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NOTES ON THE TAXONOMY AND OSTEOLOGY OF TWO SPECIES OF *MESOPLODON*

(*M. EUROPAEUS* GERVAIS, *M. MIRUS* TRUE)

BY H. C. RAVEN

During the winter of 1933–1934 two specimens representing two species of rare beaked whales were cast up on Rockaway Beach on the south shore of Long Island, approximately twenty miles from New York City. Through the kindness of the Rockaway Police and other officials the American Museum was notified in each case and the specimens were guarded until they could be sent for. The taxonomy and osteology of these specimens will be treated in the present paper. Parts of the soft anatomy will be described in a later number of Novitates.

Now that the skeletons of the two animals have been prepared it is possible to identify them with a fair degree of certainty. The first is referable to *Mesoplodon europaeus* (Gervais) and the second to *Mesoplodon mirus* True.

Mesoplodon europaeus (Gervais)

Dioplodon europaeus GERVAIS, 1845; VAN BENEDEN AND GERVAIS, 1880.
Dioplodon Gervaisi Deslongchamps, EUG., 1866.
Neoziphius europaeus GRAY, 1871.
Mesoplodon europaeus FLOWER, WILLIAM HENRY, 1878; TRUE, 1910 (part).

The type and for a long time the only known example of this species of beaked whale was one found about 1840 (Flower) floating on the surface of the sea at the entrance of the English Channel. It was discovered by the captain of a French merchant ship, who saw gulls feeding on the carcass. He had the head cut off and towed it into port. Later the skull was described and figured by Gervais and eventually deposited in the Museum at Caen in France, but some later authors doubted the validity of the species. However, on March 28, 1889, a young male beaked whale twelve and a half feet long was caught at Atlantic City, New Jersey, which proved to be of the same species. The skeleton, a cast, and photographs of this specimen were secured for the United States National Museum and it was later described in detail by True.

The third recorded specimen of this rare species is the one about to

be described, which was stranded on Rockaway Beach, Long Island, on December 22, 1933. Mr. G. G. Goodwin of the Department of Mammals in The American Museum of Natural History, with assistants from the Department of Preparation, reached the site of the stranded whale shortly before dark on the day it came ashore. He was able to get photographs of the animal by the fading light, in which some of its external characters are recorded. Mr. Goodwin has kindly allowed me to use the photographs and the measurements he made of the animal in the flesh and it is partly from these records that the following description is

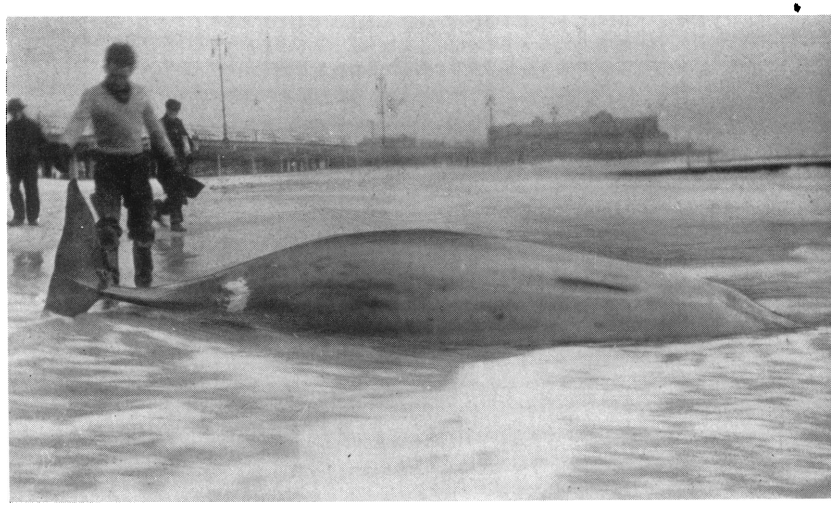

Fig. 1. *Mesoplodon europaeus* Gervais, stranded on Rockaway Beach, Long Island, December 22, 1933. A.M.N.H. No. 90051. Photograph by Mr. G. G. Goodwin.

taken. The photographs show the general form of the animal and also the pattern of the markings on the ventral surface and the genital and mammary grooves. The latter show conclusively that it was a female.

The skeleton was roughed out on the beach and transported directly to the Museum, where a plaster cast of part of the head was made. Before the skull was cleaned I was able to remove the suprarostral tissues for a study of the nasal structures, including the spermaceti organ.

EXTERNAL FEATURES

COLOR.—The general color of the animal was slaty black above, becoming somewhat lighter on the sides and below. The position of the navel was marked by a light grayish spot and light grayish areas extended irregularly along the sides and along the under surface to the fore part of the throat. A pure white area, irregular in shape and about ten inches in diameter, enclosed the genital and mammary grooves.

True (*loc. cit.*, p. 22) makes the following statement concerning the color of the Atlantic City specimen: "The natural color of the specimen had largely disappeared before I examined it, but Captain Gaskell and others who saw it while still fresh agreed that it was very dark slate-gray on the back, lighter on the sides, and whitish on the belly. I observed that a broad area between the pectoral fins was slate-gray, and contrasted with the white of the throat and belly. The whitish color ended somewhat abruptly and irregularly at the anus, and the flukes, as well as the pectoral and dorsal fins, were probably very dark slate-gray, or blackish, when fresh."

It is thus evident that the color of the two specimens was very much alike but there was considerable variation in the irregular markings of the ventral surface and sides.

FORM.—The appearance of the animal (Figure 1) was slender and fusiform, agreeing very closely with the photographs of the Atlantic City specimen mentioned above. The head behind the mouth was nearly circular in coronal section. From that point forward it tapered to the snout, first convexly, then concavely. This contour was more pronounced along the mid-dorsal line than elsewhere. The lower jaw protruded slightly beyond the tip of the upper jaw. The eyes were situated on slight eminences and a few inches behind them were the extremely small openings of the external auditory meati, situated in very slight depressions. The gular grooves were not noticed by the men who secured the specimen and the skin of the throat had been removed before I saw it.

There was a very slight constriction to indicate the presence of the neck. The thickest part of the body was considerably behind the extremity of the flippers as they lay in their normal position against the sides of the body. The tail was decidedly compressed, so that proximal to the flukes its depth dorsoventrally was much greater than its thickness from side to side. On the ventral side of the tail a keel, beginning at a point about midway between the anus and the base of the flukes, extended almost to the distal border of the flukes. Along the dorsal

surface of the tail a corresponding keel extended from the dorsal fin to approximately the same position on the dorsal surface of the flukes.

The flukes were very wide, being equivalent to 3/10 the total length of the animal. There was a faint indication of a notch between the two halves of the flukes, though their posterior margin was convex medially and concave near the extremities. The concavity of the posterior margin of the flukes, laterally, was more pronounced than in the specimen figured by True (Pl. XLI, figs. 1, 2).

The flippers were very small. The radial border was rather thick and rounded, whereas the opposite border was quite thin.

The photographs do not show the dorsal fin. It was said to have been small and set far back, about over the vent.

The following measurements were taken by Mr. G. G. Goodwin of the animal in the flesh:

Greatest length	4670 mm.
Blow-hole to end of snout	570
Eye to end of snout	580
Width of blow-hole	88
Length of flipper	355
Greatest width of flipper	125
Width at base of flipper	102

SKELETON

SKULL.—As the type specimen of this species is represented only by the skull and mandible, the most important characters for identification are of these parts.

The diagnostic characters of *M. europaeus* are readily seen in the figures, thus a detailed description of the material is considered unnecessary. In a comparison of the dorsal aspect of the skulls, the figures of the three known specimens of this species show that they agree very closely one with the other (Fig. 2 *A*, *B*, *C*), although they represent both sexes and three different growth stages. The relative age of each may be judged by the extent of coössification of the presphenoid and vomer, which in adults comes to occupy the entire mesirostrum. In young specimens it is formed by the vomer below and bounded on either side above by the medial borders of the premaxillaries (Fig. 3). In the type specimen (Fig. 2*C*) the entire mesirostral groove is filled with bone. In the United States National Museum specimen from Atlantic City (Fig. 2*A*) no ossification shows, while in the Rockaway Beach specimen (Fig. 2*B*) the posterior half of the distance from the narial openings to the tip of the rostrum is filled with bone.

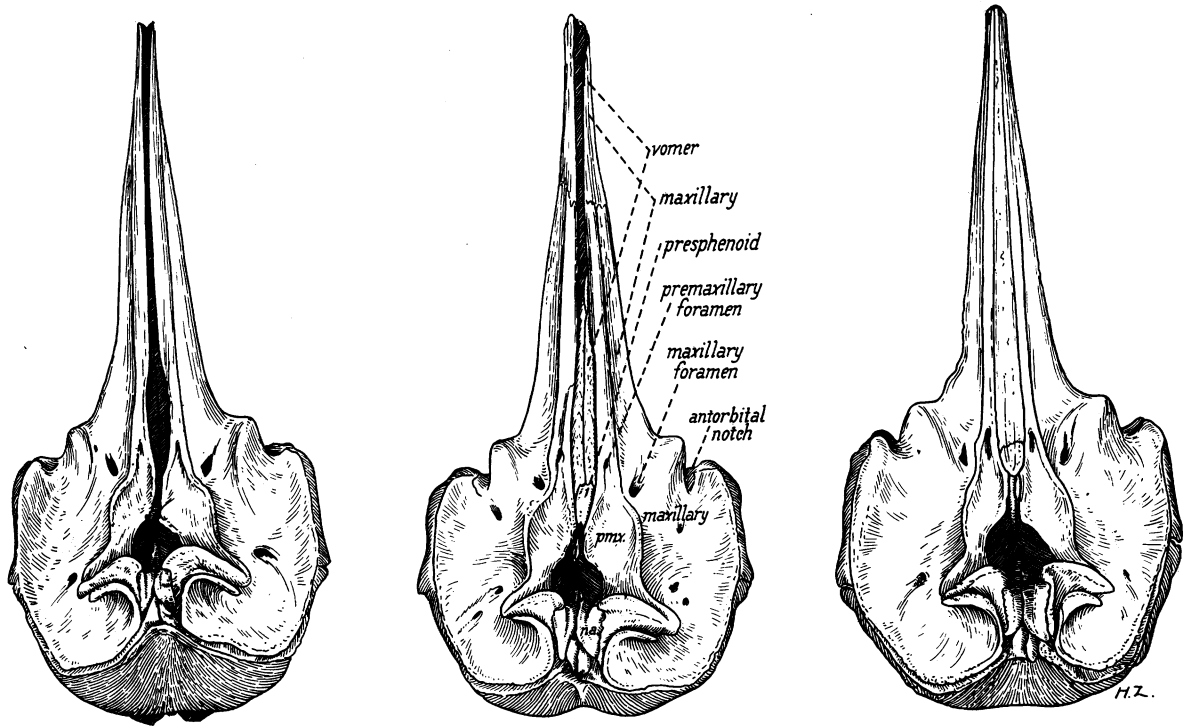

Fig. 2. Dorsal view of the skulls of three specimens of *Mesoplodon europaeus*, showing specific resemblances in morphology and three different stages in the ossification of the mesirostrum, due to age. *A*, youngest specimen, after True; *B*, A.M.N.H. specimen from Rockaway Beach; *C*, type specimen, after Brasil.

Flower used the lateral basirostral groove as an important character in separating the various species of *Mesoplodon* into two groups. This lateral basirostral groove of Flower is synonymous and homologous with the maxillary alveolar groove of less specialized mammals. The species of *Mesoplodon* having this groove frequently retain a number of small peg-like upper teeth (see figure of *M. grayi* Hale, Herbert M.). It is also analogous to the alveolar groove in the mandible. Flower described it as a groove at the base of the rostrum, commencing posteriorly in a blind pit below the tubercle of the maxillary, situated in front of the antorbital notch and bounded above and below by sharply defined prominent ridges, both formed by the maxillary. This groove is deeper in *M. grayi* than in any other species but is also readily seen in photographs of the skulls in side view of *M. layardi* and *M. densirostris*, and is entirely absent in other species, including *europaeus*.

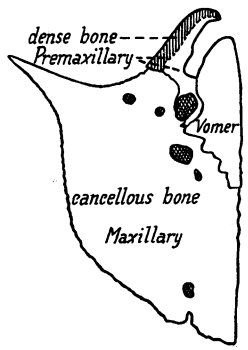

Fig. 3. A tracing of a coronal section through the rostrum of *Mesoplodon europaeus*, showing the vomer expanding dorsally, partly filling the mesirostral groove. At a younger stage the dorsal surface of the vomer was concave at this point, whereas in old individuals it fills the mesirostrum even with the premaxillary.

The relative position of the maxillary to the premaxillary foramen is apparently a constant character in a given species. The conspicuous maxillary foramen which affords an exit for the principal branch of the nervus infraorbitalis is situated close to the lateral border of the premaxillary bone, where the latter is constricted at the base of the rostrum. The premaxillary foramen in *Mesoplodon* is always located at the rostral border of the very slight depression that marks the site of the ventral spiracular, or premaxillary sac. In some species of *Mesoplodon* the premaxillary foramen is in advance of the adjacent maxillary foramen, in other species behind the maxillary foramen. This depends upon the size and shape of the sac. In *M. europaeus* the sac is relatively long, consequently the premaxillary foramen is decidedly in advance of the maxillary foramen.

TABLE I.—Dimensions of the type and three other known skulls of *Mesoplodon europaeus*

	English Channel type[1] Mus. Caen, France ♂ ? adult 1840.	Atlantic City, N. J. U.S.N.M 23346 ♂ young 1889.	Rockaway Beach, N. Y. A.M.N.H. 90051 ♀ 1933.	Middle Key, Florida A.M.N.H. 121894 1935.
Total length	765 mm.	675 mm.	780 mm.	775 mm.*
Tip of rostrum to rostral border of anterior nares	550		570	575*
Tip of rostrum to a line joining anterolateral processes of maxillaries	430	427	460	465*
Tip of rostrum to process of maxillaries between the pterygoids	480		475	450*
Tip of rostrum to posterior end of pterygoids		525	635	610*
Tip of rostrum to most anterior point of the palatines	370		390	405*
Height from vertex to ventral point of pterygoids		256	300	290
Width of rostrum at highest point of anterior palatine suture	120		105	105
Depth of rostrum at highest point of anterior palatine suture	77	40	64	70
Diameter of orifice of posterior nares immediately behind pterygoid processes	93		85	100
Greatest diameter of orifice of anterior nares	55	42	53	55
Greatest breadth of premaxillae proximally		142	158	151
Same, in front of anterior nares		104	106	100
Greatest width of skull	370		363	365
Breadth between orbits		287	330	320
Breadth at antorbital notches		182	201	195
Breadth between temporal fossae		208	236	217
Breadth of foramen magnum		34	43	45
Length of mandibular ramus	665	565	657	600*
Length of symphysis	125	116	160	110*
Tip of mandible to anterior border of tooth	75		110	55*
Greatest depth of mandible		101	111	110

[1] The measurements of the type are taken from Brasil, those of the Atlantic City specimen from True.

*75 mm. has been added to this measurement as approximately that much of the rostrum is missing.

In several species of *Mesoplodon* the antorbital notch is interrupted by a protuberance of the maxillary, which projects to a variable degree and from which a ridge of more or less prominence extends backward. In *M. europaeus* both the protuberance and the ridge extending back from it are conspicuous.

TABLE II.—Relative proportions of skull.

Percentage of width to length of skulls in *M. europaeus:*

SPECIMEN	LENGTH	WIDTH	PERCENTAGE
Type	765 mm.	370 mm.	48.3
Rockaway Beach, L. I.	780 mm.	363 mm.	46.5
Florida	775 mm.	365 mm.	47.0
	Variation 1.8%		

Percentage of depth to width of rostrum at the highest (most rostral) point of the anterior palatine suture:

SPECIMEN	DEPTH	WIDTH	PERCENTAGE
Type	77 mm.	120 mm.	64.1
Rockaway Beach, L. I.	64 mm.	105 mm.	60.9
Florida	70 mm.	105 mm.	66.6
	Variation 5.7%		

Percentage of length of symphysis to length of mandibular ramus:

SPECIMEN	MANDIBLE	SYMPHYSIS	PERCENTAGE
Type	665 mm.	125 mm.	18.7
Atlantic City	565 mm.	116 mm.	20.5
Rockaway Beach, L. I.	657 mm.	160 mm.	24.3
	Variation 5.6%		

The mandible (Figs. 4, 5*A*) of *M. europaeus* exhibits characters by which it may be distinguished from that of any other member of the genus. The symphysis is very short yet well defined and rather deep. The tooth which is compressed is entirely opposite the symphysis in young specimens but occupies more space when fully erupted and is not at the tip of the mandible. In the type specimen (Fig. 4*C*), which is much older than either of the others, the tooth is fully erupted and the alveolus about it is much deeper from dorsal to ventral border of the mandible than in the younger specimens; in these only the tip of the tooth projects above the alveolar border.

The table showing relative proportions of width to length of skull (Table II) shows that in *M. europaeus* the range of variation in these features is surprisingly small.

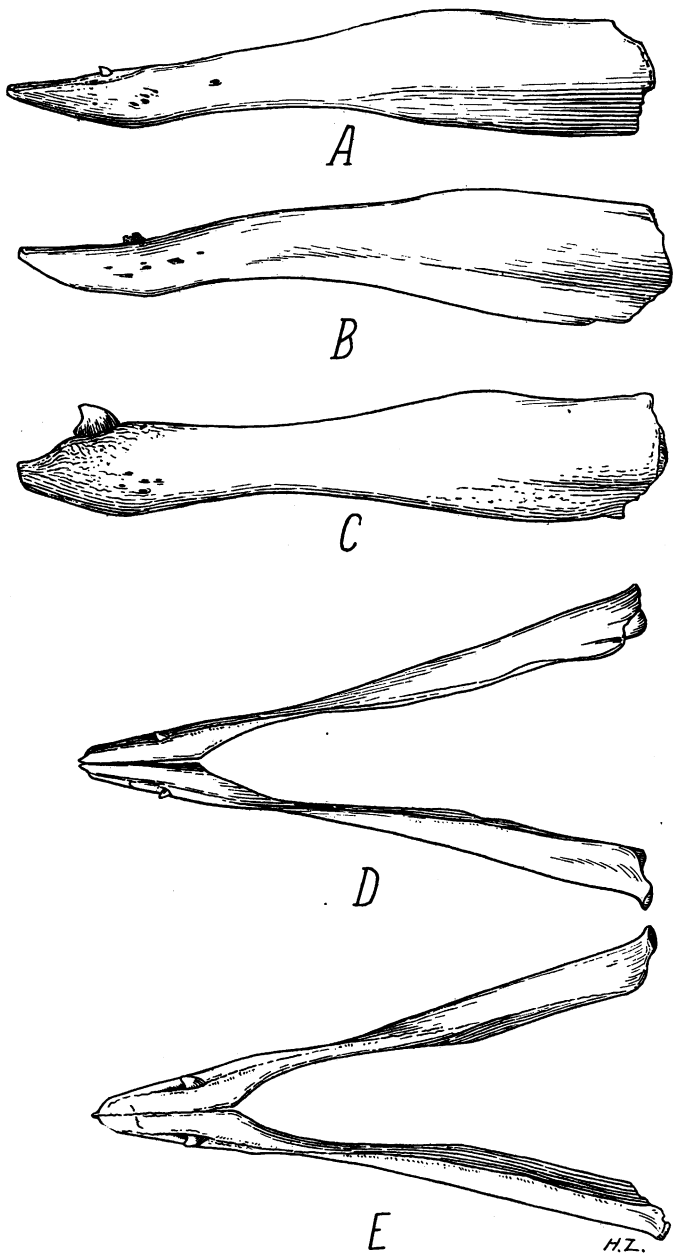

Fig. 4. Mandibular rami of *Mesoplodon europaeus*. *A*, lateral, and *D*, dorsal view, redrawn from True, of United States National Museum specimen from Atlantic City, New Jersey. *B* and *E*, lateral and dorsal views of American Museum of Natural History specimen from Rockaway Beach, Long Island. *C*, lateral view of type, redrawn from Brasil.

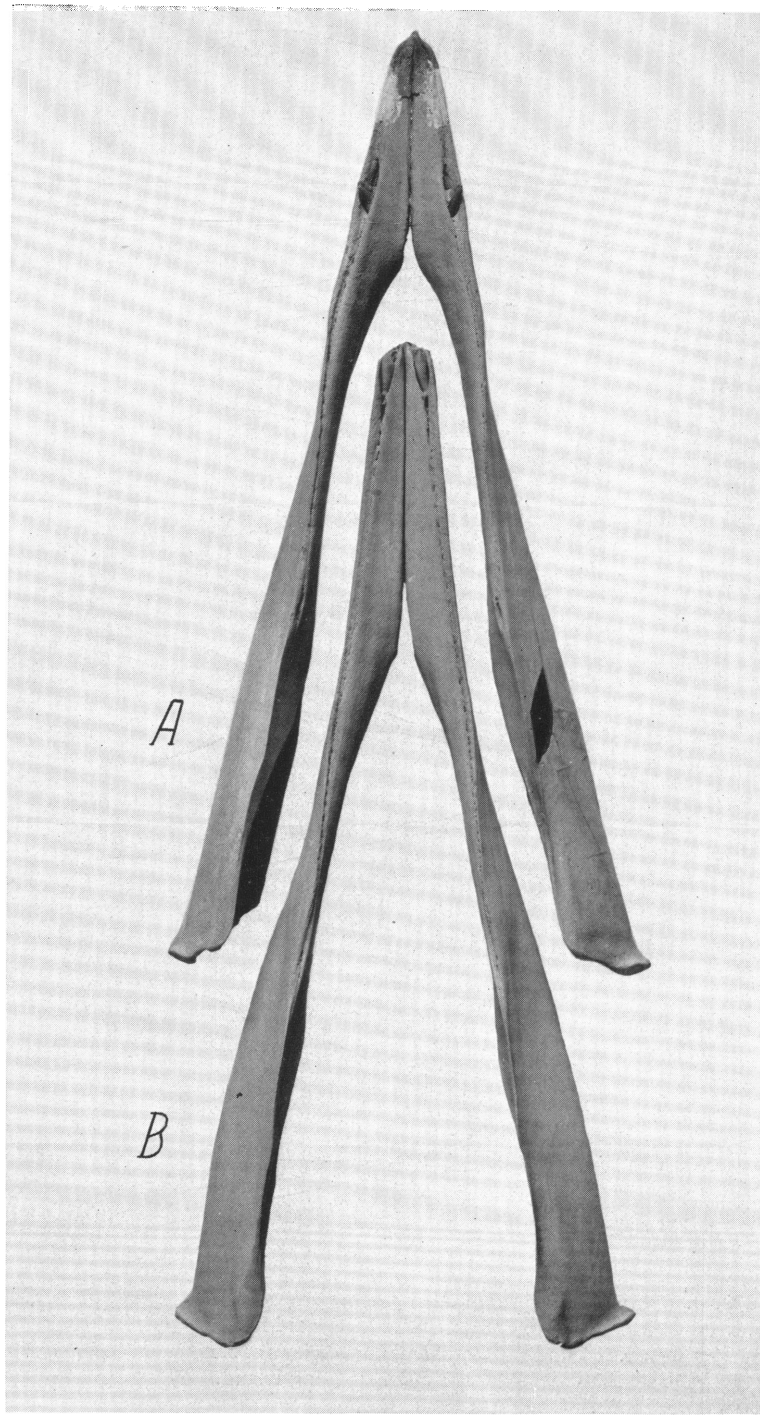

Fig. 5. Mandibles of *A*, *Mesoplodon europaeus;* and *B*, *Mesoplodon mirus*, showing the relative position of the teeth, and symphysial length.

VERTEBRAE.—The postcranial skeleton agrees closely with that of the specimen of *M. europaeus* from Atlantic City, New Jersey, described by True. A comparison of the vertebral formulae of these specimens follows:

Rockaway Beach, N. Y.	♀	C.7; Th. 10; L. 11; Ca. 19 = 47
Atlantic City, N. J.	♂	C.7; Th. 9; L. 11; Ca. 20 = 47

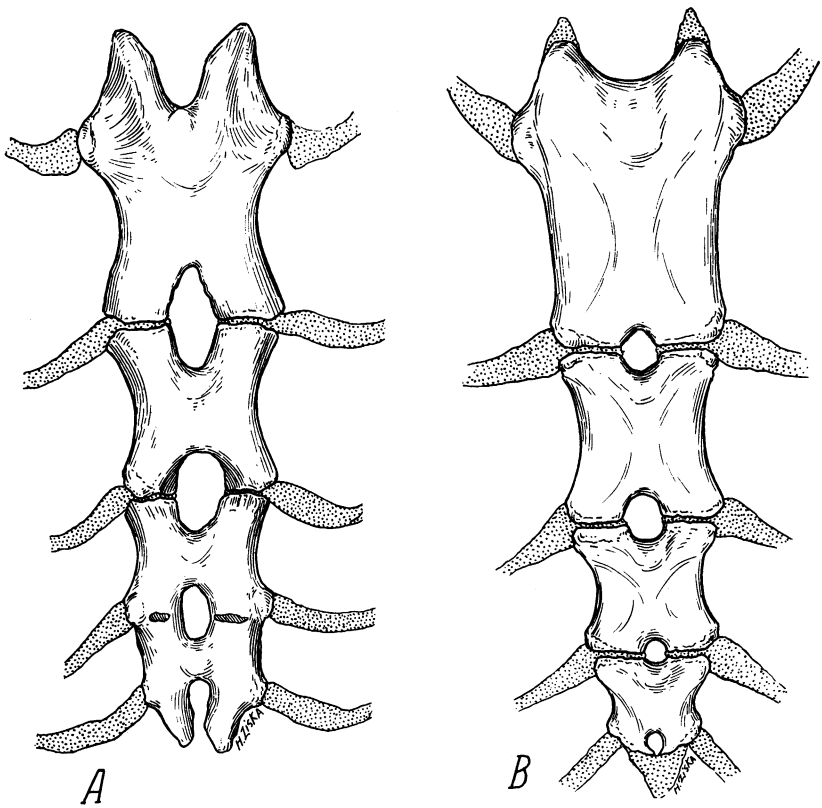

Fig. 6. *A*, sternum of *Mesoplodon europaeus; B*, that of *Mesoplodon mirus.*

True (1910, p. 16) states that an additional pair of ribs probably existed originally, which would make the formula: C. 7; Th. 10; L. 10; Ca. 20 = 47.

The first three cervicals are anchylosed together. The spinous processes of the caudal vertebrae decrease rapidly in height, as in *M. mirus* (Fig. 15), and the ten terminal caudals are without spinous pro-

cesses. Beneath the proximal caudal intervertebral spaces are nine chevrons, followed by nine intervertebral spaces without chevrons.

The first seven pairs of ribs have both head and tubercle. The

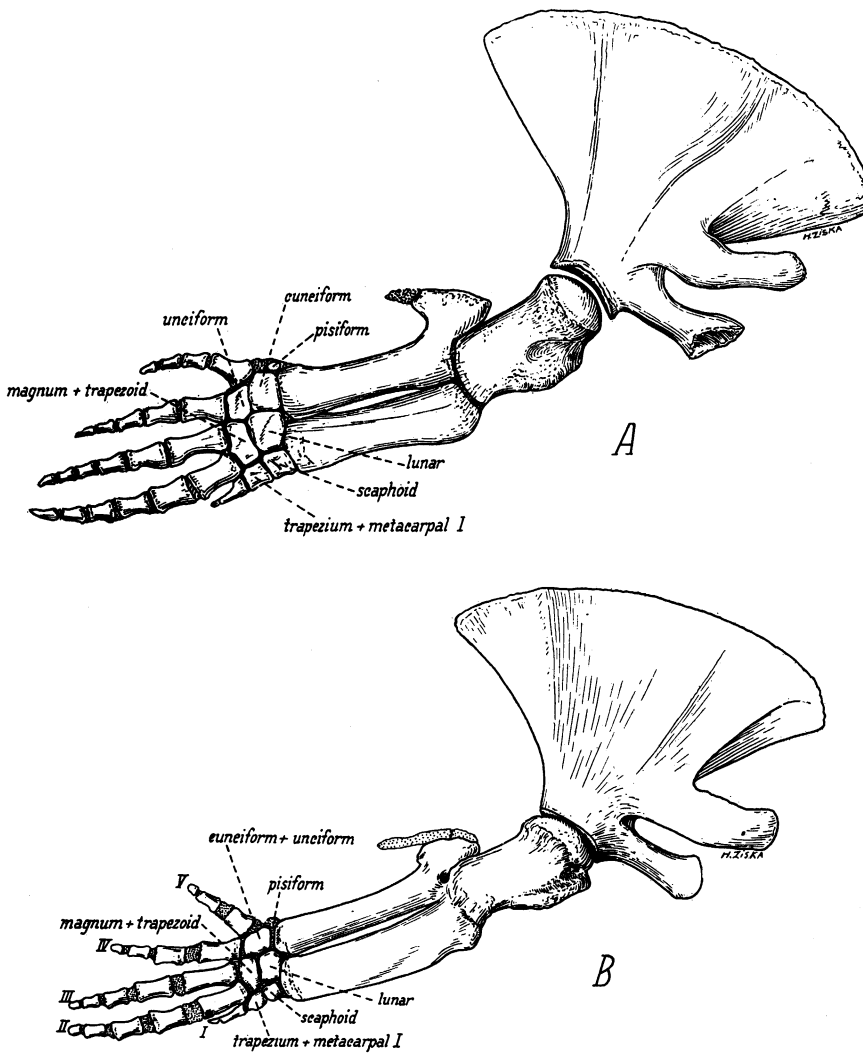

Fig. 7. Lateral aspect of the skeleton of the pectoral limb of *A*, *Mesoplodon europaeus*, and *B*, *M. mirus*.

remaining three pairs have only a single vertebral attachment. Five pairs of ribs were attached to the sternum.

STERNUM.—The sternum (Fig. 6*A*), consisting of four sternebrae, is very similar to that of the Atlantic City specimen (True, 1910, Pl. XIII, fig. 2). The chief difference is that in the present specimen the lateral margins of the manubrial processes are slightly concave, whereas they are convex in the younger animal. Otherwise the outlines are very similar and the fenestrae of corresponding size. The form of the sternum is, as True pointed out, very like that of *M. bidens* figured by Grieg (1904, p. 32, Fig. 12), but in *M. europaeus* the elements are slightly longer in proportion to their width.

PECTORAL LIMB.—A comparison of True's description and figure of the scapula of the Atlantic City specimen with those of the Rockaway Beach and Florida specimens in The American Museum of Natural History shows that a diagnostic character of *M. europaeus* is the way in which the acromion is turned forward and toward the vertebral border of the scapula; it has a decided thickening proximally, with a convex lower border. The coracoid process is about the same length as the acromion but thicker, with the distal extremity expanded and turned laterally. The coracoid is directed forward in the same plane as the blade of the scapula and forms a right angle with a line drawn from the middle of the vertebral border through the center of the glenoid.

The bones of the limb present the usual compressed form, with very little motion possible at the articulations distal to the scapulohumeral joint. There are four carpals in the proximal row, of which the pisiform is represented by a mere nodule. In the distal row there are three bones. The carpals in this specimen thus agree in detail with the figure and description of the U. S. National Museum specimen from Atlantic City and as to number and general position with those of *M. grayi* figured by Flower (1879, Trans. Zool. Soc., Pl. LXXIII, fig. 1).

A comparison of the carpus of *Mesoplodon* with that of other odontocetes, including excellent roentgenograms of a young adult *Monodon*, leads to the belief that in *Mesoplodon europaeus* the trapezium and first metacarpal are represented in the adult by one element, also that the trapezoid and magnum are coalesced.

The cuneiform and unciform are distinct in this species and united in *M. mirus*.

The phalangeal formula is: I 2; II 5; III 5; IV 4; V 3.

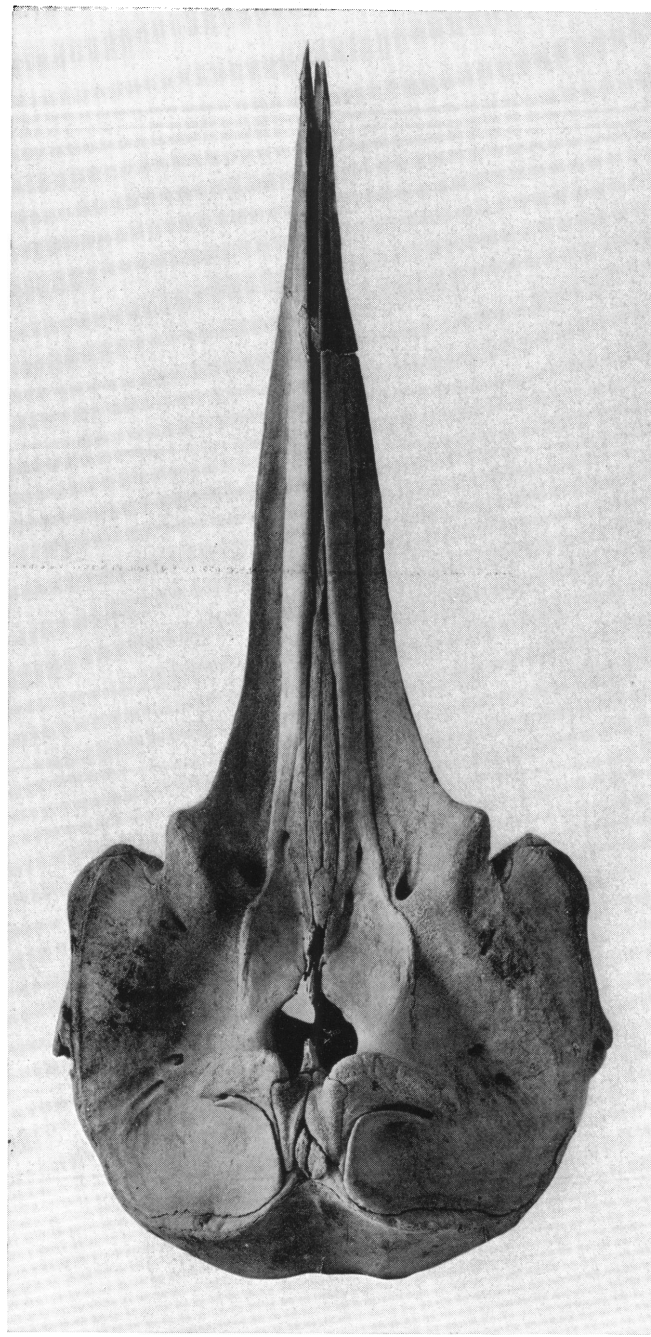

Fig. 8. *Mesoplodon europaeus*, dorsal aspect of skull.

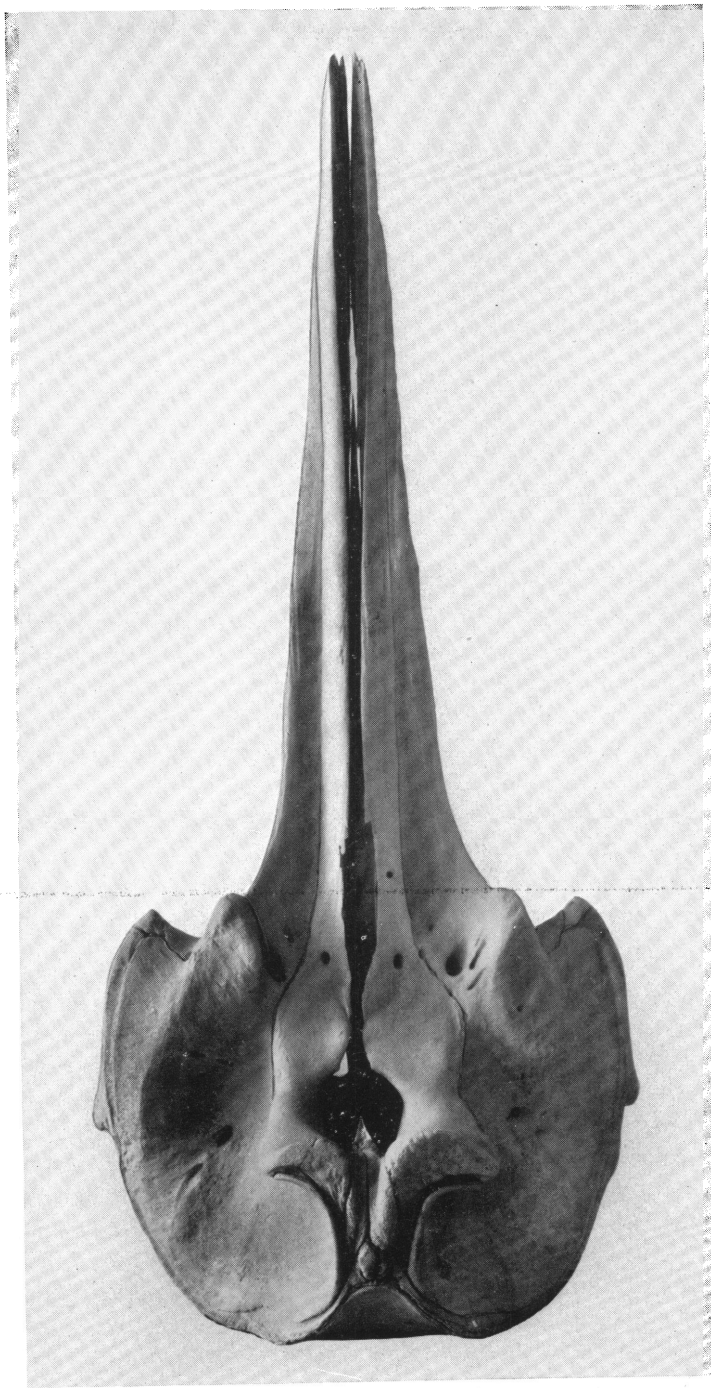

Fig. 9. *Mesoplodon mirus*, dorsal aspect of skull.

Mesoplodon mirus True

Mesoplodon mirum TRUE, 1913.
Mesoplodon hectori ANDERSON, 1901.
Mesoplodon mirus HARMER, 1919.
Mesoplodon pacificus LONGMAN, 1926.

The second beaked whale to be secured for the American Museum during the winter of 1933–1934 was stranded at Edgemere, Rockaway Beach, Long Island, on January 14, 1934. At first it was thought to be the same species as the former whale, which was stranded three weeks earlier, but when the skull was cleaned it could be positively identified as *Mesoplodon mirus*, or True's beaked whale.

The type specimen of this species was taken at Beaufort Harbor, North Carolina, on July 26, 1912, and later described and figured by Dr. Frederick W. True in the Proceedings of the United States National Museum.

In 1919 Sir Sidney F. Harmer referred two more specimens to this species. One of them had been stranded in Galway Bay, Ireland, in 1899, and described as *Mesoplodon hectori* by R. J. Anderson in 1901. The other was stranded at Liscannor, County Clare, Ireland, on June 9, 1917. On March 2, 1906, Dr. G. M. Allen and C. E. Brown collected one at Wells Beach, Maine, a male fifteen feet ten inches long, of which the skeleton and a cast are preserved in the museum at the Boston Society of Natural History. This was later recognized by Dr. Allen as belonging to True's species *mirus*.

As shown below, it seems probable that a South Pacific subspecies of this form is represented by the type of *Mesoplodon pacificus* Longman.

EXTERNAL FEATURES

COLOR.—Upper parts black, becoming slate-colored on the side and under parts. Lower sides and under parts with elongate patches of light purple that may have been pinkish or whitish in life. Some pure white markings about the navel and larger areas of pure white surrounding the urogenital and anal apertures.

The color of the type specimen was given as: "Back, slate black; lower sides, yellow purple flecked with black; median line of belly somewhat darker; a grayish area in front of vent; fins the color of the back."

With due allowances for post mortem changes, the present specimen shows no significant difference in color from the type.

FORM.—Fusiform, slender when viewed ventrolaterally, the angle at which the accompanying photograph was taken (Fig. 15); less so in

direct lateral view. Body slightly compressed laterally and caudal peduncle decidedly so, though somewhat less than in *Mesoplodon densirostris* figured by Andrews.

Laterally there was a very slight constriction to indicate the neck, which could not be seen from the side.

The flippers were low on the sides of the body and pressed into slight depressions in the sides, which may have been purely a post mortem condition; they were not sharply pointed. The ventral or radial border was thickened and nearly straight; the opposite border tapered to a thin edge and was rounded distally.

The dorsal fin (Fig. 14) was placed far back, corresponding to that of the type.

The flukes were broad both caudorostrally and laterally, their posterior margin concave laterally and evenly convex medially; without a conspicuous notch.

The dorsal and ventral caudal keels extended about halfway to the extremity of the flukes in the midline.

TABLE III.—External measurements of *M. mirus*

Adult ♀ A.M.N.H. No. 90053

Total length (between uprights)	16′	=	4870 mm.
Total length (over curves)	16′ 8″	=	5080 mm.
Tip of rostrum to rostral border of dorsal fin	9′ 10″	=	3000 mm.
Length (caudorostrally) of dorsal fin	11″	=	280 mm.
Dorsal fin to tip of flukes	5′ 5″	=	1650 mm.
Tip of rostrum to eye	2′ 1 1/2″	=	645 mm.
Tip of rostrum to proximal border of flipper	3′ 8 3/4″	=	1135 mm.
Greatest circumference	8′ 8″	=	2640 mm.
Circumference at vent	8′ 6″	=	2590 mm.

SKELETON

SKULL.—(Figs. 9, 11, 13) True gives the following diagnostic skull characters for the type of *M. mirus:* "Teeth at the extremity of the mandible, small, entirely concealed by the integument (in the adult female). Mandibular symphysis one-fourth the length of the mandible. No basirostral groove. External free border of the lachrymal bone one-half the length of the orbit; its anterior end curved upward and appearing on the superior surface of the skull where it joins the antero-external angle of the frontal plate of the maxilla. Maxillary prominences short and directed obliquely outward anteriorly, the extremity close to the maxillary notch. Maxillary foramina behind the premaxillary foramina. Frontal plates of maxillae approximately one-half as broad as long."

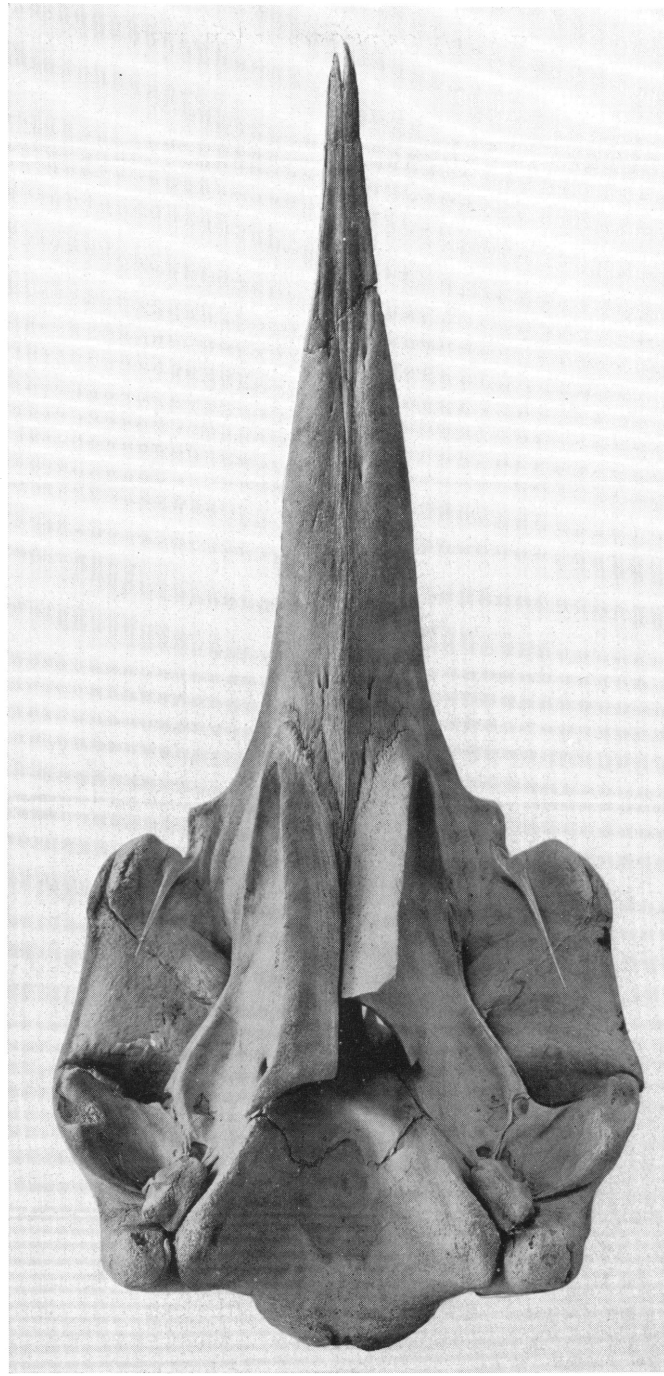

Fig. 10. *Mesoplodon europaeus*, ventral aspect of skull.

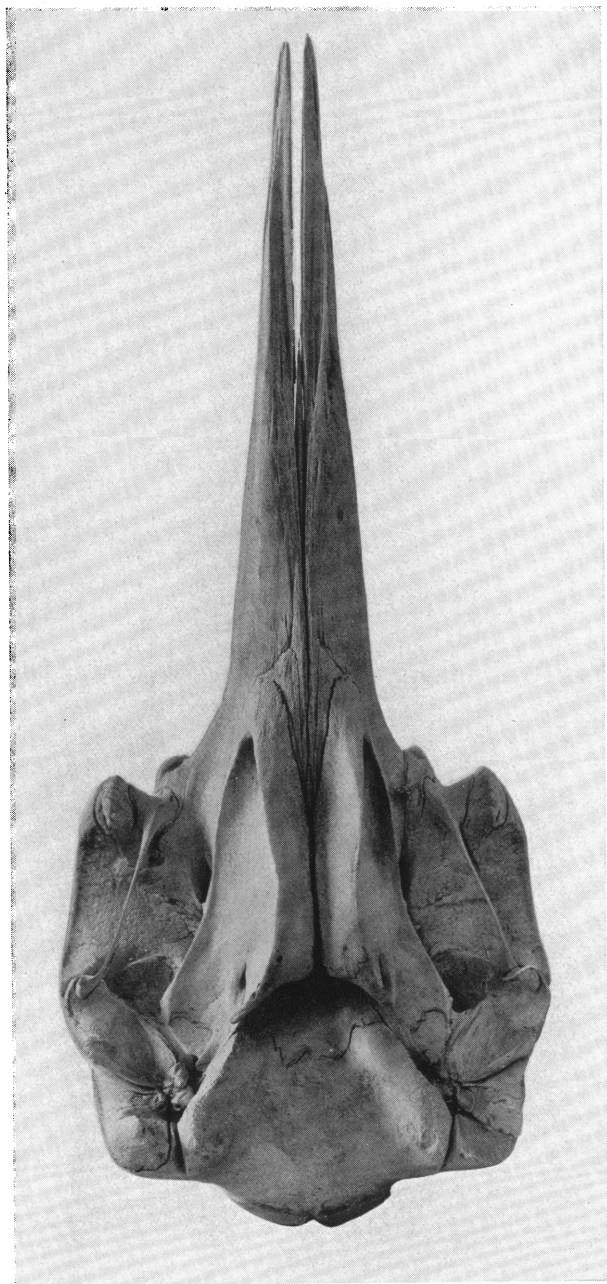

Fig. 11. *Mesoplodon mirus*, ventral aspect of skull.

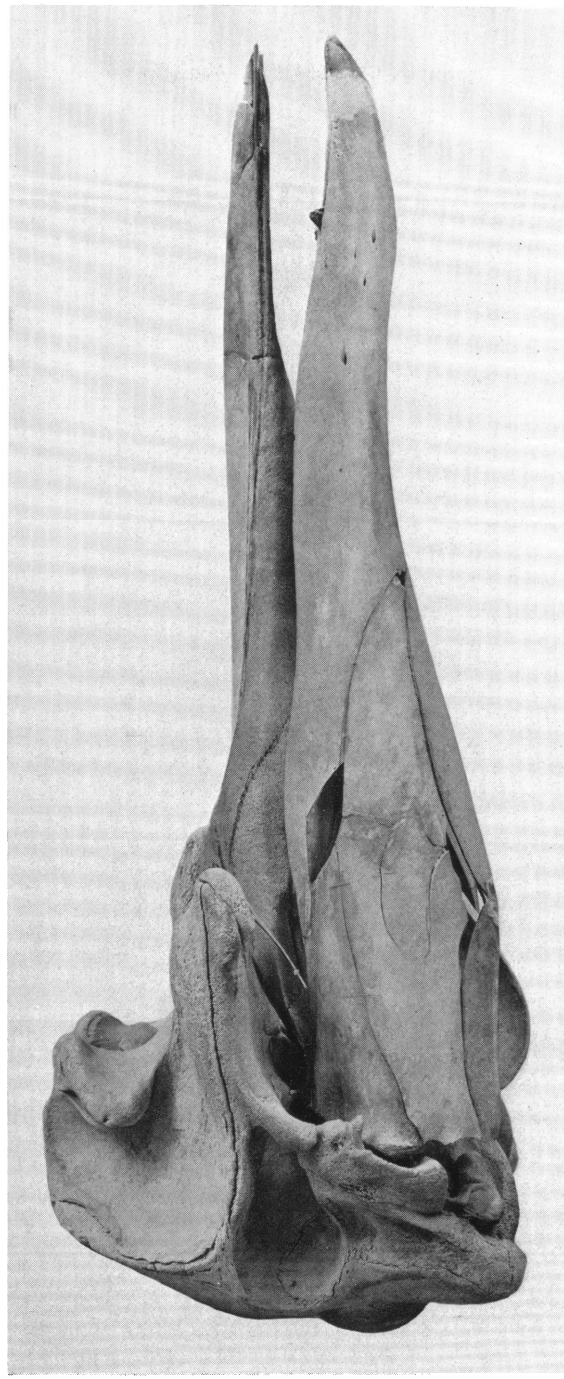

Fig. 12. *Mesoplodon europaeus*, right side of skull with mandible attached.

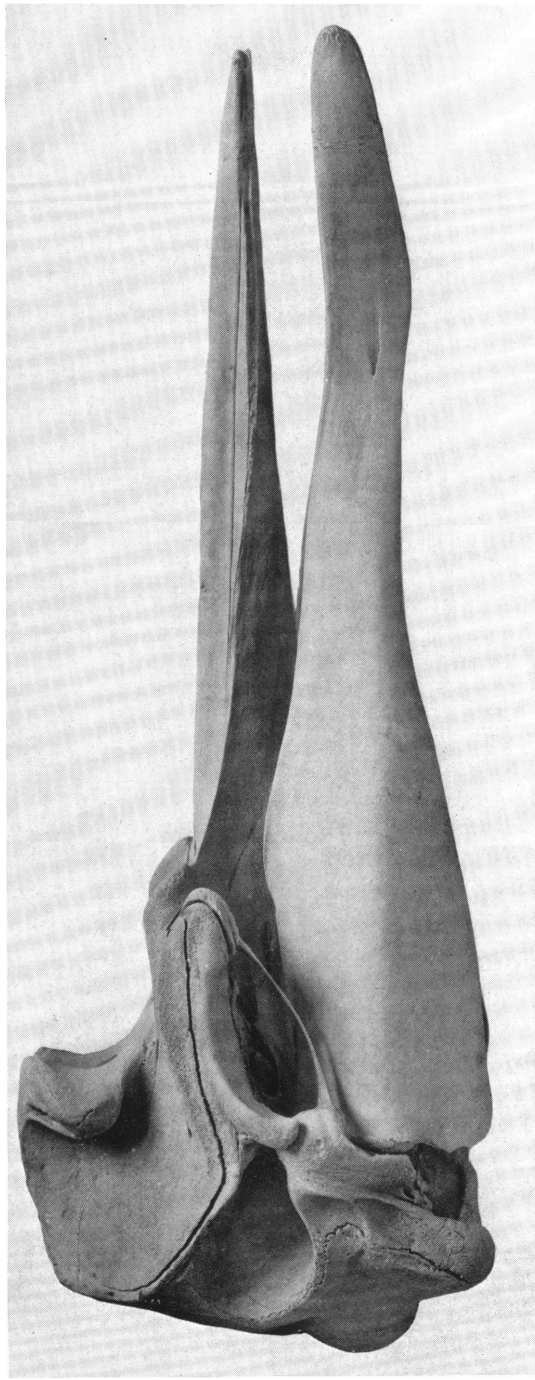

Fig. 13. *Mesoplodon mirus*, right side of skull with mandible attached.

All these diagnostic characters are well shown in the present specimen and can be clearly seen in the figures. It must be noted that there is a distinction between the maxillary prominences and the maxillary ridges.

The maxillary prominences are short and directed obliquely outward but the maxillary ridges, which are continuous anteriorly with the lateral border of the prominences, begin near the lateral border of the maxillary flanges behind and above the postorbital process of the frontal and extend forward and inward, terminating as the medial border of the maxillary notch (Fig. 9).

The mesirostral groove is, in the young of *M. europaeus* and *mirus*, a trough formed ventrally by the elongated vomer, which is concave dorsally throughout its length and laterally covered by the rostral por-

Fig. 14. Outline of dorsal fin of *Mesoplodon mirus* traced from a photograph.

tion of the premaxillae. With increasing age the presphenoid ossifies, filling the proximal part of the groove; then the vomer begins filling in the mesirostral groove with osseous tissue until in very old individuals the groove is completely eliminated. Three stages in this process are shown in figure 2, while figure 3 shows a coronal section through the right half of the rostrum of a young adult specimen of *M. europaeus*, in which the vomer has already changed from concave to convex and partly filled the mesirostral groove.

A section of the rostrum was cut in order to ascertain the relations of the bony elements. True (p. 654) states: "The mesirostral bone occupies the proximal two-thirds of the vomerine trough. It is depressed below the upper surface of the premaxillae and divided unsymmetrically into two flat portions, the surfaces of which are inclined toward each other." The section showed that the mesirostral groove becomes filled only with bone by the expansion of the vomer itself and that there is at least in these forms, no independent mesirostral bone.

In 1926 Mr. Heber A. Longman described and figured *Mesoplodon pacificus* from the Queensland coast of Australia, based upon "an unusually large skull and mandible of a Beaked Whale found at Mackay in 1882." After studying Longman's excellent description and figures and comparing them with those of specimens of *Mesoplodon mirus*, it seems to me that *M. pacificus* should not be considered a distinct species.

Longman says: "The chief characters of the new species [*Mesoplodon pacificus*] are as follows: (1) A single pair of apical mandibular teeth; (2) symphysis more than one-fourth of the mandibular length; (3) no basirostral groove; (4) rostrum very elongated, shallow, margined with a prominent flange; (5) maxillary ridges prominent and not diverging outwards; (6) maxillary foramina much enlarged; (7) no inner notches present in antorbital region; (8) lachrymal very strongly developed and forming the chief lateral constituent of the antorbital tubercle; (9) region of vertex contracted toward the occipital elements, which are almost vertical; (10) transverse diameter behind premaxillae much exceeding antero-posterior length of vertex; (11) nasals confined to anterior moity of vertex."

Of the eleven characters given in the paragraph cited from Longman, most of them are also characteristic of *Mesoplodon mirus*, as can be seen from a comparison of the published accounts and the specimen figured herein. Again referring to these characters:

(1) The apical mandibular teeth are common to all specimens of *mirus*.

(2) "Symphysis more than one-fourth the mandibular length." In the type of *M. mirus* the symphysis is 28.8 per cent of the length of the mandible; in the Liscannor 1917 specimen, 28.5 per cent, in the Edgemere, L. I., specimen, 30.4 per cent, and in the Queensland specimen of *pacificus*, 28.1 per cent; thus they all fall within very narrow limits and in all the symphysis is slightly more than one-fourth the mandibular length.

(3) "No basirostral groove." This, which is homologous with the caudal portion of the maxillary alveolar groove, is also lacking in all specimens of *mirus* and several other species. This lack of the proximal part of the alveolar groove may well be a specialization away from the more primitive condition of *M. grayi*, in which the groove is well developed and numerous peg-like teeth that were developed in it are to be found.

(4) "Rostrum very elongated, shallow and margined, with a prominent flange." Measurements show approximately the same percentages of depth to width of the rostrum in *mirus*.

(5) "Maxillary ridges prominent and not diverging outwards." *M. mirus* is the same, though most of the photographs of specimens (due to direct lighting) fail to show this character (see Fig. 9 herein).

(6) "Maxillary foramina much enlarged." Some specimens of *mirus* have approximately as large foramina (see Fig. 9).

(7) "No inner notches present in antorbital region." This is possibly an age character, judging by a comparison of figures of the type, the specimen figured by Harmer, 1924, Pl. I, and Longman, 1926, Pl. XLIII, fig. 1. It appears that the inner notch is eliminated with advancing age.

(8) "Lachrymal very strongly developed and forming the chief lateral constituent of the antorbital tubercle." Though the lachrymal forms the apex of the antorbital

tubercle in our specimen, which appears to agree with the type and the specimen figured by Harmer, 1924, it differs markedly from that of *pacificus*.

(9) "Region of vertex contracted toward the occipital elements, which are almost vertical."

(10) "Transverse diameter behind premaxillae much exceeding anteroposterior length of vertex."

(11) "Nasals confined to anterior moiety of vertex."

TABLE IV.—Dimensions of skulls of specimens of *M. mirus* and *M. mirus pacificus*.

	Type ♀ U.S.N.M.	90053 ♀ A.M.N.H.	Liscannor ♂ Brit. Mus.	Galway ? ♀ Galway Mus.	*M. mirus pacificus* ? Q'nsl'd Mus.
1.—Total length	810	820	814	762 est.	1186
2.—Height, vertex to inf. border of pterygoids	301	307	315	273	455
3.—Width at center of orbits	325	332	337	...	....
4.—Width across zygomatic prs.	345	344	356	330	520
5.—Width across occ. condyles	125	113	117	...	160
6.—Rostrum, length from level of bases of ant. orb. notches	496	510	520	485 est.	815
7.—Rostrum, width between bases of ant. orb. notches	210	213	200	...	335
8.—Rostrum, width at middle	60	65	67	...	160
9.—Breadth of expanded proximal ends of premaxillae	142	147	165	150	241
10.—Least breadth of premaxillae opposite ant. nares	118	115	120	...	....
11.—Breadth of premaxillae opposite pmx. foramina	68	77	75	...	....
12.—Greatest breadth of anterior nares	56	60	59	...	89
13.—Least distance between max. foramina	92	102	91	...	....
14.—Distance from post. border of max. foramen and end of max. protuberance	63	65	61	...	....
15.—Length of portion of vomer visible on palate	162	148	135	...	....
16.—Length of mandible	668	690	700	610	1085
17.—Length of symphysis	193	210	190	152	300
18.—Greatest height of mandible at coronoid process	117	117	122	114	187

These, too, seem to be age characters, a decrease of anteroposterior diameter of the vertex and coalescence of the elements apparently going with increased age and large size. A comparison of figures of specimens of different ages tends to bear this out.

As Longman has pointed out, the specimen from Queensland is the longest skull of all known specimens of the genus. However, it does not exceed the other skulls by a greater percentage of length than do the skulls of males exceed those of females in some other mammals; but in some, but not all, odontocetes of which I have been able to find reliable comparative measurements, the females are larger than the males; consequently as the type of *mirus* is apparently an adult female, I believe that Longman's beaked whale is possibly a Pacific race of *mirus*, its general skull and mandibular characters agreeing with *M. mirus;* but it differs in its much larger size and in the conformation of the lachrymal and the nasals. Consequently in the following pages I am considering *pacificus* as a variety of *M. mirus.*

TABLE V.—Key to the species of *Mesoplodon* based on skull and mandibular characters.

1.—Lateral basirostral groove present.....2.
Lateral basirostral groove absent.....4.
2.—Lateral basirostral groove deep and conspicuous.....*grayi.*
Lateral basirostral groove shallow and inconspicuous.....3.
3.—Vertical height of rostrum greater than its width (measured at a point halfway between antorbital notch and tip of rostrum).
Maxillary foramina rostral to premaxillary foramina.....*densirostris.*
Vertical height of rostrum less than its width.
Maxillary foramina caudal to premaxillary foramina.....*layardii.*
4.—Premaxillary foramina markedly rostral to maxillary foramina.....5.
Premaxillary foramina caudal to or in line with max. foramina.....6.
5.—Tooth compressed, situated caudal to symphysis.....*bidens.*
Tooth compressed, situated opposite symphysis.....*europaeus.*
6.—Tooth not compressed, situated at or near tip of mandible.....7.
Tooth compressed, situated caudal to symphysis.....9.
7.—Distance from occipital condyle to premaxillary foramen about equal to greatest width of skull; mental foramen multiple.....*hectori.*
Distance from occipital condyle to premaxillary foramen much less than greatest width of skull; mental foramen single.....8.
8.—Total length of skull of adult under one meter, inhabits Atlantic...*mirus mirus.*
Total length of skull of adult over one meter, inhabits Pacific...*mirus pacificus.*
9.—Maxillary protuberance and ridge very pronounced.....*bowdoini.*
Maxillary protuberance and ridge scarcely distinguishable.....*Stejnegeri.*

VERTEBRAE.—The vertebral column (Fig. 15) is in general very much like that of *M. europaeus*. The vertebral formula is C. 7; T. 10; L. 11; Ca. 18 = 46. The first three cervicals are fused. The first seven ribs are attached by both head and tubercle. The three posterior ribs are attached to the transverse processes only. The first five ribs have cartilaginous attachments to the sternum. There are nine well-developed chevrons beneath the proximal caudals and, more caudally, nine intercentral spaces without chevrons.

STERNUM.—The sternum (Fig. 6*B*) is composed of four sternebrae more rectangular in outline than those of *M. europaeus* and with smaller intersternebral fontanelles. Harmer (1924, p. 574) gives in a table the dimensions of various parts of the sternum in two specimens of *M. mirus*. I here add to his table the measurements of the present specimen.

TABLE VI.—Measurements of the parts of the sternum in three specimens of *M. mirus*.

	Total length	S^1 length	S^1 width	S^2 length	S^2 width	S^3 length	S^3 width	S^4 length	S^4 width	F^1 length	F^2 length	F^3 length	F^4 length
SPECIMEN													
Liscannor	633	254	172	144	140	128	136	135	123	10	15	22	12
Galway	437	197	141	95	106	76	106	95	80	34	38	19	14
Long Island	450	192	150	110	100	90	97	68	78	28	35	12	8

The measurements show that the various parts of the sternum undergo considerable variation in proportions, much of which may be due to age. A comparison of the specimen figured by Harmer (Pl. IV, fig. 7) and the present specimen, however, shows a close similarity.

FORE LIMB.—(Fig. 7*B*) The scapula is wider than high, with its vertebral border evenly rounded. The supraspinous fossa appears even smaller than in *M. europaeus*. The acromial process is wide and long and stands out much more from the rostral border of the scapula than it does in *M. europaeus*.

The preaxial border of the radius is slightly convex in *mirus*, whereas in *europaeus* it is concave.

The olecranon process of the ulna is not nearly so large in *M. mirus* as in *europaeus*, but in this specimen has a larger cartilage, which if ossified would make them about equal.

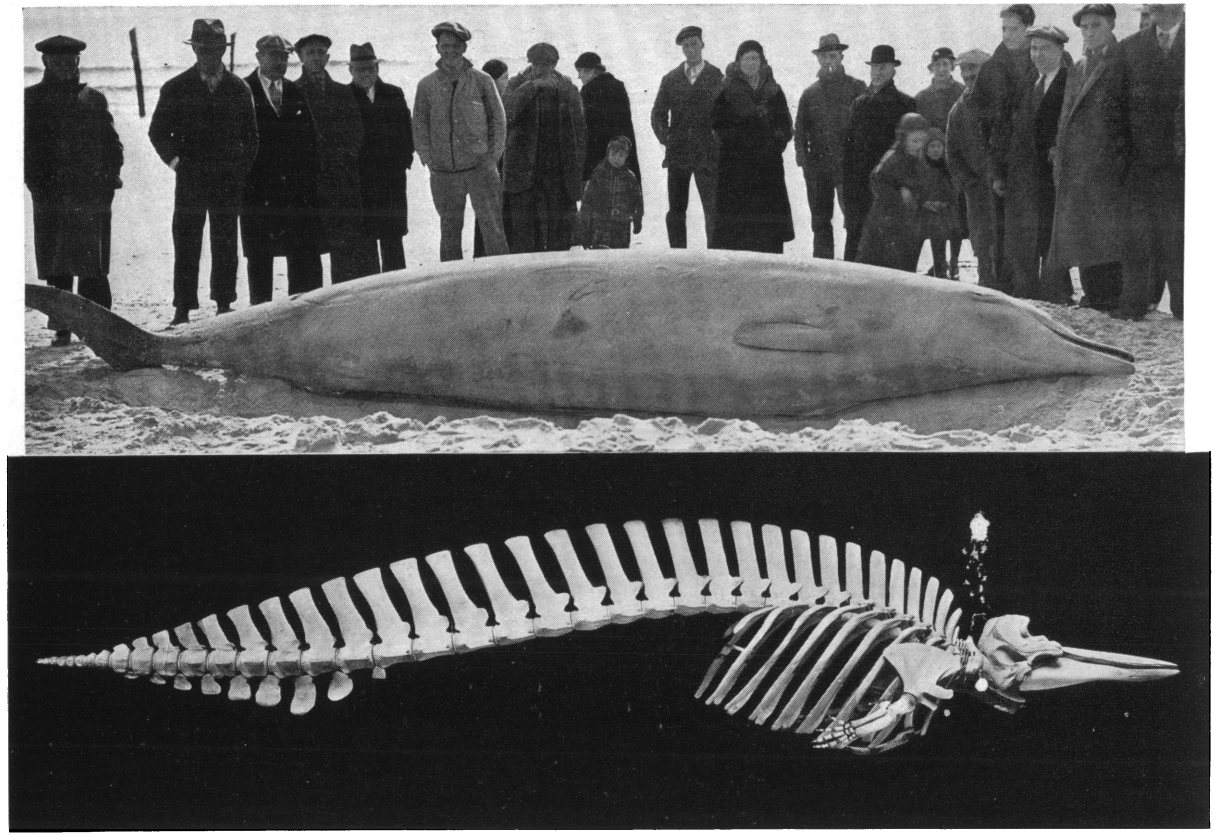

Fig. 15. *Mesoplodon mirus*, stranded at Edgemere, Long Island, January 14, 1934, and (below) mounted skeleton of the same individual.

There are five well-developed carpal elements in *mirus*. The cuneiform of the proximal row is coalesced with the unciform of the distal row and as in *M. europaeus* the magnum is coalesced with the trapezoid and the trapezium with the metacarpal of the first digit.

The phalangeal formula is I 2; II 4; III 4; IV 3; V 2.

LITERATURE CITED

ALLEN, GLOVER M. 1906. 'Sowerby's whale on the American coast.' Amer. Nat., XL, p. 359.

ANDERSON, JOHN. 1878. 'Anatomical and zoölogical researches comprising an account of the zoölogical results of the two expeditions to Western Yunnan in 1868 and 1875 and a monograph of the two cetacean genera, *Platanista* and *Orcella*.' 2 vols., text and plates. London, Bernard Quaritch. [See Pl. XLI, fig. 14, bones of the left forearm and manus of *Platanista gangetica*.]

ANDERSON, R. J. 1901. 'A note on a beaked whale.' Irish Naturalist, X, pp. 117–119.

ANDREWS, ROY C. 1908*a*. 'Description of a new species of *Mesoplodon* from Canterbury Province, New Zealand.' Bull. Amer. Mus. Nat. Hist., XXIV, Art. 13, pp. 203–215.

1908*b*. 'Notes upon the external and internal anatomy of *Balaena glacialis* Bonn.' Bull. Amer. Mus. Nat. Hist., XXIV, Art. 10, pp. 171–182.

1914. 'Notice of a rare ziphioid whale, *Mesoplodon densirostris*, on the New Jersey coast.' Proc. Acad. Nat. Sci. Phila., LXVI, pp. 437–440, Pls. XVI, XVIII.

ANTHONY, R., AND COUPIN, F. 1930. 'Recherches anatomiques sur le vestibule de l'appareil respiratoire (poche gutturale-hyoïde-larynx) du *Mesoplodon*.' Mem. d. Inst. Espanol de Oceanografia, XIV, pp. 1–40.

BRASIL, L. 1909. 'Les cétacés du Musée d'Histoire naturelle de Caen.' Bull. Soc. Linn. Normandie, (6) I, (1907), pp. 157–261. [Pls. I, II, skull; 2 text figs., tooth.]

BROOM, R. 1927. 'Some further points on the structure of the mammalian basicranial axis.' Proc. Zoöl. Soc. London, April 6, 1927, part 1, pp. 233–244.

FLOWER, W. H. 1876. 'Remarks upon Dr. von Haast's communication on *Ziphius novaezealandiae*.' Proc. Zoöl. Soc. London, pp. 477–486.

1878. 'A further contribution to the knowledge of the existing ziphioid whales: genus *Mesoplodon*.' Trans. Zool. Soc. London, X, part 11, pp. 415–437.

1885. 'An introduction to the osteology of the Mammalia.' Third Ed. London. Macmillan and Co. 382 pp.

FRASER, F. C. 1934. 'Report on Cetacea stranded on the British coasts from 1927–1932.' British Museum (Natural History). Printed by Order of the Trustees. No. 11. [*Mesoplodon bidens*, Fig. 8.]

GERVAIS, PAUL. 1848–1852. 'Zoologie et paléontologie françaises. Nouvelles recherches sur les animaux vertébrés dont on trouve les ossements

enfouis dans le sol de la France. . .' 2 vols., text and plates. Paris, Arthus Bertrand. 544 pp. Second Edition, 1859.

1854–1855. 'Histoire naturelle des mammifères.' Vol. II. Paris, L. Curmer. [*Mesoplodon*, pp. 320, 321.]

GRAY, J. E. 1865. 'Notes on the whales of the Cape; by E. L. Layard, Esq., of Capetown, Corr. Memb. With descriptions of two new species.' Proc. Zool. Soc. London, 1865, pp. 357–358.

GREGORY, WILLIAM K. 1910. 'The orders of mammals.' Bull. Amer. Mus. Nat. Hist., XXVII, Feb., 1910, pp. 1–524.

1920. 'Studies in comparative myology and osteology, No. IV. A review of the evolution of the lacrymal bone of vertebrates with special reference to that of mammals.' Bull. Amer. Mus. Nat. Hist., XLII, Art. 2, pp. 95–263.

GRIEG, JAMES A. 1904. 'Bidrag til kjendskaben om *Mesoplodon bidens*, Sow.' Bergens Mus. Aarbog. 1904. Afhandlinger og Aarsberetning, pp. 1–39.

HAAST, JULIUS VON. 1876*a*. 'Notes on the skeleton of *Ziphius novae-zealandiae*.' Proc. Zool. Soc. London, pp. 466–477.

1876*b*. 'Notes on *Mesoplodon floweri*.' Trans. and Proc. New Zealand Inst., pp. 442–450.

1876*c*. 'On *Oulodon;* a new genus of ziphioid whales.' Trans. and Proc. New Zealand Inst., IX, pp. 450–457.

HALE, HERBERT M. 1931*a*. 'Beaked whales–*Hyperoodon planifrons* and *Mesoplodon layardii*—from South Australia.' Rec. S. Austr. Mus., IV (1928–1932), pp. 291–311.

1931*b*. 'The goose-beaked whale (*Ziphius cavirostris*) in New Ireland.' Rec. S. Austr. Mus., IV (1928–1932), pp. 312, 313.

1931*c*. 'The pigmy right whale (*Neobalaena marginata*) in South Australian waters.' Rec. S. Austr. Mus., IV (1928–1932), pp. 314–319.

HARMER, S. F. 1914–1927. 'Report on Cetacea stranded on the British coasts during 1913–1926. Reports 1–10.' Mem. Brit. Mus. (Nat. Hist.). Printed by Order of the Trustees of the British Museum.

1924. 'On *Mesoplodon* and other beaked whales.' Proc. Zool. Soc. London, part 2, pp. 541–587.

HINTON, MARTIN A. C. 1925. 'Reports on papers left by the late Major G. E. H. Barrett-Hamilton relating to the whales of South Georgia.' Publ. by the Crown Agents for the Colonies. London.

IREDALE, TOM, AND TROUGHTON, E. LEG. 1934. 'A check-list of the mammals recorded from Australia.' Austr. Mus., Sydney, Mem. VI. [Family Hyperoodontidae, pp. 60–62.]

KELLOGG, REMINGTON. 1928. 'The history of whales—their adaptation to life in the water.' Part I, Quart. Rev. Biol., III, No. 1, March, pp. 29–76. Part II, Quart. Rev. Biol., III, No. 2, June, pp. 174–208.

LONGMAN, HEBER A. 1926. 'New records of Cetacea, with a list of Queensland species.' Mem. Queensland Mus., VIII, pp. 266–278.

LYDEKKER, R. 1911. 'A rare beaked whale.' Proc. Zool. Soc. London, 1911, pp. 420–422.

OLIVER, W. R. B. 1922. 'A review of the Cetacea of the New Zealand seas.' I. Proc. Zool. Soc. London, pp. 557–585.

PYCRAFT, W. P. 1935. 'President's Address.' Trans. Norfolk and Norwich Nat. Soc., XIV, part I, pp. 1–30.

RAVEN, H. C., AND GREGORY, WILLIAM K. 1933. 'The spermaceti organ and nasal passages of the sperm whale (*Physeter catodon*) and other odontocetes.' Amer. Mus. Novitates, No. 677, 18 pp.

SCHULTE, H. VON W. 1916. 'Anatomy of a foetus of *Balaenoptera borealis*.' Mem. Amer. Mus. Nat. Hist., (N.S.) I, part 6, pp. 389–502.

STEPHEN, A. C. 1931. 'True's beaked whale (*Mesoplodon mirus*) new to the Scottish fauna.' Scottish Naturalist, No. 187, January–February, pp. 37–39.

TRUE, FREDERICK W. 1910. 'An account of the beaked whales of the Family Ziphiidae in the collection of the United States National Museum, with remarks on some specimens in other American museums.' Bull. U. S. Nat. Mus., LXXIII, pp. 1–89.

1913. 'Description of *Mesoplodon mirum*, a beaked whale recently discovered on the coast of North Carolina.' Proc. U. S. Nat. Mus., XLV, No. 2007, pp. 651–657.

VAN BENEDEN, P. S., AND GERVAIS, PAUL. 1880. 'Ostéographie des Cétacés, vivants et fossiles....' I. Text. II. Plates. Paris, Arthus Bertrand. 4to. 634 pp.

VROLIK, W. 1848. 'Natuur- en Ontleedkundige Beschouwing van den *Hyperoodon*.' Natuurkundige Verhand. van de Hollandsche Maatsch. d. Wetensch. te Haarlem, V, part 1, pp. 1–128.