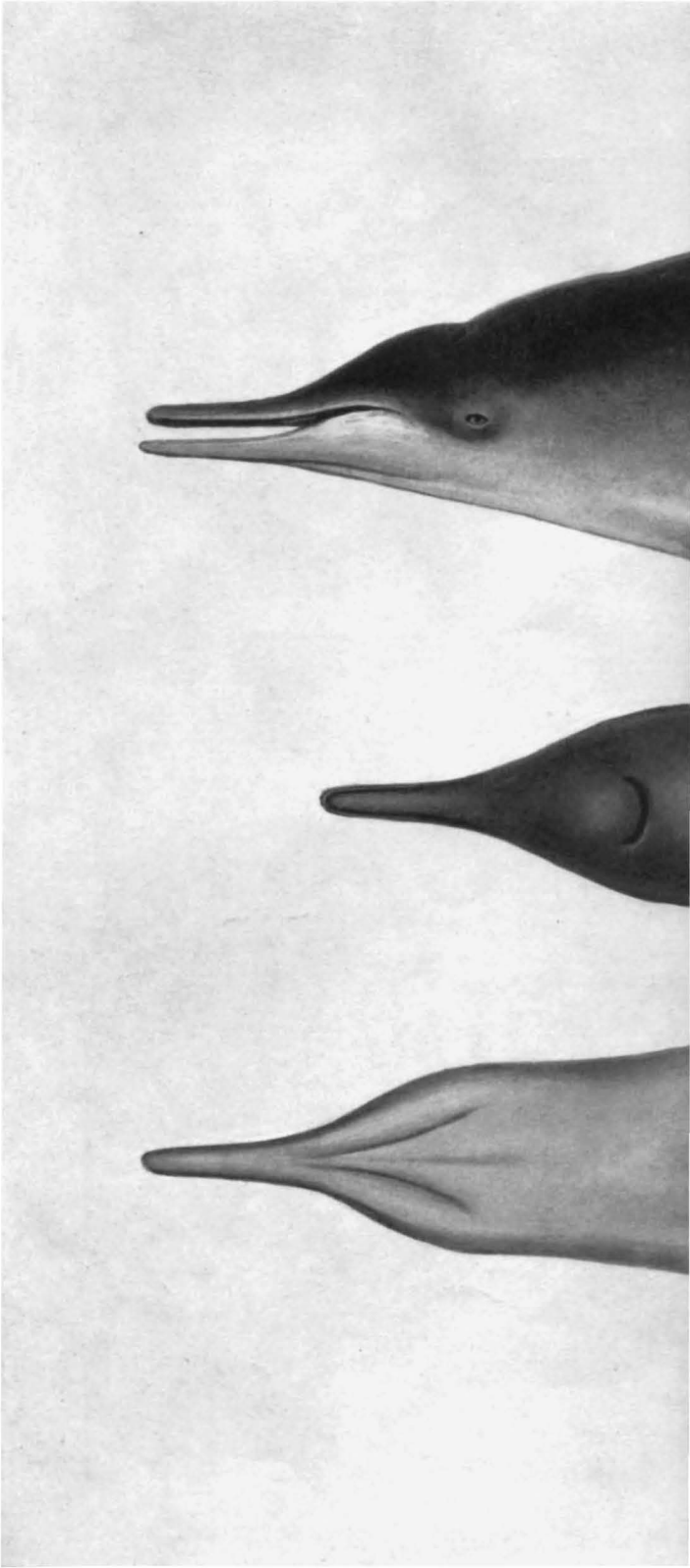
PLATE II

Hyperoodon rostratus (Müller), Leiden Museum reg. no. 7218.
Upper row, first to fourth maxillary teeth of left side.
Middle row, first to fourth, and eighth and ninth maxillary teeth of right side.
Lower row, tenth to fifteenth maxillary teeth of right side.
All figures × 5.

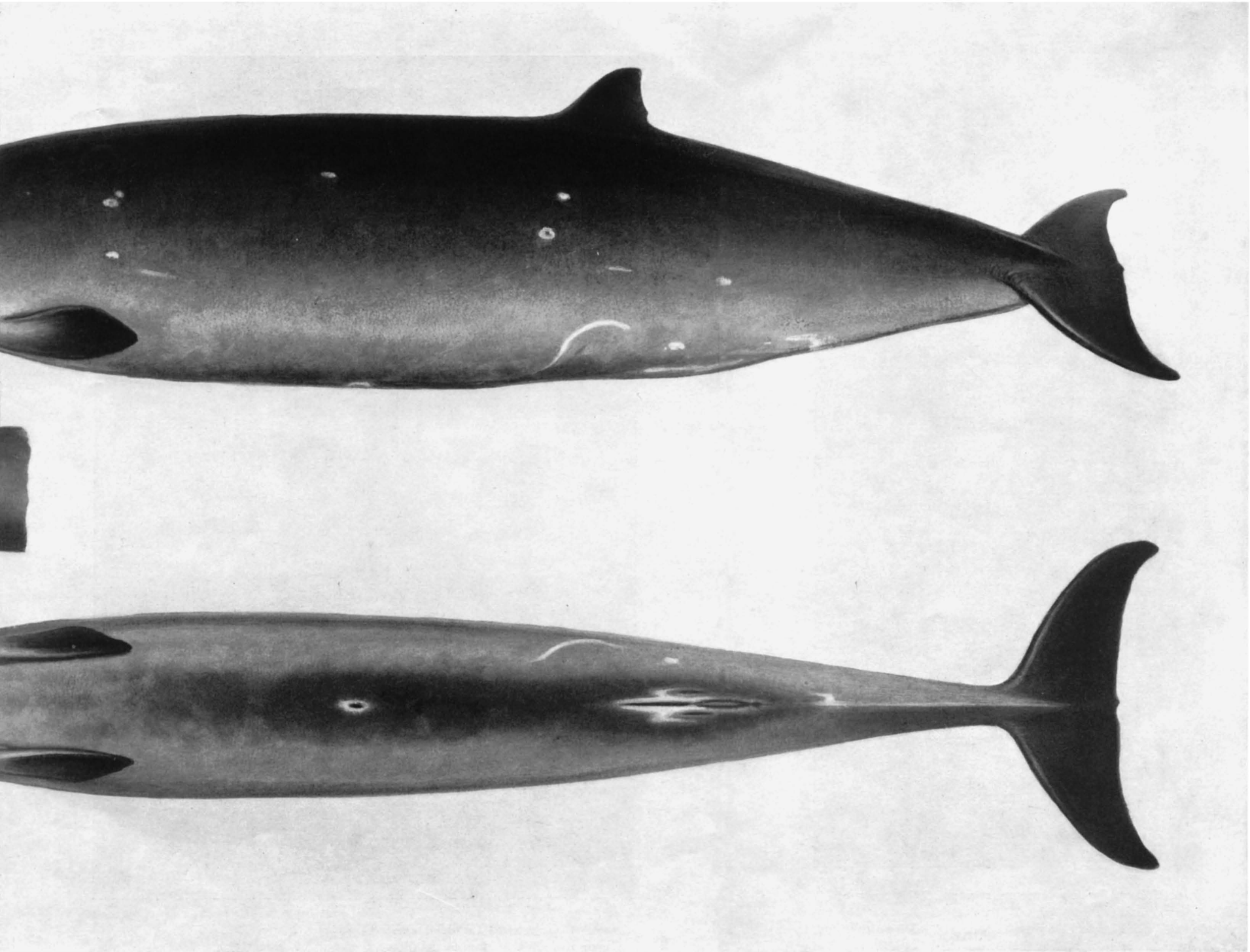




Mesoplodon bidens (Sowerby), Leiden Museum reg. no. 2114.
Upper figure, dorsal view, one twenty-sixth natural size.
Lower figure, oblique ventral view of head and throat, approximately one fourth natural size.



Meso



grayi von Haast, Leiden Museum reg. no. 1638, lateral and ventral view, and dorsal view of head. One fourteenth natural size.

tinge was visible. The black was interrupted by numerous splashes and smears, of irregular shape and distribution, and of a lighter colour. The colour was not appreciably lighter on the belly than above. Certain parts were grey, namely the anterior edges of the tail-flukes, part of the lower jaw (which was partly white) and the upper jaw, which had white edges. 1914, 43, a female, was black above, leaden-grey below; and 1916, 21, which was probably a female, from the evidence of its concealed teeth, was described as black with a white lower surface".

In connexion with VON HAAST's remarks cited above it is interesting that the lateral parts of the specimen of *Mesoplodon grayi* stranded on the Dutch coast had a brownish grey colour. In other respects there are differences, but these are of minor importance when compared to the very strong variation in colour observed in *Mesoplodon bidens*.

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