

**Article XL.—A NEW PLESIOSAUR, *LEUROSONDYLUS*, FROM  
THE EDMONTON CRETACEOUS OF ALBERTA.**

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ONE of the most interesting specimens secured by the American Museum expedition to Alberta in 1912 is a plesiosaur found associated with dinosaur remains high up in the brackish water Edmonton beds. This specimen extends the history of the group considerably later in time than any heretofore recorded and so far as known marks the termination of this group of Mesozoic reptiles. Heretofore no marine vertebrates have been recorded above the Fox Hills.

The Edmonton formation is, as I have stated in other articles in this 'Bulletin,' intermediate in age between the Judith River (Belly River) and the Lance Cretaceous with faunal facies closer to the former. The strata are approximately 750 feet thick and conformably overlie the Pierre, the contact with which is well defined. They in turn are overlain (apparently conformably) by the Paskapoo Eocene with no stratigraphic break to show the Lance time hiatus. In the lower strata brackish water invertebrates predominate, while in the upper strata fresh water forms are increasingly abundant. Near the middle of the strata, about 400 feet above the Pierre, there is a bed of *Ostrea glabra* several feet thick and widely distributed. This is approximately the horizon of our plesiosaur although no invertebrates were actually associated with it. During four consecutive seasons' work in the Edmonton beds, no other specimen, not even a fragment of a marine vertebrate, has been observed excepting three vertebræ of entirely different character found near this specimen in the same level.

The specimen No. 5261 Am. Mus. Coll. comprises a considerable part of the skeleton, including 35 vertebral centra and 16 spines, of which there are 12 cervicals, 18 dorsals and 5 caudals; 30 ribs, 7 abdominal ribs, coracoids, scapulæ, humeri, ilia, ischia, pubes, femora, 3 epipodials, 7 meso- and metapodials and 15 phalanges.

This skeleton was disarticulated and massed together in a steep hillside, some parts having been weathered out and lost down the waterways. It was evidently a young, though nearly mature animal and the bones are uncrushed so that characters pointed out below may be used for classification.

Apparently this form is related to *Elasmosaurus* and may be assigned to the *Elasmosauridæ*, as that family is now understood. Its characters,

however, do not come within any described genus and the name **Leurospondylus** is given to it in reference to the flat vertebræ. This is a medium long-necked plesiosaur with neck relatively longer than in *Polycotylus*. Compared with the skeleton of *Cryptocleidus oxoniensis* mounted in the American Museum it would have been during life about seven feet in length exclusive of the head. The characters by which it is distinguished from fairly well known American genera is better understood by a comparison of similar parts.

*Elasmosaurus*: Cervical vertebræ sixty or seventy in number and longer than broad; dorsals wider than high and wider than long. Spines of vertebræ wide and not high. Scapulæ meeting in middle line. No interclavicular foramen. Coracoids with interclavicular bar broadly separated posteriorly. Ischia short and flat. Niobrara and Pierre Cretaceous.

*Cimoliasaurus*: Characters from the type of the genus only may be used until more adequate material is secured from the same horizon. A relatively short necked form. Cervical vertebræ with articular ends concave, about as long as high and wider than long, ribs single headed. Dorsals oval in outline, articular ends concave and longer than cervicals. Caudals short and oval in section. Greensands (Pierre)? of New Jersey.

*Polycotylus*: Cervical vertebræ twenty-six in number; dorsals twenty-eight or twenty-nine inclusive of pectorals and sacrals. All vertebræ short and deeply concave. Chevrons articulating in a deep pit. Coracoids meeting throughout in symphysis with long clavicular process. Ischia elongated. Paddles with four epipodial bones, all much broader than long. Niobrara Cretaceous.

*Trinacromerum*: Cervical vertebræ twenty-three in number including pectorals, all short, oval in section and deeply concave. Dorsals twenty-three, oval in section and deeply concave. Coracoids large, broad plates with slender clavicular process. Ischia elongate. Benton Cretaceous.

*Brachauchenius*: Cervical vertebræ thirteen in number, smoothly rounded below without vascular foramina, shallow concave at extremities and broader than long. Dorsals more than twenty-two, anterior longer than mid-dorsals. Benton Cretaceous.

#### **Leurospondylus ultimus** gen. et sp. nov.

*Generic and Specific Characters*: Vertebræ all short, much wider than long with articular faces flat. Ribs single-headed throughout. Coracoids without clavicular processes; posterior processes widely separated. Obturator foramina not separated? Ischia triradiate curved plates uniting at anterior-internal angle, posterior angles widely separated. Humerus and femur of equal length.

Twelve *cervical* vertebræ are preserved, a very small one (Figs. 1-2, A and Fig. 3, A) from far forward in the series, probably just back of the axis; seven in succession from near the middle of the series (Figs. 1-2, B), all of the same length, width and height, and four in succession from a little further back near the pectoral region (Figs. 1-2, C) wider than those in

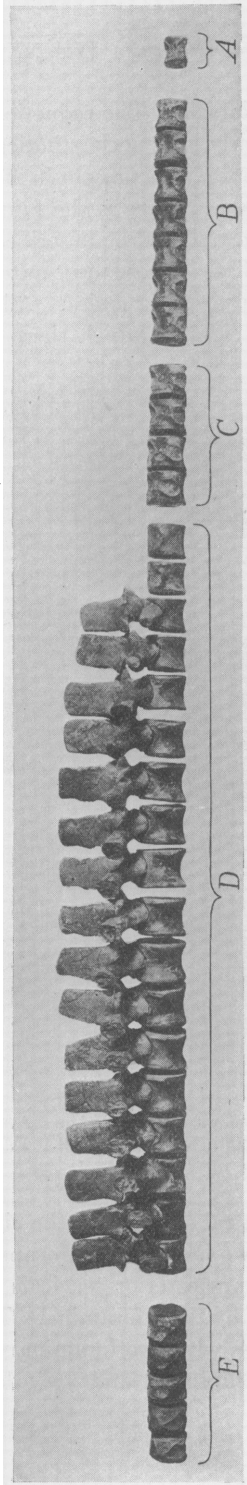


Fig. 1. Vertebral column, side view,  $\frac{1}{2}$  natural size. A, 3rd? cervical. B, 12th-18th? cervicals. C, 21st-24th? cervicals. D, 28th-46th? dorsals. E, 49th-53rd? caudals.

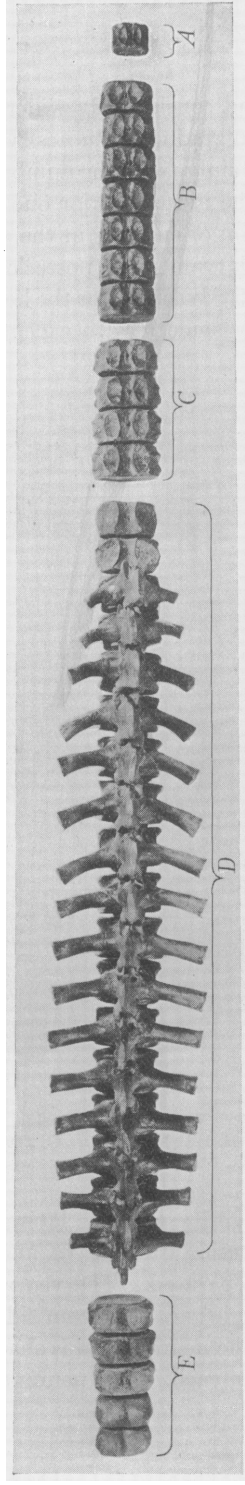


Fig. 2. Vertebral column, dorsal view,  $\frac{1}{2}$  natural size. A, 3rd? cervical. B, 12th-18th? cervicals. C, 21st-24th? cervicals. D, 28th-46th? dorsals. E, 49th-53rd? caudals.

front and considerably wider than the anterior dorsals. The reduction in size is so gradual in successive vertebræ that a fairly long neck is indicated and certainly twice the number preserved, if not more, were present in life.

In the most anterior one and in the middle series there is the faintest indication of cupping in the articular ends but they should be described as amphiplatyan. The posterior ones are perfectly flat. Those most anterior are relatively longer for the height than those of the posterior series. All are perfectly smooth with exception of the anterior eight in which there is a

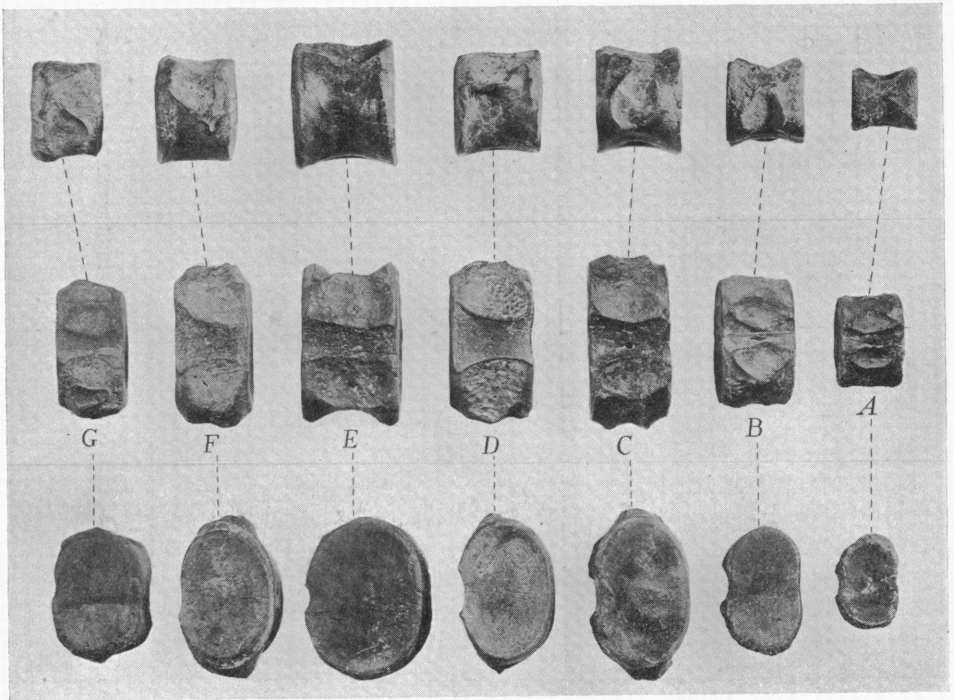


Fig. 3. Vertebral centra, side, dorsal, and anterior end views,  $\frac{2}{3}$  natural size. A, 3rd? cervical. B, 12th? cervical. C, 24th? cervical. D, 4th? dorsal. E, 10th? dorsal. F, 1st? caudal. G, 5th? caudal.

slight rugosity near the lateral borders. The ventral surfaces of the eight most anterior are concave, and in each there are two large venous foramina widely separated. The ventral surfaces of the four posterior cervicals are flat or slightly convex from side to side and marked by three foramina. The floor of the neural canal is shaped like an hour-glass with two foramina side by side in each. The neurapophysial facets are ellipsoidal and very deep

in the anterior vertebræ and less deep, broader and set farther apart in those most posterior in position. The pleurapophysial or costal facets are single throughout and are placed slightly posterior to the center of the vertebræ, looking downward and outward, the lower border of the pit being below the plane of the centrum. Anteriorly in the series they are deep excavations but posteriorly they are less deep and extend away from the body of the vertebræ.

The *dorsal series* (Figs. 1-2, D) is represented by sixteen centra to which spines have been fitted, and two centra without spines. The rise, increase in size, and inclination of transverse processes up to mid series, then uniform decrease to posterior end forms a perfect gradation, and I believe the complete dorsal series is represented excepting the transitional pectoral and pelvic vertebræ. None of the spines and centra were united but the association is fairly well determined by the neurapophysial facets and transverse processes. The centra are all short for their height and very wide. The articular surfaces are uniformly flat, ellipsoidal in outline and broader than high with the margins faintly rounded, the cartilaginous borders limited by a slender smooth line. Those from the mid series are higher than anterior or posterior ones. On the sides and ventral surfaces the centra are deeply constricted in the middle, and on the ventral surface of the anterior and posterior centra there are two vascular foramina separated by a rounded ridge. In the mid series there are three, four, and even five foramina of unequal size. The floor of the neural canal is widest at the posterior end and quite broad, separating the shallow neurapophysial facets which anteriorly and posteriorly in the series slope down on the sides of the centra.

The *neural arches* are characterized by medium high spines, thin transversely and very broad antero-posteriorly with weak zygapophyses. The transverse processes are comparatively long with oval, elongate rib facets. Those most anterior in the series are small and short while those most posterior are short and massive. The anterior ones are low down on the arch and look outward and decidedly backward; they rise rapidly and incline backward less in succeeding positions. Posterior to mid series they are quite straight and massive and are successively reduced in length.

The five *caudal vertebræ* (Figs. 1-2, E) may well have been in succession, probably the first five. All are short and broad and the reduction in size is rapid. In the first three the neurapophysial and diapophysial scars are shallow and united. The first chevron probably appeared between the third and fourth vertebræ, for there are faint shallow scars on the posterior but not on the anterior end of the third. Evidently the tail was very short.

*Ribs* are preserved from different parts of the column, all single-headed. Those from the cervical region are compressed from above downward and

wide at the ends. The dorsal ribs in mid series are long, massive and curved in the vertical plane, forming a low arch. The head is expanded and flat on the articular surface which is roughened for cartilaginous attachment. The shaft, which on the anterior face bears longitudinal ridges for attachment of muscles, is convex on the anterior face and flat posteriorly. Beyond the middle it is elliptical in cross-section with the distal end expanded and flat. The posterior dorsal ribs shorten rapidly, are flatter with less expanded heads and pointed distal extremities. One sacral rib is preserved, in which the shaft is short and flat and the distal end is expanded with cartilaginous area defined on the end. Several complete and partially complete *abdominal ribs* are preserved, representing different elements of the plastron. One, evidently a median, is extremely long and slender, oval in cross-section, arched like a bow and terminates in sharp points with posterior surface of ends excavated for attachment of the lateral elements. The lateral elements are not different from those of other plesiosaurs.

*Pectoral Girdle:* The *scapulae* are incomplete but apparently were of the usual triradiate form. It is not possible to determine from the fragments whether the ventral rami came in actual contact at the symphysis or were united by cartilage. *Clavicles* and *interclavicles* are missing.

The *coracoids* (Fig. 4) are large flat plates with broad posterior processes widely separated. The clavicular or epicoracoid process is totally lacking, a condition that may be due to age, although taken in conjunction with other characters, I am inclined at present to consider it of generic significance. On the external face the glenoid portion is massive, two-fifths of it forming the facet for union with the scapula. It meets the humeral articular surface in a very obtuse angle. The border of the coraco-scapular foramen is shallow emarginate. The symphyseal portion of the bone is more massive than the glenoid and the symphysis equals two-thirds the total length of the coracoid. Anteriorly a small portion is emarginated for attachment of epicoracoid, evidently a cartilaginous rod in this individual. Back of the symphysis the bone becomes very thin at first and then thick on the border of the posterior process, which is widely separated from that of its mate. The outer border of this process is shallow emarginate and quite thick. The ventral surface is nearly flat excepting near the middle of the symphyseal border where it is considerably elevated and with its mate forms a prominent protuberance in the middle of the symphysis.

In outline these coracoids closely resemble *Elasmosaurus snowii* from the Niobrara Cretaceous of western Kansas, figured and described by Williston (Am. Jour. Sci., Vol. XXI, pp. 228-229, 1906). Other parts of the skeleton, however, show very different characters.

The *humerus* (Fig. 5, A) is short and although proximal and distal articu-

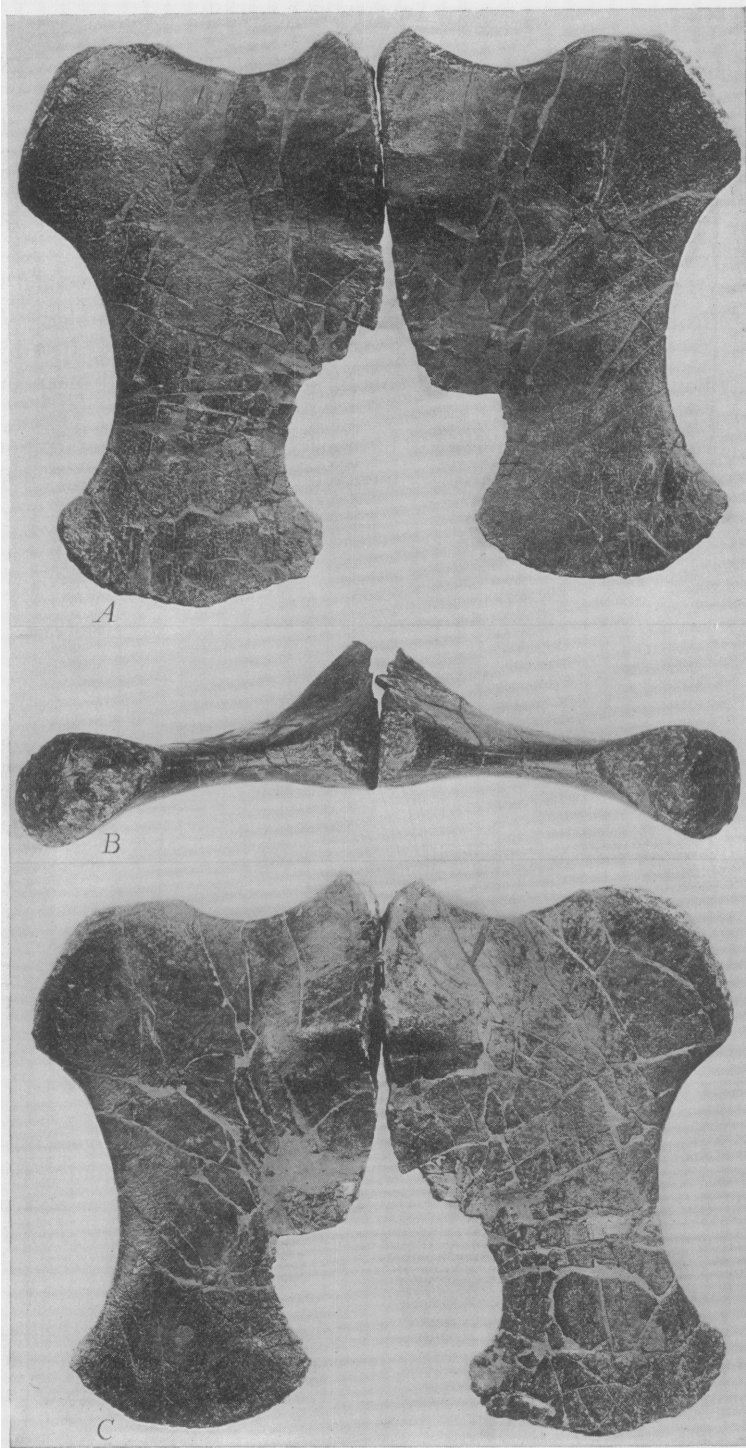


Fig. 4. Coracoids in position,  $\frac{2}{3}$  natural size. A, visceral surface. B, anterior end, visceral surface below. C, ventral surface.

lar borders are exfoliated the full length of the bone is preserved. The head is oval and roughened for muscular attachment but the tuberosity is missing. The shaft is flattened and bears two large nutritive foramina on the upper surface. Distally it is expanded though not so much as in *Cryptocleidus*, with ulnar and radial facets not defined.

The *Pelvic Girdle* (Fig. 6) especially the ischium, shows a marked departure from the *Elasmosaurus* type which it most nearly resembles. Apparently in this genus the *foramina obturatoria* were not separated by a cartilaginous rod, a character that should be plainly indicated in an individual of this age.

The *ilium* (Fig. 6) is a round rod of bone that tapers gradually from the lower to the upper end and is very concave on the outer surface. Its lower

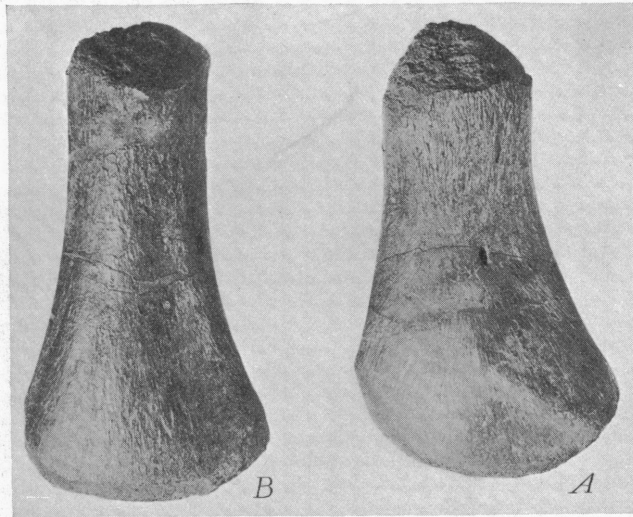
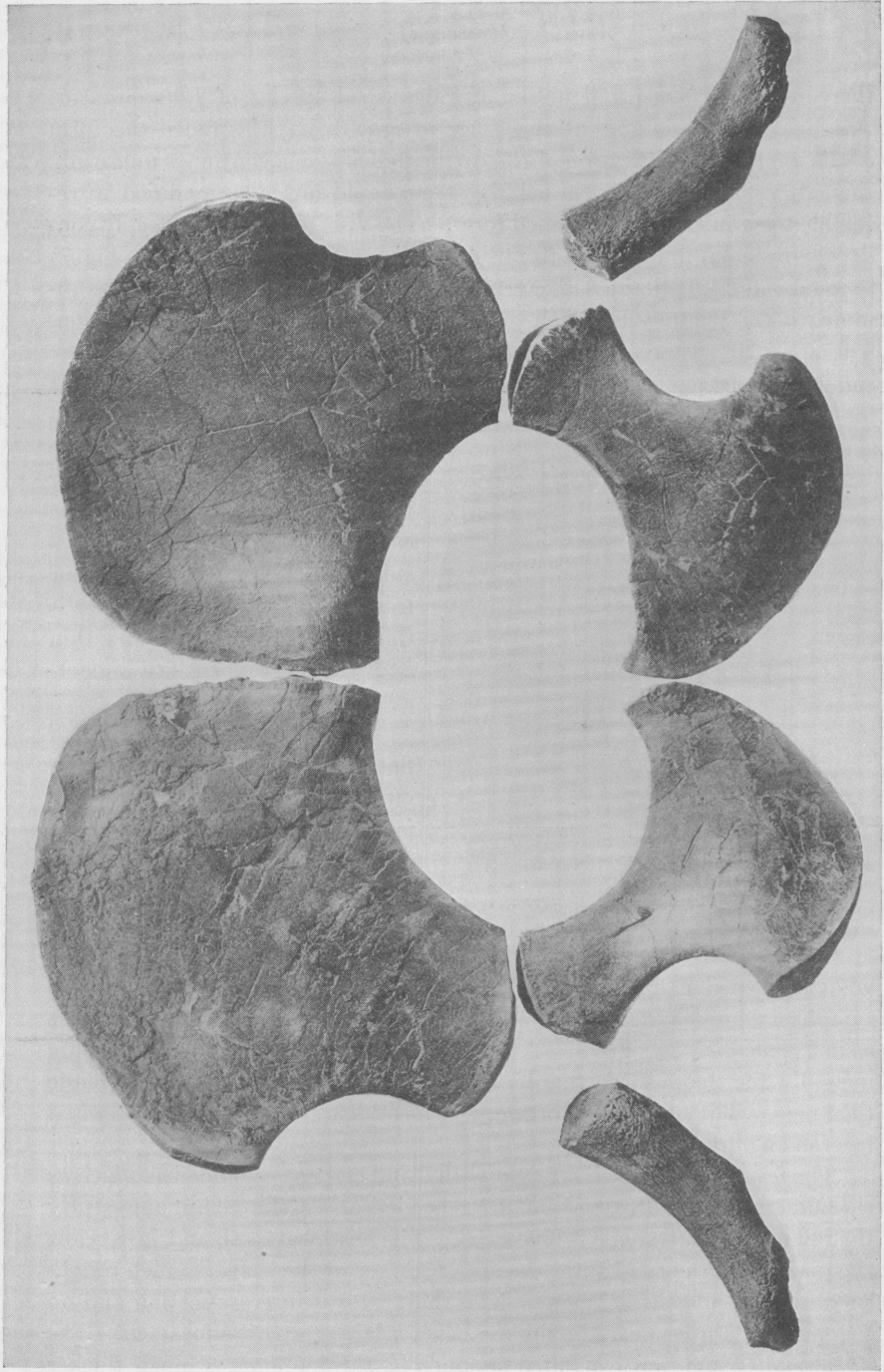


Fig. 5. Left humerus, A, and left femur, B. Dorsal views,  $\frac{2}{3}$  natural size.

end is expanded and oval with a small area marked off and rugose on the inner border for union with the ischium. The shaft is round, and near the middle on the posterior border there is a prominent tubercle for muscular attachment. The upper end is not expanded but considerably excavated on the inner margin and very rough for strong ligamentous attachment to the sacral ribs.

The *ischium* (Fig. 6) is of the usual hatchet-head form but markedly triangular. In position the ischia met at the anterior internal angles and the posterior angles were widely divergent. This feature is more pronounced





**Fig. 6.** Pelvic girdle, visceral surface,  $\frac{2}{3}$  natural size.

than in *Cryptocleidus* and unlike any described species of *Elasmosaurus*. The bones of Plesiosaurs at this stage of growth have assumed the form of the adult, and ossification of the cartilaginous tracts continues uniformly thereafter. These ischia, in a later stage, could never be modified to resemble the adult of any described form. The visceral surface is deeply concave both longitudinally and from side to side. The ventral surface (Fig. 7) is convex and a high ridge extends from the posterior border of the acetabulum to the symphysis which gives the neck a triangular cross-section. The articular surface of the head is divided into two unequal facets, the smaller for articulation with the pubis. No distinct facet is marked off for the ilium, union with which was evidently cartilaginous. Both posterior and anterior borders are deeply incised and on the latter just before the symphysis there is a prominent tubercle for muscular attachment. The anterior third of the symphyseal border is thick, the middle third very thin and the posterior third moderately thick.

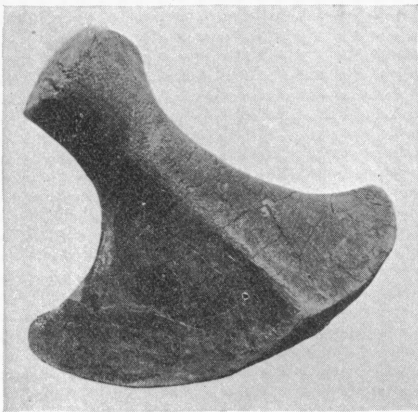


Fig. 7. Ischium, ventral surface,  $\frac{2}{3}$  natural size.

The *pubis* (Fig. 6) is a broad flat bone almost quadrilateral in outline. Its symphyseal border is much thickened, rugose and straight, meeting the opposite bone without interposition of cartilaginous wedges. The anterior border is convex and somewhat thickened showing cartilaginous attachment that extended from the symphyseal border to the outer angle, which is not produced into a process as in *Trinacromerum* or *Cryptocleidus*. The outer border is thin and deeply incised while the posterior border is moderately concave and of knife-blade thickness. The acetabular portion, which is thickest, unites with the ischial facet in an obtuse angle.

The *femur* (Fig. 5, B) is straight with distal end not expanded as much as the humerus. The proximal and distal borders are exfoliated but apparently the full length of the bone is preserved. The head was oval, and just below the position of the trochanter the upper surface of the shaft is much roughened for muscular attachment. The shaft is oval in cross-section and on the anterior border near the middle bears a large nutritive foramen. The distal end though not expanded as much as the humerus is much thicker and facets for articulation with tibia and fibula are not defined.

*Podials:* Twenty-five podial bones are preserved but on account of their immature condition cannot be placed in exact position with any degree of certainty. Three are identified as epipodials, probably left ulna, left radius, and left tibia. These are thicker and larger than the succeeding mesopodials, eight of which are present. All are flat polygonal elements with borders not well defined. There is no way of determining whether there were three or four elements in the distal row.

Sixteen phalanges are present, four of which are proximal in which the shaft is flattened and quadrilateral in cross-section. The distal phalanges are cylindrical becoming smaller and smaller toward the end of the paddle.

*Measurements.*

		mm.		mm.		mm.
Vertebra, 3rd? cervical centrum, length		21	width	32	height	20
" 12th? " " "		24	"	45	"	26
" 24th? " " "		27	"	58	"	32
" 4th? dorsal " " "		27	"	54	"	32
" 10th? " " "		33	"	54	"	40
" 1st? caudal " " "		25	"	53	"	33
" 5th? " " "		23	"	45	"	30
Coracoid		"	186	"	125	
Ilium		"	100			
Ischium,	antero-posterior	"	130	"	125	transverse
Pubis	" "	"	136	"	160	"
Femur		"	160	"	85	distal end
Humerus		"	155	"	90	" "

