

A P P E N D I X .

ART. XIV.—*Description of New Dinosaurian Reptiles*; by O. C. MARSH. (With Plate I.)

RECENT explorations in the West have resulted in the discovery of many remains of Dinosaurs, some of which are of more than ordinary interest. A few are from the Jurassic, but most of them are from the Cretaceous, especially from the upper portion, in the so-called Laramie formation. Those found in the latter horizon show a high degree of specialization, and present some anatomical features not before observed in this group of reptiles. Several of the new forms are briefly described below, and will be more fully discussed in a later communication.

Triceratops serratus, sp. nov.

First in importance of the new discoveries is a nearly perfect skull of the genus *Triceratops*, a typical example of which (*T. flabellatus*) was described and figured by the writer in the last number of this Journal.* The present skull is more perfect than any hitherto found, and exhibits admirably the strongly marked characters of the genus. It is likewise of gigantic size, being nearly six feet in length (1·8^m), although the animal was not fully adult.

A striking peculiarity of this skull, which has suggested the specific name, is a series of bony projections on the median line of the parietal crest. The latter is elevated along this line to support them, and the sides descend rapidly to their union with the squamosals. There is a second series of elevations along the middle of the squamosal bone as it falls away from the base of the horn-core, but these are much less prominent.

The orbit is nearly circular in form, instead of oval, and is situated above, and forward of its position in the species referred to. The quadrato-jugal meets the anterior process of the squamosal, forming a closer union than in the skull previously figured. In this respect, and in the elevations on the squamosal, it approaches a much smaller specimen at present referred to the genus *Ceratops*.

*This Journal, vol. xxxviii, pp. 501-506, December, 1889.

The nasal horn-core is wanting in the present specimen, as it was not ossified with the nasals. It projected upward and forward. The nasal bones extend outside the superior branch of the premaxillaries, the lateral suture uniting the two being nearly vertical.

The present specimen is from the Ceratops beds of Wyoming, in essentially the same horizon of the Laramie as the skull of *Triceratops flabellatus*, to which reference has been made.

Triceratops prorsus, sp. nov.

A second skull of this genus, fully adult, and of nearly equal dimensions, was secured at the same time as the specimen last described. It is in excellent preservation, although somewhat distorted, and evidently belongs to a distinct species.

The nasal horn-core and the rostral bone are in position, and perfect. The former is very large, and is directed straight forward, its upper surface being nearly on a line with the superior face of the nasals. It is somewhat oval in transverse section, and pointed in front, the apex being directly above the anterior extremity of the rostral bone. It is so firmly coössified with the nasals that no trace of a suture can be observed. Its external surface is rugose from vascular impressions, indicating that it was covered by horn, thus forming a most powerful weapon.

The huge frontal horn-cores are more massive, and less slender, than in the species above described.

The parietal crest is not so broad as in the two species last described, but appears to resemble more strongly that of *Triceratops horridus*, its sides being inclined downward, as if to protect the neck.

The rostral bone, likewise, is very similar to that in the last species, but is somewhat more compressed. The two forms may be readily distinguished by the nasal horn-core, for in *T. horridus*, this is comparatively small, and points directly upward, instead of straight forward, as in the present species.

With this skull were found several cervical vertebræ, and some other portions of the skeleton. The atlas, axis, and third vertebra are firmly anchylosed with each other, and their ribs, also, are coössified in the same mass. This union, unknown hitherto among the *Dinosauria*, was evidently rendered necessary to afford a firm support for the enormous skull. The remaining cervical vertebræ are short and massive, and the articular faces of the centra are concave or nearly flat.

The present specimen is from the Laramie of Wyoming, and was found in the same vicinity as the skull above described.

Ceratops paucidens.

The specimen recently described by the writer under the name *Hadrosaurus paucidens** should probably be referred to the genus *Ceratops*, as a comparison with more perfect specimens indicates a much closer affinity with that genus than at first supposed. In addition to the maxillary described, one of the premaxillaries is in good preservation. This agrees in general features with the corresponding bone in *Triceratops*, but is less specialized. Its inner surface is deeply concave, showing that the two premaxillaries did not meet each other closely, as in *Triceratops*, but apparently only in front. This species, as well as the type of the genus, *Ceratops montanus*, represents smaller, less specialized forms of the family, and may be from a lower geological horizon than the gigantic reptiles which the writer has recently made known.

In addition to the special characters of the *Ceratopsidæ* shown in the skull, as stated by the writer in this Journal (vol. xxxviii, p. 505), the following features seen in other parts of the skeleton may be mentioned:

- (1) The atlas and axis, and one or more adjoining cervical vertebræ are coössified with each other.
- (2) Their cervical ribs are likewise firmly united with the same vertebræ.
- (3) The remaining cervical vertebræ are short, and have the articular faces of the centra nearly flat.
- (4) The trunk vertebræ have very short centra, with flat articular ends. Above the centra, they resemble the vertebræ of *Stegosaurus*.
- (5) The sacrum was strengthened by union with several adjacent vertebræ.
- (6) The caudal vertebræ are short and rugose, and the tail was of moderate length.
- (7) The ilium is elongated, especially in front; the ischium slender, and directed backward.
- (8) The pubis extended forward, and its posterior branch was wanting.
- (9) The limbs were short and massive, and all four were used in locomotion.
- (10) The feet were all provided with broad hoofs, as in *Stegosaurus*.
- (11) The bones of the skeleton all appear to have been solid.
- (12) Dermal ossifications were present, and some species were protected by heavy armor.

* This Journal, vol. xxxvii, p. 336, April, 1889.

Ornithomimus velocæ, gen. et sp. nov.

The high degree of specialization in the reptiles above described has a partial parallel in a small group of typical *Ornithopoda* from the same horizon. Various specimens of these, recently secured, represent a distinct genus and several species. The most marked characters already determined are manifest in the limbs and feet, and these have been selected for description in the present notice. A typical example is shown on Plate I, figures 1-3, which is the type specimen of the species here described.

On the distal part of the tibia represented in figure 1, the astragalus is seen in place, with a very large ascending process, larger than in any dinosaur hitherto known. The calcaneum is also shown in position, but the slender fibula is absent. This bone was complete, but of little functional value. The tibia and all the larger limb bones were hollow, with thin walls, as indicated in the section, figure 1, c.

In figure 5, the corresponding parts of a young ostrich are shown for comparison. The slender, incomplete fibula is in place beside the tibia. The astragalus with its ascending process, and the distinct calcaneum, are also shown in position. The almost exact correspondence of these different parts in the bird and reptile will be manifest to every anatomist.

The most striking feature of the foot belonging with the reptilian tibia is shown in the metatarsals represented in figure 2, A. These are three in number, and are in the same position as in life. They are the three functional metatarsals of the typical *Ornithopoda* and of Birds. The distal ends of these bones correspond in size and relative position in the two groups, but here, in the present specimen, the reptilian features cease, and those of typical Birds replace them. In all the reptiles known hitherto, and especially in Dinosaurs, the second, third, and fourth metatarsals are prominent in front, at their proximal ends, and the third is usually the largest and strongest. In birds, the place of the third is taken above by the second and fourth, the third being crowded backward, and very much diminished in size.

This character is well shown in figure 6, which represents the second, third, and fourth metatarsals of a young turkey, with the tarsal bones absent. In the reptilian metatarsals seen in figure 2, the same arrangement is shown, with the tarsals in place. The second and fourth metatarsals have increased much in size in the upper portion, and meet each other in front.

The third metatarsal, usually the largest and the most robust throughout, here diminishes in size upward, and takes a subordinate, posterior position, as in birds. The correspondence between the metatarsals of the bird and reptile are here as strongly marked as in the tibiæ and their accompanying elements, above described.

In figure 3, the three phalanges represented belong with the second metatarsal, and were found together in place.

The three metacarpals represented in figure 4 were found together in position, near the remains of the hind limb here described. Their very small size indicates that they may possibly belong to a smaller individual, but, with this exception, there is no reason why they do not pertain to the same specimen as the hind foot.

The remains of the present species here described were found in the Ceratops beds of Colorado.

Two other species, apparently of the same genus, are represented by various specimens from the same horizon, in Montana. One of these, which may be called *Ornithomimus tenuis*, was about twice the bulk of the present form. The third metatarsal was much more compressed transversely, both in the shaft and distal end. The bone was also much more slender medially than in the above species. The transverse diameter of this metatarsal at its distal end was 30^{mm.}, and the antero-posterior diameter, 35^{mm.}

A third species, much larger, may be called *Ornithomimus grandis*. The third metatarsal was about 600^{mm.} in length, and its distal end 90^{mm.} in transverse diameter, and 80^{mm.} in antero-posterior diameter.

These various remains represent a distinct family, which may be called the *Ornithomimidae*.

Barosaurus lentus, gen. et sp. nov.

A new genus of the *Sauropoda* is indicated by various remains of a very large reptile secured by the writer during the past season. The most characteristic portions examined are the caudal vertebræ, which in general form resemble those of *Diplodocus*. They are concave below, as in the caudals of that genus, but the sides of the centra are also deeply excavated.

In the anterior caudals, this excavation extends nearly or quite through the centra, a thin septum usually remaining. In the median caudals, a deep cavity on each side exists, as shown in figures 1 and 2, on page 86.

On the distal caudals, the lateral cavity has nearly or quite disappeared. All the caudal vertebræ are proportionally shorter than in *Diplodocus*, and their chevrons have no anterior projection, as in that genus.

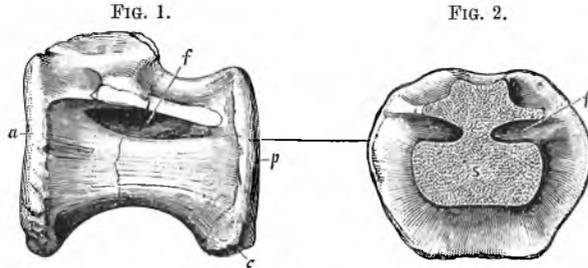


FIGURE 1.—Caudal vertebra of *Barosaurus lentus*, Marsh; side view.

FIGURE 2.—The same vertebra, in section; front view.

a, anterior end; c, face for chevron; f, lateral cavity; p, posterior end; s, section.

Both figures are one-eighth natural size.

The remains on which the present description is based are from the *Atlantosaurus* beds of Dakota, about two hundred miles further north than this well-marked horizon has hitherto been recognized.

For important aid in securing the fossils above noticed, the thanks of the writer are due to Mr. J. B. Hatcher, Dr. C. E. Beecher, and Mr. G. L. Cannon, Jr. The type specimens will be more fully described and figured by the writer under the auspices of the U. S. Geological Survey.

New Haven, Conn., December 21, 1889.

EXPLANATION OF PLATE I.

FIGURE 1.—Left tibia of *Ornithomimus velox*, Marsh; A, front view; B, distal end; C, transverse section.

FIGURE 2.—Left metatarsals of same specimen; A, front view; B, proximal ends; C, transverse section; D, distal ends.

FIGURE 3.—Phalanges of second digit of same foot; front view. A, first phalange; B, second phalange; C, third, or terminal phalange.

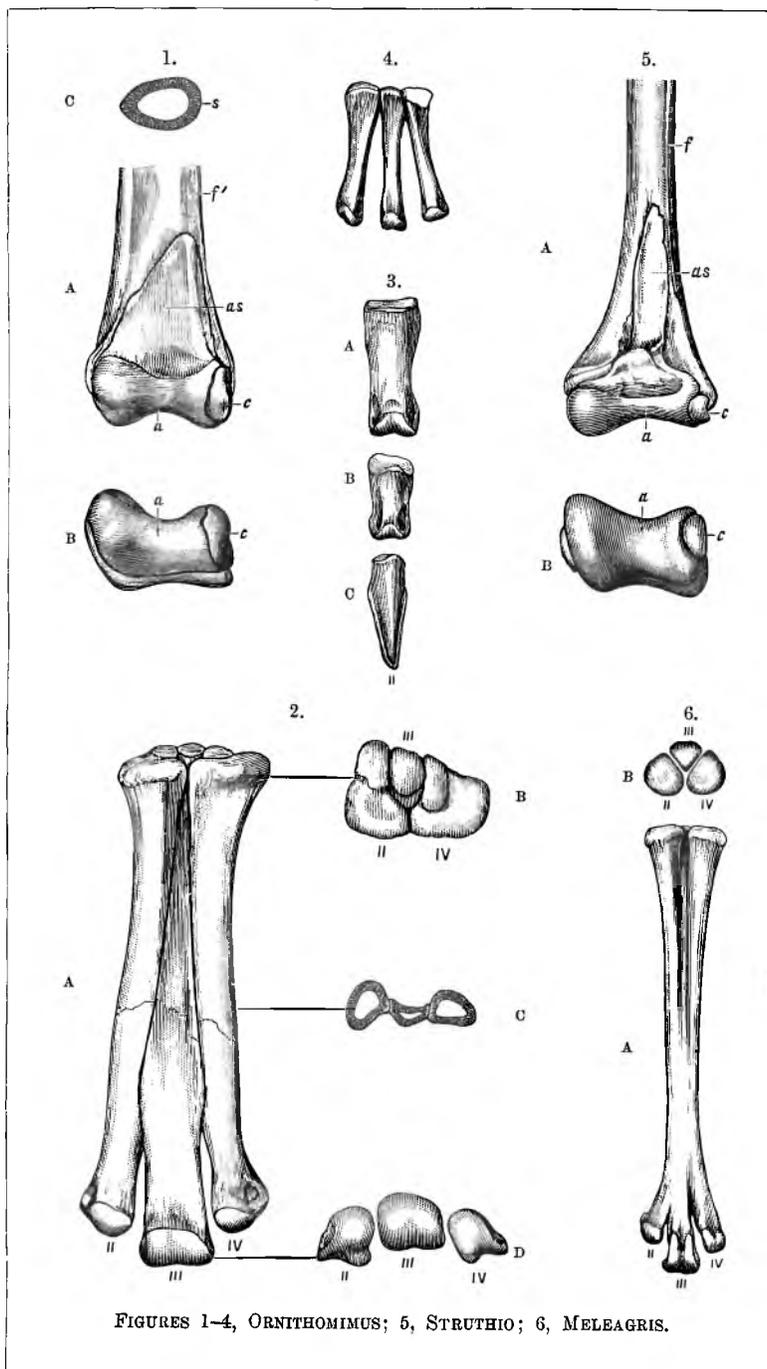
FIGURE 4.—Left metacarpals of same species, perhaps of smaller individual; front view.

FIGURE 5.—Left tibia of young Ostrich (*Struthio camelus*, Linn.); A, front view; B, distal end. The separate calcaneum was first observed by the writer's assistant, Dr. G. Baur, who prepared the specimen.

FIGURE 6.—Left metatarsals of young turkey (*Meleagris gallipavo*, Linn.); A, front view; B, proximal ends.

a, astragalus; as, ascending process of astragalus; c, calcaneum; f, fibula; f', face for fibula; II, second metatarsal; III, third metatarsal; IV, fourth metatarsal.

Figures 1-4 are one-third natural size, and figures 5 and 6, one-half natural size.



FIGURES 1-4, ORNITHOMIMUS; 5, STRUTHIO; 6, MELEAGRIS.