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(With Four Plates)

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Assistant Curator, Division of Mammals, U. S. National Museum

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A MIOCENE LONG-BEAKED PORPOISE FROM CALIFORNIA

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(With Four Plates)

The fossil porpoise described in this paper was presented to the United States National Museum by G. M. Cunningham of the Standard Oil Company of California, Bakersfield, Calif. This skull unquestionably represents an undescribed species of one of the long-beaked porpoises. Its closest affinities appear to be with the Patagonian Lower Miocene genus *Argyrocetus* to which it is tentatively referred.

ARGYROCETUS JOAQUINENSIS new species

Type.—U.S.N.M. No. 11996. An incomplete skull, lacking the major portion of the rostrum, the superior border and right half of supraoccipital, the hinder outer border of right supraorbital process, the upper portion of right exoccipital, the right zygomatic process with exception of postglenoid portion, the tympanic bullae and periotics on both sides, and all of the teeth with the exception of one crown.

Type locality.—About 12 miles northeast of Bakersfield and 1,000 feet west of Pyramid Hill, in sec. 14, T. 28 S., R. 29 E., Kern County, Calif.; shown on Caliente Quadrangle, United States Geological Survey.

Horizon.—This skull was embedded in a fine-grained calcareous sandstone nodule, which was found about 75 feet below the top of the Vedder zone during May, 1930, by Max Steineke of the Standard Oil Company of California. The following invertebrate fossils were obtained at the same locality and identified by William F. Barbat: *Pecten bowersi* Arnold, *Pecten perrini* Arnold, *Ostrea titan* Conrad, *Cardium vaqueroensis* Arnold, *Spisula granti* Wiedey, *Dosinia margaritana* Wiedey, *Phacoides sanctaecrucis* Arnold, and *Chione* indet. The sands of the Vedder zone[1] lie about 1,400 feet

[1] Wilhelm, V. H., and Saunders, L. W., Report on the Mt. Poso oil field. Summary of operations California oil fields. 12th Ann. Rep. State Oil and Gas Supervisor, California State Min. Bur., San Francisco, vol. 12, no. 7, pp. 6, 8-9, January, 1927.

below the top of the Temblor formation; the Vedder zone has a maximum thickness of 85 feet in the Mount Poso area and underlying these sands are 550 to 650 feet of marine sediments, making a total thickness of 2,000 to 2,100 feet. The Vedder horizon, according to G. M. Cunningham, is older than the Barker's ranch locality which has been described by F. M. Anderson.[1] It is the opinion of Mr. Barbat that this horizon should be correlated with the Vaqueros formation which is thought to be equivalent in time with the Burdigalian [=Langhian] stage of the European Tertiary.

DIAGNOSIS

As compared with *Argyrocetus patagonicus* Lydekker,[2] this species is characterized by an elevated vertex formed for the most part by the elongated nasals and the hinder ends of the thickened premaxillaries, the mesorostral gutter is narrower, and the hamular processes of the pterygoids are conspicuously prolonged backward. It agrees with *A. patagonicus* in having a broad, concave ∩ shaped supraoccipital shield, in having the outer borders of the maxillaries at the base of the rostrum slope downward, and in having the vertex contracted antero-posteriorly.

SKULL

Dorsal view.—Although the major portion of the rostrum is destroyed it is obvious that this skull belongs to one of the long-beaked porpoises. The dorsal surface of the skull is constituted almost entirely by the maxillaries and the premaxillaries; the hinder extremities of the premaxillaries, the nasals, and the small wedgelike bone (presumably frontal) form the vertex of the skull. The maxillary notches are well marked. From the dorsal aspect the maxillaries are seen to increase in width from the broken extremity of the rostrum posteriorly. When they reach the level of the maxillary notches the maxillaries are thrust backward over the supraorbital processes of the frontals and expanded laterally to form the so-called frontal plates. These thin plates of the maxillaries and the corresponding underlying lateral extensions of the frontals roof over the temporal

[1] Anderson, F. M., The Neocene deposits of Kern River, California, and the Temblor basin. Proc. California Acad. Sci., ser. 4, vol. 3, pp. 98-100, November 9, 1911.

[2] Lydekker, R. Contributions to a knowledge of the fossil vertebrates of Argentina. Pt. II. Cetacean skulls from Patagonia. Anal. Mus. La Plata, vol. 2 for 1893, pp. 10-12, pl. 5, figs. 1, 1a, 2, 3, 1894.

fossae. The maxillary does not entirely sheathe the preorbital angle of the supraorbital process. The hinder margins of the left maxillary are probably imperfect above the temporal fossae. The dorsal surface of the left maxillary is depressed opposite the nasals and slightly convex above the supraorbital processes of the frontals. The internal margin of the maxillary, with the exception of the narrow tongue-like portion, which overlaps the frontals on the vertex, is in contact with the premaxillary for practically its entire length. Two foramina, which are connected with the infraorbital canal, are present on each maxillary. The most posterior one of these is situated above the temporal fossa. The other foramen is located at or near the level of the maxillary notch and from it a deep groove extends forward for a distance of at least 20 mm. The outer border of the maxillary at the base of the rostrum is not bent upward as in *Eurhinodelphis,* but is curved obliquely downward. In correlation with this tapering of the rostrum the maxillary decreases in breadth anteriorly and the sides become more nearly vertical. Anterior to the maxillary notches the premaxillaries are fairly thick and their upper surfaces are convex. Their inner margins become closely approximated at a point 130 mm. in front of the maxillary notches. The raised outer convex portions of the premaxillaries diverge strongly between this point and the maxillary notches, and constitute the outer border of the more or less flattened internal portions of the premaxillaries. In consequence of their tapering, these elevated outer convex surfaces disappear in front of the presphenoid. The premaxillaries commence to expand horizontally in front of the nasal bones and attain their maximum width at the level of the anterior walls of the narial passages. Opposite the narial passages there is an oval concavity on each premaxillary. The posterior end of each premaxillary is relatively broad, conspicuously thickened, and its dorsal surface is raised to the level of the nasals. The premaxillary foramina are moderately large and are situated behind the level of the anterior maxillary foramina. Each of these premaxillary foramina opens into a broad groove, which is continued obliquely backward and outward to a point opposite the narial passages. The internal border of the premaxillary, which is somewhat flattened in front of the presphenoid, narrows rapidly and finally disappears anteriorly under the raised convex outer strip. The premaxillaries do not approximate each other as closely in front of the narial passages as in *Eurhinodelphis bossi* from the Calvert formation of Maryland and hence the mesorostral gutter is not roofed over for a distance of 160-175 mm. Proxi-

mally, the floor of the mesorostral gutter is contributed by the premaxillaries and the vomer.

The apex of the mesethmoid rises to the level of the dorsal surfaces of the premaxillaries. The mesethmoid sheathes the dorsal and lateral faces of the presphenoid and thus forms a partition between the narial passages superiorly, fills in the frontal fontanelle, and provides support for the nasals, and also for the vertex of the skull. The anterior narrowing of the narial passages is correlated with the distal enlargement of the presphenoid. Notwithstanding the horizontal expansion of the premaxillaries, most of the anterior end of the presphenoid is exposed. The presphenoid is the porous bone that forms a plug across the proximal end of the mesorostral gutter, but does not rise to the level of the premaxillaries above.

The frontals are largely hidden from a dorsal view, being overspread by the premaxillaries and maxillaries laterally and by the nasals medially. Posteriorly the frontals abut against the supraoccipital on the vertex and it is barely possible that a very narrow strip of these bones may have been exposed between the hinder ends of the nasals and the missing dorsal crest of the supraoccipital.

The elongated nasals are relatively large (35 x 16.5 mm.) and are placed on the vertex between the posterior extremities of the premaxillaries, but do not overhang the narial passages. The anterior border of each nasal is bevelled off obliquely. The hinder ends of the nasal bones are unusually thick (pl. 3). Behind the right nasal and nearly in the midline, there is a small wedge-shaped bone which may be either an exposed portion of the right frontal or a fortuitous division of the right nasal.

Lateral view.—Aside from the relatively large size of the braincase, the skull (pl. 2) is characterized by a rather high temporal fossa which is partially roofed over by the maxillary and the underlying lateral extension of the frontal, a fairly wide orbit, and a long zygomatic process. The rostrum is somewhat depressed proximally and compressed from side to side anteriorly.

The orbit is strongly convex, the outer margin of the supraorbital process of the frontal being thickened, while the superimposed plate of the maxillary is thin and shelving. The preorbital portion of the supraorbital process of the frontal is rounded, while the postorbital angle is almost trihedral. The small lacrimal is closely appressed to the preorbital angle of the supraorbital process and its inner end is mortised into the under surface of the maxillary. The jugal is a very slender bone whose anterior end is ankylosed with the lacrimal below

the maxillary notch and whose styliform process is extended backward beneath the orbit to the anteroventral angle of the zygomatic process where it is expanded into a broad thin plate. The jugal was unavoidably removed while the skull was being freed from the matrix.

The zygomatic process of the squamosal is thickened dorso-ventrally and is almost in contact anteriorly with the postorbital angle of the supraorbital process. As a whole the zygoma is robust, slightly curved, and rather long; the dorsal profile slopes gradually forward and upward. The postglenoid portion of the zygoma curves downward and then forward. The greatest length of the left zygoma is 90 mm. and the dorso-ventral diameter anteriorly is 18 mm.

The crest formed by the contact of the supraoccipital with the hinder ends of the frontals is destroyed but it was presumably the highest point in the dorsal profile. The dorsal profile of the skull slopes rather steeply from the vertex to the level of the maxillary notches. On each side of the vertex, the frontal plate of the maxillary is depressed. The supraorbital process of the frontal and the superimposed maxillary do not rise above the level of the premaxillary in front of the narial passages. The temporal fossa is much longer than the orbit. In the temporal fossa the parietal is suturally united inferiorly with the squamosal, anteriorly and superiorly with the frontal, and posteriorly with the supraoccipital. Hence the parietals are excluded from the vertex of the skull. When viewed from the side, the occipital condyles are seen to project considerably beyond the level of the hinder surfaces of the exoccipitals. The basicranial axis is bent downward from the axis of the rostrum.

Posterior view.—This surface (pl. 3) attains its greatest breadth at the level of the exoccipitals. These exoccipitals are relatively large, are coalesced with the supraoccipital above, and are projected outward and backward like wings. Their external margins are sinuous-rounded, and are produced outward so that they conceal for the most part the postglenoid processes when viewed from behind. Anteriorly the exoccipital is in contact with the squamosal and inferiorly it is united with the basioccipital. The suture between the exoccipital and the basioccipital lies internal to the deep jugular incisure and the former constitutes the hinder border of the falcate process of the latter. At the bottom of this incisure and near the posterior margin there is a small condylar foramen. Externally the upper portion of the exoccipital is produced backward, forming a crest which follows the curvature of the hinder end of the temporal fossa. This thin-

edged crest is continuous with the corresponding portion of the supraoccipital and together they form a prominent lambdoid crest. The dorsal contour of the supraoccipital is uncertain since this portion of the lambdoid crest has been destroyed. Between the upper limits of the temporal fossae the supraoccipital is deeply concave. The greatest breadth of the supraoccipital is about equivalent to its vertical diameter above the foramen magnum.

The foramen magnum is sub-oval in outline; its transverse diameter is 35 mm. and its vertical diameter 24 mm. The occipital condyles are considerably broader near the apex than near the base, and their articular surfaces curve outward and forward. Their internal faces converge inferiorly and have a sharp hinder edge. The external margins of the occipital condyles are convex and are not set off from the exoccipitals by distinct necks. The outer border of the left condyle has been damaged and the entire articular surface of the right condyle is missing. Below the occipital condyles and internal to the exoccipitals are the descending plates of the basioccipital and they in turn are separated from the large paroccipital processes by the deep jugular incisures.

Ventral view.—Near the base of the rostrum the ventral surfaces of the maxillaries are closely approximated and the keel of the vomer is entirely concealed.

The lacrimal is closely appressed to the anterior face of the supraorbital process of the frontal and its internal end is mortised into the ventral face of the maxillary; the anterior end of the jugal is ankylosed with the lacrimal below the maxillary notch. Inasmuch as no suture can be found it should be stated that these three bones constitute the lower margin of the maxillary notch.

The jugal is a long, slender bone consisting of a short triangular enlarged anterior portion ankylosed with the lacrimal, and a styliform posterior process. The posterior end of the styliform process is dorso-ventrally flattened and extremely thin, being loosely attached to the ventral face of the zygomatic process. The jugal was unavoidably removed during the preparation of this specimen.

There is nothing peculiar about the position of the palatines. They are suturally united medially in front and are closely appressed to the under surfaces of the maxillaries. Viewed from the side, the palatine extends forward beyond the level of the maxillary notch and projects backward above the external reduplication of the pterygoid to the anterior margin of the optic canal. Close to its posterior extremity, the palatine presumably comes in contact with the orbitosphenoid which lies above it.

The relations of the pterygoids with the surrounding bones is essentially in agreement with that of *Eurhinodelphis bossi*. The external reduplication of the pterygoid is for the most part destroyed. Remnants of the ends of the outer plate on the left side show that the internal and external plates of the pterygoids are separated from each other by a narrow interval anteriorly, but posteriorly they are widely separated. Hence the usual pterygoid sinus must have been present. The curved internal plate contributes the lower outer surface for the narial passage. The combined internal and external plates of the pterygoid seemingly contribute to the formation of the elongated, backwardly projecting hamular process which constitutes a posterior extension of the palatal surface. The anterior margin of the external plate of the pterygoid is united by an irregular suture with the palatine. The external plate of the pterygoid is suturally united with the squamosal and palatine, and apparently is in contact with the parietal and alisphenoid.

The outer wall of the cranium in the region of the alisphenoid and orbitosphenoid is imperfect. The optic canal, while seemingly confluent with the sphenorbital fissure, nevertheless has its course marked by a definite groove. This canal should be bounded anteriorly near its origin by the descending portion of the orbitosphenoid.

A recess is formed by the backward extension of the alisphenoid (Pl. 4) and the contiguous underlying lateral process of the basioccipital, which completely excludes the periotic and tympanic from the inner wall of the cranium. On the roof of this recess and near its posterior end is a large orifice that corresponds to the *foramen lacerum posterius* for the nerves associated with the jugular leash.

The thin descending plates or falcate processes of the basioccipital are directed downward and outward; anteriorly they are suturally united with the internal plates of the pterygoids which overlap the basisphenoid.

The distinguishing features of the squamosal are the large size and strength of the zygomatic arch, the short robust postglenoid process, and the thin falciform process which is directed forward and downward in front of the tympano-periotic recess. The zygoma is rather large and is directed slightly outward. The ventral glenoid surface is an oval concavity, looking forward, inward, and downward. A narrow groove for the external auditory meatus traverses the squamosal behind the postglenoid process. The hinder end of the squamosal is suturally united with the exoccipital and between this suture and the transverse groove for the external auditory meatus a rounded tuberos-

ity is formed. Internal to the glenoid fossa and on the ventral surface of the squamosal there is a longitudinal depression, deeper posteriorly than anteriorly. This depression commences at the base of the inner face of the postglenoid process and extends forward to the anterior or temporal margin of the squamosal. The ventral portion of the squamosal, internal to this last-mentioned fossa, is prolonged downward and inward to form a thin plate which, when complete, is suturally united with the external reduplication of the pterygoid.

The paroccipital process is relatively thick, its ventral aspect is roughened, and internally in conjunction with the descending plate of the basioccipital an incisure is formed for the passage of the so-called jugular leash and associated nerves.

REMARKS

Porpoises with long slender rostra predominated in the pelagic faunas of the Lower Miocene, as is evidenced by the occurrence of *Argyrocetus* in Patagonia, and *Ziphiodelphis, Schizodelphis* [=*Cyrtodelphis*], *Eoplatanista*, and *Acrodelphis* in Italy. The two last-mentioned genera are sufficiently distinct from the California skull to eliminate them from further consideration.

Although the proportions of this skull (Pl. 1) and the relations of the bones constituting the dorsal surface are strongly suggestive, at first glance, of *Eurhinodelphis longirostris*[1] from the Upper Miocene Anversian stage of the Antwerp Basin, Belgium, there are some well-marked differences. The skull from California has a smaller orbit, a longer and more slender zygomatic process, a relatively greater transverse diameter at the level of the preorbital angles of the supraorbital processes, the zygomatic width is somewhat less, the hinder extremities of the premaxillaries are greatly thickened and are applied to the lateral surfaces of the elongate nasals, the supraoccipital shield is strongly concave, and the occipital condyles are less protuberant. The nasals are missing on the type skull of *E. longirostris* (No. 3249, Mus. Roy. Hist. Nat. Belgique, Bruxelles) and the elements marked *N* on Abel's plate (1902, Pl. 11) are actually the frontals, into which the nasals were mortised. It is certain, however, that *E. longirostris* has much wider nasals than the California porpoise. The braincase of *Argyrocetus joaquinensis* is somewhat

[1] Abel, O., Les dauphins longirostres du Boldérien (Miocène supérieur) des environs d'Anvers. Pt. II. Mém. Mus. Roy. Hist. Nat. Belgique, Bruxelles, vol. 2, pl. 11, 1902.

narrower at the level of the supraorbital processes than that of *Eurhinodelphis bossi*[1] from the Upper Miocene Calvert formation of Maryland, and the construction of the vertex is quite different. In *E. bossi,* which is approximately the same size as *A. joaquinensis,* the nasal bones are quite small, the area of both nasals being somewhat less than the exposed portions of the combined frontals on the vertex, and the thin outer border of the maxillary at the base of the rostrum is bent upward.

The genus *Eurhinodelphis* is not known to occur in Lower Miocene deposits. There are, however, three related genera that are characteristic of this geological stage. The long-beaked porpoise, *Ziphiodelphis abeli,*[2] from the Lower Miocene Langhian sandstone quarries of Bolzano, Italy, has the vertex similarly contracted in an antero-posterior direction, the transverse diameter of the nasals being almost twice the antero-posterior diameter, the exposed portion of the combined frontals on the vertex is approximately equivalent in area to that of the two nasals, and a small interparietal is present. The supraoccipital shield is nearly vertical and flattened transversely, the rather thin outer borders of the maxillaries are bent upward at the base of the rostrum, and the hinder extremities of the premaxillaries are not conspicuously thickened. The teeth, however, have the roots markedly enlarged below the base of the enamel crown, but are rapidly attenuated toward the extremity. This genus seems to have its closest affinities with *Eurhinodelphis.*

As regards *Schizodelphis sulcatus* from marine sediments belonging to the Lower Miocene Langhian stage at Gauderndorf near Eggenburg, Austria,[3] and also from the Langhian sandstone quarries at Belluno in Upper Italy,[4] the nasals are quite small, the frontals com-

[1] Kellogg, R., On the occurrence of remains of fossil porpoises of the genus *Eurhinodelphis* in North America. Proc. U. S. Nat. Mus., vol. 66, art. 26, pp. 1-40, pls. 17, 1925.

[2] Dal Piaz, G., Sui vertebrati delle arenarie Mioceniche di Belluno. Atti Accad. sci. veneto-trentino-istriana, Padova, Cl. I, Anno V, pp. 13-16, figs. 5-7, 1908; Basani, F., and Misuri, A. Sopra un Delfinorinco del calcare Miocenico di Lecce (Ziphiodelphis abeli Dal Piaz). Mém. R. Accad. Lincei Cl. sci. fis. mat. e nat., Roma (5), vol. 9, fasc. 2, pp. 25-38, pl. 1, fig. 6, 1912; Dal Piaz, G., L'Istituto geologico dell' Università di Padova nel 1922. Notizie Sommarie. Mém. Ist. Geol. R. Univ. di Padova, vol. 6, p. 11, fig. 6, 1922.

[3] Abel, O., Untersuchungen über fossilen Platanistiden des Wiener Beckens. Denkschr. k. Akad. Wiss. math.-naturw. Kl., Wien, vol. 68, pp. 839-874, pls. 1-4, 1899.

[4] Dal Piaz, G., Sugli avanzi di Cyrtodelphis culcatus dell'arenaria di Belluno. Pt. I. Palaeontographia Italica, Pisa, vol. 9, pp. 187-220, pls. 28-31, text figs. 16, 1903.

prise the major portion of the large vertex, the area of the exposed portions of the frontals on the vertex being considerably larger than that of the two nasals, a small interparietal is present, the zygomatic process is relatively short and robust, and the roots of the teeth are shaped somewhat like a heraldic battle axe. In so far as our present knowledge goes the proportions, relations, and structural peculiarities of the several elements entering into the composition of the braincase and rostrum of *Schizodelphis* are sufficiently pronounced to eliminate this genus from consideration.

The long-beaked porpoise, *Argyrocetus patagonicus*,[1] from the Lower Miocene Patagonian marine formation at Castillo, opposite Trelew, on the coast of Chubut Territory, Argentine Republic, resembles this California skull somewhat, for the vertex is contracted antero-posteriorly and the backward rostral thrust has carried the maxillary to the supraoccipital, but the two nasals are about equivalent in area to that of the exposed portions of the frontals on the vertex and the mesorostral gutter is relatively wide. This skull, unfortunately, is imperfectly preserved, both zygomatic processes being incomplete, the supraorbital processes are broken off, and the hinder ends of the premaxillaries are missing. The shape of the supraoccipital shield, the elevation of the vertex, and the proportions of the skull of *Argyrocetus patagonicus* approximate in the main the skull from California. These resemblances seem to warrant the tentative allocation of the California skull to the genus *Argyrocetus*, though this is done with considerable hesitation, since the material upon which both species are based is quite fragmentary.

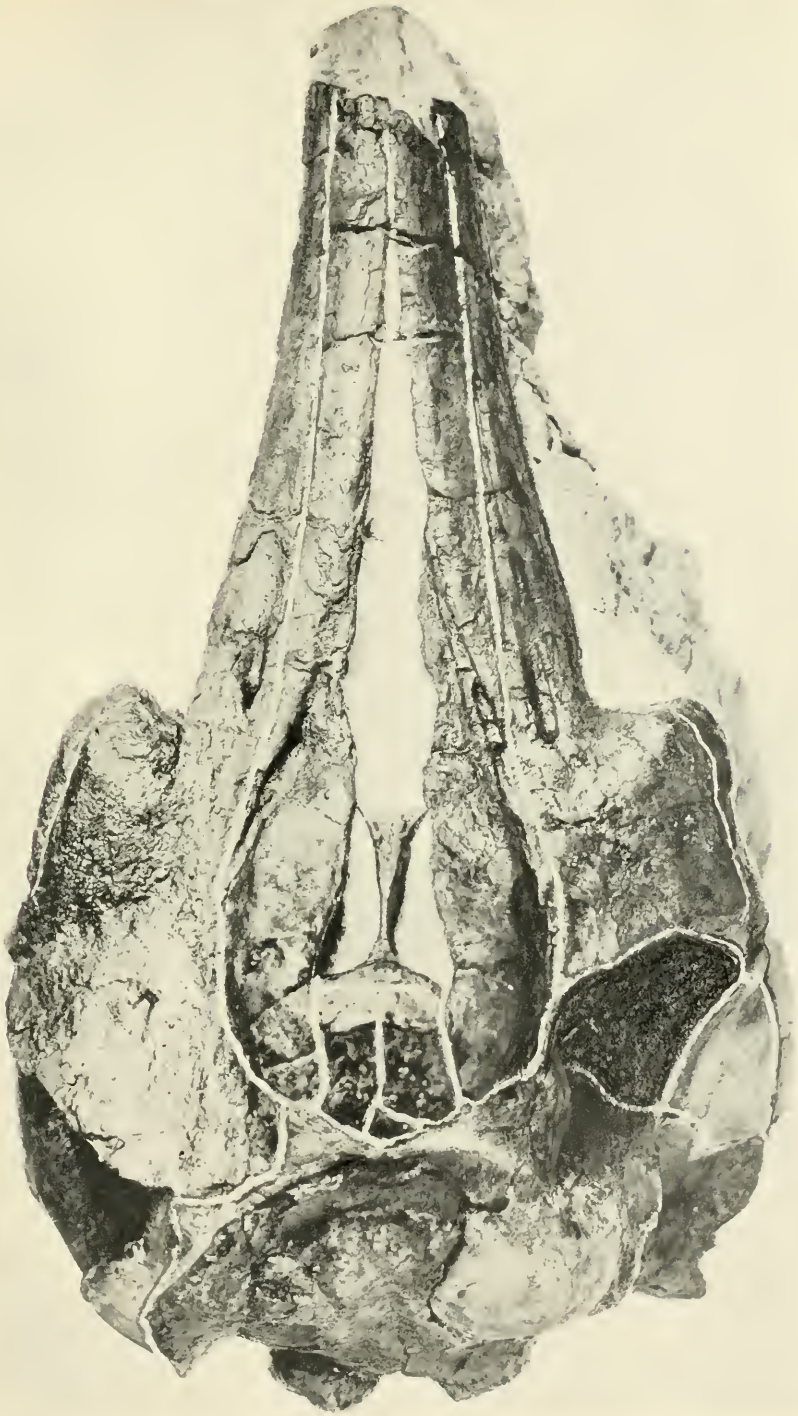
TEETH

The crown of a single tooth, presumably from the right maxillary, is embedded in the matrix 12 mm. in front of the broken extremity of the rostrum. The crown of this tooth is lanceolate in outline, it curves outward and then inward, and is flattened transversely. The anterior and posterior margins of the crown are rounded and not carinate, and the enamel is essentially smooth. The hinder end of the maxillary tooth row lies 60 mm. in front of the maxillary notch.

[1] Lydekker, R., Contributions to a knowledge of the fossil vertebrates of Argentina. Pt. II. Cetacean skulls from Patagonia. Anal. Mus. La Plata, vol. 2 for 1893, pp. 10-12, pl. 5, figs. 1, 1a, 2, 3, 1894.

Measurements of the skull (in millimeters)

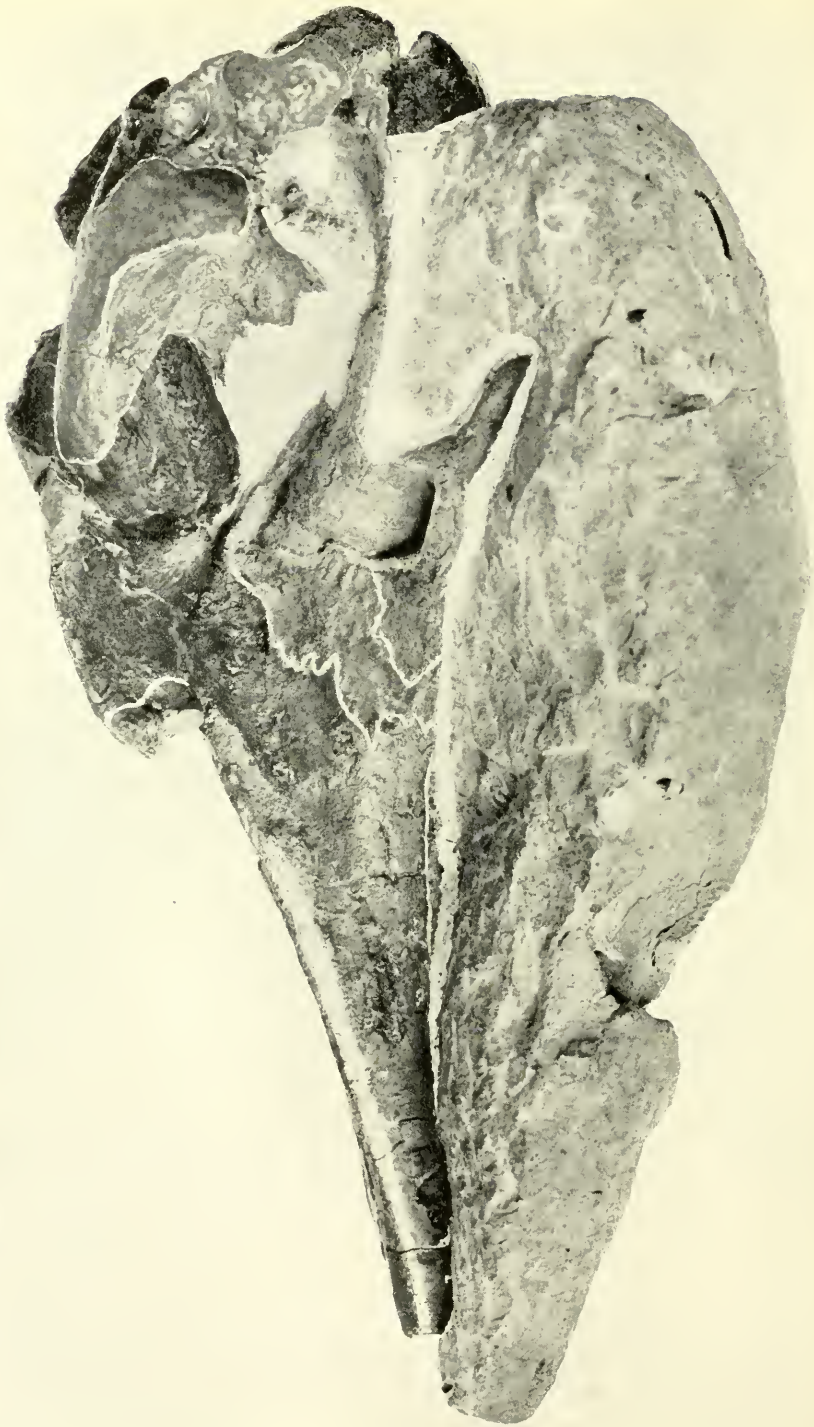
Total length, as preserved	370
Transverse diameter of skull across preorbital angles of supraorbital processes of frontals	176
Transverse diameter of skull across postero-external angles of supraorbital processes of frontals	204±
Distance across skull between outer surfaces of zygomatic processes	210±
Distance across skull between outer margins of exoccipital bones	178+
Distance between inner margin of left occipital condyle and outer margin of left exoccipital	72
Distance between outer angles of paroccipital processes	167
Distance between outer surfaces of descending processes of basioccipital	98
Distance between outer margins of occipital condyles	74
Greatest or oblique-vertical diameter of left occipital condyle	44
Maximum transverse diameter of left occipital condyle	33
Transverse diameter of foramen magnum	35
Vertical diameter of foramen magnum	24
Distance from upper margin of foramen magnum to apex of supraoccipital shield	105+
Vertical distance from basioccipital to apex of supraoccipital shield	116+
Distance from ventral face of hamular process of pterygoid to dorsal surface of nasal bone	156
Greatest vertical depth of skull at level of anterior borders of narial passages	87
Greatest vertical depth of rostrum at level of maxillary notches	57
Greatest vertical depth of rostrum at broken extremity (165 mm. in front of maxillary notches)	35
Preorbital angle of left supraorbital process to posterior face of left occipital condyle	215
Greatest distance between outside margins of premaxillaries at level of narial passages	85
Greatest breadth of left premaxillary at level of anterior border of narial passages	33.5
Greatest breadth of left premaxillary at level of maxillary notch	21
Breadth of rostrum at level of maxillary notches	108
Greatest antero-posterior diameter of left supraorbital process of frontal	83
Antero-posterior diameter of left nasal along suture	35
Transverse diameter of left nasal, anteriorly	16.5
Greatest length of left zygomatic process	90
Width of braincase 10 mm. below squamosal-parietal suture in temporal fossae	122



Argyrocetus joaquinensis new species. Type.
Dorsal view of skull. About one-half natural size.

Argyrocetus joaquinensis new species. Type.
Lateral view of skull. About one-half natural size.

Argyrocetus joaquinensis new species. Type.
Posterior view of skull. About one-half natural size.



Argyrocetus joaquinensis new species. Type.
Oblique view of ventral surface of skull. About one-half natural size.