

Article XIX.—THE SKELETON OF *SAUROLOPHUS*, A CRESTED
DUCK-BILLED DINOSAUR FROM THE EDMONTON
CRETACEOUS.

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PLATES XLII AND XLIII.

The discovery of this new genus of the family Trachodontidæ was first announced through the publication of a detailed description of the skull (Bull. Amer. Mus. Nat. Hist., Vol. XXXI, art. xiv, pp. 131-136, 1912). The skeleton has now been prepared and placed on exhibition in the American Museum so that it is possible to give generic and specific characters as far as available in this specimen.

Type of genus and species, No. 5220, a nearly complete skeleton.

Paratype, No. 5221, a disarticulated skull and jaws.

Plesiotype, No. 5225, a complete ischium.

Horizon and locality of type, Edmonton formation, 500 feet below top of beds. Tolman Ferry, Red Deer River, Alberta, Canada.

When found, the bones were for the most part articulated excepting cervical vertebræ, a few of the distal caudals, fore limbs and right pes which were scattered near by.

In preparing the specimen as a panel mount the bones have been retained in the original matrix and chiselled out in relief. None of the missing parts have been modelled but broken spines and chevrons have been painted in from the corresponding bones in the mounted skeleton of *Trachodon mirabilis* (No. 5730). The terminal end of the ischium which is characteristic of this new genus is copied from the cotype (No. 5225, Am. Mus. Coll.).

In this specimen the hind limb bones have been flattened by lateral pressure so that they appear to be more massive than in *Trachodon*. This, however, is a result of circumstances incident to fossilization. In the right femur, for instance, throughout the distal half of the shaft not only the side but the front surfaces as well are presented in this view.

The appended table of measurements shows that this animal was about the size of the skeleton of *Trachodon mirabilis* mounted in the American Museum and somewhat larger than the mounted skeleton of *Trachodon (Closaurus) annectens* Marsh, No. 2414 of the National Museum collection in Washington. In a critical study of a large amount of material representing many species of this family, I find that it is impossible to rely on absolute measurements for specific determination on account of distortion incident

to fossilization or to asymmetry of the two sides. Frequently humeri and femora from two sides of the same individual will vary as much as two inches in length. In the description of the skull of *Saurolophus* an error was made in stating that the spines of the dorsal vertebræ are high in this genus, the mis-statement was made by comparing other material now known to represent a distinct genus. It will not be necessary to repeat here the description of the skull (*loc. cit.*).

***Saurolophus osborni* Brown.**

Generic and specific Characters: Skull with long posterior bony crest formed by prolongation of frontal, prefrontal and nasal. Lachrymal very long. Superior process of premaxillary extending to posterior border of nares. Radius and humerus of equal length. Sacrum composed of eight vertebræ. Pelvis with ischium terminating in expanded foot-like end; pubis with short anterior expanded blade; ilium strongly arched, anterior process a decurved thin vertical plate. Femur with fourth trochanter below middle of shaft. Phalanges of digits II and IV short.

Some of the anterior as well as the posterior vertebræ are missing. The vertebral formula of this genus is different from that of *Trachodon*. There were at least 12 cervicals, 20 dorsals, 8 sacrals and 50 + caudals.

Cervical Vertebræ: The cervical vertebræ are of the typical trachodont form with anterior ends of centra convex and posterior ends deeply concave. Six are present, determined as second, third, fourth, fifth, sixth and seventh.

The axis spine is a high thin plate bifid from the middle to the anterior end and longer antero-posteriorly than the centrum. On succeeding preserved cervicals the spines are greatly reduced in size or wanting. Each vertebra carries a rib.

From the size and form of those present compared with known skeletons of *Trachodon* there were at least twelve vertebræ in the neck.

Dorsal Vertebræ: The centra of the dorsal vertebræ are not visible from the right side but in preparation it was possible to determine on the opposite side that they were of the same general form as those of *Trachodon mirabilis*, with articular faces slightly concavo-convex. As determined by the ribs, transverse processes and spines of succeeding vertebræ, borne out by comparison with the skeleton of *Trachodon*, the first and second dorsals are missing; in the third, fourth and fifth the spines are short, rising very little above the transverse processes. In succeeding anterior dorsals they are much inclined backward, about of the same height as in *Trachodon* and very broad antero-posteriorly. Back of the mid-dorsal section the spines gradually decrease in breadth antero-posteriorly and incline forward toward the top more in each succeeding vertebra. This disposition allows of a normal

compound arch of the column as though the animal usually assumed an upright position. The transversè processes increase in size from the third to the ninth and are inclined at the same angle as the spines; then decrease proportionately in size back to the twentieth, each supporting a rib.

Sacrum: The sacrum is composed of eight vertebræ with spines separated, higher and more massive than others of the vertebral series. The centra are not visible. In *Claosaurus*, a well established genus, the type of which is *Claosaurus agilis* Marsh from the Niobrara Cretaceous, the sacrum is composed of seven vertebræ. In *Trachodon*, the last survivor of the family in the Lance formation, the sacrum is composed of nine vertebræ. Thus a vertebra is added to the sacrum in each genus representing the family in succeeding geological formations.

Caudal Vertebrae: The caudal series is continuous down to the fiftieth vertebra. Those most anterior lie in the original matrix as found, apparently separated as in life by the space occupied by cartilage. The anterior centra are quite broad and short with nearly amphiplatyan articular surfaces; the sides of the vertebræ are quite deeply excavated. The reduction in length is very gradual, those of the middle part of the series being almost as long as the first. Nineteen of the anterior vertebræ have transverse processes, which gradually decrease in size from the second. The first is extremely massive and abutted against the posterior process of the ilium. All of the caudals present carry chevrons excepting the three most anterior, the first chevron being between the fourth and fifth centra. The chevrons were apparently of the same size and form as those of *Trachodon mirabilis*, from which the broken parts have been painted. From the size of the last vertebra present it is estimated that about four feet of the end of the tail is missing.

Ribs: The ribs appear to be more massive than those of *Trachodon* although it is possible that the massive appearance is accentuated by lateral pressure as instanced in the femur. The fifth, sixth, seventh and eighth were of about the same length. The eighth is most massive. They decrease in width and length proportionately back to the fifteenth, and from that point back to the sacrum are quite small.

Shoulder Girdle: The fore limbs are of about the same form as those of *Trachodon* but different in proportion of the parts. The scapula of the right side was in position when found and in the mounted skeleton has not been changed. It is straighter than in *Trachodon*, but some of the lateral curvature has been modified by pressure. It is interesting to note here that in every specimen of *Trachodon* in which the skeleton has been found articulated the scapulæ are low down in position, the blade lying nearly across the middle of the ribs. From cumulative evidence it seems probable

that the blade of the scapula was in life normally low in position. In this specimen the posterior end of the scapula overlies the ninth rib.

The humerus, ulna, radius and manus apparently are of the same form as in the genus *Trachodon*, but the radius and humerus are equal in length. In *Trachodon* the radius is much shorter than the humerus. The manus was scattered and partly missing. In the mounted specimen the bones of the right manus are assembled nearly as they would be in life. Metacarpals II and V only are preserved. They are about the same size as in *Trachodon mirabilis*. The two ungual phalanges II³ and III³ are preserved in the right manus.

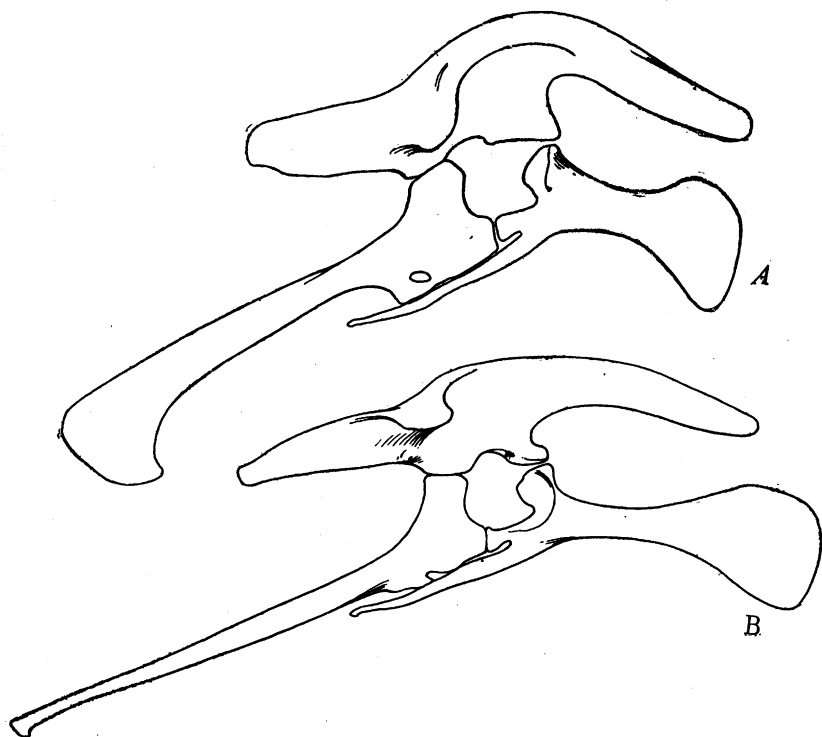


Fig. 1. Outline of pelvises, $\frac{1}{16}$ natural size. A, *Saurolophus osborni*; B, *Trachodon mirabilis*.

Pelvic Girdle: The pelvic girdle (Fig. 1A) shows characters quite as distinctive as the skull. The ilium is much deeper and more massive than in *Trachodon* (Fig. 1-B) with the anterior process decurved, thin and vertical. In the genus *Trachodon* this portion of the ilium is much straighter and triangular in form. The posterior process is broad and vertical.

The pubis differs slightly in form from that of *Trachodon*, especially in the anterior blade in which the neck portion is narrower than in *Trachodon mirabilis* with the expanded part of the blade proportionately less deep and shorter. The post-acetabular portion, or post pubis, is not visible.

The most striking feature of the pelvis is that of the ischium, which is more massive and distinctly different in form from that of the genus *Trachodon*. In this specimen the distal half is missing but in the plesiotype the entire bone is preserved. It unites with its mate along the distal half of the shaft and the distal end terminates in an enlarged foot similar to the ischia of Theropoda. The entire bone is more massive than in *Trachodon*, and the narrowest part of the shaft is about 30 centimeters below the acetabulum, from which point it gradually expands to the distal end. In another specimen, not yet prepared but identified as the same genus, the ischia form a greater angle with the caudal certebrae than in *Trachodon* and the body was deeper at this point. In this specimen the distal end or foot of the ischium is expanded so that it is seven inches in length antero-posteriorly and quite massive. It is not conceivable that this bone supported the animal while in a resting position as it did in the Theropoda, but it unquestionably formed attachment for large caudo-abdominal muscles. That the abdominal muscles were heavier is borne out by the massive ribs in this specimen. In *Trachodon* the ischium terminates in a blunt rounded point.

The femur is of the same length and general form as that of *Trachodon*, although in this specimen both femora are crushed flat so that they appear to have a greater circumference of the shaft. The great trochanter is massive and as high as the head, while the top of the lesser trochanter ends about three inches below it. The position of the fourth trochanter cannot be accurately defined although it is lower than in *Trachodon*. The anterior foramen in the distal end of the femur is completely bridged over. Tibia and fibula apparently do not differ from those of *Trachodon*. Astragalus and calcaneum are not coössified with the tibia and fibula and apparently are not distinguishable from those of *Trachodon*. The second row of tarsals is missing.

The metatarsals have the same form and proportional size as in *Trachodon*. The phalangeal formula is the same as in *Trachodon*, and the phalanges have the same form, but II¹⁻² and IV¹⁻²⁻³⁻⁴ are much reduced in length.

Trachodon and another genus of the family to be described in a following paper were coëxistent with *Saurolophus* but the latter appears to have been most abundant of all the Edmonton dinosaurs. From the great number of its remains found in the Red Deer exposures it was far more numerous in the Edmonton than *Trachodon* was in the later Lance formation.

Comparative Measurements.¹

Total length of body along the spinal column.

Trachodon mirabilis, 32 ft.

Trachodon (Clausaurus) annectens, 26 ft. 3 in. Mounted skeleton, U. S. National Museum Coll., No. 2414.

Saurolophus osborni, No. 5220, 32 ft. (computed).

	1. mm.	2. mm.	3. mm.
Skull.			
Total length premaxillary to paroccipital process.....	1200		1100
Length in front of teeth.....	500		420
“ of quadrate.....	350		410
Width of premaxillaries at widest part.....	380		380
“ “ skull across distal points of paroccipital process .	320		
Length of dentition.....	380		350+
Lower Jaw.			
Total length	1050		980
“ “ of dentary.....	830		820
“ “ predentary.....	210		250
“ “ dentition.....	390		350+
Greatest depth through middle of jaw including teeth.....	150		190
Pectoral Girdle and Fore Limbs.			
Scapula, length.....	900	810	970
“ width widest portion of blade.....	220	200	230
“ “ narrowest portion of blade.....	140	130	130
Coracoid, length.....	215		90+
Humerus, length	610	501	500
“ “ of deltoid ridge.....	310	280	310
“ transverse diameter of inner condyle.....	100	110	85
“ least circumference of shaft.....	255		
Ulna, length.....	680	500	630
“ least circumference of shaft.....	190	170	
Radius, length.....	620	440	600
“ least circumference of shaft.....	175	120	
Metacarpal II, length.....	250	200	245
“ III, “	330	220	
“ IV, “	330	215	
“ V, “	130	75	120
Sternal bone, length.....	460	400	
“ “ width at widest portion of blade.....	140		

Pelvic Girdle and Hind Limbs.

Ilium, length.....	1160	1030+	1150
“ “ of anterior process.....	480	410+	470
“ “ posterior “	390	360	350

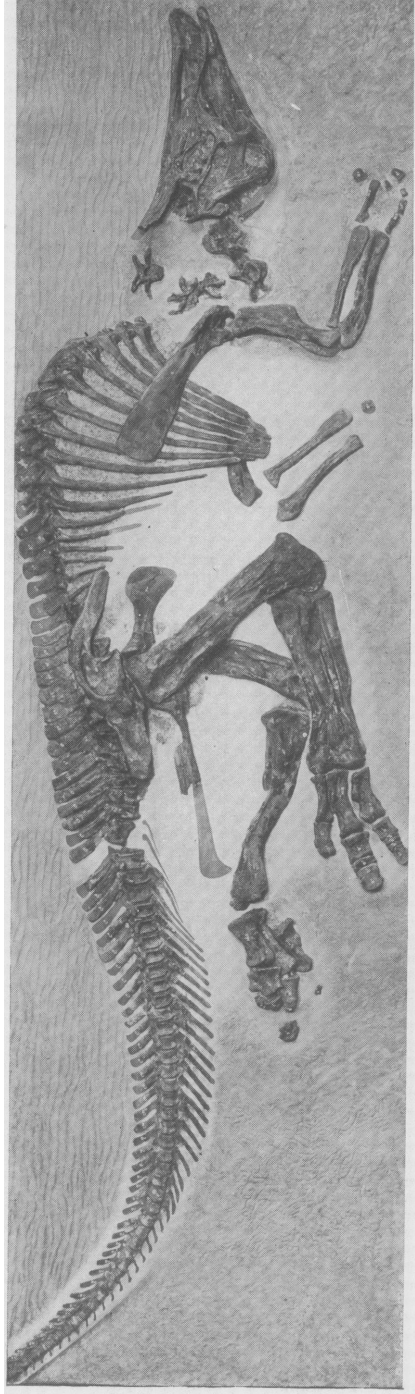
¹ 1, *Trachodon mirabilis*; 2, *Trachodon (Clausaurus) annectens*; 3, *Saurolophus osborni*.

	1. mm.	2. mm.	3. mm.
Pubis, length.....	1150	630	
“ width of preacetabular expansion, widest part.....	310	200	220
“ length of preacetabular process.....	590	360	450
Ischium, length.....	1200	1090	
Femur, length.....	1150	1040	1170
Tibia, length.....	1020	870	1000
“ width of proximal end antero-posteriorly.....	350?	310	
“ “ “ “ transversely.....	170	220	
“ “ “ distal “ “.....	310	230	320
“ “ “ “ antero-posteriorly.....	180	160	200
Fibula, length.....	970	820	920
“ width of proximal end, anteroposteriorly.....	190	160	130
“ “ “ distal “ “.....	125	65	
Calcaneum, length proximo-distally.....	120		
“ width, transverse.....	165		
Metatarsal II length.....	280	280	280
“ II transverse diameter, proximal end.....	110		90
Metatarsal II, transverse diameter, distal end.....	110		100
“ III, length.....	420	340	370
“ III, transverse diameter, proximal end.....	180	100	140
“ III “ “ distal “.....	170	130	130
“ IV length.....	330	275	300
“ IV transverse diameter proximal end.....	85		100
“ IV “ “ distal end.....	110		120
Digit II, length proximal phalanx median line.....	130	130	120
“ II, “ median “ “ “.....	70	55	60
“ II, “ ungual “ “ “.....	80	110	
“ III, “ proximal “ “ “.....	140	120	130
“ III, “ second “ “ “.....	60	50	40
“ III, “ third “ “ “.....	50	40	40
“ III, “ ungual “ “ “.....	100	100	100
“ IV, “ proximal “ “ “.....	110	90	95
“ IV, “ second “ “ “.....	40	30	25
“ IV, “ third “ “ “.....	30	20	22
“ IV, “ fourth “ “ “.....	45	30	25
“ IV, “ ungual “ “ “.....	100	90	105



TYPE OF *Saurolophus osborni* BROWN.

Skeleton lying on right side, skull surrounded by ripple-marked sandstone, vertebral column at left, tail extending under the man.



TYPE OF *Saurulophus osborni* BROWN.

Panel mount. The bones are in the original matrix and chiseled out in relief. Incomplete bones restored by painting on the base.

