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PRELIMINARY NOTICES OF SKELETONS AND SKULLS OF DEINODONTIDÆ FROM THE CRETACEOUS OF ALBERTA

BY W. D. MATTHEW AND BARNUM BROWN

1.—**Gorgosaurus libratus** LAMBE. Skeleton in position as found. Belly River formation, Alberta.

This skeleton, No. 5428, was obtained by the American Museum Expedition of 1913, in charge of Barnum Brown. The locality is Red Deer River, Alberta, Canada.

It was prepared by Peter Kaisen and placed on exhibition in 1918. It is nearly complete, except for the tail, of which only three distal caudals and the spine of the first caudal are preserved.

The position of the skeleton, with the head thrown backward so that the top of the skull rests against the backbone, and the legs doubled up under the body, shows well in the illustration (Fig. 1). This position is commonly seen in articulated skeletons resting upon the side. It is the usual thing with the Belly River dinosaurs, although most strikingly displayed among those with a flexible or slender neck. In the Ceratopsia and ankylosaurs the neck is too short and stiff to permit of a complete reversal of the skull, but in *Monoclonius*, No. 5351, the skull in its original position was drawn upward and backward as far as the limits of its movement permitted. This has been partially corrected in the completed mount. In the trachodont skeletons, *Procheneosaurus* No. 5340, *Corythosaurus* No. 5240, and others, the same position is clearly seen. In the long, slender-necked *Struthiomimus* the head is completely reversed, as it is in this skeleton.

It is usual in preparing a panel mount of a skeleton to correct this distortion by resetting the skull and sometimes the anterior cervicals. In consequence, it is not so common in exhibition specimens as in those that are brought in from the field. But, so far as our experience goes, it is the usual thing in an articulated fossil skeleton. It is quite as common among fossil mammals as among dinosaurs. Skeletons of *Stenomylus* (the "Gazelle Camel"), *Promerycochœrus*, etc., show the same thing.

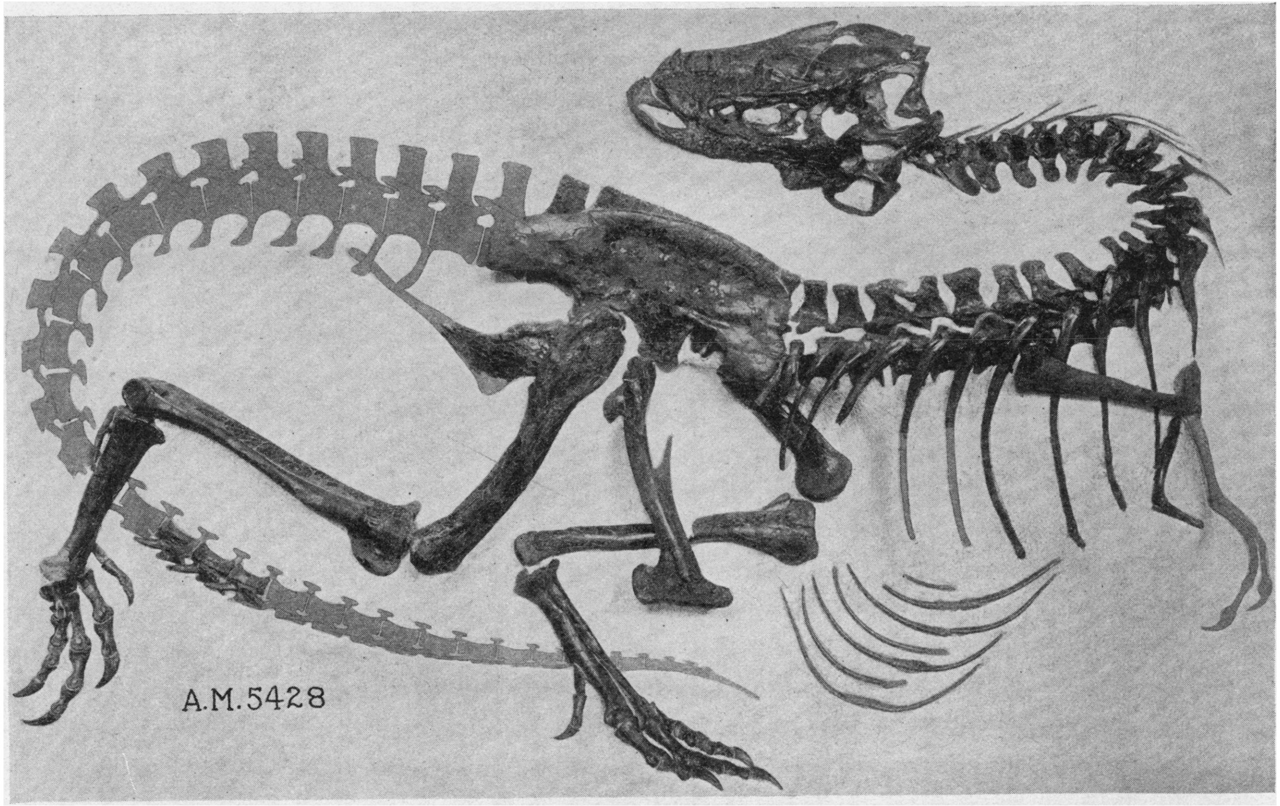

Fig. 1. *Gorgosaurus libratus* Lambe.

Skeleton mounted as found in the rock. The parts restored are painted on the panel. Amer. Mus. No. 5428. Length of panel 12 feet.

This position has been cited by Moodie as evidence of the animal's death in that peculiar form of spasm "opisthotony," characteristic of lockjaw, and hence as indicating the prevalence of that disease among the Cretaceous dinosaurs. The explanation appears to us untenable. For, not only is the position characteristic of most articulated fossil skeletons found lying on their side, but it is equally common among the modern skeletons of sheep or cattle that are found lying out on the Western plains. These animals certainly did not die of lockjaw, but of exposure, cold, hunger, or various forms of disease. Nor is it reasonable to suppose that lockjaw was the usual cause of death among extinct mammals and dinosaurs.

The explanation probably lies in the shrinkage of ligaments along the dorsal side of the neck and backbone after death. In the course of decay of the fleshy parts the connection of the under side of the neck with the shoulder girdle is rotted away, while the more resistant ligaments on the dorsal side of the spine, less deeply buried in flesh, tend more to desiccation and shrinkage. While these relations will be modified in each individual instance by the circumstances of burial, they hold sufficiently true in general to account for the observed facts.

In comparison with the fine skeleton of *Gorgosaurus libratus* in the Ottawa Museum, described in detail by Mr. L. M. Lambe, this specimen has the skull much more complete, but the tail and the fore-limbs much less so. The missing parts of the specimen have been painted in outline on the panel block, and are clearly shown in the photograph.

Tail restored except for caudals 17–19. Distal end of ischium restored. Proximal parts of right metapodials restored, also parts of two ribs. Right humerus, radius, and forefoot restored.

2.—**Gorgosaurus libratus** LAMBE. Skeleton in running pose. Belly River formation, Alberta.

This skeleton, No. 5458, was obtained by the American Museum Expedition of 1914, in charge of Barnum Brown. The locality is Red Deer River, Alberta, Canada.

It was prepared and mounted by Peter Kaisen and placed on exhibition in May 1921. The mount is a large panel, 23x14 ft., made in eight sections which are easily separable for convenience in removal, as the panel is too large and unwieldy to be handled easily as a single block. Each section consists of a wooden framework in which the individual bones or blocks of matrix containing several bones left in the original rock have been articulated in position and clamped in

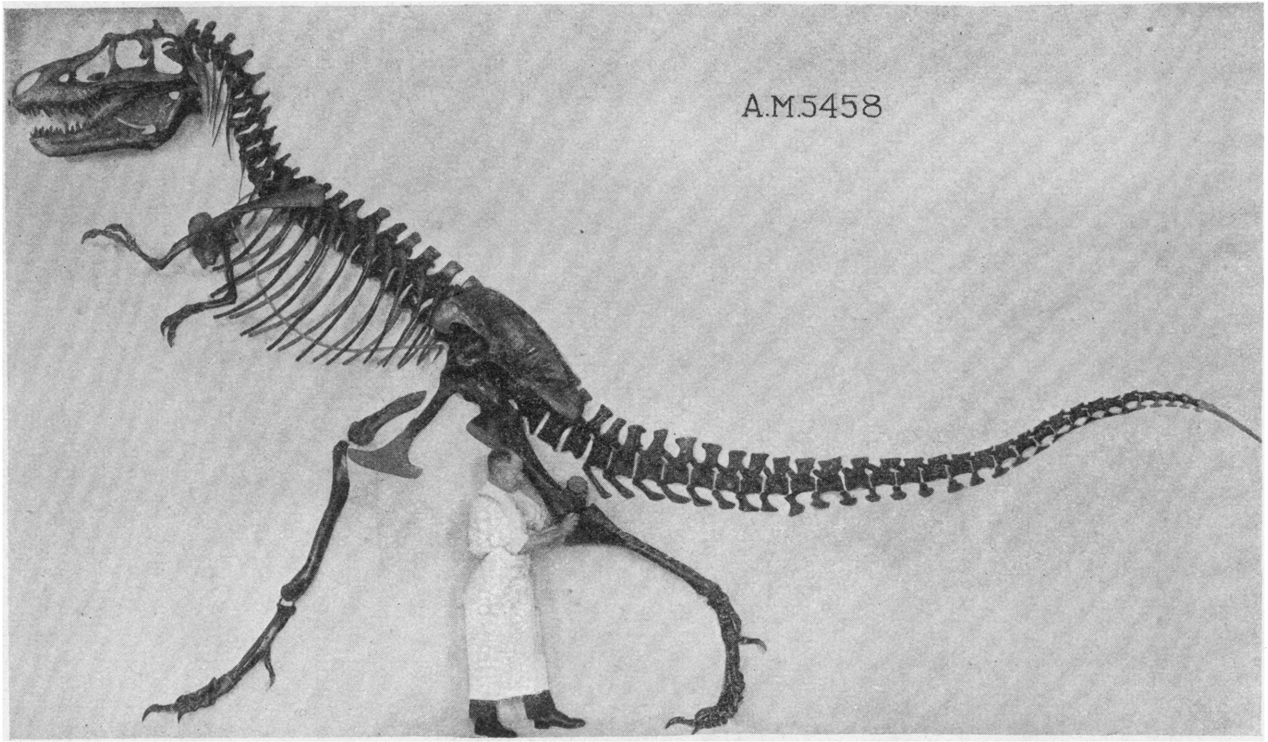

Fig. 2. *Gorgosaurus libratus* Lambe.

Skeleton mounted in running pose. The missing parts are painted on the panel, except for parts of the right fore and hind limbs, restored in plaster. Amer. Mus. No. 5458. Length of panel 24 feet.

place with steel straps and braces. The front of the framework between the bones of the skeleton is covered by a galvanized wire mesh faced with tinted plaster of paris, the surface of the plaster being chipped to give the effect of a chipped stone block. The thickness of the netting and plaster facing is only about an inch, and the sections are by no means heavy to handle, except for the weight of the petrified bones themselves. When set up, the sections are bolted in position, and the back of the framework is covered by panels of compo-board. The skull and jaws are supported on steel brackets and are removable without disturbing the remainder; the left forelimb and shoulder girdle are also separately removable.

The design of this mount embodies certain practical advantages in that, in spite of its gigantic size, it can readily be taken down, removed, and re-erected elsewhere without damage or loss of unity, save for the slight chipping at the edges of the sections, which can easily be touched out with a little plaster after the specimen has been set up where desired. The skull and forelimb are supported by steel brackets free of the background and can be removed for study when desired.

The pose adopted (Fig. 2) is that of a running dinosaur, and was studied from photographs of running lizards and from the dinosaur footprints of the Connecticut Triassic sandstones. In addition to the classic photographs by Saville-Kent, we used photographs of the Western Tiger Lizard recently taken by Mr. G. K. Noble.

Many western lizards run on their hind legs when in haste, as may be seen from a study of their tracks on the sand. The photographs show that the animal has the fore part of the body well raised from the ground and the tail projects backward as a balance to the weight of the body. The tiger lizard, however, does not swing the legs directly under the body, as a bird does when running, but flings the leg outward to one side in the middle of the step. This is conditioned by the shortness of the leg and the articulation of the femur outward from the side of the body instead of beneath it as in birds or mammals. This relation is clearly seen in the characters of the lizard femur. The tibial condyles are wholly beneath (posterior) instead of extending partly distal. The head of the femur is almost wholly proximal, instead of partly lateral. In these features the dinosaur femur differs from that of ordinary reptiles and approaches the type characteristic of birds and mammals. This is correlated with the greater relative size of limb to body, which is characteristic of mammals and birds, as compared with other reptiles. It is concluded that the bipedal dinosaurs

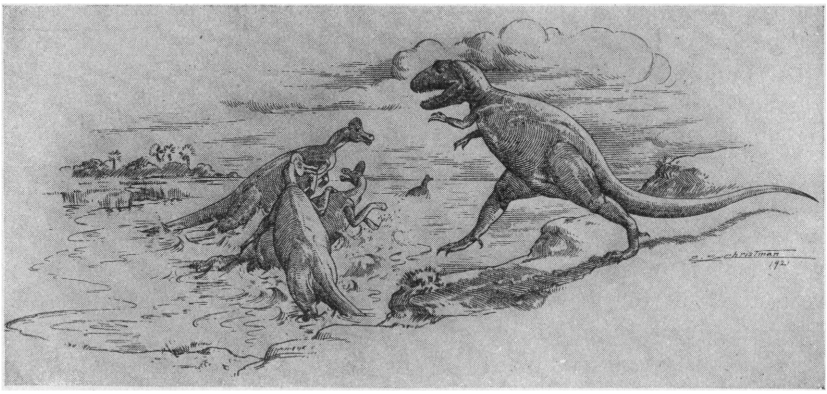

Fig. 3. Restoration of *Gorgosaurus* by E. C. Christman, illustrating the pose of skeleton, Fig. 2. The animal is represented as chasing a small herd of duckbill dinosaurs (*Corythosaurus*) which take refuge in the water.

walked with a comparatively straight step, swinging the hind limb well under the body and with the foot near to the median line of movement of the animal. In the quadrupedal dinosaurs the position of the forelimb, secondarily readapted to the support of the body, appears to have been with the elbow everted to a varying degree. The carnivorous dinosaurs, however, are fully bipedal even in the Jurassic, and in *Gorgosaurus* the forelimb is so small as to have no practical influence even in balancing the weight. The animal appears to have walked and run much like a gigantic bird, save that the long tail served to balance the weight of the large and heavy head and shoulders. The balance is, of course, incomplete, the pitching forward of the body being as essential to maintaining the speed of the step as it is in a man running.

The length of the stride shown in the mount is not nearly so extreme as in a swiftly running lizard; but an animal of such size and weight could not take so long a stride as a smaller and lighter creature. Comparison of the stride of a running elephant with that of a dog or cat running clearly brings out this difference, which would be inferred from the laws of mechanics in their relation to the size of any animal.

The 4th to 19th caudals are restored, and all beyond the 30th. Distal half of left femur, left tibia and most of left fibula restored. Distal ends of ischium and pubis restored. Right ribs restored and some parts of left ribs. Parts of forelimbs.

3.—**Gorgosaurus sternbergi,** new species. Standing skeleton. Belly River formation, Red Deer River, Alberta.

This is a very finely preserved skeleton, No. 5664, obtained by Mr. C. H. Sternberg in 1917 and purchased by the Museum. It is of smaller size and more slender proportions than *G. libratus*. The jaws

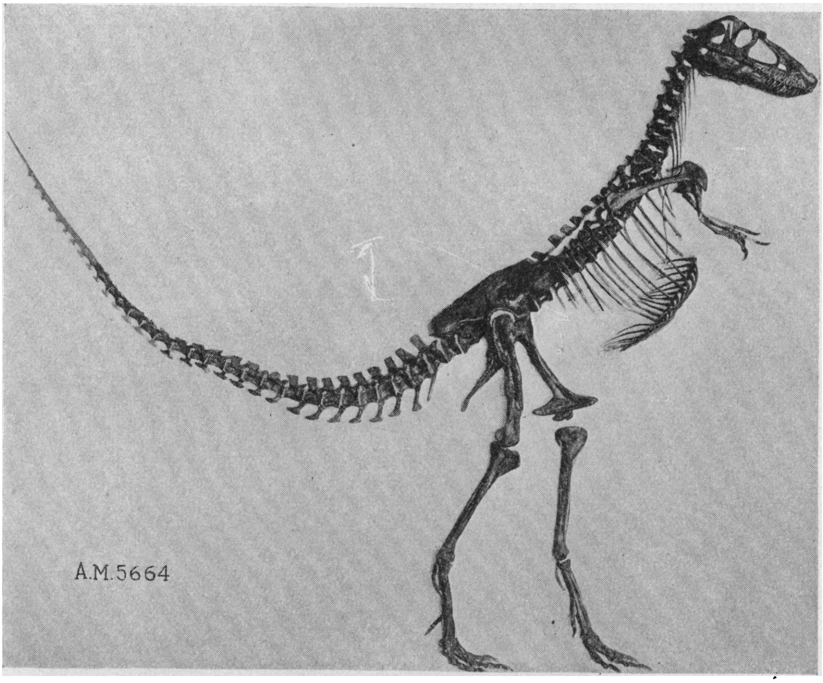

Fig. 4. *Gorgosaurus sternbergi,* new species.
Skeleton mounted in standing pose. Amer. Mus. No. 5664. Length of panel 16 feet.

are much less massive and the muzzle is more slender, the maxilla more elongate and shallow, the orbital fenestra more circular. The tibia is considerably longer than the femur. These and various other differences of proportion might be regarded as age characters in a single species and in support of this is the fact that in this skeleton the pelvic bones are still separate or partly so. There is nothing else to indicate immaturity.

This is the most complete of the deinodont skeletons in our collections. The tip of the tail, beyond the 24th caudal, is restored, also the left radius, metacarpal i and phalanx ii_2; the left ribs are restored. The abdominal rib basket is nearly complete.

The pose of this skeleton (Fig. 3) is that of a standing animal in as upright a position as the *Gorgosaurus* would normally assume.

4.—**Gorgosaurus libratus** LAMBE. Skeleton No. 5434. Belly River formation, Red Deer River, Alberta. Expedition of 1914.

This individual is the largest of the series. It lacks the tail and hind feet; the forelimbs and forefeet are preserved, except for a few foot bones missing from one side or the other. Only the skull and jaws are at present on exhibition.

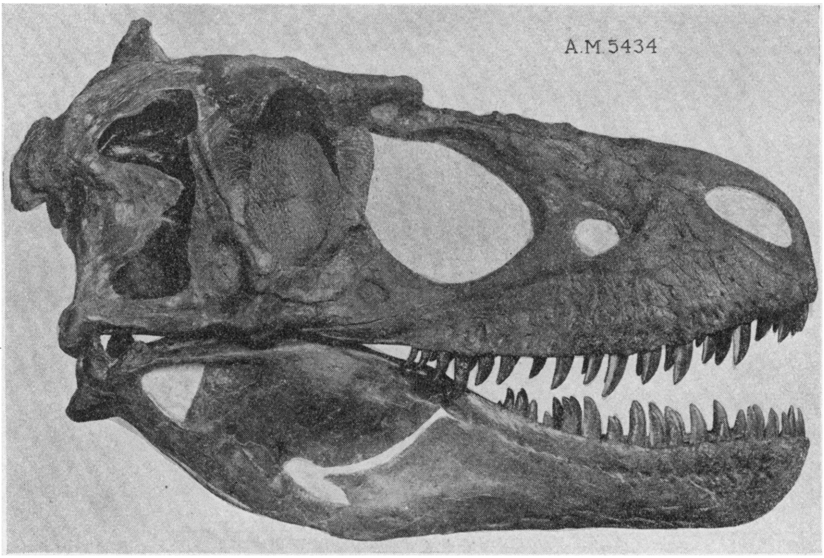

Fig. 5. *Gorgosaurus libratus* Lambe.

Skull and jaws from skeleton No. 5434. This is the best of four nearly complete skulls of this species in the American Museum collection. Length of skull 42 inches.

5.—**Gorgosaurus libratus** LAMBE. Skull and jaws, No. 5336. Belly River formation, Red Deer River, Alberta. Expedition of 1913.

A few bones of the skeleton are associated with this skull. The posterior part of the lower jaws is mostly restored in plaster. It agrees nearly in size with No. 5458 skeleton in running pose and with the type of the species in the Ottawa Museum.

6.—**Albertosaurus.** Skull, hind limb, and tail. Topotypes of *A. sarcophagus.*

To this genus are provisionally referred a large series of partly associated bones, representing several individuals, found together in a quarry in the Edmonton beds by the expedition of 1911. They were the first specimens to show clearly the construction of the deinodont pes, demonstrating its ornithomimid type and showing that the large species referred to *Ornithomimus* by Marsh were really of this group. (Owing to the incompleteness of the median metatarsal this fact was not shown by the *Tyrannosaurus* skeleton found in 1903.) The skull, hind limb, and tail have been prepared and placed on exhibition, but the two latter are temporarily withdrawn.

The material here shown does not demonstrate any valid generic distinctions of the genus *Albertosaurus,* which has never been differentiated from *Deinodon* or *Gorgosaurus.* The extreme reduction of the premaxillæ may, however, be a generic character. It is, at all events, a marked distinction from the large *Gorgosaurus,* although less clearly so from *G. sternbergi.* Detailed comparisons may show other and more certainly valid distinctions.

Table of Comparative Measurements

	"*Lælaps*" *aquilunguis*	5664, *Gorgosaurus sternbergi*	5458, Skeleton (running)	5434, Skeleton	5336, Skull, *G. libratus*	Type, *G. libratus*	*Albertosaurus*	*Tyrannosaurus*
Length of skull, pmx—mand. cond.		678	990	1050	980			1355
Length of skull, pmx—occ. cond.				990	925			1210
Height of skull, supraocc. crest—mand. cond.		205+		425	393			635
Width of skull across quadrato-jugals			330	crushed	380			835
Length of lower jaw		690	985	1025	E.990	950		1205
Depth of lower jaw at 8th tooth			107	120	105		100	
Upper dentition, length		340	465	540	495		385	
Lower " "			425	425	420		340	
Height of muzzle above last tooth		160	250	310	260			
Length of 9 cervical vertebræ		600						960
Length of 23 presacral vertebræ		1642	2550					3144
Length of sacrum		472	665			690		975
Length of 24 caudal vertebræ		2450						
Length of 37 caudal vertebræ est'd			4500					
Length of ilium		695	1040					1500
Height " "		305	465			438		
Length of pubis		610				980		E.1200
Width of distal end of pubis		360						
Length of ischium		465				762		1236
Femur, length	E.900	700	E.1025			1040		1280
Tibia, length—astragalus	E.855	748	990			1000		1166
Fibula, length		680				883		
Tibia and fibula, diam. dist. end		125						
Metatarsus, length		480	625			E.594		E.700
Metatarsal III, diam. across distal end		56	91			92		
Metatarsal IV, diam. across distal end		28	63			65		
Phalanx, first of mt. iii		78	173			163		
Pes, total length		830	1060					
Scapula, coracoid+length		620		965		1086		
Scapula, min. width shaft		40		60		56		
Coracoid, major diameter		180		275		210		
Humerus, length	E.305	205		328		324		360
Ulna, "		125		200		180		
Radius, "		100		163		156		
Metacarpal i, length		40		60		48		
" ii, "		60		110		98		
Phalanx 1, length				145				
Total length of manus		245		335		E.288		
Max. length of ribs (on curve)		E.800				1238		