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PINOCETUS POLONICUS GEN.N., SP.N. (CETACEA) FROM THE MIOCENE LIMESTONES OF PIŃCZÓW, POLAND

Abstract. — An incomplete skeleton with a damaged skull of a whale of the family Cetotheriidae, discovered near Pińczów, central Poland, is described and assigned to the new genus and species, *Pinocetus polonicus*. In the structure of the skull with its telescopic shape it is similar to *Aulocetus sammarinensis* Capellini, family Cetotheriidae. In the present writers' opinion, *Pinocetus polonicus* and *Mixocetus elysius* belong to the same evolutionary stock. It is suggested that *Pinocetus* was not yet an efficient swimmer and was incapable of rapid and deep diving. It lived in shallow Miocene seas, but could also reach distant off shore areas.

INTRODUCTION

The Miocene limestones from the environs of Pińczów, in the southern margin of the Holy Cross Mts., belong to the lower part of the Opolian substage (Krach *et al.*, 1970) of the Badenian stage. They commonly contain the remains of elasmobranch fish, less frequently Teleostei (Kowalewski, 1930; Jerzmańska, 1958; Pawłowska, 1960; Radwański, 1965) and sometimes the bones of whales (Ryziewicz, 1969). The composition of the fauna is indicative of a warm, subtropical sea (Pawłowska, 1960; Radwański, 1965).

The aim of the present paper is to describe an incomplete skeleton of a whale of the family Cetotheriidae, found in a Miocene limestone quarry worked for the construction industry at Nowa Wieś near Pińczów.

Within the geographical range of the Miocene Cetotheriidae, the Pińczów locality, situated near 51° North is among the most northerly. In the northern hemisphere, the most important finds of the Cetotheriidae come from areas situated at the following latitudes: Belgium, near Antwerp, about 51°N; USSR, coast of Black Sea and Crimea, 45°N; USA, Chesapeake Bay and California, 38°N and 25° to 30°N respectively.

The skeleton of *Pinocetus polonicus* gen.n., sp.n. is preserved in natural articulation. Although damaged, the skull is almost complete and the vertebrae are arranged in succession. The carcass of the animal was certainly laying on the bottom on its side and this position caused the deformation of the transverse processes of the lumbar vertebrae and crushing of the ribs. The skeleton was excavated during the exploitation of limestone in the quarry and it was then that the skull, mandible and other parts were damaged.

Skeletons of fossil whales, with articulated bones are very rarely found, since the bones of Cetacea being porous and filled with drops of fat, are subject to a much earlier destruction than those of other vertebrates. At large depths, only such parts of the skeletons of whales are accumulated as the very compact and hard tympanic bullae. Fragmentary skeletons of whales, with their bones articulated could be preserved in a comparatively shalow sea only in the case when the remains were rapidly covered with sediment (Kellogg & Whitmore, 1957). Usually moving waters, tides, waves and currents separate and scatter particular parts of the skeleton. The state of preservation of the skeleton of *Pinocetus polonicus* indicates that its carcass was buried at the bottom of a shallow sea in the place where sediments were quickly accumulated and where the water was calm. Likewise, the connection between the braincase and rostrum has been preserved intact the suture connecting the ascending process of the maxilla and the frontal is present. This is also indicative of a rapid burial of this skeleton. This connection is very weak in the Mysticeti and very frequently the rostrum is broken off in fossil specimens (Miller, 1923).

The skeleton of *Pinocetus polonicus* here described is the property of the Museum of the Earth, Polish Academy of Sciences, Warsaw, (abbr. MZ).

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DESCRIPTION

Genus *Pinocetus* gen. nov.

Type species:Pinocetus polonicus sp.n.
Derivation of the name: after the town Pińczów and *ketos* (Gr.) = whale.
Type horizon, locality and diagnosis: as for the type species.

Pinocetus polonicus sp.n.

(text-figs 1-5, pls XXIII—XXX)

Type specimen: an incomplete skeleton, with a damaged skull and damaged mandibles, twenty-six vertebrae, right scapula, right humerus and a fragmentary radius (MZ VIII/Vm-750).

Type horizon and locality: Badenian M_4, Nowa Wieś near Pińczów, Poland.

Diagnosis. — A species differing from other Cetotheriidae in the combination of the following characters: Medium size, the entire skeleton about 7.5 m long. Skull slightly telescoping in the occipital region, with short supraoccipital shield. Nasal long. Temporal fossae perpendicular to the median axis of skull. Tympanic bulla wide with flattened posterior surface. Vertebrae with relatively elongate centra: centrum of the Xth dorsal vertebra longer than wide. No lateral foramen in the axis, but present in further cervical vertebrae. Costal foveae present on the centra of cervical vertebra VII and dorsal vertebrae I to III. Scapula large with a prominent acromion; humerus and radius elongate.

Occipital region (pls. XXIII—XXIV). — The anterior part of the supraoccipital shield preserved is triangular; a flat crest, fading out about halfway the length of shield, runs medially. The margins of this bone are raised. Rough attachment areas of the semispinal muscles of the head occur on both sides of the medial crest. Lateral parts of the occipital, supraoccipital and exoccipital are destroyed and the cast of the braincase is exposed.

Dimensions (in mm) of the skull of *Pinocetus polonicus* gen.n., sp.n.:

Length: basion — prostion	1.570	
Length: apex of supraoccipital shield — opistion	260	
Length of braincase	320	
Maximal width of occiput	350	
Width across zygomatic processes	706	
Height: supraoccipital apex — palatine	218	vertically
Height: supraoccipital slope — roof of choanae	175	vertically

Temporal region, top view (text-fig.1; pl. XXIII). — Only right parietal preserved, they meet anteriorly each other in front of the supraoccipital shield and form a narrow, 75 long and 12 to 16 mm wide, sagittal crest. An angle between the slope of the supraoccipital shield and parietal crest amounts to 147°. The anterior process of the parietal covers part of the frontal about 40 mm long and 60 mm wide. The parietals and frontals are joined at this place by a suture having longitudinal intermeshed notches.

The exposed part of the frontal in front of the sagittal crest is about 25 mm long. The anterior temporal crest, characteristic of some Cetotheriidae, runs across the frontal; in the interorbital region it is arcuate and runs further through the supraorbital process dividing it into two unequal parts, a longer anterior and a shorter posterior. Both surfaces of the supraorbital process are inclined at an obtuse angle to each other, the posterior surface more strongly sloping inside the temporal fossa. Anteriorly, the frontal is overlapped by the nasal, premaxilla and the ascending process of the maxilla. This part of the frontal is about 175 mm long, while its total maximal length reaches 300 mm. The anterior part of the frontal, covered by the ascending process of the maxilla, displays longitudinal folds, corresponding to the sculpture of the lower surface of the maxilla. The posterior margins of the supraorbital process, aligned at an angle of 90° to the longitudinal axis of the skull to the orbital margins. The anterolateral margin of the supraorbital process forms the posterior wall of a groove situated on the boundary between the frontal and maxilla while its anterior wall is formed by the maxilla. This groove is more than 190 mm long and about 20 to 30 mm wide. Remains of the lachrymal are preserved on the outer angle of the groove in the right side of the skull. The orbit, measured along a straight line, is 130 mm long and, measured along the margin of the supraorbital process, 170 mm long.

Rostrum (pls XXV, XXVI). — The widest part of the rostrum is situated along the line connecting the preorbital processes of maxillae; the incision of the rostral portion of a considerable size, as the width of rostrum, measured across the preorbital maxillary processes, amounts to 580 mm and, in the incision, only 360 mm. The ascending maxillary process is widely triangular with its base corresponding to the line connecting the anterior margins of the maxillary preorbital process. The posterior end of this process reaches almost as far as the anterior temporal crest. Part of the maxilla forming the wall of the groove occuring on the boundary between the frontal and the upper jaw, extends posteriorly, into a thin plate of the maxillary suborbital process (text-figs 3, 4).

The outer margins of the rostrum are nearly parallel to each other as far as halfway along its length. Further anteriorly, the rostrum gradually narrows and its margins become arcuate. The rostrum under study is broken in several pieces and its transverse sections, thus exposed, allow one to observe the internal structure of this part of the skull.

In the transverse section of the rostrum, 28 cm from the apex of the supraoccipital shield, the considerably damaged nasals are about 49 mm wide. On the surface of the skull, the premaxilla is very narrow in this place, its width on either side amounting to about 24 mm and only right premaxilla is preserved. Its lower and lateral sides surround the nasal meatus, while its upper, slightly convex surface is inclined towards the centre. At the top, the maxilla reaches the premaxilla, while the lower and medial maxillary surfaces adhere to the palatine. In this place, the maxilla is relatively thick and spongy. The nasal meatus is oval in transverse section. At the base of rostrum, the palatine bones are thin and adhere to a robust vomer, but they do not meet each other medially. Thirty-tree centimetres from the apex of the supraoccipital shield, the transverse section of the rostrum intersects the anterior ends of the nasals. The reconstructed length of the nasals amounts to about 195 mm. The palatine bones do not reach this region. In this place, the nasal meatus is somewhat wider and higher. Also wider are the premaxillae. Over a small space, the maxillae form lateral walls of the nasal meatus, higher up they contact premaxillae and downwards adhere, in the form of thin palotal plates, to the vomer. Fifty-eight cm from the apex of the supraoccipital shield, and twenty-five cm from the anterior end of the nasals, the internal gutter of the rostrum is heart-shaped. A sharp keel runs along the lower surface of the vomer, the lateral surfaces of which are overlaid by thin palatal plates of the maxilla. The maxillae do not form parts of the walls of the internal gutter of the rostrum and at the top they contact the premaxillae. Halfway along the length of the rostrum, the internal gutter continues to be heart-shaped, but is lower and narrower. In this place, the vomer is thin and its lateral walls reach higher than half the height of the rostral gutter. In the centre of their upper surface, the premaxillae form a deep groove about 30 cm long running from the nostrils anteriorly. The anterior margin of the vomer is situated about 40 cm from the tip of the rostrum. In this region, the largest width of the premaxillae amounts to 60 mm and the internal rostral gutter is wider than high. The gutter is surrounded at the top by premaxillae, which on the lower side do not contact each other laterally or at the bottom. The maxillary palatal plates nearly reach the medial line of rostrum. Seventeen cm from the anterior end of the rostrum (prostion), the internal gutter is circular in transverse section and is 36 mm in diameter. On the upper surface of the rostrum, the right premaxilla overlaps the left and on the lower surface the left premaxilla is extended slightly to the right, exceeding the medial line, while the right one does not touch it, so that a narrow fissure occurs between the two bones. The lateral parts of the premaxillae are flattened and their upper surface is in this place more convex than the lower. In the anterior part of rostrum, the maxilla is situated on its lower surface only, where it is thin and terminates gently narrowing anteriorly. In this place, it is 53 mm shorter than the premaxillae. The termination of the rostrum is formed only by the premaxillae narrowing anteriorly in the form of a gentle arch. A small, 10 mm wide and 16 mm long notch occurs on the anterior parts of these bones. The premaxillae are in this place asymmetric, the right one slightly overlapping the left from above, while on the lower surface the width of the right bone is smaller (53 mm) than the left and amounts to 59 mm. The fissure on the lower surface, separating the two bones, gradually extends anteriorly. A groove about 48 mm long runs along the anterior margin of the premaxilla, on the both sides, towards a sizable aperture.

Dimensions (in mm) of the rostrum of the skull in *Pinocetus polonicus* gen.n., sp.n.:

	MZ VIII/Vm 750	
length of rostrum: posterior margin of premaxillary — prostion	about 1.223	reconstructed
width of rostrum across preorbital processes	580	
width of maxilla in this same place	185	
length of the upper surface of maxilla, measured diagonally	about 1.170	reconstructed
width of the maxillar suborbital process	about 130	
width of rostrum halfway its length	295	
width of premaxilla in this same place	100	

Lower part of skull (text-fig. 2; pls XXIV and XXIX). — In the region of the foramen magnum, the occipital is destroyed, while a cast of the foramen magnum, the condyle eminence and a cast of mirabile arterial network, covering both halves of the cerebellum, are preserved. The situation of basion and opistion, as well as the diameter of the foramen magnum can be determined. The posterior part of the basioccipital is destroyed, the lower surface of the occipital between lateral protuberances is almost flat, with a longitudinal striation on it. A cast of the inside of tympanic bulla is preserved to the right of the lateral protuberance, while to the left there is only its imprint. The left tympanic bulla is preserved separately almost complete (pl. XXIX, fig. 1). Dorsally and ventrally, the tympanic bulla of *Pinocetus polonicus* is rhomboidal and slightly contracted anteriorly, while laterally its ventral wall is slightly arcuate in outline. Its posterior surface is flattened. A prominent posterior process is situated on the involucrum of the tympanic bulla. A sigmoid process, whose apex is broken off, occurs halfway along the length of the outer lip and across the longitudinal axis of the tympanic bulla. A low, but robust medial process is situated behind it. The basioccipital borders on vomer anteriorly, which, along the medial line of skull, forms a vertical partition gradually descending posteriorly between the internal choanae. Dorsally, the choanae are surrounded by the lateral plates of the vomer, while ventrally, medially and more anteriorly by the palatine plates and externally and posteriorly — by the pterygoids. The pterygoids are strongly developed, lining the lateral, dorsal and — also the ventral walls of the nasal meatus, reaching the tympanic bulla and also stretching over the lateral walls of the temporal fossa as far as the greater wing of the sphenoid bone. The last-named, destroyed bone also contacted the squamosal and parietal. A sharp protrusion, with its end contacting the medial ridge of the vomer, was formed posteriorly by the palatine bones along the medial line of skull.

{Dimensions (in mm) of the skull of *Pinocetus polonicus* gen.n., sp.n.}:

length of tympanic bulla	67
width of tympanic bulla	44
length of palatine bone	about 350
width of choanae	68
length of vomer	about 1.100
posterior width of vomer	52
external width of basioccipital between lateral protuberances	124
length of basioccipital	95
width of skull on the greater wing of the sphenoid bone	134
length: basion — anterior end of the palatine bone	510
length: basion — posterior end of the palatine bone	173
length: basion — anterior margins of choanae	218
length: basion — posterior margins of pterygoid	110
length: opistion — posterior margins of premaxillary	300

Telescoping of the skull in Pinocetus polonicus

The telescoping character of the skull in *Pinocetus polonicus* has been determinated according to Kellogg's (1928) and Deschaseau's (1961) criteria. Fragmentary frontals, exposed along the medial line of the skull, form a quadrangular surface limited posteriorly by the parietals and anteriorly by the anterior temporal ridge. The degree of overlapping the frontal by the parietal is indicated by the manner of connecting the two bones in the medial region of the skull, where a suture about 40 mm long occurs. In their anterior part, the parietals are relatively narrow and 60 cm wide, while in the temporal fossa they are considerably wider so that their posterior width amounts to 132 mm. The parietals fuse together along the medial line of skull, forming a sagittal crest 75 mm long. A relatively small part of the parietals is situated in front of the apex of the supraoccipital shield, the index of the ratio of the whole length of the parietal (196 mm) to the length of its anterior sector amounting to 27,2⁰/₀.

The apex of the supraoccipital shield does not reach the line connecting the anterior ends of the zygomatic process, the distance between them being about 80 mm, while that from the apex to the line connecting the anterior outer margins of the orbits amounts to about 193 mm and, to the line connecting their posterior margins — to 58 mm. These dimensions indicate a slight anterior displacement of the supraoccipital shield, althoug the shield itself is strongly inclined as shown by the angle between the slope of shield and the basioccipital which amounts to 35°.

The maxillary ascending processes, the premaxillae and the nasals cover the anterior part of the frontal about 175 mm long up to the temporal crest. The maxillary ascending process is fairly long, reaching about 90 mm. Along the posterior margin of this process, the maxilla protrudes about 170 mm beyond the line connecting the anterior margins of the supraorbital processes, while the posterior ends of the nasals and premaxillae are withdrawn from this line at about 120 mm. The distance between the apex of the supraoccipital shield and the posterior margin of the nasals amounts to 95 mm. As follows from these distances, the rostrum is conspicuously withdrawn which is particularly marked in the structure of, the frontal, on which the anterior temporal crest and a characteristic long suture, connecting the frontal and the maxillary ascending process, have been developed. The withdrawal of the rostrum is relatively stronger than the anterior displacement of the supraoccipital shield.

The distance between the nostrils and the internal choanae is long (360 mm) and corresponds to the length of the nasal meatus. This considerable length of the nasal meatus depends, among other things, on a small degree of telescoping in the structure of the skull of *Pinocetus polonicus*, in particular in its posterior region.

Mandible (text-fig. 5; pl. XXVII, fig. 2)

Both mandibles are fragmentary, with the articular region completely destroyed in the left and partly in the right mandible. The anterior termination of the horizontal ramus of the mandible is high and narrow. Along the ramus, the height is variable, the width gradually increasing up to the coronoid process. Yet further posteriorly, the width considerably decreases. A groove with two apertures facing anteriorly occurs on the upper margin of the anterior end of mandible, while the aperture of the mandibular canal is situated anteriorly. The inner surface of the ramus of the mandible is in this region more convex in the upper than in the lower, smaller part, the two parts being separated from each other by a longitudinal ridge. The upper margin of the ramus of the mandible, at first rounded in the region of the largest bent of the mandible and then turning into a sharp ridge about 90 cm from the anterior end of mandible. This ridge runs as far as the coronoid process.

The mental foramina are distributed near the upper surface of mandible on the outer side of the ramus. Each of them is situated at the bottom of a trough and directed anteriorly. The inner surface of the ramus is fairly flat and the outer convex, the largest width of the ramus occurring in the lower half of its height. Six nutrient foramina, the first of them, about 20 mm, and the last about 670 mm from the anterior end of mandible, are situated below the upper margin of the inner surface of the mandibular ramus. The mandibular condyle and the coronoid process are destroyed to a considerable extent. From an oblique position of the margin running posteriorly from the coronoid process the conclusion may be drawn that the upper part of condyle was strongly convex externally and, therefore, its largest width might be approximately the same as its height.

Dimensions (in mm) of the mandible in *Pinocetus polonicus* gen.n., sp.n.:

length along the external curvature	about 1560 reconstructed
length in a straight line	about 1520 reconstructed
length: posterior margin of condyle — margin of mandibular canal	about 165
height of the posterior part of mandibular canal	about 50
largest width of condyle	about 87
width of condyle measured at the bottom along the lateral groove	about 68
height of condyle	about 120 reconstructed

Dimensions (in mm) and indices (in %) [1] of the sections of mandible in *Pinocetus polonicus* gen.n., sp.n.:

Distance from the anterior end of mandible	Left mandible height	Left mandible width	Right mandible height	Right mandible width
100	96(6.2)	40(2.5)	96(6.2)	36(2.3)
300	88(5.6)	55(3.5)	97(6.2)	47(3.0)
500	93(5.9)	56(3.6)	90(5.7)	56(3.6)
700	91(5.8)	62(3.9)	91(5.8)	60(3.8)
900	84(5.4)	67(4.3)	— —	— —
1245	105(6.7)	64(4.1)	97(6.2)	68(4.3)
1320 (coronoid process)	140(8.9)	69(4.4)	145(8.9)	62(3.9)
1390	98(6.2)	63(4.0)	— —	— —
the smallest behind the coronoid process	— —	— —	89(5.7)	55(3.5)

Cervical region. — Vertebrae I to VI arranged in natural order and vertebra VII, set together with an adjoining dorsal vertebra, have been preserved in this part of the axial skeleton. The cervical vertebrae are medium-sized and not fused with each other. Vertebra II is so preserved that it is impossible to state with certainty if it had or had not the lateral foramen, but we may presume that there was no such a foramen. In vertebrae III to V inclusively, this foramen is surrounded by diapophyses and parapophyses of the vertebrae. The parapophysis of vertebra VI preserved is very thin, which indicates that the lateral foramen of this vertebra probably was not closed. The largest vertebra of the cervical sector is the atlas, and the shortest are vertebrae IV and VI. The atlas is also the widest and the width of the cervical vertebrae decreases posteriorly from it. The length of the cervical sector of the specimen of *Pinocetus polonicus* described amounts to about 280 mm:

The atlas is a massive vertebra of medium length. The foramen of its neural canal is wide, particularly so in the upper part, but its diameter is smaller than the largest width of the anterior articular surface of atlas. The neural arch of the atlas is flat and low, with a low, superior tubercle occurring on the medial line of the arch. A fairly wide, but short vertebral-arterial canal, in which the vertebral artery and mirabile cervical network were situated, occurs at the pedicle of the arch.. Wide diapophyses project high-up laterally at the level of the upper part of the anterior articular surfaces. The posterior articular surfaces are large and have deep posterior vertebral incisions. As compared with other cervical vertebra, the axis is very massive. The foramen of its canal is wide, but lower than that of the atlas. The pedicle of the vertebral arch is strongly inclined anteriorly. The length of the neural spine amounts to 42 mm and it was probably fairly high. The transverse process, with its upper margin sloping posteriorly, is also directed on the whole posteriorly; it is triangular and narrowing from the base outwards and ventrally. The lateral foramen, which occurs on the whole on cervical vertebra II in the Mysticeti, was probably lacking. A wide depression for the cervical vascular network occurs on the posterior surface of the transverse process. The odontoid process on the axis is conical, but not very protuberant, 35 mm long, 53 mm high and 47 mm wide. An oval space, limited by the incisions of vertebrae I and II is 36 mm high and 27 mm long. The upper articular processes of the axis are large and wide, their posterior margins oval.

[1] Indices, given in parentheses, have been calculated in relation to the entire length of the mandible in a straight line.

Vertebrae III to V are considerably less massive than the two former ones. Their neural canal gradually extends and becomes lower, preserving its triangular shape. The neural arches are short. The upper articular processes are considerably smaller than in vertebra II. The diapophyses and parapophyses, which surround wide lateral foramina on vertebrae III and IV, are relatively delicate, the parapophyses of vertebra III being bent stronger anteriorly than those of the vertebrae IV and V. In its massive character, vertebra VI differs only slightly from V, lacking the epiphysis and the lower part of centrum and having fairly wide diapophyses which are more strongly sloping anteriorly than those on vertebra V. What remained of vertebra VII is only a small fragment having a small and narrow costal fovea, which is situated low down.

In the Recent whales, the neck makes up to 4.2% of the length of body in *Eschrichtius gibbosus* Erxleben, 3.4—3.7% in various species of *Balaenoptera* and 2.4% in *Balaena* (Tomilin 1957, 1962). Assuming that the neck of *Pinocetus polonicus* 280 mm long, had similar proportions to the length of the entire body as that in the Recent whales, the entire length of the representatives of this species would, therefore, amount to 6.6 m, 7.6—8.2 m and 11.7 m respectively. Of the lengths thus calculated, due to the degree of elongation of the cervical vertebrae, the proportions are transitional between those in *Balaenoptera* and those in *Eschrichtius gibbosus* and seem to be the most reliable. The length of the skull of *Pinocetus polonicus* would make up one-fifth or a quarter of the entire skeleton.

Dimensions (in mm) and indices (in %[2]) of the cervical vertebrae in *Pinocetus polonicus* gen.n., sp.n.:

	Cervical vertebrae						
	I	II	III	IV	V	VI	VII
length of centrum	50	37	33	32	35	29	55
	(17.8)	(13.2)	(11.8)	(11.4)	(12.5)	—	(19.7)
width of centrum	156	148	107	98	98	—	—
	(55.7)	(52.9)	(38.2)	(35.0)	(35.0)	—	—
height of centrum	101	120	104	—	—	—	—
height of neural canal	81	65	—	—	—	—	—
width of neural canal	60	—	—	—	—	71	—
length of neural arch	30	54	27	27	23	23	—
	(10.7)	(19.3)	(9.6)	(9.6)	(8.2)	(8.6)	—

Thoracic region (XXIX, figs 2—4). — Dorsal vertebrae II and III are preserved in the form of small fragments only, which cannot be measured. Also vertebrae XI or XII are lacking and for this reason it is impossible to reconstruct the length of the entire thoracic sector of the axial skeleton of *Pinocetus polonicus*. The length of this sector, composed of dorsal vertebrae I to X, amounts to 803 mm. The first four pairs of ribs were provided with a capitulum and a tubercle each, and were connected with cervical vertebra VII and dorsal vertebrae I to III. Further dorsal vertebrae have costal foveae on the transverse processes. The neural spines of dorsal vertebrae IV and V were arranged vertically and, beginning with vertebra VI, sloping posteriorly.

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[2] Indices, given in parentheses, have been calculated in relation to the length of cervical sector of the axial skeleton in *Pinocetus polonicus*, amounting to 280 mm.

Dorsal vertebra I is preserved only partially, its centrum is wide, oval and short, with a straight and not concave outline, of the ventral face of the shaft. A narrow and high articular surface for the capitulum of rib-pair II, situated higher than in cervical vertebra VII, occurs laterally and posteriorly on the centrum of vertebra I. The wide and short pedicle of the vertebral arch projects laterally and on the outer side of the upper margin of shaft. The posterior epiphysis is lacking and the anterior is separated from the shaft by a fissure.

The strongly damaged shaft of the dorsal vertebra II is preserved only in the form of a neural arch with its spine having the anterior margin obliquely sloping posteriorly. The posterior margin of the spine is vertical and the spine itself contracts dorsally. The neural foramen is wide triangular and preserved with its upper articular processes. The centrum of dorsal vertebra III, damaged anteriorly and dorsally and lacking the anterior epiphysis is, on its posterior surface, oval in outline and slightly contracting dorsally. The vertebral notch is deeply incised. The short diapophysis projects at the pedicle of the neural arch and runs anteriorly. The costal fovea is situated high on the centrum of the vertebra, its length amounting to 20 mm and width 37 mm. The ventral surface of the centrum of dorsal vertebra IV is straight in outline, its epiphysis being suboval. Fine apertures for nutrient blood vessels are preserved on the lateral wall of the centrum with the vertebral foramen triangular, low and large. The spine of the neural arch is flat, wide and directed straight dorsally. The vertebral incision is deep. The margins of the upper articular process are oval in outline. The diapophysis is short, develops from the pedicle of vertebral arch and is directed anteriorly. A costal fovea occurs at the end of the diapophysis. The centrum of the dorsal vertebra V is concave ventrally. Both epiphyses are preserved, the posterior one slightly contracting ventrally. The neural foramen is narrower and somewhat higher than those of the vertebra IV. The diapophyses are short, massive, directed anteriorly and have costal foveae. The vertebral incision is deep but lower than that in vertebra IV. The centrum of dorsal vertebra VI is spool-like and concave laterally and ventrally. The anterior epiphysis is lacking. The diapophyses develop from the upper part of the centrum anteriorly, with costal foveae occuring on them. The pedicle of the vertebral arch is long, the neural spine very slightly sloping posteriorly and the posterior margin of the spine is vertical. The vertebral incision is deep. The centrum of dorsal vertebra VII is spool-like, with both epiphyses preserved. The neural process is slightly sloping posteriorly. The transverse processes develop lower than in vertebra VI and have articular surfaces for the ribs. Vertebra VIII, with a spool-like centrum, has a characteristic foramen of the neural canal shaped like an equilateral triangle. Both epiphyses are present. The neural spine is wide and sloping posteriorly; large upper articular processes occur at the base of the neural arch. The vertebral incision is deep and high. The transverse processes develop on the level of the upper surface of the shaft. Costal foveae are preserved. Dorsal vertebra IX, with a spool-like shaft, has a triangular neural canal which is higher than wide. Both epiphyses are present; their fusion to the centrum of vertebra IX gives evidence that the skeleton under study belonged to an adult individual, the same is the case in the Recent Mysticeti (Kellogg, 1965). The neural spine is wide and sloping posteriorly, transverse processes develop laterally, horizontally and have costal foveae preserved and the upper articular processes are large and have wide vertebral incisions. The centrum and neural canal of dorsal vertebra X are similar to those in vertebra IX.

The thoracic region of the axial skeleton of *Pinocetus polonicus* is marked by wide and large neural spines, massive but rather short diapophyses and articular processes which, in their shape and arrangement, resemble those in *Balaenoptera acutorostrata* Lacepède.

Dimensions (in mm) of the dorsal vertebrae in *Pinocetus polonicus* gen.n., sp.n.:

	Dorsal vertebrae									
	I	II	III	IV	V	VI	VII	VIII	IX	X
length of centrum	55	64	68	70	78	78	92	95	99	104
width of centrum	111	—	115	108	108	108	108	105	101	99
height of centrum	65	—	72	71	—	82	81	82	80	83
width of neural canal	—	—	72	65	60	55	46	45	42	40
height of neural canal	—	—	—	—	—	—	—	—	56	49

Lumbar region. — Nine lumbar vertebrae, I to IX, are preserved. Their lengths gradually increase posteriorly, the same as the widths and heights of centra. These are medium-sized vertebrae, with their widths not much smaller than their lengths. The neural spines and transverse processes are massive.

Lumbar vertebra I is damaged; its neural arch with a large fragment of neural spine and the upper part of centrum are preserved, but the transverse process is lacking. The anterior epiphysis is lacking, the posterior is oval. The lower articular surfaces are mounted high at the base of the neural spine. The neural canal is narrower than high. The neural spine is wide and sloping posteriorly. The transverse processes and neural spine of lumbar vertebra II are broken off; the centrum of this vertebra is long and wide, the anterior and posterior epiphyses oval. The neural canal is slightly contracted as compared with that of vertebra I. The pedicle of the neural arch is shorter and, consequently, the intervertebral foramina are wider. The transverse processes are long and flat, about 69 mm long at the base and 160 mm wide. They grow laterally out of the upper half of the vertebral centrum and are directed as a whole anteriorly. The posterior margin of the transverse process is situated lower than the anterior and its base lower than the outer margin.

Lumbar vertebrae III to V are very damaged, their centra almost completely destroyed, the neural spines are imprinted as a whole in the rock and the bones of these spines preserved only fragmentarily. The right transverse processes, preserved complete, are similar to those of lumbar vertebra II, but somewhat narrower, shorter and, probably as a result of compression, very strongly sloping ventrally. The height of the neural spines increases from lumbar vertebra III to V and, measured on the posterior margin from the upper edge of the vertebral incisure amounts to 147—190 mm. These spines are flat and long, their length amounting at the base to about 100 mm. Also much damaged are lumbar vertebrae VI and VII.

Vertebra VIII has its centrum preserved. It is slightly longer than wide, and wider than high. The dorsal, concave surface of the centrum has a prominent, elongate crest. Neural spines of these vertebrae, about 200 mm high, are flat and about 95 mm long at the base. Lumbar vertebra VIII has its neural arch broken off and transverse processes very damaged. The posterior epiphysis is lacking. Likewise, a large fragment of the centrum of lumbar vertebra IX has been preserved.

Dimensions (in mm) of the lumbar vertebrae in *Pinocetus polonicus* gen.n., sp.n.:

	Lumbar vertebrae								
	I	II	III	IV	V	VI	VII	VIII	IX
Length of centrum	106	114	110	117	117	117	117	121	123
Width of centrum	108	110	—	—	—	—	110	110	112
Height of centrum	83	88	—	—	—	—	90	92	94
Width of neural canal	40	36	—	—	—	—	38	—	38
Height of neural canal	46	47	—	—	64	—	+46	—	—
Length of the base of neural arch	70	63	—	63	63	63	64	—	67

Scapula (pl. XXX). — The right scapula has been preserved almost complete. Embedded in a limestone block, this specimen is visible from its medial side. Its anterior margin is rectilinear and the scapular incision gently passes into the coracoid process, of which only part of the base has been preserved and, therefore, we may only surmise that it was small. The upper margin of the scapula is the largest and occurs in the form of a small arch. Its width, measured along the curvature, amounts to 520 mm and, in a straight line, to 470 mm. The two dimensions considerably exceed the length of the scapula (330 mm). The posterior margin of the scapula is somewhat damaged. The neck of the scapula is short, wide and slightly separated from the remaining parts of this bone. The glenoid articular cavity is shallow and oval depression directed downwards. The acromion is very large and flat. The insertion area of the serratus anterior muscle on the surface of scapula is relatively small. There also occur a wide subscapular fossa and distinctly outlined three muscular lines to which the subscapularis muscle was attached. Judging by prominent insertion areas, this strong retractor of the humerus was probably very large which indicates a strong musculature of the fins. The musculature lines, starting in the subscapular fossa, run radially over the surface of scapula and are slightly bent posteriorly. The medial line is the longest. The muscular lines surround three shallow depressions, of which the posterior one is the deepest.

Humerus and radius (pls XXVII, XXVIII). — The right humerus has been preserved almost complete, except for some damage in the region of the greater tubercle and the head of humerus. The proximal articular surface of the humerus faces posteriorly, laterally and slightly dorsally, while the distal surface is somewhat extended anteriorly as compared with the proximal. The angle of the bend of the long axes of the proximal and distal epiphyses amounts to about 30° only, while in quadrupedal mammals it approaches 90°. The shaft of the humerus is short, wide, massive, flattened laterally and substraight. Its anterior surface is smooth and its radial tuberosity only slightly marked. This tuberosity served as an insertion area for the muscles of shoulder group such as supraspinatus muscle extending the shoulder or the deltoid muscle retracting it. The neck of the humerus is extremely short and its head is hemispherical which indicates the possibility of swinging and rotary movements, extending and retracting the limb. The surface of the head is smooth, except for slight wrinkles and a roughness occurring ventrally and on the periphery. The greater and lesser tubercles are separated by a very shallow intertubercular surface on which the biceps tendon was inserted. The two tubercles are low, do not project above the surface of the humeral head and their ridge are not marked. The distal articular surface of the humeral head and their ridges are not marked. The distal articular surface of the humerus is composed of two parts: a larger and slightly convex anterior radial face, 60 mm in anteroposterior and 42 mm in lateral diameter and a smaller, also slightly convex posterior ulnar face, 57 mm in anteroposterior and 46 mm in lateral diameter. Posteriorly, the ulnar face upturns onto the shaft of the humerus. Both parts of the articular surface are arranged at an angle of about 125° to each other.

A proximal fragment of the right radius has been preserved with an almost complete articular surface and large part of the shaft, but without the distal articular surface. The proximal articular surface of the radius corresponds on its form to the radial face of the humerus and terminates posteriorly in a fairly wide transverse margin. The ulnar tuberosity occupies an area shaped like a high triangle below the articular surface and is very indistinct. The shaft of the radius, flattened laterally and slightly bent, is rather slender, its diameter differing from each other more than corresponding diameters of the articular surface.

The total lenght of the upper part of the anterior limb, including scapula, humerus and radius, amounts to more than 775 mm in *Pinocetus polonicus*, the length of scapula constituting 42.6 per cent, the humerus 29 per cent and the radius 28.4 per cent of the whole.

Dimensions (in mm) of the humerus and radius in *Pinocetus polonicus* gen.n., sp.n.:

	Humerus	Radius
Length	225	more than 220
Anteroposterior diameter of the proximal part of shaft	123	more than 62
Lateral diameter of the proximal part of shaft	98	49
Anteroposterior diameter of the head of humerus	90	—
Lateral diameter of the head of humerus	90	—
The smallest anteroposterior diameter of shaft	78	64
The smallest lateral diameter of shaft	53	29
The anteroposterior diameter of the distal part of shaft	95	—
The lateral diameter of the distal part of shaft	54	—

COMPARISONS

(Tables 1-3; text-fig. 6)

The family Cetotheriidae is represented by numerous species occuring in the late Tertiary, identified frequently on the basis of a very fragmentary material, for example, single elements of the skeleton or incomplete remains of single individuals known from one locality only. For this reason, in describing new material one should take into account the possibility of an erroneous evaluation of differences occurring within this family. Since a relatively complete skeleton was found at Pińczów, the material described has primarily been compared with the Miocene species of the Cetotheriidae, known from more complete skeletons. Thus, the data concerning the following species of the Cetotheriidae have been made use of:

Aglaocetus moreni (Lyddeker) (see Moreno, 1892; Lyddeker 1894; Cabrera, 1926; Kellogg 1934); *Aglaocetus patulus* Kellogg (see Kellogg, 1968); *Aulocetus sammarinensis* Capellini (see Capellini, 1899, 1901); *Cetotherium mayeri Brandt* (see Rjabinin, 1934, 1937); *Cetotherium* aff. *mayeri* Brandt and other species (see Spaski, 1933, 1939, 1943, 1951, 1954; Brandt, 1842, 1871, 1872, 1873, 1874; Kellogg, 1925); *Cophocetuls oregonensis* Packard & Kellogg (see Packard & Kellogg, 1934); *Diorocetus hiatus* Kellogg (see Kellogg, 1968); *Mauicetus lophocephalus* Marples (see Benham, 1942; Marples, 1956); *Mesocetus hungaricus* Kadič (see Capellini, 1904; Kadič, 1907); *Mesocetus agrami* Van Ben. (see Karmberger, 1883, 1892); *Mixocetus elysius*, Kellogg (see Kellogg, 1934); *Parietobalaena palmeri* Kellogg (see Kellogg,

Table 1

DIMENSIONS (IN MM) AND INDICES (IN %) OF THE SKULL OF *PINOCETUS POLONICUS* GEN.N., SP.N. AND SOME CETOTHERIIDAE

	Pinocetus polonicus	*Aulocetus sammarinensis*	*Cophocetus oregonensis*	*Aglaccetus moreni*	*Aglaccetus patulus*	*Parietobalaena palmeri*	*Mixocetus elysius*	*Diorocetus hiatus*	*Pelocetus calvertensis*	Range of variability and its mean value
Lenght of skull basion — prostion	1570	1295	1203	1890	1600	1105	2434	1365	1895	1105—2434 1595
1 : widths measured on zygomatic process	45	53	52	45.5	48.4	40	46.2	40.3	49.9	40—53 46.2
1 : lengts of supraoccipital shield	16.6	17.4	17.5	17.5	19.1	18.8	16.6	15.8	17.2	15.8—19.1 17.4
1 : distances between the apex of supraoccipital shield and posterior margin of nasal	5.9	4.0	7.5	4.4	4.3	5.4	3.2	8.4	4.7	3.2—8.4 5.3
1 : lenght, premaxillary	74.8	75.2	75.6	80.2	72.9	73.9	82.2	75.8	76.8	72.9—82.2 76.4
1 : lenght of maxillar ascending process	8.9	9.3	7.6	6.9	3.0	2.3	10.8	—	5.3	2.3—10.8C 6.8
1 : lengts of nasal	12.4	11.1	13.1	12.6	14.4	10.9	12.0	—	6.1	6.1—14.4C 11.5
1 : nasal — prostion distances	64.3	64.1	61.7	67.7	58.6	64.1	70.9	—	71.0	58.6—71.0C 65.3
Lenght of premaxillary: width of rostrum	30.6	—	31.6	38.1	43.8	37.9	33.0	—	44.0	31.6—44.0C 37.0
Lenght of premaxillary: lenght of supraoccipital shield	22.1	23.1	23.1	21.8	26.1	25.5	20.3	20.8	22.3	20.3—26.1 22.8

1924, 1968); *Pelocetus calvertensis* Kellogg (see Kellogg, 1965); *Tiphyacetus timblorensis* Kellogg (see Kellogg, 1931).

Species of the Cetotheriidae from the uppermost Miocene of the environs of Antwerp (Van Beneden, 1886), housed in the Museum of the Royal Institute of Natural Sciences in Brussels, are preserved very fragmentarily and differ considerably from *Pinocetus polonicus.* For this reason, they have been excluded from the discussion.

Capellini's (1901) description was supplemented by information on the skull of *Aulocetus sammarinensis* received from the Geological and Palaeontological Museum of the University of Bologna and which allowed the writers to make a more accurate comparison with the skull of *Pinocetus polonicus.*

Of Recent Mysticeti, *Eschrichtius gibbosus* (Van den Brink, 1957) of the family Eschrichtidae and various species of the genus *Balaenoptera* (Slijper, 1938), in particular *B. acutorostrata* (of the family Balaeonopteridae) have been taken into account for comparison as most closely related to the genus *Pinocetus.* Also the dimensions of *B. acutorostrata* from the Pliocene of Valmontasca, Italy (Caretto, 1970) and of a Recent specimen caught near the Norwegian coast have been utilized.

In the size of its skull (which may give a notion of the dimensions of the whole body), *Pinocetus* is similar to the Oligocene species *Mauicetus lophocephalus* or to the Miocene *Aglaocetus patulus.* Other whales, *Aglaocetus moreni*, *Pelocetus* and *Mixocetus* are much larger and have longer skulls, while *Parietobalaena*, *Cophocetus*, *Aulocetus*, *Diorocetus* and various species of *Cetotherium* are markedly smaller than *Pinocetus.* Our specimen of *Pinocetus* was an adult, but still a young individual and, therefore, we may presume that the dimensions of fully growth representatives of this species might have been even larger. The skull of *Pinocetus* is marked by the large width of its posterior part as indicated by its high index of the ratio of length to width measured by the zygomatic processes and by its narrow rostrum, as the index of the ratio of the length of premaxilla and the width of the rostrum is low in *Pinocetus* (table 1). *Aglaocetus patulus, Pelocetus* and *Aulocetus* have skulls considerably wider both in the posterior region and on the rostrum, whereas *Mixocetus* has a narrow skull. The skull of *Parietobalaena* differs in being narrow in the posterior region and having a wide rostrum.

In the development of its occipital region, that is, in the shape of the supraoccipital shield, its length as compared with that of the entire skull and primarily in a degree of the anterior advancement of the supraoccipital shield, measured by a distance of its apex from the line connecting anterior ends of the zygomatic process, *Pinocetus* is similar to *Aulocetus sammarinensis* and *Mixocetus elysius*, in whose skulls the apex of the shield does not reach the line connecting the anterior ends of the zygomatic processes and the shield itself is short. In the structure of the occipital region *Pinocetus* differs from *Parietobalaena palmeri* and *Aglaocetus patulus*, in which the apex of the supraoccipital shield is advanced far beyond the line connecting the ends of the zygomatic processes and the shield is very long. Likewise, in *Pinocetus* the ratio of the length of premaxilla to that of the supraoccipital shield differs from that of *Parietobalaena palmeri* and *Aglaocetus patulus*. The remaining species compared display a transitional character as concerns the structure of the occipital region.

The distance between the apex of the supraoccipital shield and the posterior margin of the nasal is fairly large in *Pinocetus*, very large in *Diorocetus hiatus* and relatively small in *Mixocetus elysius*. The nasal of *Pinocetus* is long, which differentiates this whale from *Pelocetus calvertensis* having a very short nasal. The ratio of the total length of the skull to the nasal-prostion distance in *Pinocetus* represents a transitional value, while *Aglaocetus patulus* is marked by a small and *Mixocetus elysius* and *Pelocetus calvertensis* by a large nasal-prostion distance.

A considerable withdrawal of the rostrum is observed on the skull of *Pinocetus*, in which the maxillary ascending processes are long, while in *Pelocetus calvertensis, Aglaocetus patulus* and *Parietobalaena palmeri* these processes are very short. The position of the temporal fossae, perpendicular to the medial axis of skull is a common characteristic of the skulls of *Pinocetus, Aulocetus, Mixocetus, Aglaocetus moreni, Pelocetus* and *Cophocetus*, while in *Diorocetus, Parietobalaena, Aglaocetus patulus* and *Cetotherium* these fossae are oblique.

With regard to the structure of the skull, *Pinocetus* seems to be most similar to *Aulocetus sammarinensis*, whose skull is, however, wide, but this considerable width may depend on the state of preservation of an individual specimen. In *Aulocetus*, the rostrum is somewhat withdrawn beyond the centre of the orbis, that is, somewhat further than in *Pinocetus*, which indicates a more emphasized telescoping of the skull in *Aulocetus*.

According to Kellogg (1968), there is no constant correlation between the dimensions of the skull and the size of the tympanic bulla, or, at most, it is very slight. He did not notice any characters of its structure that might serve for identyfying particular species of the Cetotheriidae. In addition, he calls in question the suitability of the varying outline of this bone in whales for the purpose of identification. These views are undoubtedly correct and the specific assignement of separately found tympanic bullae is difficult. However, in combination with known characters of other parts of skeleton, the structure of the tympanic bulla may supplement the description of a species. In the outline and proportions of the tympanic bulla, *Pinocetus* differs from *Mauicetus, Mixocetus, Aglaocetus patulus, Diorocetus, Pelocetus, Tiphyacetus, Cetotherium mayeri* and *Cetotherium* aff. *mayeri*; its region of the involucrum of the tympanic bulla is different from that in *Cophocetus* and *Cetotherium mayeri* and its posterior process is different than that in *Pelocetus*. The tympanic bulla of *Pinocetus* is most similar in shape to that of *Parietobalaena*, except for a certain flattening of its posterior surface occurring in *Pinocetus* ventrally of the posterior process. In relation to the length of skull, the tympanic bulla of *Pelocetus* and *Eschrichius cephalus* is smaller than in *Pinocetus*, while those of *Parietobalaena, Cophocetus* and *Cetotherium* are comparatively larger.

Indices (in⁰/₀) of the tympanic bulla in *Pinocetus polonicus* gen.n., sp.n. and other Miocene Mysticeti

Species	Ratio of the length of skull to the length of tympanic bulla	Length to width ratio of the tympanic bulla
Cophocetus oregonensis Packard & Kellogg	5.1	52.5
Pinocetus polonicus gen.n., sp.n.	4.3	65.7
Aglaocetus patulus Kellogg	4.6	61.8
Parietobalaena palmeri Kellogg	5.4	52.8—61.0
Pelocetus calvertensis Kellogg	3.4	54.7
Diorocetus hiatus Kellogg	4.5	69.8
Mixocetus elysius Kellogg	4.1	56.9
Tiphyacetus timblorensis Kellogg	—	54.5
Cetotherium mayeri Brandt	5.1	56.4
Eschrichtius cephalus Cope	2.9	51.7

The degree of the curvature of the mandible, determined by the ratio of its rectilinear length to that measured along the outer curvature is in *Pinocetus, Aglaocetus moreni* and *Parietobalaena* considerably lower, about 103 per cent, than in *Aulocetus sammarinensis* in which this index amounts to 108.9 per cent. The ramus of the mandible in *Pinocetus* is relatively higher than that in *Aglaocetus moreni* and *Mixocetus*, but lower than in *Pelocetus* and *Cetotherium*. In addition, the mandible of *Pinocetus* is thicker than the very thin mandible of *Cetotherium*. There are also differences in the shape and size of the coronoid process which is low in *Pinocetus*, small and low in *Cetotherium* and *Eschrichtius cephalus* and markedly high in *Aulocetus sammarinensis* and young individuals of *Parietobalaena palmeri*. The groove which makes up an insertion area of the medial pterygoideus muscle, is situated similarly in both *Pinocetus* and *Parietobalaena palmeri*, that is, it does not stretch over the posterior surface of mandible.

Indices (in%) of the mandible in *Pinocetus polonicus* gen.n., sp.n. and other Cetotheriidae

Species	The ratio of the rectilinear length of mandible to the length measured along outer curvature	The ratio of the rectilinear length of mandible to the height of the coronoid process
Pinocetus polonicus	103.3	9.2
Aglaecetus moreni (Lyddeker)	103.3	12.0
Cophocetus oregonensis Packard & Kellogg	—	11.3
Parietobalaena palmeri Kellogg	103.4—106.1	7.5—13.00
Aulocetus sammarinensis Capellini	108.9	14.8
Diorocetus hiatus Kellogg	—	10.6
Mixocetus elysius Kellogg	—	10.9

The Oligocene *Aetiocetus cotylalveus*, (suborder Archaeoceti, family Aetiocetidae), whose structure displays indubitable relationships with the Cetotheriidae, has the axial skeleton with elongate vertebral centra and narrow and relatively long centra of cervical vertebrae. Of its dorsal vertebrae, vertebra IX is marked by the width of centrum almost equalling its length and vertebra X in which the centrum is longer than wide. The axial skeleton of *Pinocetus* differs from that of *Aetiocetus cotylalveus* primarily in having shorter anterior cervical vertebrae (Emlong, 1966).

Among the oldest Cetotheriidae, the axial skeleton of *Mauicetus* (*M. brevicollis* Marples) is marked by an exceptionally strong flattening of the centra of cervical vertebrae III to VII. Also flattened are the centra of dorsal vertebrae I to IV, while the atlas has a long centrum and the posterior dorsal vertebrae have elongated centra. The adaptation of the structure of the anterior sector of the axial skeleton, consisting in the flattening of the centra of the cervical and anterior dorsal vertebrae, appears, therefore, very early in the evolution of the Cetotheriidae. In *Mauicetus brevicollis*, the cervical region is, however, relatively long compared with the length of the thoracic region between vertebrae I and X (text-fig. 6).

Taking into account the degree of elongation or flattening of the centra of the vertebrae in the cervical region and the thoracic sector between vertebrae I and X, the axial skeleton of the whale *Pinocetus* is marked by:

1. an elongation of the centrum of cervical vertebra VII, while the remaining cervical vertebrae display an average degree of the elongation of their centra;
2. an elongation of the centres of the anterior dorsal vertebrae; a similar tendency is also displayed by *Pelocetus, Cophocetus, Mixocetus, Diorocetus*, and *Balaenoptera acutorostrata*;
3. a larger length than width of the centrum of dorsal vertebra X in *Pinocetus*; *Mixocetus* and *Parietobalaena* (text.-fig. 6) are similar in this respect.

Table 2

INDICES (IN %) OF THE AXIAL SKELETON OF *PINOCETUS POLONICUS* GEN. N., SP.N. AND OTHER MYSTICETI

	Pinocetus polonicus	*Parietobalaena palmeri*	*Diorocetus hiatus*	*Pelocetus calvertensis*	*Cetotherium mayeri*	*Cetotherium aff. mayeri*	*Cetotherium furlongi*	*Balaenoptera acutorostrata* Italy	*Balaenoptera acutorostrata* Norway
Ratio of the length of the cervical sector to the length of center of cervical vertebra I	17.8	23.9	—	27.0	29.1	22.6	16.7	19.8	21.4
Lenght of the cervical sector to length of center of cervical vertebra II	13.2	20.6*)	—	22.2	17.2	13.6	27.6	23.8	16.1
Length of the cervical sector to length of center of cervical vertebra III	11.8	10.3	—	9.8	10.9	9.1	9.5	10.6	8.9
Lenght of the cervical sector to length of center of cervical vertebra IV	11.4	11.5	—	10.1	10.0	10.4	10.4	10.6	10.7
Length of the cervical sector to length of center of cervical vertebra V	—	12.4	—	—	10.0	12.2	10.4	11.1	12.5
Length of the cervical sector to length of center of cervical vertebra VI	10.4	10.7	—	12.4	10.0	14.5	11.3	11.9	14.3
Length of the cervical sector to lenght of center of cervical vertebra VII	19.6	10.7	—	10.7	12.7	17.6	13.6	12.2	16.1
Length of skull to length of cervical sector	18.0	—	20.7	18.1	9.1	—	—	21.6	15.6
Length of skull to length of dorsal sector (vertebrae I to X)	51.5	—	45.4	37.0	24.8	—	—	52.8	61.3
Length of dorsal sector (vertebrae I to X) to length of cervical sector	34.9	45.0	45.7	48.9	36.7	39.5	33.1	38.8	25.9

*) No epiphyses were found on cervical vertebrae II to VII and on some dorsal vertebrae.

The elongation of the cervical and thoracic region of the axial skeleton of *Pinocetus* differentiates this species distinctly from *Cetotherium*, in which the anterior part of the axial skeleton is strongly shortened (table 2, text.-fig. 6). The lateral foramen occurs in *Pinocetus* on cervical vertebra III, while *Aglaocetus patulus* is devoid of this foramen on vertebra III and young specimens of *Parietobalaena* — on all cervical vertebrae. In *Pinocetus* this foramen does not occur on the axis, as in *Pelocetus*, but unlike *Cophocetus* which has a lateral foramen. According to Kellogg (1965), such a structure of the axis may result from the closing of this foramen during growth by exostosis. Since the specimen of *Pinocetus* belongs to an adult (the epiphyses of dorsal vertebra IX in *Pinocetus* are fused with the centrum, which in the Recent Mysticeti is indicative of an individual maturity; Kellogg, 1965), but not old individual, it may be presumed that the process of closing the foramen in *Pinocetus* would have to occur in a relatively early stage of its development and is not related with a more advanced age of the animal.

The occurrence of costal foveae for the capitula of further ribs on the centres of the six anterior dorsal vertebrae is characteristic of the Cetotheriidae as, for example, in *Parietobalaena palmeri*, *Cetotherium mayeri* and some others. On the other hand, in *Pinocetus* these articular surfaces occur only on dorsal vertebrae I to III.

None of the vertebrae of *Pinocetus* displays any traces of fusing with the adjoining ones, while in *Pelocetus calvertensis* some of the vertebrae, for example, II and III may be fused. In addition, an ossification of the longitudinal ventral copula was found in the lumbar region of a specimen of *Pelocetus calvertensis*, which was bound to cause the stiffening of this part of axial skeleton (spondylitis deformans or osteophytosis). The lumbar section of the axial skeleton in *Pinocetus* is not significantly shorter than in *Pelocetus*.

	Pinocetus polonicus	*Cetotherium* aff. *mayeri*	*Balaenoptera acutorostrata*	
			Italy	Norway
Ratio of the length of the skull to (S+H+R)*)	about 49.4	41.2	63.9	62.6
(S+H+R) to length of scapula	about 42.6	39.3	35.8	36.9
(S+H+R) to length of humerus	about 29.0	26.7	25.0	24.5
(S+H+R) to length of radius	about 28.0	34.0	38.8	37.5
Length of scapula to length of humerus	67.2	68.8	69.9	64.7

*) The sum of the lengths of scapula (S), humerus (H), and radius (R).

No data are available on the structure of the anterior limb of the Oligocene Cetotheriidae and those, concerning the structure of this limb in more complete skeletons preserved together with skulls of the Cetotheriidae which are younger stratigraphically, are incomplete to a considerable extent. In relation to the length of skull, the scapula of *Pinocetus* is wider than that of *Cophocetus, Pelocetus* and, in particular, *Diorocetus* and *Tiphyacetus*, whose scapulae are very narrow. On the other hand, it is narrower than the scapulae of *Mixocetus* and *Cetotherium* aff. *mayeri*. No acromion occurs on the scapula of *Pelocetus*, the same as in the Recent *Megaptera novaeangliae* Borowski, while in *Pinocetus* this process is very well developed. Three muscular lines occur on the medial surface of scapula in *Pinocetus* and the scapula of *Cetotherium* aff. *mayeri* is provided with four such lines. The part of scapula in the total length of the anterior limb, that is, the sum of the length of the largest scapula (S), of humerus (H) and radius (R), is in *Pinocetus* somewhat larger than in *Cethotherium* aff. *mayeri* and *Balaenoptera acutorostrata* (table 3).

In relation to the length of the skull, the humerus of *Pinocetus* is longer than that in *Cetotherium mayeri* and *Cetotherium* aff. *mayeri*, approximately the same as in *Pelocetus, Diorocetus* and *Eschrichtius cephalus* and considerably shorter than in *Cophocetus*. The length of the humerus is usually inversely proportional to that of the metacarpal bones and, therefore, the metacarpus of the limb in *Cophocetus* was probably shorter than that in *Pinocetus* and more elongate in *Cetotherium mayeri* and *Cetotherium* aff. *mayeri*. The ratio of the anteroposterior diameter measured halfway along the length of the shaft of humerus to the length of humerus is in *Pinocetus* and *Cophocetus* fairly low and in *Pelocetus, Eschrichtius cephalus* and *Mesocetus agrami* markedly higher. The head of the acromial joint of humerus in *Pinocetus* is round in circumference and hemispherical, while in *Pelocetus* and *Eschrichtius cephalus* this head is oval, which limited the movements of the limbs in these whales to the swinging motion only. The humerus of *Pinocetus* is marked by a relatively slight development of the tuberosity. On the anterior, radial surface of humerus in *Pelocetus*, the tuberosity of the rugose area is very strongly developed. The shaft of humerus is provided in *Tiphyacetus timblorensis* and *Mesocetus agrami* with a distinct tuberosity extending below the greater tubercle and having on its surface the insertion area of the larger pectoralis muscle. On the posterior surface of the shaft of the humerus a considerably elongate depression occurs in *Tiphyacetus timblorensis* above the ulnar articular face. This depression, forming an attachment area for the triceps muscle, does not occur in *Pinocetus*. The part of humerus in the total length of the anterior limb is in *Pinocetus* somewhat larger than in *Cetotherium* aff. *mayeri* and *Balaenoptera acutorostrata*.

The ratio of the length of the scapula to that of the humerus in *Pinoce-*

Table 3

INDICES (IN %) OF THE ANTERIOR LIMB OF *PINOCETUS POLONICUS* GEN. N., SP.N. AND OTHER MYSTICETI

	Pinocetus polonicus	*Cophocetus oregonensis*	*Mixocetus elysius*	*Diorocetus hiatus*	*Pelocetus calvertensis*	*Thiphyacetus timblorensis*	*Cetotherium mayeri*	*Cetotherium aff. mayeri*
Ratio of the length of skull to the width of the largest scapula	28.5	26.7	30.8	22.7	25.5	—	—	30.0
Length of skull to length of humerus	14.3	17.1	—	14.5	13.6	—	11.6	11.0
Length of humerus to its anteroposterior diameter measured in the middle of shaft	34.7	34.0	—	—	40.6	—	—	—
Length of humerus to its anteroposterior diameter measured in the proximal part of shaft	54.7	53.4	—	—	—	—	50.0	—
Length of humerus to its anteroposterior diameter measured in the distal part of shaft	42.2	43.7	—	—	—	44.9	45.7	48.5
Length of humerus to antero-posterior diameter of its head	40.0	42.2	—	—	42.9	39.5	—	—
Length of humerus to antero-posterior diameter of its ulnar articular face	25.3	27.7	—	—	—	—	—	—

tus and *Cetotherium* aff. *mayeri* represents a transitional value between those in *Balaenoptera acutorostrata* from the Pliocene of Valmontasca, Italy and in a specimen of this same species, caught near the Norwegian coast (table 3).

The radius of *Pinocetus* is damaged, lacking its proximal part and, therefore, any comparisons are rather difficult. Its presumed length was approximately equal to that of the humerus. In *Cetotherium* aff. *mayeri* the humerus is considerably shorter than the radius, similarly in *Balaenoptera acutorostrata*. As referred to the length of the skull, the total length of the anterior limb of *Pinocetus* is markedly larger than in *Cetotherium* aff. *mayeri*, while in both the Pliocene and Recent representatives of *Balaenoptera acutorostrata*, this ratio is considerably higher than in *Pinocetus*.

Conclusions. — The characters of *Pinocetus* separate this whale from all the compared representatives of the family Cetotheriidae. The differences found in the structure of the skull, axial skeltons and limbs are so numerous and important that they justify the erection of a new genus and species. Within the family Cetotheriidae, *Pinocetus polonicus* is most similar, in the structure of its skull and type of telescoping, to *Aulocetus sammarinensis*. In addition, the two species occur in coeval deposits. The similarity in the type of telescoping of the skull and in the structure of the axial skeleton, between *Pinocetus polonicus* and *Mixocetus elysius*, allows one to presume that in the two species occurring in Miocene deposits varying in age belong to one and the same evolutionary series, in which the development led to a considerable increase in the dimensions, narrowing of the skull, reduction in the distance between the apex of the supraoccipital shield and the posterior margin of nasal and, finally, to the extension of the scapula.

THE MODE OF LIFE AND THE ADAPTATIVE FEATURES OF *PINOCETUS POLONICUS* GEN.N., SP.N.

Pinocetus polonicus, whose rostrum and mandible are characteristically elongate, had a baleen similar as in other Mysticeti. Vascular grooves arranged much the same as in *Balaenoptera acutorostrata* occur on the bones of the ventral surface of its rostrum. Thus, the manner of food intake was bound to be similar as in the Recent Mysticeti.

The shifting of the apertures of the nasal cavity towards the dorsal surface of the skull is observed in the evolution of the Cetacea. This was an adaptative response to the pressure of water exerted anteriorly on the soft part of the facial region of head. The force of this pressure is related to the speed of swimming (Winge, 1921). The apertures of the nasal cavity in *Pinocetus* are yet considerably withdrawn from the apex of the skull and the anterior wall of the braincase and nasals are long. The situation of these bones is nearly horizontal as in the Recent species *Eschrichtius gibbosus*. Since in *Pinocetus* the aperture of the nasal cavity was situated considerably lower than the apex of skull, it may be presumed that to have a breath of air this whale had to put out a relatively large part of its head above the surface of water so that the air intake was not so efficient in them as in the Recent Mysticeti. The nasal meatus in whales is short, considerably extended and nearly vertical. Such a structure is ascribed by Winge (1921) to changes in pressure and temperature. The nasal meatus of *Pinocetus* is not yet transformed to such an extent but is relatively long and arranged obliquely.

The structure of the thorax in *Pinocetus* displays the following adaptative characters. The effects of changes in pressure at the moment of diving on the anterior part of thorax were emphasized by Winge (1921). Diaphragmatic respiration is developed in whales to a varying degree. In the Mysticeti, the ribs do not participate in respiratory movements. According to Slijper (1936, 1958), the adaptation to diving caused the loss in the whales capability of moving the ribs during breathing and of thoracic respiration. Staying at large depths, rapid and unexpected changes in pressure during diving and in particular during surfacing, require considerable multidirectional flexibility of the ribs. The anterior part of the thorax in the Cetotheriidae is relatively rigid, since six pairs of anterior ribs are connected in them with the vertebrae by means of heads and tubercles. There are only four pairs of such ribs in *Pinocetus* and there are indicative of a larger extent of mobility of the thorax and greater ease of submersion and surfacing as compared with other Cetotheriidae. Due to the fragmentary preservation of the ribs, the shape of the thorax in *Pinocetus* may be reconstructed to a limited degree only. A relatively small curvature of the proximal part of the anterior ribs, having a head and tubercle, suggests that the anterior part of the thorax was oval and probably wider than high in transverse section. Due to the shape of the centra of the dorsal and lumbar vertebrae, the thorax of *Pinocetus* was undoubtedly elongate. The elongation of the thorax is primary in character, since this is an elongation of particular vertebrae without an increase in the number of vertebrae themselves. An axial skeleton of such a structure could not be very flexible, but the insertion area of muscles was considerably increased. With the form of the thorax, observed in *Pinocetus*, the lungs could only be situated low, which caused a small degree of swimming stability. The thorax in whales is the widest on the average behind the sixth pair of ribs (Slijper, 1936). In *Pinocetus*, the transverse section in this place could have the width at most approaching the height, so that the thorax was not barrel-like in shape.

According to Slijper (1936) considerable importance should be attached, during studies on the evolution of whales, to the structure of the axial skeleton, in which various changes in musculature and circulatory system are reflected. The following conclusions may be drawn on the adaptative features of *Pinocetus* to an aquatic mode of life. The tail section of the body makes up the driving organ in the Cetacea. The caudal region of the axial skeleton has not been preserved in *Pinocetus polonicus* and, therefore, any direct evaluation of this region is impossible. The lumbar vertebrae of whales are similar, particularly in the size of their centra, to the largest anterocaudal vertebrae, but they lack haemal arches, which is related with the development of musculature. Lumbar vertebrae VIII and IX, preserved in *Pinocetus*, are markedly longer than the width of their centra. The centra themselves of these vertebrae are not very thick, their lateral processes are massive and flat, their high neural arch has a flattened neural spine, which is higher than the length of lateral process; for example, the length of lateral process on the last dorsal vertebrae makes up about 63 per cent of the height of the neural arch and, in lumbar vertebra IV, about 66 per cent. Such proportions are typical of the Mysticeti (Slijper, 1936) and with such a structure of vertebrae the muscles of the longissimus dorsi muscle system are inserted not only on the lateral processes and neural arch, but also on the lateral surfaces of the neural spine. If such is the case, the multifid muscle system is poorly developed and, of the extensor muscles of the axial skeleton, very strongly developed is the longissimus dorsi muscle which plays an important role during movement. The neural spines of the vertebrae of *Pinocetus* are long and sloping posteriorly, except for those of the first dorsal vertebrae, which are lower and project perpendicularly. As follows from the above, the nuchal muscles, in particular the semispinal muscle which extends the axial skeleton and head laterally turns the spine, did not extend themselves far towards the posterior part of thorax in *Pinocetus* and had not a very extensive insertion area on a relative small occipital. This muscle group of *Pinocetus* was not, therefore, strong. Despite a relatively long neck with no fused vertebrae and due to a poor musculature of this region, the bending of the body of *Pinocetus* in the anterior centre of flexion — which is an articular connection between the occipital condyles and cervical vertebra I — was rather limited. On the other hand, the musculature of the tail, which had elongate centra of the vertebrae, was certainly strong and the bending of the body took place mostly in the posterior center of flexion. The size of the centra of the vertebrae, which is not large in *Pinocetus*, seems to be indicative of rather small or medium dimensions of the whale and not of its poor swimming capability. The axial skeleton of *Balaenoptera physalus* L. and many other whales is nearly rectilinear (Parry, 1949) and it was probably so in *Pinocetus*.

The foreflippers of whales closely adhere to the body during their swift movements in water and take various positions withdrawn from its sides when the animal swims slowly and turns the fins. The humerus in *Pinocetus* limbs has a hemispherical head of the acromial joint, which allowed the shale more complete rotary movements of the fin than in the case of an articular head varying in diameter. The humerus is relatively long, wide and, in the distal part, contracted, which in this species is an primitive character. The shortening of the humerus in whales is a later adaptation, which facilitates turning the limb, since the shorter its axis, the smaller is the effort necessary for its turns (Mchedlidze, 1964, 1970; Kellogg, 1969). The humerus of *Pinocetus* displays only slight traces of muscle insertion areas and is shorter than the forearm. Such a structure of the fins indicates that they did not function efficiently when the animal swam in curves or slowed down.

The adaptation improving the efficiency of swimming, which is marked in the structure of the axial skeleton and limbs in *Pinocetus*, reached a varying degree of advancement in two regions of skeleton. If the strongly developed musculature of the lumbar and caudal parts of the axial skeleton facilitated strong movements of the body such as swimming, submersion and surfacing, and thus gave the possibility to swim far from shore, the musculature of the anterior part of the body was considerably weaker (diving, turning the head) and the limbs could turn in various directions, but their turns required a considerable effort of muscles, which were poorly developed.

During swimming, the head of a whale is strongly thrust anteriorly and rigidly mounted on a short and immobile neck. The cervical sectore of the axial skeleton of *Pinocetus* is formed by fairly long vertebrae, of which vertebrae I, II and VII are elongate and not fused with each other. This sector is connected with slightly flattened vertebrae of the thoracic region. The odontoid process of cervical vertebra II is short, wide and obtuse, the articular surfaces of cervical vertebrae I and II are not completely flat and the occipital condyles of the skull are correspondingly prominent. The skull of *Pinocetus* does not display any traces of the fusing of particular bones, its rostrum being fairly long, but its ossifications are fine and thin. As follows from these observations, the adaptation of the structure of the anterior part of body in this genus to a stronger pressure of water exerted caudally and occurring during horizontal swimming, seems not yet to be perfect.

As indicated by several characters of the structure of *Pinocetus*, this whale was not yet a very good swimmer. The strong musculature of the posterior part of the thorax and tail might be advantageous not only for fast swimming, but also and primarily for bending the body during surfacing or submersion. Due to the stiffening of the anterior part of thorax, these whales were incapable of fast swimming and deep diving. Presumably, they fed in shallow parts of the sea, although, judging by the elongation of the centra of vertebrae, they were capable of reaching water areas more distant from the shore.

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PINOCETUS POLONICUS GEN.N., SP.N. (CETACEA) Z WAPIENI MIOCEŃSKICH PIŃCZOWA (POLSKA)

Streszczenie

W mioceńskich wapieniach wydobywanych w kamieniołomie w Nowej Wsi koło Pińczowa, obok szczątków ryb spotykane są także kości waleni. Między innymi znaleziono tam niekompletny szkielet walenia należący do rodziny Cetotheriidae Cabrera nazwanego *Pinocetus polonicus* gen.n., sp.n. Kości tego szkieletu były zachowane w naturalnym porządku, czaszka była prawie kompletna, ale uległa uszkodzeniu w czasie wydobywania okazu. Zwłoki tego osobnika musiały leżeć na boku, co wywołało odkształcenie wyrostków poprzecznych na kręgach lędźwiowych i zgniecenie żeber. Znalezisko to jest tym bardziej interesujące, że szkielety waleni, których kości są połączone znajduje się w stanie kopalnym stosunkowo rzadko.

Z porównania *Pinocetus polonicus* z innymi Cetotheriidae miocenu wynika, że jest on pod względem budowy czaszki najbliższy gatunkowi równowiekowemu *Aulocetus sammarinensis* Capellini. Jednak czaszka *Aulocetus* jest bardzo szeroka a rostrum przesunięte trochę dalej ku tyłowi niż u *Pinocetus*, co świadczy o bardziej podkreślonej teleskopowości czaszki *Aulocetus*. Biorąc pod uwagę stopień wydłużenia lub spłaszczenia trzonów kręgów w okolicy szyjnej i odcinku piersiowym od kręgu I—X *Pinocetus* odznacza się:

1) wydłużeniem trzonu VII kręgu szyjnego; pozostałe kręgi szyjne wykazują średni stopień wydłużenia trzonów;
2) wydłużeniem trzonów przednich kręgów piersiowych; podobna tendencja występuje też u *Pelocetus, Cophocetus, Mixocetus, Diorocetus* i *Balaenoptera acutorostrata* Lacépède;
3) długością trzonu X kręgu piersiowego *Pinocetus* większą od szerokości; ta cecha występuje także u *Mixocetus* i *Pariaetobalaena*.

Podobieństwo istniejące w teleskopowości czaszki i budowie kręgosłupa między *Pinocetus polonicus* i *Mixocetus elysius* Kellog pozwala przypuszczać, że oba te gatunki spotykane w różnych wiekowo poziomach miocenu należą do jednego szeregu rozwojowego, w którym rozwój prowadził do znacznego powiększenia rozmiarów, zwężenia czaszki, zmniejszenia odległości między szczytem łuski potylicznej a tylną krawędzią kości nosowej i do rozszerzenia łopatki.

Czaszka *Pinocetus* była wyposażona w fiszbin. Otwory nosowe odsunięte od szczytu czaszki i przedniej ścianki mózgoczaszki, oraz wydłużone kości nosowe nadają temu waleniowi charakter pierwotny. Otwór nosowy znajdował się wyraźnie poniżej szczytu czaszki i z tego powodu *Pinocetus* dla zaczerpnięcia powietrza musiał wystawiać stosunkowo dużą część głowy nad powierzchnię wody. Kanał nosowy *Pinocetus* jest ustawiony ukośnie i jest stosunkowo długi. Klatka piersiowa *Pinocetus* w stosunku do innych Cetotheriidae była bardziej ruchliwa, ponieważ tylko cztery pary żeber łączą się z kręgami przy pomocy głowy i guzka. Była ona wydłużona ale w sposób pierwotny — przez wydłużenie trzonów poszczególnych kręgów a bez zwiększenia ilości samych kręgów; przednia część tułowia miała przekrój owalny. Przy takiej formie klatki piersiowej płuca mogły być tylko umieszczone nisko, co powodowało małą stabilność ciała przy pływaniu. Wydłużenie kręgów wskazuje na małą giętkość kręgosłupa ale powierzchnia przyczepów mięśni była duża, szczególnie silnie umięśniona była okolica lędźwiowa i nasada ogona, natomiast okolica karkowa, zespół *musculus semispinalis*, była znacznie słabiej umięśniona. Ze względu na taki rozwój mięśni wyginanie ciała u *Pinocetus* następowało głównie w tylnym centrum wyginania a nie w przednim znajdującym się między kłykciami potylicy a pierwszym kręgiem szyjnym. Płetwy *Pinocetus* charakteryzowała możliwość ruchów obrotowych (półkulista głowa kości ramiennej), ale ruchy te były niesprawne ze względu na słabe umięśnienie kończyny i wydłużenie kości ramiennej.

Pinocetus przypuszczalnie nie był dobrym pływakiem, silne umięśnienie tylnej partii tułowia i ogona mogło być wykorzystywane nie tyle dla szybkiego pływania ale przy wyginaniu ciała w trakcie wynurzania się czy pogrążania w wodzie. Usztywnienie przedniej części klatki piersiowej nie pozwalało mu na szybkie i głębokie nurkowanie. Waleń ten był mieszkańcem przede wszystkim niegłębokich mioceńskich mórz ale był on już zdolny do wypływania na obszary wód bardziej odległe od brzegu na co wskazują wydłużone trzony kręgów.

ТЕРЕСА ЧИЖЕВСКА & ЗБИГНЕВ РЫЗЕВИЧ

PINOCETUS POLONICUS GEN. N., SP. N. (CETACEA) ИЗ МИОЦЕНОВЫХ ИЗВЕСТНЯКОВ МЕСТНОСТИ ПИНЬЧУВ (ПОЛЬША)

Резюме

В миоценовых известняках, добываемых в карьере в с. Нова-Весь близ г. Пиньчув, вместе с остатками рыб встречаются кости китообразных. Среди них был найден неполный скелет представителя семейства Cetotheriidae Cabrera, названного *Pinocetus polonicus* gen. n., sp. n. Кости скелета находились в естественном положении, череп почти комплектный, однако был поврежден при извлечении экземпляра. Тело животного было захоронено на боку, что обусловило деформацию поперечных отростков на бедренных позвонках и сжатие ребер. Эта находка имеет важное значение, так как скелеты китообразных с соединенными костями встречаются в ископаемом состоянии сравнительно редко.

Сравнение *Pinocetus polonicus* с другими миоценовыми Cetotheriidae доказывает, что по строению черепа он наиболее сходен с одновозрастным видом *Aulocetus sammarinensis* Capellini. Однако у *Aulocetus* череп более широк и ростр сдвинут назад, что является признаком более четко выраженной телескопичности черепа *Aulocetus*. Изучение формы шейных и грудных позвонков с I по X показывает, что *Pinocetus* обладает следующими признаками:

1) удлиненный шейных позвонок VII; остальные шейные позвонки характеризуются средней длиной;

2) удлиненные передние грудные позвонки; такого типа признак наблюдается и у *Pelocetus, Cophocetus, Mixocetus, Diorocetus* и *Balaenoptera acutorostrata* Lacépède;

3) длина X грудного позвонка *Pinocetus* превышает ширину; этот признак отмечается также у *Mixocetus* и *Pariaetobalaena.*

Сходства в телескопичности черепа и строении позвоночника у *Pinocetus* и *Mixocetus elysius* Kellog позволяют предполагать, что оба вида, распространенные в разновозрастных горизонтах миоцена, принадлежат к одному эволюционному ряду, развитие которого происходило путем значительного увеличения размеров животного, сужения черепа, сокращения интервала между верхушкой затылочной мыщелки и задним краем ноздрей, расширения лопатки.

Череп *Pinocetus* был снабжен китовым усом. Носовые отверстия отодвинуты от верхушки черепа и от передней стенки мозговой коробки, носовые кости вытянутые, что придает этому животному первичный характер. Носовое отверстие располагалось намного ниже макушки черепа и в связи с этим *Pinocetus*

для зачерпывания воздуха был вынужден выставлять над поверхностью воды большую часть головы. Носовой канал *Pinocetus* сравнительно длинный, располагался косо, по сравнению с другими Cetotheriidae обладал более пожвижной грудной клеткой, так как лишь четыре пары ребер соединялись с позвонками посредством головки и бугорка. Она была удлинена, но примитивным образом — путем удлинения отдельных позвонков, без увеличения их количества. Передняя часть туловища имела овальное сечение. При такой форме грудной клетки легкие могли помещаться низко, что не давало большей стабильности при плавании. Удлиненные позвонки снижали гибкость позвоночника, однако поверхности прикрепления мускулов были большие. Особенно сильно мышцы были развиты в бедренной части и у основания хвоста, значительно слабее в шейной части и в системе *musculus semispinalis*. Вследствие такой мускульной системы изгибы тела *Pinocetus* происходили, главным образом, в заднем центре изгибания, а не в переднем, который располагался между затылочными выступами и первым шейным позвонком. Плавники *Pinocetus* обладали способностью вращательного движения (полушаровая форма головки плечевой кости), однако их подвижность была ограничена слабыми мышцами конечности и удлинением берцевой кости.

Pinocetus очевидно не являлся быстро плавающим животным. Сильно развитые мышцы задней части туловища и хвоста предназначались в основном для изгибов тела при выплывании на поверхность и погружении в воду. Мало гибкая передняя част грудной клетки препятствовала быстрому и глубокому нырянию. Описанное животное обитало, главным образом, в неглубоком миоценовом море, однако обладало уже способностью заплыва на большие расстояния от берега, что доказывается удлиненными позвонками.

EXPLANATION OF PLATES

All fragments shown in Plates XXIII to XXX belong to a specimen of *Pinocetus polonicus* gen.n., sp.n. Coll.No MZ VIII/Vm-750, Miocene M_4, Pińczów.

Plate XXIII

Occipital and temporal parts of skull, dorsal view, ca × 0.2; Z fragmentary right zygomatic arch.

Plate XXIV

Occipital and temporal parts of skull, ventral view, ca × 0.25.

Plate XXV

Fragmentary rostrum: *a* dorsal and *b* ventral view, ca × 0.3; *AV* anterior margin of vomer, ca 400 mm from the end of rostrum.

Plate XXVI

Terminal part of rostrum: *a* ventral, *b* distal and *c* dorsal views, ca × 0.5.

Plate XXVII

Fig. 1. Right humerus: *a* distal and *b* proximal articular surfaces; ca × 0.6.
Fig. 2. Terminal part of the left mandible: *a* dorsal and *b* medial views; ca × 0.6.

Plate XXVIII

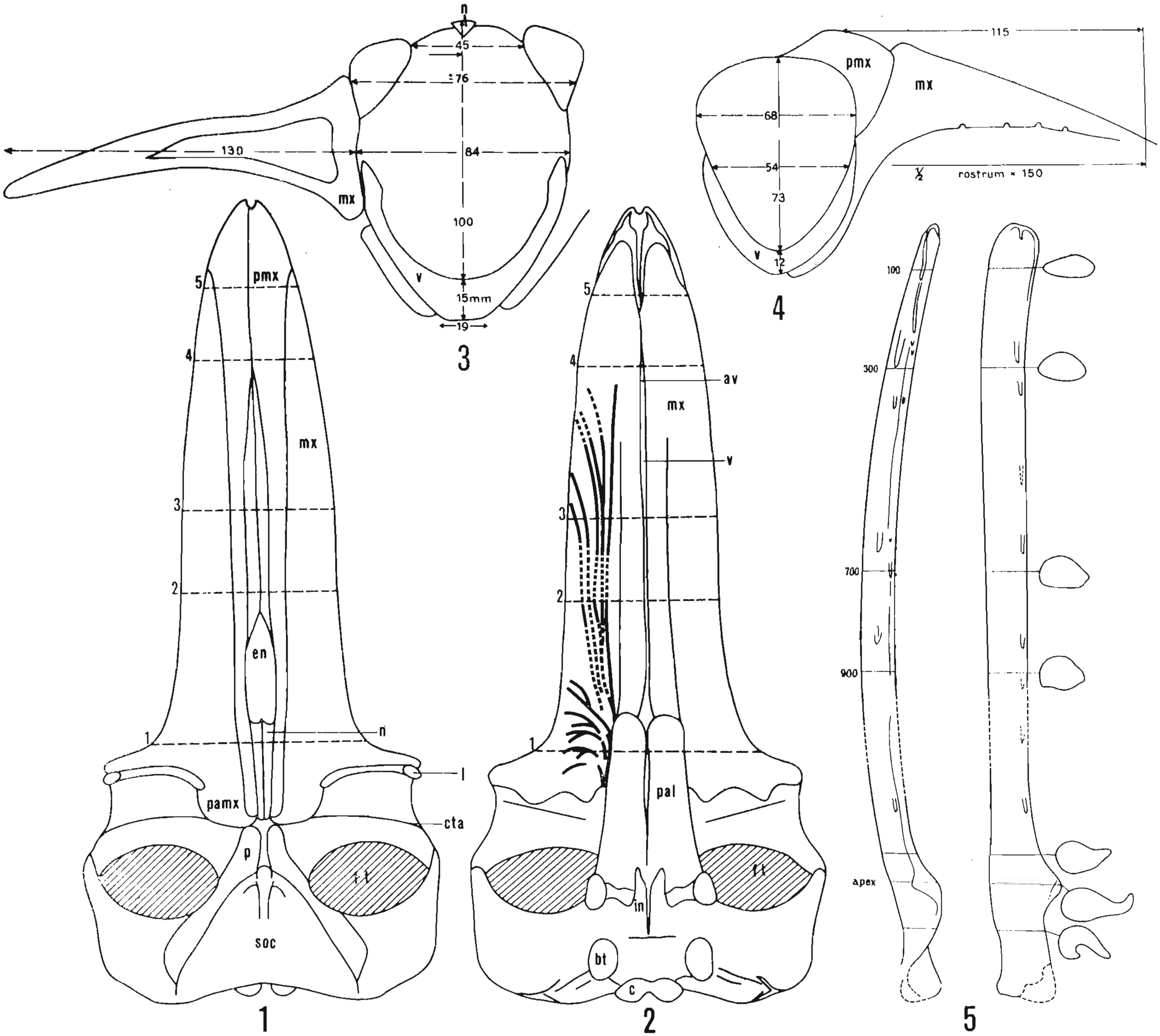
Fig. 1. Right humerus: *a* anterior and *b* posterior views; ca × 0.5.
Fig. 2. Fragmentary right radius in external view, ca × 0.5.

Plate XXIX

Fig. 1. Left tympanic bulla: *a* external, *b* medial, *c* dorsal and *d* ventral views; ca × 0.6.
Figs 2, 3, 4. Epiphyses of dorsal vertebrae: *2* VII, posterior; *3* IX, anterior; *4* VIII, posterior; ca × 0.6.

Plate XXX

Right scapula, viewed from the medial surface, ca × 0.3.



Figs 1-5. Reconstruction of skull and mandible of *Pinocetus polonicus* gen.n., sp.n. Coll. No MZ VIII/Vm — 750, Miocene M_4, Pińczów. 1 — Dorsal view, × 0.1; *av* anterior margin of vomer, *bt* tympanic bulla, *c* occipital condyles, *cta* anterior temporal margin, *en* nasal aperture, *ft* temporal fossa, *in* choanae, *l* lachrymal, *mx* maxilla, *n* nasal, *p* parietal, *pal* palatal bone, *pamx* ascending maxillary process, *pmx* premaxilla, *soc* supraoccipital shield, *v* vomer; *1—5* lines of the transverse sections of rostrum described. 2 — Ventral view. 3 — Arrangement of the bones of rostrum in a transverse section through the anterior margins of nasals about 330 mm from the apex of supraoccipital shield; the right maxilla is shown; width of rostrum in this place amounts to 360 mm. 4 — Arrangement of the rostrum bones in a transverse section, 580 mm from the apex of supraoccipital shield; the left premaxilla and maxilla are shown. 5 — Left mandible as viewed from the external and dorsal surface; outlines of transverse section marked; ca × 0.1.

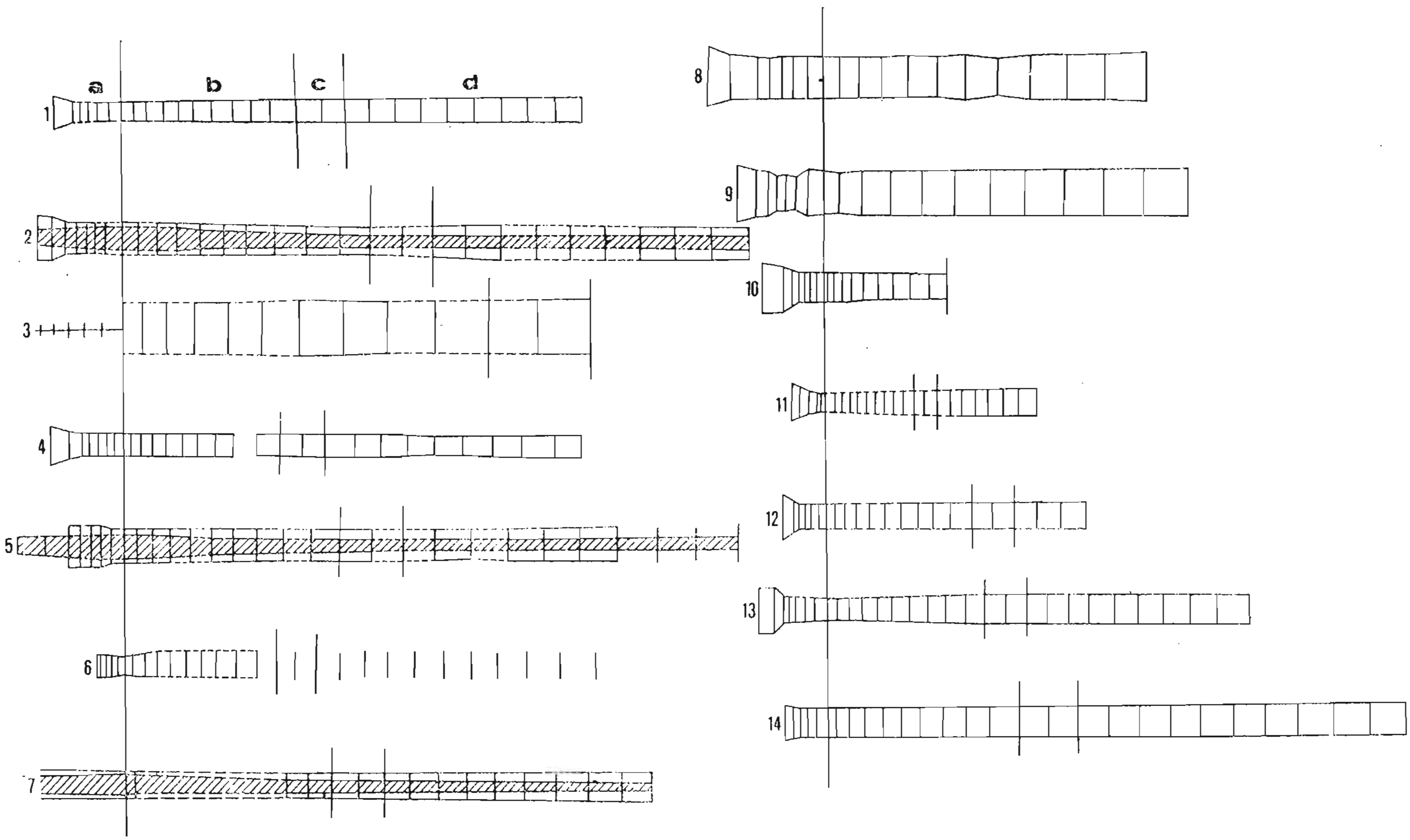
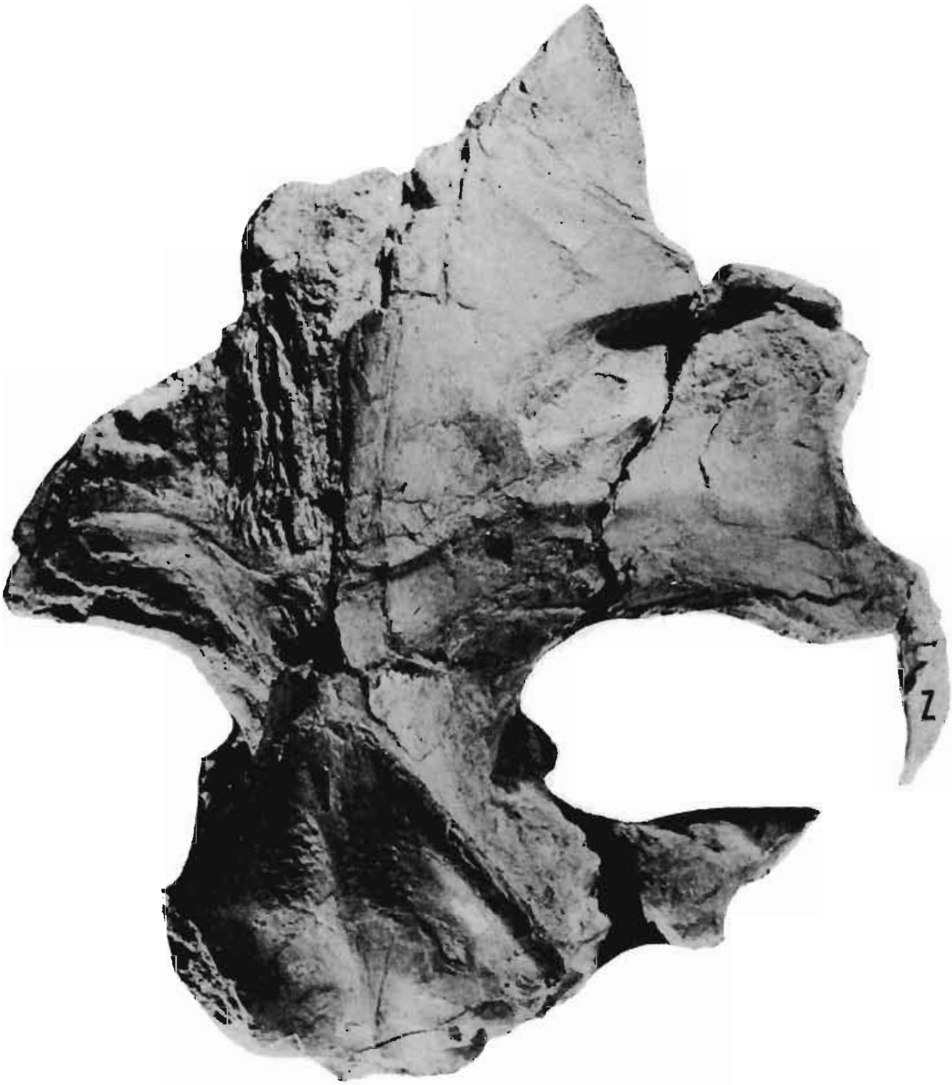


Fig. 6. Diagrams of the cervical, thoracic and lumbar sectors (vertebrae I—IX) of the axial skeleton of: 1 — *Aetiocetus cotylalveus*, 2 — *Pinocetus polonicus*, 3 — *Mixocetus elysius*, 4 — *Parietobalaena palmeri*, juv., 5 — *Pelocetus calvertensis*, 6 — *Cophocetus oregonensis*, 7 — *Diorocetus hiatus*, 8 — *Balaenoptera acutorostrata*, Pliocene, Italy, 9 — *B. acutorastrata*, Recent, Norway, 10 — *Mauicetus brevicollis*, 11 — *Cetotherium mayeri*, 12 — *Cetotherium* cf. *mayeri*, 13 — *Cetotherium* cf. *mayeri*, 14 — *Mesocetus hungaricus*; ca × 0.05. *a* cervical vertebrae, *b* dorsal vertebrae I—X, *c* further dorsal vertebrae, *d* lumbar vertebrae I—X. The width of neural canal is shown in diagrams: 2, 5 and 7.



Phot. Z. Staniewski

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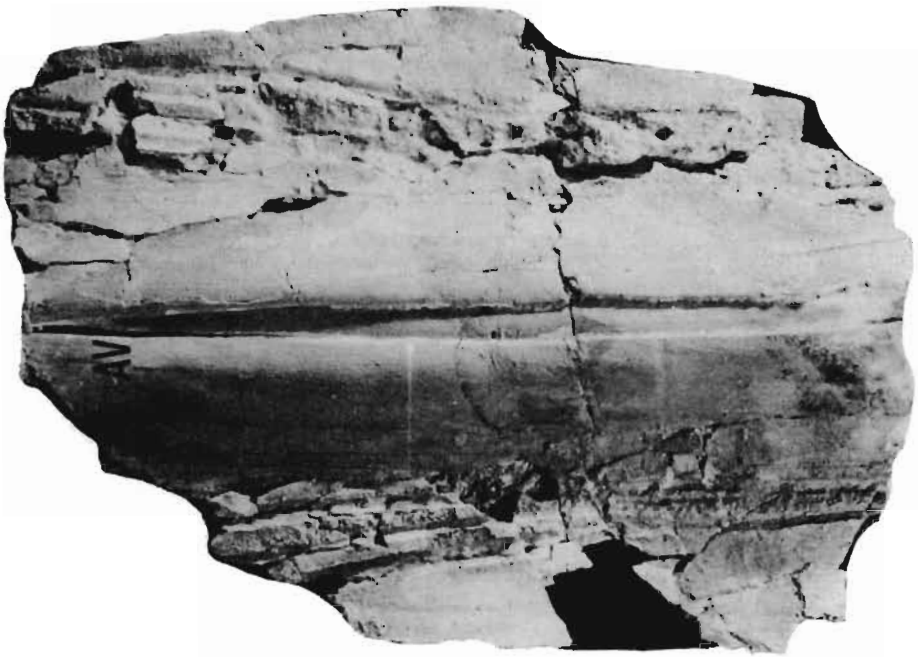
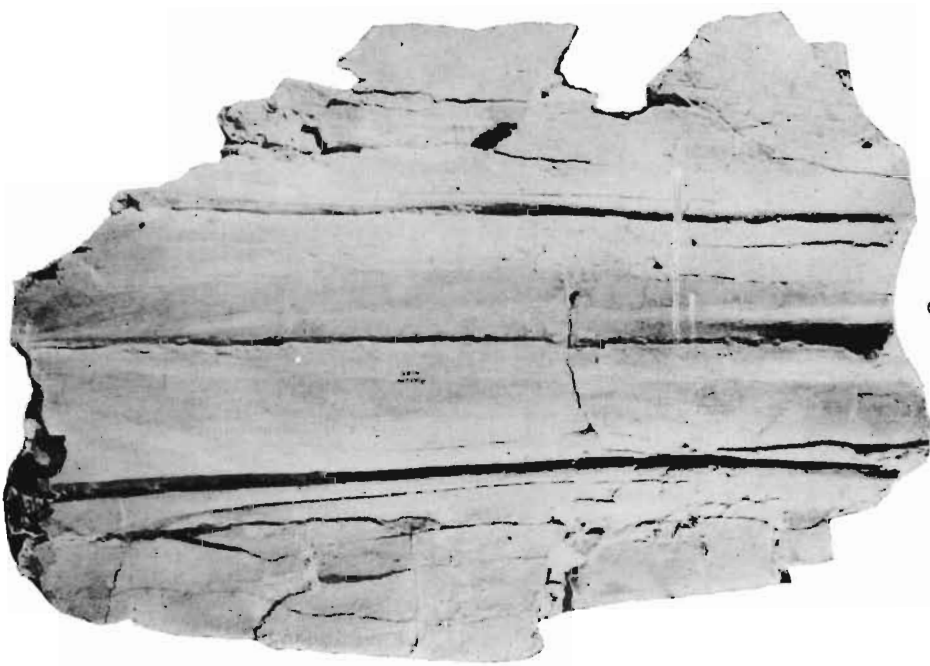


b



a

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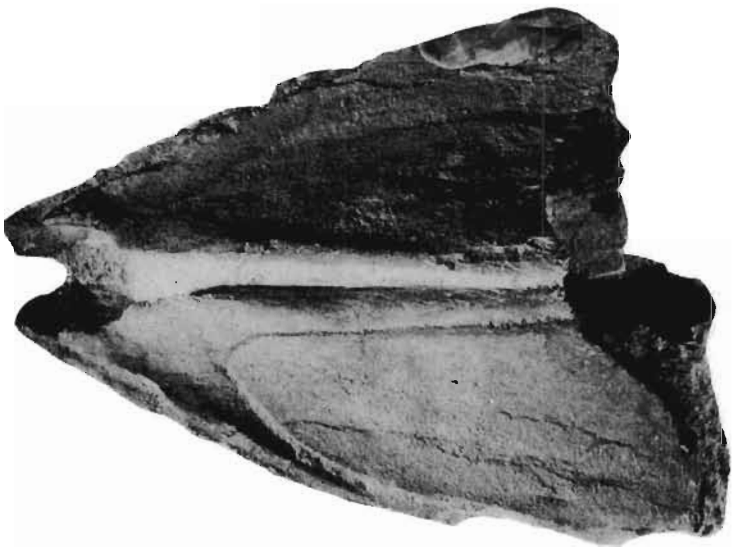
c



a

b

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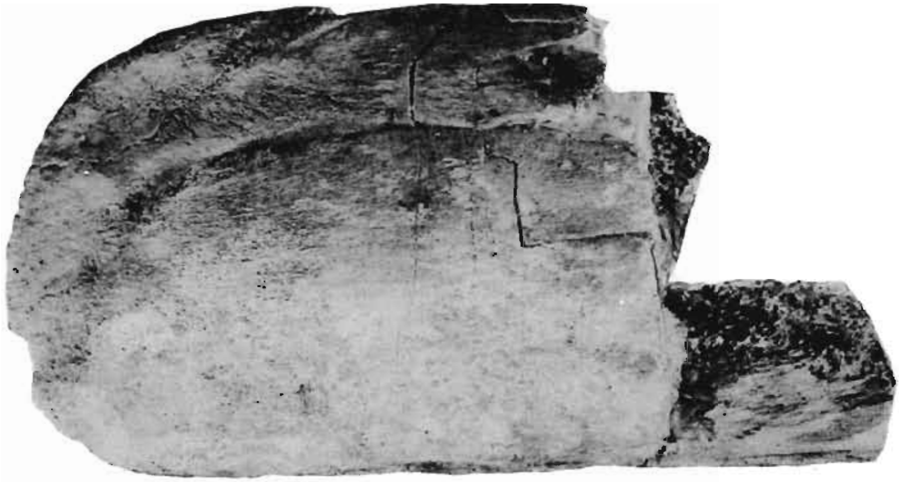

2b

2a

1a

1b

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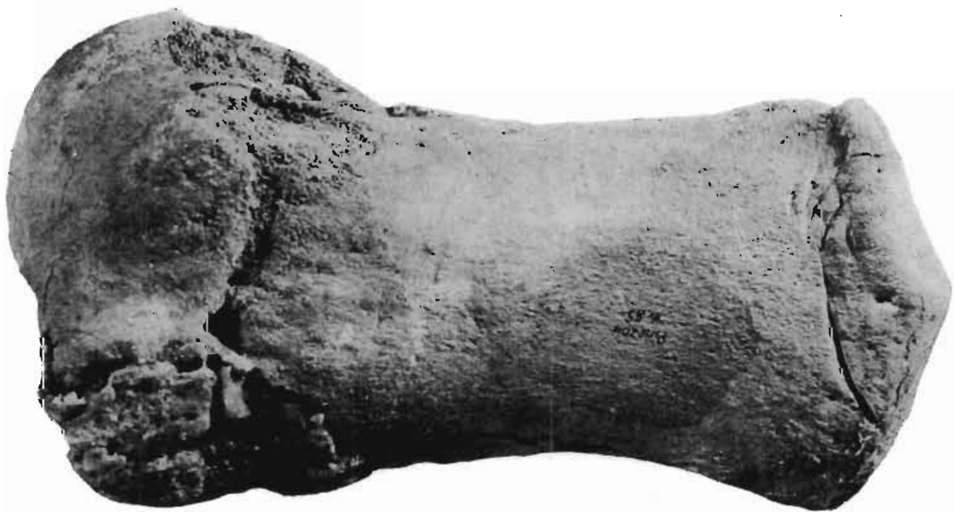
1b

2



1a

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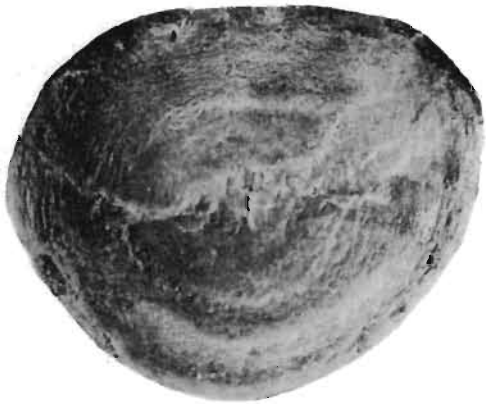
1a

1b

1c

1d

2



3

4

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