

**Article IV.—DESCRIPTION OF A SKULL AND SOME VERTEBRÆ OF THE FOSSIL CETACEAN DIOCHOTICHUS VANBENEDENI FROM SANTA CRUZ, PATAGONIA.**

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PLATES I-V.

The collections of the American Museum of Natural History contain a very fine, nearly perfect skull and a few vertebræ and ribs of a fossil porpoise which the authorities of the Museum kindly placed in my hands for study and description. The specimen is from the marine beds at Pescadores, Santa Cruz Territory, Patagonia, on the Santa Cruz River, about 8 miles above its mouth and was collected in 1899. It bears the catalogue number 9485. I have identified it as *Diochotichus vanbenedeni*.

Before proceeding to the description of this important specimen, it seems to me desirable to give the synonymy of the species, which is as follows:

***Diochotichus vanbenedeni* (Moreno).**

*Notocetus Van Benedeni* MORENO, Rev. Mus. La Plata, Vol. III, 1892, p. 397, pl. ii. (Preoccupied by *Notiocetus* AMEGHINO, 1891.)

*Diochotichus van Benedeni* AMEGHINO. Enum. Synopt. Mamm. Foss. Éocène. Patagonie, Feb. 1894, p. 182.

*Argyrodelfis benedeni* LYDEKKER, Anal. Mus. La Plata, Pal. Argentina, Vol. II (1893), Apr. 1894,<sup>1</sup> Cet. Skulls, p. 12, pl. vi.

Various opinions are held as to whether a generic name differing from an earlier one by one letter only is invalid, but in so difficult a group as the Cetacea, it seems best to consider that such is the case. In this account, *Notocetus* Moreno, 1892, is regarded as preoccupied by *Notiocetus* Ameghino, 1891.

The specimen of *Diochotichus* under consideration consists of (1) a nearly perfect cranium, which, however, lacks the earbones, nasals, palatines and teeth; (2) the mandible, which lacks the condyles and about one-half the symphysis; (3) the atlas and six thoracic vertebræ, all nearly perfect; (4) three ribs, one nearly perfect; and (5) a few miscellaneous fragments. The skull and vertebræ have been partly restored, the anterior end of the symphysis of the mandible, the tips of the processes of the vertebræ, etc., having been added in plaster. The cranium is a little fractured and compressed in the region of the left maxillary notch, so that the breadth across the orbits is less than it was originally. The terminal alveolus is lacking on the right side, and three others in the middle of the series on the same side have been restored. The rami of the mandible are fractured longitudinally and considerably depressed, and 12 pairs of alveoli have been added to the symphysis anteriorly to restore it to its original length.

<sup>1</sup> Fide Trouessart.

The dimensions of the skull, together with those of the type, as given by Moreno, are as follows:

Dimensions of two skulls of *Diochotichus vanbenedeni*.

	No. 9485, Amer. Mus. Nat. Hist. Santa Cruz R., Patagonia.	Type, Bahía Nueva, Patagonia (Moreno).
	mm.	mm.
Total length of skull . . . . .	634	582 <sup>1</sup>
Length of rostrum . . . . .	433	368
Length of braincase . . . . .	118	116
Greatest breadth between parieto-occipital borders . . . . .	142	140
Height of occiput, between upper margin of foramen magnum and occipital crest . . . . .	97	91
Height of foramen magnum . . . . .	40	33
Breadth " " " . . . . .	40	33
Height of occipital condyles . . . . .	46	47
Length of temporal fossa . . . . .	115	102 <sup>2</sup>
Greatest height of temporal fossa . . . . .	74	71 <sup>2</sup>
Least distance between temporal fossæ posteriorly.	128	135 <sup>2</sup>
Breadth between centers of orbits . . . . .	252 <sup>3</sup>	230
Breadth of nasals anteriorly . . . . .	48 <sup>4</sup>	46 <sup>2</sup>
Breadth of rostrum at maxillary notches . . . . .	142	114 <sup>2</sup>
Breadth of premaxillæ at same point . . . . .	89	—
Greatest distance between inner edges of premaxillæ in front of nares . . . . .	28	22 <sup>?</sup>
Breadth of rostrum opposite last pair of teeth . . . . .	86	84
Breadth of maxillæ at middle of rostrum . . . . .	52	44 <sup>2</sup>
Breadth of premaxillæ at same point . . . . .	30	28 <sup>2</sup>
Greatest thickness of maxillary protuberance . . . . .	28	39
Length of palatine sinus . . . . .	92	95 <sup>2</sup>
Length of superior tooth-row . . . . .	363	315 <sup>2</sup>
Distance between posterior alveolus and maxillary notches . . . . .	59 <sup>?</sup>	60
Length of posterior upper alveolus . . . . .	9	—
Breadth " " " " . . . . .	6.5	—
Length of middle alveolus . . . . .	9.5	7 <sup>2</sup>
Breadth " " " " . . . . .	8	5.5 <sup>5</sup>
Length of anterior alveolus . . . . .	11.5	11
Breadth " " " " . . . . .	9	6
Length of mandible (actual condition) . . . . .	580	530
" " symphysis (actual condition) . . . . .	282	202
Distance between posterior end of symphysis and posterior border of alveolus of last lower teeth . . . . .	80	—
Breadth of mandible at base of symphysis . . . . .	56	49

<sup>1</sup> "Without including the part which is lacking."

<sup>2</sup> From the figure.

<sup>3</sup> Twice one half. The actual breadth is a little less, due to compression.

<sup>4</sup> Breadth of cavity in which nasals rested.

<sup>5</sup> Measurements of alveoli from the figure are probably unreliable, as Moreno gives the breadth of a middle tooth as 7 mm.

The agreement of the two specimens in dimensions, as shown by the foregoing measurements, is so close, taken as a whole, that it seems to me to leave no room for doubt that the Santa Cruz skull represents *Diochotichus vanbenedeni*. A few discrepancies, however, which appear to be real ones, deserves mention. The height of the maxillary protuberance in the type-skull, for example, is considerably greater than in the Santa Cruz skull. This difference may be due to age, as in the case of some of the ziphioid whales, to which *Diochotichus* is probably not so distantly related. The distance between the posterior margins of the temporal fossæ, however, is proportionally somewhat greater in the type-skull than in the Santa Cruz specimen, which seems to negative the idea that the former is the older. This is again contradicted by the fact that the nasals appear to be ankylosed to the frontals in the type-skull and some of the teeth remain in the alveoli, while in the Santa Cruz skull both the nasals and the teeth were free, and have been lost.

However these differences may be accounted for, it does not seem to me that they outweigh the close similarity of the two skulls in the form and disposition of the various bones, and in the majority of the dimensions. Some differences which appear to be of importance, but which in my opinion are not really so, will be mentioned in connection with the description of the Santa Cruz skull.

The data regarding the type-skull, which are mentioned in connection with the following description of the Santa Cruz specimen, are taken from Moreno's account and figures.

*Description of the Santa Cruz Skull, No. 9485. Plates I, II, III, Fig. 1, and IV, Fig. 1.*

*Superior aspect.*—Viewed from above, the most noticeable feature of the skull posteriorly is the great extension backward of the margins of the temporal fossæ, the line of which reaches nearly to the middle of the occipital condyles. This overhang is greater than in the type-skull. The occipital crest is arcuate, being convex backward in the median line, and convex forward on each side. Immediately below the crest, the occipital bone is very concave, especially on the sides; but lower down it is convex transversely. The condyles do not project so much as indicated in the figure of the type-skull.

The expanded proximal portion of the maxillæ is nearly horizontal and flat over the greater part of its surface, and quite thin. It is bent upward where it meets the nasals, and the region external to this raised margin is concave, especially on the left side. Over the orbit the maxillary plate is

rather abruptly bent upward, the anterior extremity being the highest. The plate is not greatly thickened in this region, the maxillary protuberance being formed by the frontal rather than by the maxilla. The latter bone does not entirely overlap the orbital plate of the frontal, but leaves the marginal portion of the latter exposed, especially anteriorly, where the uncovered margin of the frontal is 17 mm. broad. This is not shown in Moreno's figures, in which the lines of demarcation between the frontal and maxilla are not indicated.

The maxillary notch is not intact on either side, but appears to have had about the same form as shown in Moreno's figures, the frontal making an angle of about  $45^{\circ}$  with the maxilla. On the right side of the Santa Cruz skull the tip of the frontal is abraded, so that the angle is nearly one of  $90^{\circ}$ .

The portion of the superior surface of the maxillæ immediately in front of the notches is nearly horizontal and rather narrower and thicker and the free margins not so convex as shown in the figures of the type-skull. More anteriorly the superior surface of the maxillæ becomes broader and strongly inclined downward, and at the tip, is nearly vertical. This surface is widest near the middle of the beak and also a little concave.

The premaxillæ, especially on the right side, are thickened at the posterior ends. They do not reach the frontals proximally, being separated by an interval of about 13 mm. They rested against the nasals (lacking in this skull) for about 10 mm. The proximal third of each premaxilla is fusiform in outline, the surface nearly plane and inclined downward and inward. The outer margins of this portion of the premaxillæ are convex and farthest apart opposite the superior nares. The prenasal triangle is depressed and extends about 100 mm. beyond the maxillary notches. In the distal two-thirds the premaxillæ are convex, as in the typical dolphins, such as *Tursiops*, etc. Immediately in front of the triangle, the surface is nearly horizontal, but more anteriorly is inclined at an angle of about  $45^{\circ}$  so as to be nearly in the same plane with the upper surface of the maxillæ. The two premaxillæ are narrowest a little anterior to the middle of the beak, where the breadth between their outer margins is 26 mm.; but more anteriorly they become expanded again, and near the tip their combined breadth is 33 mm. In their anterior expansion, the premaxillæ resemble those of some species of *Squalodon*, such as *S. tiedemani*, *bariensis*, etc. This character is not shown in Moreno's figures of the type of *Diocotichus*.

A large premaxillary foramen is located about 28 mm. in advance of the line of the maxillary notches on the right side of the Santa Cruz skull, and there are two similar foramina on the left side, the more anterior of which is about in line with the foramen of the right side. Deep channels run out of these foramina posteriorly, and extend along the outer border of the

expanded portion of the premaxillæ, at least as far as the line of the middle of the superior nares.

The nasal bones (which are lacking) were about 27 mm. long, and the two together about 41 mm. broad. The posterior end of each rested against a triangular, median projection of the frontal, which separated it from the occipital crest by a distance of about 18 mm. in the median line.

The nasal region is peculiar, and unlike that of any other genus with which I am acquainted, though resembling *Squalodon* in some respects. The posterior upper end of the vomer, instead of being greatly expanded and nearly erect, as in typical delphinoids, consists of a rather thin septum, with a sharp anterior edge, and inclined backward more than 45°. The upper end of the septum is expanded to form a shelf on which the nasal bones rested. Between the nares, the septum, instead of being thin above, is expanded to receive the mesethmoid. The mesethmoid is pushed back to the middle line of the nares, instead of appearing in advance of them, as in most Odontoceti. Behind the nares the narial septum rests on a broad shelf, apparently part of the frontals. The upper surface of this shelf is somewhat grooved, and the grooves lead on each side into a large foramen (about 15 mm. in diameter), which appears to lead directly into the cranial cavity. The foramina of the two sides are not entirely similar, the one on the left side being a little smaller, more irregular, and a little higher up than that on the right side. There is, furthermore, a smaller one external to and somewhat in advance of it. These foramina appear to be for the exit of olfactory nerves, similar ones having been observed by Prof. Abel in *Eurhinodelphis*,<sup>1</sup> though they were much smaller. They also occur in *Squalodon*.

The ossified portion of the mesethmoid which is embraced by the vomer extends anteriorly, as already stated, but very little beyond the nares. In front of it, the median area is occupied by a very wide and deep trough, the sides of which are formed by the vomer and premaxillæ. This trough extends to the end of the beak, but becomes gradually narrower and shallower anteriorly.

The mesial region, just described, differs greatly from the same region in the type-skull, as depicted in Moreno's figures. In the latter, the premaxillæ are represented as meeting in front of the nares and continuing in contact to the end of the beak, so that the vomerine trough is entirely obscured. A careful examination of the figure, however, convinces me that this is probably an error of the lithographer. On each side of the median line, in the region of the prenarial triangle, there is a rather faint line, which probably marks the inner margin of the premaxilla. The area between these

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<sup>1</sup> Mém. Mus. Roy. Hist. nat. Belg., Vol. II, 1902, pl. xvii, fig. 2.

two lines is so shaded that it is perhaps allowable to interpret it as a depression or trough. If, however, the whole mesial area is really in the same plane, it would seem to show that in old individuals the cartilage which occupies the vomerine trough becomes ossified.

*Inferior aspect.*—Viewed from below, the occipital condyles project strongly. The basioccipital has a median ridge, with distinct concavities on each side. The lateral wings of the basisphenoid are of moderate size and thickness, and were not very strongly divergent originally. Their middle portion is occupied by a transverse ridge, convex anteriorly, which meets the median ridge of the basioccipital at the anterior end. The posterior end of the vomer, as preserved, is transverse, and is located 85 mm. anterior to the foramen magnum. Originally, however, it probably extended somewhat farther back. In front of the nares, it extends far downward as a thin ridge ending in a tubercle. The zygomatic processes, though somewhat out of their proper position, were apparently but little divergent. The glenoid fossa is inclined inward and is narrow and very long, its breadth being 36 mm. and its length 84 mm. The postglenoid process is small, short, pointed, and not so strongly recurved as shown in Moreno's figures. The inferior surface of the thick orbital plates of the frontal is not strongly concave distally, but a deep and large concavity occupies the proximal portion. The postorbital process is very large, thick, and prominent.

In front of the nares, on each side of median line, is a large triangular concavity, about 73 mm. long and 35 mm. high at the middle, which might be considered as marking the position of the palatine bones. As there are, however, several parallel furrows in front of it, on the surface of the maxillæ, I am inclined to think that the concavities are really in the vomer, and that the parallel lines represent the palatine suture. If such be the case, the palatine bones are lacking altogether. On the right side, behind and external to the right naris, there is an elongate plate of bone, which probably represents the outer plate of the pterygoid. It articulates posteriorly with an internal process of the zygomatic, as in *Stenodelphis*.

The palate is nearly flat posteriorly, but deeply grooved in the median line in the anterior half. At the distal extremity, however, it is again flat. The vomer is really visible from the nares nearly to the middle of the beak, but this is probably in part due to a slight spreading apart of the maxillæ posteriorly. The visible lozenge-shaped portion, such as is seen in *Eurhinodelphis*, etc., is about 113 mm. long and about 11 mm. broad at the middle. In front of it, the premaxillæ are seen on each side in a deep groove. The latter bones increase very much in breadth anteriorly, and appear to occupy the whole of the terminal portion of the beak for a distance of 41 mm., the two terminal pairs of alveoli, and the greater part of the third pair being in the premaxillæ rather than in the maxillæ.

The superior alveoli on the left side number 21, and a slight depression at the proximal end of the row may represent a twenty-second. On the right side 19 alveoli can be counted, two, or perhaps, three, being lacking at the proximal end of the row. The row is straight except at the proximal end, where it is turned upward. The alveoli are circular in section, but as all of them are inclined forward, the apertures are somewhat elliptical. This forward inclination is greatest at the anterior end of the series. All the upper alveoli are also somewhat inclined outward. The four posterior pairs (on the left side) are a little smaller than those which precede them. The alveoli are irregularly placed, the antero-posterior breadth of the septa varying from 4 mm. to 12 mm.

*Lateral aspect.*— Viewed from the side, the occipital condyles project considerably beyond the line of the exoccipitals. The posterior margins of the temporal fossæ also project very much beyond the surface of the supraoccipital. The margin of the fossa, which is nearly complete on the right side, presents a very peculiar conformation postero-inferiorly. The posterior margin, instead of forming a continuous curve across the suture between the parietal and squamosal, extends vertically downward, and ends abruptly. The portion of the margin which is on the zygomatic process, joins the vertical portion just mentioned about 15 mm. above its free end. The portion of the supraoccipital which extends outward and backward to meet the border of the fossa overhangs the portion of the same bone lower down, being separated by a deep pit opening downward. This unique conformation might very naturally be supposed to have resulted from distortion, but I can conceive of no readjustment of the bones which would make the margin of the temporal fossa continuous. If the zygomatic portion were pushed farther back, the anterior end of the zygomatic process would be too far behind the postorbital process of the frontal. These parts are, indeed, already somewhat too far apart, owing to the fact that the zygomatic process has been pressed upward. From the same cause, the temporal fossa appears smaller than it was originally. (See Moreno's figures.)

The superior border of the temporal fossa, formed by the postero-external plate of the frontal, is nearly straight, but somewhat inclined downward anteriorly. The orbital plate of the frontal, on the other hand, is somewhat inclined upward anteriorly. The angle between them is about the same as shown in Moreno's figures. The postorbital process, as already mentioned, is very long and thick. Its depth is 27 mm. and its breadth antero-posteriorly at the base, 32 mm. The orbit is not strongly arched, and is less than half as long as the temporal fossa.

The zygomatic process is thick, oblong, and obtuse at the extremity. Its outer surface is convex, except proximally, where there is a deep pit.

*Posterior aspect.*— Viewed from behind, the principal features of the skull are the low and broad supraoccipital, bounded above by the very slightly convex occipital crest, the deep pits above the condyles, and the peculiar infolding of the supraoccipital, already described. The foramen magnum is large. The exoccipitals extend outward and backward inferiorly and their surface is convex. Their lower free borders are much below the condyles.

#### *Mandible.*

As already mentioned, the symphysis is broken off near the middle, and the anterior portion has been restored in plaster. Near its proximal end, the two halves of the upper surface meet along the median line at a slight angle. The two rami meet at an acute angle, which is not noticeably rounded at the apex. There are no distinct traces of grooves on the inferior surface of the symphysis. The condyles are lacking, and the coronoid process is broken. The latter appears to have been long and rather low originally. The orifice of the dental canal is situated at a distance of 164 mm. behind the symphysis.

Ten pairs of alveoli are preserved, of which four pairs are behind the symphysis. They are circular and nearly vertical.

#### *Tympanic bone.* (Plate III, Figs. 2-4.)

A right tympanic bone accompanies the skull. It is 50 mm. long and appears small in proportion to the size of the skull, although it fits well into the space at the side of the basisphenoid. In form, as well as in size, it so closely resembles the tympanic bone of *Schizodelphis crassangulum* (Case) that had it been found separately, it might have been supposed to belong to that species. The differences are only those of detail, such as less roughness of the surface, etc.

Viewed from below, the bulla is triangular in outline, the posterior border being deeply emarginated, or bilobed, and the anterior abruptly acuminate. The furrow between the outer and inner lips is straight and extends to within 10 mm. of the anterior extremity. The inferior surface of both lips is convex, except for a depression in the inner lip near the anterior end. The middle portion of the inferior surface is rugose.

Viewed from without, the outer lip is oval, being deeper posteriorly than anteriorly, and somewhat projecting. The sigmoid process is thick, crescentic, and but little inclined backward. The surface of the lip is convex and quite smooth.

The inner lip is somewhat more than one-half as deep as the outer. The



anterior half of the upper free border slopes downward rapidly to the acuminate anterior extremity of the bulla. The internal surface is slightly concave near the middle, but convex elsewhere. It is rugose near the lower border. The thickened and convoluted posterior portion of the inner lip occupies rather more than one half its length.

Viewed from behind, the bulla presents two nearly equal, convex lobes, the furrow between them being only a little internal to the middle line. The outer lobe (or lip) extends downward very little beyond the inner lip.

The posterior process of the bulla, which articulates with the periotic, is nearly vertical, but curved inward toward the extremity. It is narrow and convex externally.

The dimensions of the bulla are as follows:

	mm.
Greatest length . . . . .	49
Greatest breadth . . . . .	28
Length of acuminate anterior extremity . . . . .	10
Greatest breadth of outer lip, exclusive of sigmoid process . . . . .	28
The same, including the sigmoid process . . . . .	34
Greatest breadth of inner lip . . . . .	17
Length of the whorl, or convoluted portion from the posterior border . . . .	28
Length of periotic process . . . . .	21
Breadth of the same . . . . .	8

### *Vertebræ. (Plate V.)*

The skull is accompanied by seven vertebræ; namely, the atlas and six thoracics. The thoracics I consider to be the 1st, 2d, 3d, 5th, 6th and 7th. All the epiphyses are detached from the centra, and only one is preserved. It is very thin.

The atlas, in its general appearance, resembles that of *Inia*, but is far more like that of certain forms from the Maryland Tertiary, which, I believe, represent *Eurhinodelphis*. The vertebra is very long, the neural arch very broad (*i. e.*, antero-posteriorly), and the foramen on either side of it large and completely surrounded by bone. The anterior articular facets are very deep, and are separated below by a wide interval. The postero-inferior median process for the support of the odontoid is short, but very broad.<sup>1</sup> On each side of the body are two superimposed transverse processes, the upper one being much the longer, and directed upward and backward. There is a distinct pit in front of the conjoined roots of the two processes, and a similar one behind them. The posterior articular facets are plane, except at the lower end, where they are narrowed and convex, or rather angular. The body between them in the median line is nearly plane, as is also the

<sup>1</sup> See Moreno's description of the atlas in *Rev. Mus. La Plata*, Vol. III, pp. 399-400, 1892.

upper surface of the process which supports the odontoid. A low, longitudinal ridge occupies the anterior half of the neural arch in the median line and is met by a transverse ridge which extends between the two superior foramina, and rises into a conical projection in the median line. The neural canal is very large, and about as high as broad. It is constricted below the middle on each side, by a projection situated between the anterior and posterior articular facets.

*1st Thoracic vertebra.* The centrum of this vertebra is about one half as long as broad, with the faces somewhat triangular, on account of the flat superior margin. The neural canal and the ends of the centrum have about the same dimensions and form. The neural arch is about as broad antero-posteriorly as the centrum, and much depressed. The spine has been restored, but appears to have been low originally. The anterior and posterior zygapophyses are oval, the former inclined inward and upward, the latter outward and downward. The metapophyses are about as long as the centrum is broad, and are oval and slightly expanded at the extremity. They are on a level with the superior border of the centrum and a little inclined downward and forward.

*2d Thoracic vertebra.* The centrum of this vertebra is triangular, like that of the 1st thoracic, but more depressed, and is more than half as long as broad. The neural arch is broad, the spine longer, inclined forward, and apparently somewhat pointed originally. The metapophyses are shorter and broader than those of the 1st thoracic. They are situated above the level of the upper border of the centrum, and are curved downward at the extremities and slightly expanded. The anterior zygapophyses are well defined, but smaller than the posterior ones, and are placed at an angle with them.

*3d Thoracic vertebra.*—This vertebra resembles the 2d thoracic in most of its characters, but the metapophyses are higher and broader, and are a little inclined upward; the terminal articular facet is elliptical, large, and deeply concave. The neural spine is erect and acuminate. The anterior zygapophyses do not extend forward beyond the line of the anterior border of the metapophyses. They take the form of shallow ill-defined depressions.

*5th Thoracic vertebra.* This vertebra is similar to the 3d thoracic, except that the metapophyses are shorter and less expanded at the end, the neural spine broader, and inclined backward, and the anterior zygapophyses indistinct. The outer sides of the neural arch are concave.

*6th Thoracic vertebra.* This vertebra resembles the preceding, but the metapophyses are still shorter, and are separated from the anterior zygapophyses by an emargination. The latter are again distinct and projecting and are inclined inward. The sides of the neural arch are deeply concave, and there is a low tubercle on the anterior border of the centrum above the

middle. The posterior zygapophyses are small, rather indistinct, high, and close together. The neural spine is very broad.

*7th Thoracic vertebra.* This vertebra is quite unlike the preceding. The anterior zygapophyses are large, close together, deeply concave, and nearly vertical. They are widely separated from the metapophyses, which are lower down than in the preceding vertebra, and are inclined downward. The process on the centrum is restored, but originally was apparently much longer. The two processes, taken together with the side of the neural arch, which is deeply concave, form a nearly complete ring, as in *Mesoplodon* and other genera of ziphioids. The succeeding vertebra probably had a distinct transverse process on a lower level.

In all the characters above enumerated, the vertebræ are thoroughly ziphioid, the genus *Diochotichus*, if judged by the vertebræ alone, being clearly related to this group of cetaceans.

*Measurements of vertebræ of Diochotichus vanbenedeni.*

No. 9485, Amer. Mus. Nat. Hist. Pescadores, Santa Cruz, Patagonia.	Atlas	Thoracics					
		1st	2d	3d	5th	6th	7th
Greatest breadth . . . . .	mm. 118	mm. 127 <sup>1</sup>	mm. 117	mm. 113	mm. 94 <sup>1</sup>	mm. 82	mm. 86 <sup>1</sup>
" height from middle of centrum below . . . . .	87	85 <sup>1</sup>	119? <sup>1</sup>	136	143	144 <sup>1</sup>	—
Length of centrum . . . . .	54	26	33	33	40	44	45
Breadth " " (ant.) . . . . .	—	45	48	50	45	46	42
Height " " ( " ) . . . . .	—	39	36	35	35	35	38
Breadth across ant. articular processes	82	78 <sup>3</sup>	77 <sup>3</sup>	60? <sup>3</sup>	—	40?	28
Height of ant. articular processes . . .	47	—	—	—	—	—	—
Breadth of ant. articular processes . .	31	13 <sup>3</sup>	10 <sup>3</sup>	—	—	—	21 <sup>6</sup>
Height of post. articular processes . .	39	—	—	—	—	—	—
Breadth of post. articular processes . .	24	13 <sup>4</sup>	15 <sup>4</sup>	15 <sup>4</sup>	12 <sup>4</sup>	8 <sup>4</sup>	7 <sup>4</sup>
Least breadth of neural arch (antero- posteriorly) external to posterior zygapophysis . . . . .	32	19	14	19	22	29	30
Height of neural spine . . . . .	14 <sup>2</sup>	14 <sup>1</sup>	51? <sup>1</sup>	71	86	92 <sup>1</sup>	—
Breadth of neural spine at base (ant.- post.) . . . . .	—	18	26	34	43	44	40?
Length of superior transverse process .	28 <sup>1</sup>	38 <sup>5</sup>	38 <sup>5</sup>	50 <sup>5</sup>	41 <sup>5</sup>	35 <sup>5</sup>	31 <sup>5</sup>
" " inferior transverse process .	5	—	—	—	—	5	22? <sup>1</sup>
" " infero-posterior process . . .	14	—	—	—	—	—	—
Height of neural canal . . . . .	40	31	35	35	36	31	31
Breadth of neural canal . . . . .	43	43	39	35	33	26	21

<sup>1</sup> Restored.<sup>2</sup> Transverse ridge.<sup>3</sup> Anterior zygapophyses.<sup>4</sup> Posterior zygapophyses.<sup>5</sup> Metapophysis, from top of centrum.<sup>6</sup> Nearly vertical; restored.

*Ribs. (Plate IV, Figs. 2-4.)*

One nearly complete rib, and the upper portion of two others, accompany the vertebrae. They appear to be the 2d, 6th and 7th, or 8th. In the second rib, the neck is long, and the head and tubercle well differentiated, the distance between the centers of the articular facets (as restored) being 51 mm. The greatest breadth of the rib is 24 mm. It is only slightly convex anteriorly, and the angle is rounded.

The sixth rib is more slender and rounded. The tubercle is more prominent, and the neck shorter. Its dimensions are as follows: Distance between centers of articular facets of head and tubercle (as restored) 41 mm.; greatest breadth of rib, 21 mm.

The third fragment, which represents the proximal end of a seventh or eighth rib, is 98 mm. long, and nearly straight. It terminates in a double articular facet, the two parts of which (presumably representing the approximated head and tubercle) are nearly separated by a deep groove. The superior surface of the angle is flattened, with the posterior margin projecting a little. The breadth across the double terminal facet is 32 mm., and the greatest breadth at the angle, 16 mm.

*Relationships of the Species.*

The relationships of *Diochotichus* seem to me to be very clearly indicated by the skull described above. It belongs to the family Squalodontidae, but presents marked differences from *Squalodon* and *Prosqualodon*, as well as striking resemblances. It agrees with *Squalodon* in the general conformation of the frontal plates of the maxillae, which are shorter anteriorly than the thick frontals beneath them. The vomerine trough is very wide and deep. The zygomatic processes of the temporal are thick and oblong in shape. The mesethmoid is large and long. The premaxillae are expanded anteriorly, and twisted at the proximal end. The ethmoid plate is pierced by large olfactory foramina. The symphysis of the mandible is long.

While it corresponds with *Squalodon* in all the foregoing characters, it differs in being much smaller and in having single-rooted teeth, the crowns of which are nearly simple.

The following squalodont and inioid genera have been described from the Patagonian Tertiary:

## SQUALODONTIDÆ.

*Prosqualodon* Lydekk.

1. Type-skull from Port Madryn, Bahia Neuva, Chubut Territory.<sup>1</sup>
2. Mandible, teeth, vertebræ, etc., from San Julian, Santa Cruz Territory. In Princeton University.<sup>2</sup>

*Diachotichus* Amegh.

1. Type-skull and vertebræ from Port Madryn, Bahia Neuva, Chubut Territory.<sup>3</sup>
2. Skull, vertebræ, etc., from Pescadores, mouth of Santa Cruz River, Santa Cruz Territory. In American Museum of Natural History, New York. Described above.

## INIIDÆ.

*Proinia* True.

1. Type-skull from Darwin Station, Santa Cruz Territory. In Princeton University.<sup>4</sup>
2. Cervical vertebra from San Julian, Santa Cruz Territory. In Princeton University.<sup>4</sup>

Dr. A. E. Ortmann has asserted that the Tertiary formations at Port Madryn, San Julian, Darwin Station, and the mouth of the Santa Cruz River belong to one and the same series, the Patagonian beds, and that "the Patagonian beds are Lower Miocene."<sup>5</sup> According to Dr. Ameghino, the genera *Prosqualodon*, *Diachotichus*, *Diaphorocetus* (= *Hypocetus*) and *Scaldicetus*, with others, are found in the formation which he designates as "the Julian, the inferior portion of the Patagonian formation," and regards as Eocene.<sup>6</sup>

Following either of these two authorities, and taking into consideration also the various European species of *Squalodon*, the inference is that in the very early part of the Tertiary, the squalodont type was thoroughly estab-

<sup>1</sup> See Ameghino, Bol. Inst. Geogr. Argent., Vol. XVII, p. 99, 1896.

<sup>2</sup> See True, Smithsonian. Misc. Coll. (Quart. Issue), Vol. LII, pl. iv, p. 447, 1909.

<sup>3</sup> See Ameghino, *loc. cit.*

<sup>4</sup> See True, *loc. cit.*, pp. 441 and 444.

<sup>5</sup> Princeton Patagonian Expedition, Vol. IV, Palæontology, 1, pt. 2, 1901-6, pp. 274, 275, 283, 285, 297, etc.

<sup>6</sup> Anal. Mus. Nac. Buenos Aires, ser. 3, Vol. VIII, pp. 473 and 505, 1906; ser. 3, Vol. I, p. 3, 1902.

lished, and was represented by numerous very distinct forms, comprising at least three genera. Since two of the squalodont genera were living together in the same Patagonian formation with both inioid and physeterine genera, it seems to me hardly probable, as Prof. Abel contends, that the Iniidæ were derived from the Middle Miocene squalodont genus *Neosqualodon*, the Physeteridæ from the Middle Miocene genus *Squalodon* (type-species, *S. grateloupii*), etc. We must go farther back in time to find the real prototypes of these families. To escape from this conclusion, it would appear to be necessary to assume that the Patagonian beds are of later date than that which has been assigned to them by the paleontologists who have given them the most detailed study. But of this there is, so far as I am aware, no satisfactory evidence at present.<sup>1</sup>

#### EXPLANATION OF PLATES.

##### *Diochotichus vanbenedeni.*

Amer. Mus. No. 9485. Pescadores, Santa Cruz, Patagonia.

##### PLATE I.

Skull, superior aspect. A little less than  $\frac{1}{3}$  nat. size.

##### PLATE II.

The same skull. Inferior aspect. A little less than  $\frac{1}{3}$  nat. size.

##### PLATE III.

Fig. 1. The same skull. Lateral aspect. A little less than  $\frac{1}{3}$  nat. size.

Fig. 2. Right tympanic bulla. Inferior aspect. Nat. size.

Fig. 3. The same bulla. Superior aspect. Nat. size.

Fig. 4. The same bulla. Posterior aspect. Nat. size.

##### PLATE IV.

Fig. 1. Skull. Posterior aspect, showing interrupted posterior border of temporal fossæ. About  $\frac{2}{3}$  nat. size.

Figs. 2-4. Ribs. A little less than  $\frac{2}{3}$  nat. size.

##### PLATE V.

Figs. 1, 2. Atlas. Anterior and posterior aspects.

Figs. 3, 4. First thoracic vertebra. Anterior and posterior aspects.

Figs. 5, 6. Third thoracic vertebra. Anterior and posterior aspects.

Figs. 7, 8. Seventh thoracic vertebra. Anterior and posterior aspects.

All figures about  $\frac{2}{3}$  nat. size.

<sup>1</sup> Notice should, however, be taken of the remark of Dr. E. von Stromer regarding *Prosqualodon*, which is as follows:

"*Prosqualodon* Lydekker, according to its organization and its geological age, should rather be called *Postsqualodon*." (Beitr. Pal. und Geol. Oesterr.-Ung. und Orients, Vol. XXI, p. 172, foot-note, 1908.)