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New remains of Archaeoceti from the Paleogene of Antarctica

ABSTRACT: Whale bones from the upper Eocene — ?lower Oligocene La Meseta Formation of Seymour (Marambio) Island, West Antarctica, are assigned to the Archaeoceti. They most probably belong to an undetermined genus of the family Basilosauridae Cope, 1867; subfamily Dorudontinae Barnes and Mitchel, 1978.

Key words: Antarctica, Seymour (Marambio) Island, Paleogene, Archaeoceti.

Introduction

Whale remains described herein come from the upper Eocene — ?lower Oligocene sediments of Seymour (Marambio) Island, West Antarctica (the La Meseta Formation, unit III according to Elliot *et al.* 1975, 1982). They have been collected by members of the 9th Polish Antarctic Expedition during the Argentine — Polish Field Party in 1985, along with penguin remains (*see*: Myrcha and Tatur 1986, 1988). Geographical and geological situation of the locality is given by Myrcha and Tatur (1988) and by Gaździcki *et al.* (*in press*), and is here recalled in Fig. 1.

For the first time, whale remains were collected by the Swedish South Polar Expedition in 1901—1903 from Seymour Island. This material, referred to as *Zeuglodon* sp. by Wiman (1905), came from approximately the same strata, but from another locality, as the Polish one and presents the same association of the whale and penguin bones. Its conspecifity with the Polish material is highly probable but may not be demonstrated owing to lack of correspondence of the skeleton parts preserved in both cases. Both of them represent the short-center Archaeoceti — dorudontids rather than the long-center basilosaurins (and, thus, not *Zeuglodon*). More recently, whale materials from Seymour Island have been reported by Kellog (1936)

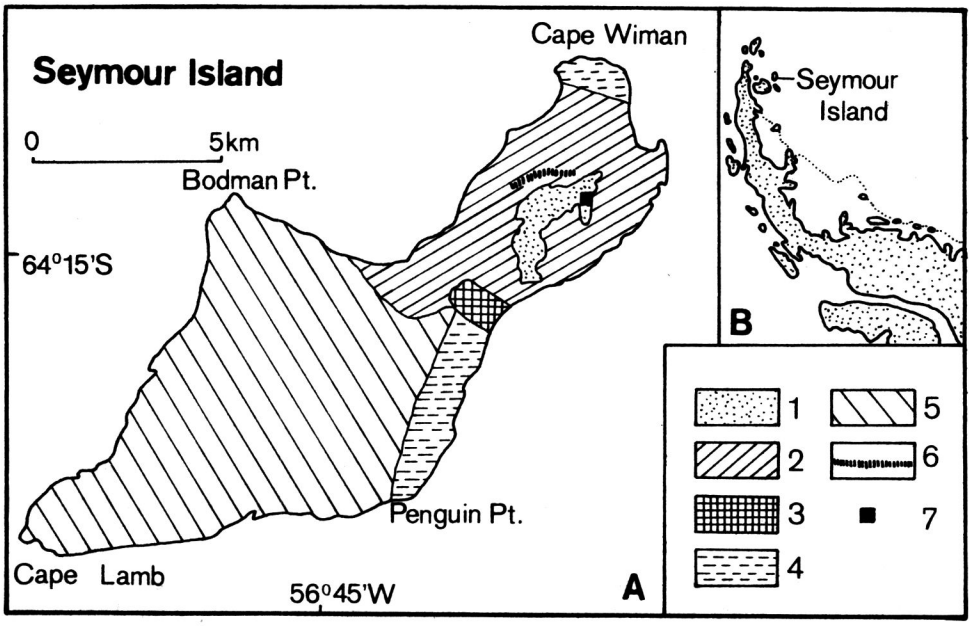

Fig. 1. Location map of Seymour Island (A) in the Antarctic Peninsula sector (B). 1 — Quaternary, 2 — La Meseta Formation, 3 — Cross Valley Formation, 4 — Sobral Formation, 5 — Lopez de Bertodano Formation, 6 — Penguin and whale bone-bearing horizon, 7 — Argentine *Vicecomodoro Marambio* Base.

and Elliot *et al.* (1975), and referred to as „*Zeuglodon*" by Fordyce (1980). These materials were not available for comparison.

The material described herein is housed in the Institute of Paleobiology, Polish Academy of Sciences, for which the acronime ZPAL is used.

Systematic paleontology

Order Cetacea Brisson, 1762
Suborder Archaeoceti Flower, 1887
Family? Basilosauridae Cope, 1867
Subfamily? Dorudontinae Barnes and Mitchel, 1978
gen. et sp. indet.

(Pls. 1—2, Figs. 2—4)

Material. — ZPAL M-VII/1 Centrum of a lumbar vertebra with right transverse process (Table 1).

ZPAL M-VII/2 Neural arch of a posterior thoracic or lumbar vertebra with neural spine broken off at the base (Table 2).

ZPAL M-VII/3 Right ventrolateral portion of the seventh cervical vertebra with a fragment of transverse process (Table 1).

ZPAL M-VII/4 Manubrium of the sternum (Table 3).

Description. — ZPAL M-VII/1 (Fig. 2 and Pl. 1, Fig. 2a-b) is a platycelous dorsoventrally flattened centrum with anterior and posterior articular surfaces oval and subequal to one another. These surfaces bear slightly protruding bony coats made of the epiphyses intimately fused with the centrum. Traces of the neural arches cover almost the anterior 3/4 of the

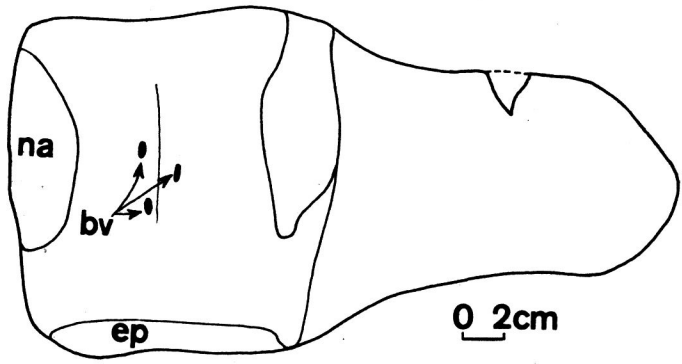

Fig. 2. Lumbar vertebra, ZPAL M-VII/1, in dorsal view. Posterior downwards; bv — foramina for basiventral vain, ep — epiphysis coossified with centrum; na — trace of neural arch roots.

length of the dorsal surface. Between them the width of the neural canal is more than a half of the width of the centrum. A sagittal crest extends along the ventral surface of this canal, two pairs of foramina for the basivertebral vein being irregularly distributed on its sides.

Short (Table 1) stout transverse process is supported by almost the entire

Table 1

Dimensions of vertebrae ZPAL M-VII/1 and 3 in cm

	1	3
Length of centrum with epiphyses	15.5	
Height to width of:		
cranial articular surface	13.5/16	7.5/app.8.4
caudal articular surface	13.5/16	8.4/11.4
Length to width of neural arch root	11/2.5	
Width of neural canal	8.5	
Length of transverse process	17	
Antero-posterior diameter of root of transverse process	app.13	4.7

lateral surface of the centrum and is directed obliquely ventrolateral, so that its dorsal surface is inclined laterally and the ventral one slightly medially. The cranial and caudal margins of the transverse process are subparallel while converging at the distal extremity. There is neither incision nor foramen for the intervertebral artery. This fact along with the width of the neural

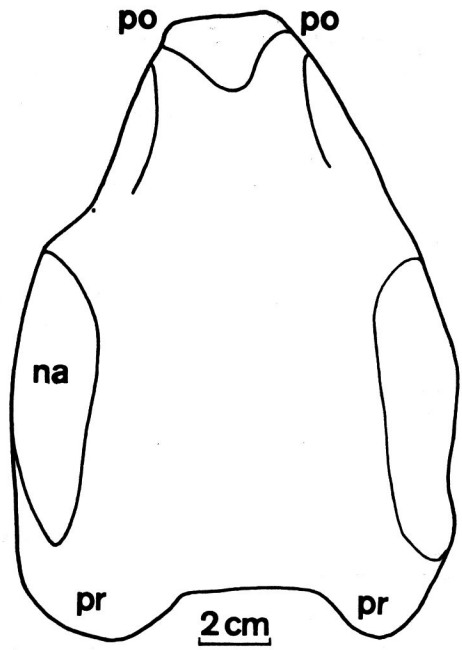

Fig. 3. Neural arch of a lumbar or thoracic vertebra, ZPAL M-VII/2, in ventral view. Anterior downwards; na — traces of neural arch roots; po — rudiments of postzygapophyses; pr — rudiments of prezygapophyses.

canal indicates a lumbar rather than caudal location of the vertebra, whereas the low position of the transverse process points to a posterior part of this region of the vertebral column.

ZPAL M-VII/2, (Fig. 3 and Pl. 2, Fig. 1 a-b), a dorsal part of the neural arch, is very long with respect to its roots that are about 50% of its total length. A postzygapophyseal part protrudes posteriorly about three times as much as does the prezygapophyseal part in the anterior part of the arch. Neither of them has a functional articular surfaces, but the overall shape of the pre and postzygapophyses is retained. The former are anteriorly protruding processes rounded in outline, separated by a wide incision and provided with metapophyseal bone thickenings on their lateral surfaces, the latter correspond to the oblique furrows situated in the corners of the trapezoidal bottom face of the posterior tapering part of the arch (Fig. 3). The postzygapophyseal part has a flat posterior surface that is suggestive of a vertical position of the posterior border of the neural spine. The anterior border of the preserved part of the neural spine is inclined posterodorsally.

The size of roots of the neural arch ZPAL M-VII/2 corresponds with that of the traces of neural arch left on the centrum ZPAL M-VII/1. But the total length of the arch exceeds the length of this centrum and the

prezygapophyseal and postzygapophyseal regions protrude over the centrum extremities into the neighboring segments. Such a significant degree of overlap is here considered as primitive for the Cetacea.

ZPAL M-VII/3 (Fig. 4 and Pl. 1, Fig. 1a, b, c) is cervical vertebra VII. The centrum is very short (Table 1) and provided with an antero-posteriorly flattened transverse process (instead of dorso-ventrally flattened process characteristic of the caudals). These characters, along with the lack of the anterior demifacet for the capitulum of the rib and the lack of the transverse foramen, suggest a location of the centrum at the end of the cervical series.

The centrum is lower than wide and tapering off anteriorly. A distinct ventral ridge devides its ventral surface into two ventrolateral ones. Both articular surfaces of the centrum bear traces of cartilage. A preserved basal part of the transverse process is situated obliquely with respect to the centrum, so that its anterior wall remains parallel to the cranial articular surface and the posterior one forms an angle of about 135° with the caudal surface. Posterior to the base of the transverse process a small tuberosity is probably a posterior demifacet for the capitulum of the rib. The size and position of the neural arch may not be reconstructed from its fragmentary base.

ZPAL M-VII/4 (Pl. 2, Fig. 2 a, b) is a manubrium of the sternum. This is an elongated massive bone wider dorsally than ventrally and slightly notched medially in front. Both the anterior and dorsal surfaces are flattened as a whole with a slight sagittal concavity. They are perpendicular to each other. Ventral surface is concave from end to end, and convex from side to side. The anterior end bears deep costal cavities, one on each lateral side. They are shifted ventrally and recall ligamentous fossae of the distal extremity of the metacarpal in ventral aspect of the bone. The dorsal

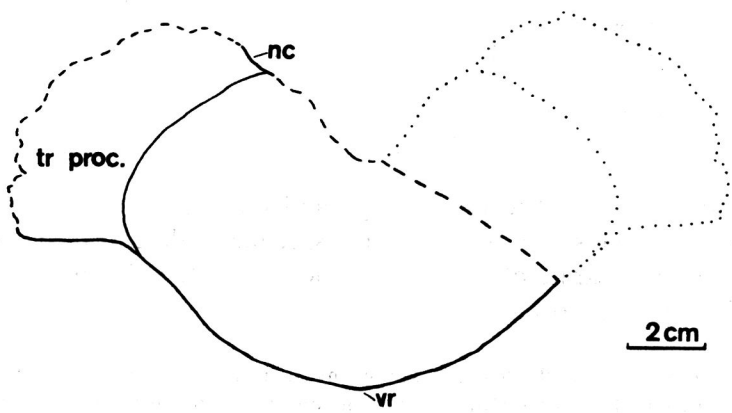

Fig. 4. Cervical vertebra VII. ZPAL M-VII/3 in cranial view; nc — wall of neural canal; tr proc. — transverse process; vr — ventral ridge. Broken line — damaged parts; dotted line — missing parts.

surface of the manubrium is strongly expanded near the middle of its length, while strongly tapering posteriorly, which makes it distinctly pear-shaped. The posterior extremity of the manubrium has its lateral and posterior surfaces strongly roughened for cartilage.

Discussion. — Whale remains described herein have been assigned to a suborder Archeoceti on the basis of a strong posterior protrusion of the postzygapophyseal part of the neural arch *i.e.* a comparatively small degree of reduction of the zygapophyses in the lumbar region of the vertebral column. The assignement of the remains to the subfamily Dorudontinae of the family Basilosauridae is most probable, because of the shortness of the centrum of the lumbar vertebra ZPAL M-VII/1, assuming that all the bones belong to the same animal. The total size of the vertebral column of this animal has been estimated for about 7 m, about two times the size of *Zeuglodon* osiris as reconstructed by Slijper (1936,

Table 2

Dimensions of neural arch M-VII/2 in cm

Maximum length	18,5
Length in sagittal axis	17
Length to width of neural arch root:	
left	8/2.5
right	9/2.5
Spread of metapophyses	13
Maximum width of prezygapophyseal part	5

Table 3

Dimensions of manubrium sterni ZPAL M-VII/4 in cm

Length	14.5
Maximum width	10.3
Width of cranial end: dorsal	7.5
ventral	8.2
Dorsoventral diameter of: cranial end	6.6
caudal end	5.3

Abb. 156 and Table 22). The morphology and dimensions of the described vertebrae are very close to those of the specimens described by Wiman (1905) from the same strata of Seymour Island, but only a few measurements are available for comparison.

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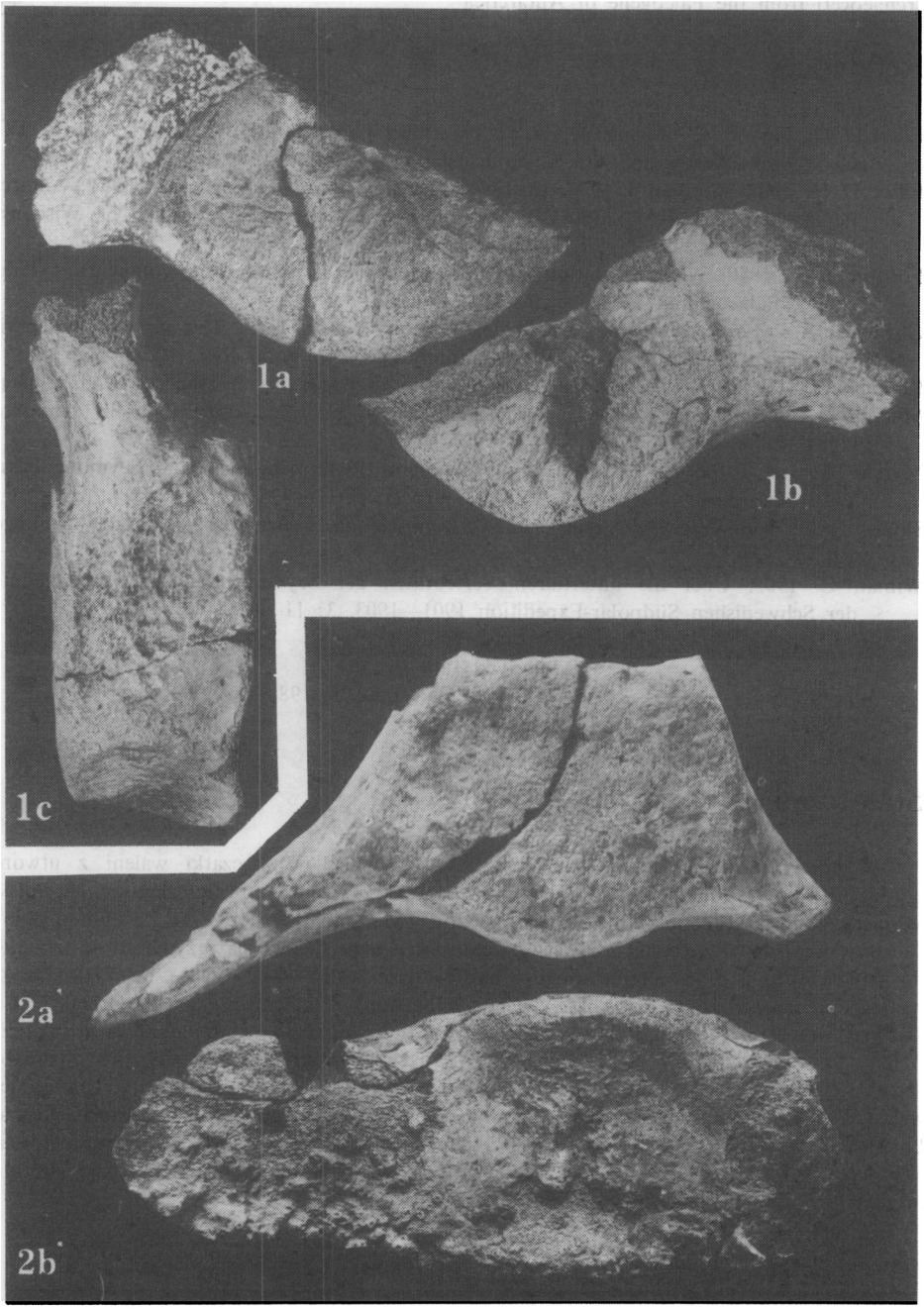
Streszczenie

W pracy opisano i zilustrowano (fig. 2—4 i pl. 1—2) szczątki waleni z utworów górnego eocenu — ?dolnego oligocenu formacji La Meseta zebrane przez członków IX Polskiej Wyprawy Antarktycznej PAN na Wyspie Seymour (Marambio), Antarktyka Zachodnia (fig. 1).

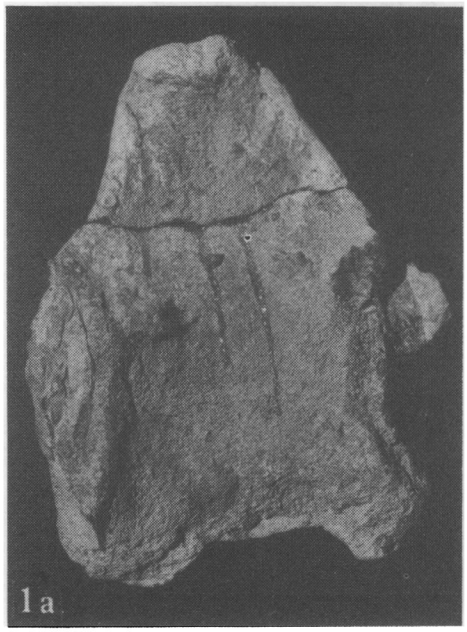
Stosunkowo słaby stopień redukcji zygapofyz kręgów wskazuje na przynależność szczątków do Archaeoceti, a bardzo mała długość trzonu kręgu lędźwiowego ZPAL M-VII/1 (tab. 1) na jego przynależność do krótkokręgowych Archaeoceti z podrodziny Dorudontinae rodziny Basilosauridae i takąż przynależność wszystkich opisanych szczątków, przy założeniu, że pochodzą z jednego osobnika. Bliskość wymiarów opisanych szczątków (tab. 1—3) do rozmiarów szczątków opisanych przez Wimana (1905) pod nazwą *Zeuglodon* sp. z warstw tego samego wieku Wyspy Seymour sugeruje ich konspecyficzność. Inne szczątki waleni z utworów formacji La Meseta Wyspy Seymour (Kellogg 1936, Elliot *et al.* 1975) cytowane pod nazwą *Zeuglodon* (Fordyce 1980) nie były dostępne dla badań porównawczych. Reprezentują one przypuszczalnie także podrodzinę Dorudontinae (Elliot *et al.* 1975).

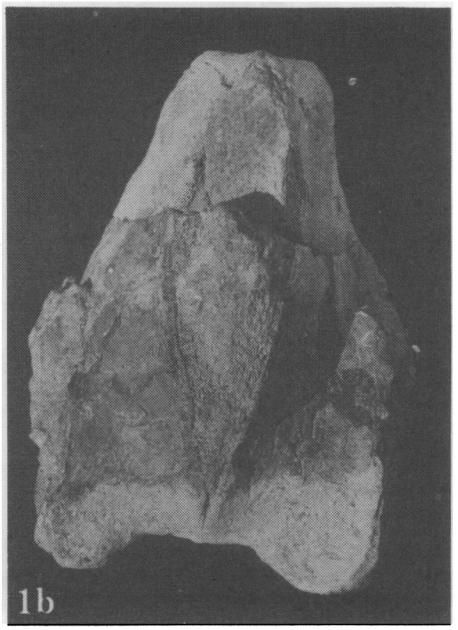


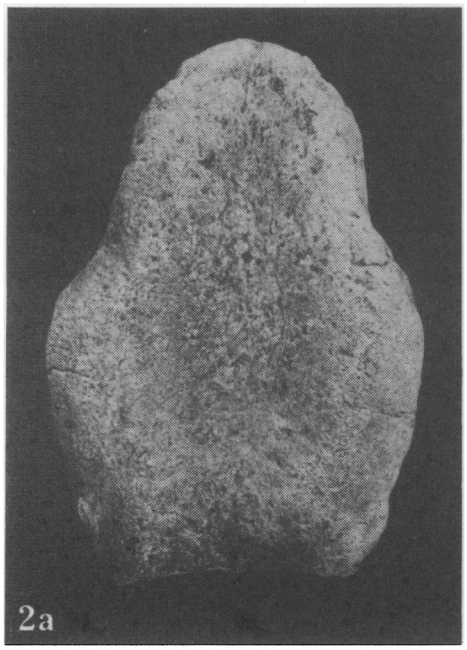
Suborder Archaeoceti
Family ?Basilosauridae
Subfamily ?Dorudontinae

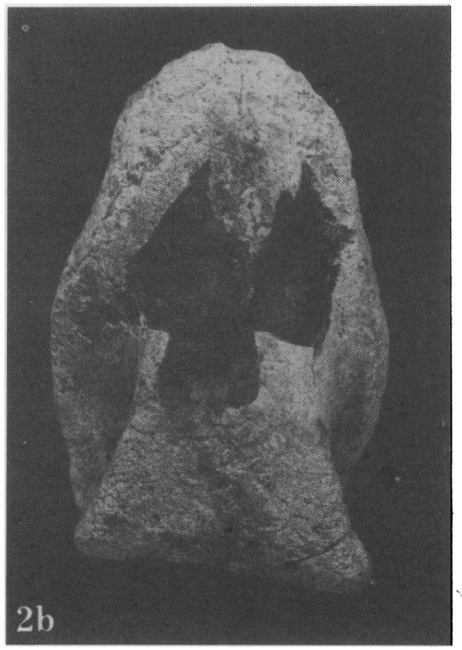
1. Fragmentary cervical vertebra VII, ZPAL M-VII/3, ×0.48 a — caudal view, b — cranial view, c — ventral view. 2. Centrum of a lumbar vetebra, ZPAL M-VII/1, with transverse process, ×0.26; a — cranial view, b — ventral view.

Seymour Island, La Meseta Formation









Suborder Archaeoceti
Family ?Basilosauridae
Subfamily ?Dorudontinae

1. Neural arch of a posterior thoracic or lumbar vertebra ZPAL M-VII/2, ×0.38; anterior is downwards; a — ventral view, b — dorsal view. 2. Manubrium of the sternum, ZPAL M-VII 4, ×0.47; anterior is downwards; a — dorsal view, n — ventral view.

Seymour Island, La Meseta Formation