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## SAUROPODA AND THEROPODA OF THE LOWER CRETACEOUS OF MONGOLIA<sup>1</sup>

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The discovery of Sauropoda was one of the most interesting results of the Expedition. From the *Psittacosaurus mongoliensis* life zone, Oshih (Ashile) formation, Red Mesa, Oshih Basin, Mongolia, were collected by the Expedition of 1922 two characteristic sauropod teeth which bear considerable resemblance to those of *Camarasaurus* Cope and of *Caulodon* Cope, and are widely different from those of *Diplodocus*

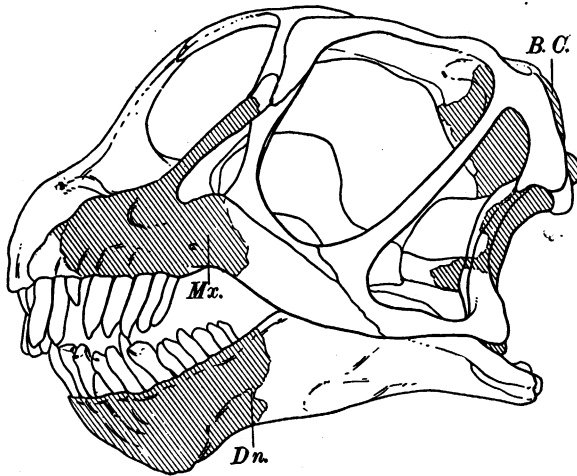


Fig. 1. Key to *Camarasaurus* skull (Amer. Mus. Cope Coll. 5761), shaded; outlines restored from referred skull (Amer. Mus. 467). One-tenth natural size. After Osborn and Mook, 1921, p. 286, fig. 29.

Marsh. Both the characters of the teeth and their occurrence in a new locality and life zone prompt their reference to a new genus of Sauropoda, family Camarasauridæ.

A comparison of the type and paratype teeth with those of *Camarasaurus* (see Osborn and Mook, 1921, pp. 286, 287, Figs. 29 and 30, Fig.

<sup>1</sup>Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 26.

1 of this article) indicates that the type teeth of *Asiatosaurus* belong in the lower jaw, the smaller type tooth being posterior, the larger paratype tooth being anterior in position; the family resemblance to *Camarasaurus* is quite strong. The generic characters are very distinct; all the teeth of *Camarasaurus* (*op. cit.*, Fig. 30) and of the type of *Caulodon diversidens* (*op. cit.*, Pl. LX) have subspatulate crowns, expanding at the base, contracting toward the summit, with a prominent median and symmetrical internal ridge. Compare *Asiatosaurus* type (Fig. 2) with *Caulodon diversidens* type (*op. cit.*, Pl. LX, figs. 1a, 1b, 5a, 5b). A second important difference is the asymmetry of the summit of the crown in *Asiatosaurus* as compared with the symmetry of the crown summit in *Camarasaurus*. A third difference is the more robust fang anteroposteriorly seen in the paratype (Fig. 3) of *Asiatosaurus*, as compared with the much less robust fang in the large anterior and central teeth of *Camarasaurus*.

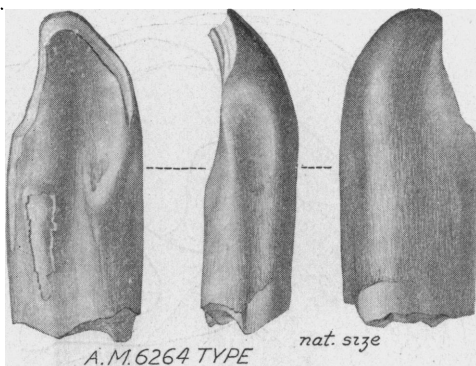


Fig. 2. Type of *Asiatosaurus mongoliensis* (Amer. Mus. 6264). Supposed posterior tooth in the dentary series. Natural size.

### ***Asiatosaurus mongoliensis*, new genus and species**

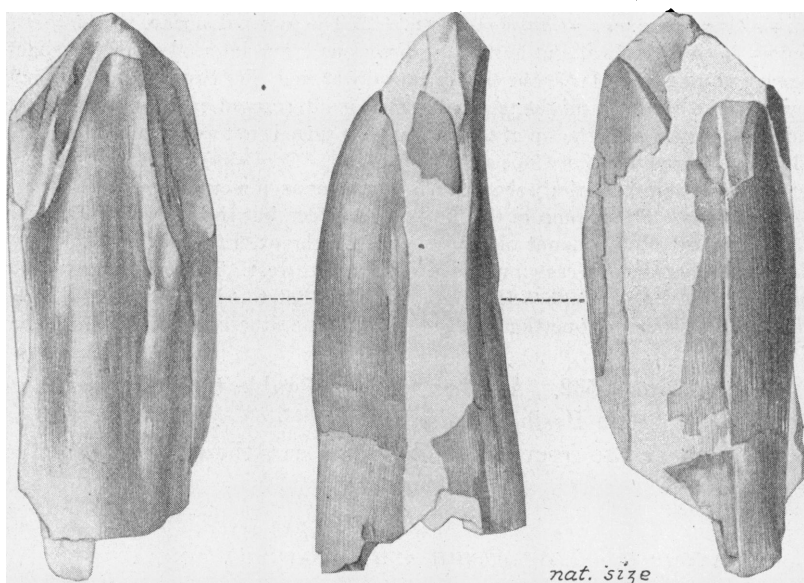
TYPE.—The tooth chosen is the most characteristic (Amer. Mus. 6264), reproduced herewith natural size (Fig. 2); this is believed to be a posterior tooth of the lower jaw or dentary bone. The paratype (Amer. Mus. 6294) is of much larger size and is believed to be an anterior tooth of the dentary. The type and paratype teeth have certain general characters in common but differ greatly in size.

HORIZON.—Oshih (Ashile) formation, *Psittacosaurus mongoliensis* life zone, Mongolia.

LOCALITY.—According to Granger these teeth were found approximately on the same level about one hundred feet apart; we are certain that they do not belong to the same individual; it is probable that they belong to the same species. We cannot be positive, however, that they belong to the same species, or as to their position in the jaw, until more complete material is found with the teeth *in situ*.

GENERIC CHARACTERS.—*Asiatosaurus*, derived from the Greek 'Ἀσία, Asia, and σαύρα, lizard. Type: (?Posterior) maxillary or dentary tooth, small, concavo-convex; subspatulate crown, slightly expanding superiorly; two lateral external and one median internal vertical grooves. Paratype: (?Anterior) enlarged tooth with transverse equaling anteroposterior (ap. 126 mm.=tr. diameter) diameter of fang, expanded summit, convexo-concave (internal section), shallow lateral and internal vertical grooves.

TYPE DESCRIPTION.—(1) The type tooth (Fig. 2) measures 41 mm. in height as preserved, 47 mm. in circumference, 18.2 mm. in anteroposterior direction (i.e., parallel with the direction of the tooth-row) and 11.7 mm. perpendicular to this direction; the external surface is convex in both vertical and horizontal directions; near



A. M. 6294 PARATYPE

Fig. 3. Paratype of *Asiatosaurus mongoliensis* (Amer. Mus. 6294). Supposed to be an anterior tooth of the dentary. Natural size.

each edge is a broad, shallow vertical groove. (2) The internal surface is flat at the base, but concave in both vertical and horizontal directions near the apex of the crown. The surface therefore roughly resembles the inner or upper surface of a spoon. A small median groove extends vertically through the base of the bowl-shaped depression. (3) The edges are straight and parallel near the base of the tooth, but near the crown are beveled by worn surfaces; the latter are asymmetric in development, one being rather convex in profile and extending down only 15 mm. from the apex, while the other is concave and extends downward about 30 mm. The two worn surfaces unite at the apex into a single surface. The unequal degree of wear on opposite edges gives an asymmetric appearance to the entire tooth. The worn surfaces face some-

what inward, being entirely visible on the internal aspect of the tooth, and not at all visible on the external aspect. This indicates that the tooth is near the posterior end of the dental series.

Comparison of its asymmetrical form with that exhibited by the teeth in the mounted skull of *Morosaurus* in the American Museum (Amer. Mus. 969) indicates that it belongs to the right side.

PARATYPE.—(1) The paratype tooth (Amer. Mus. 6294) is about 74 mm. in length as preserved, and about 80 mm. in circumference; at the base its anteroposterior diameter is equal to its transverse, 27 mm. The crown is damaged, the expanded upper portion being broken; near the tip the anteroposterior diameter exceeds the transverse.<sup>1</sup> This contrasts with the broader and more flat horizontal sections of Cope's *Camarasaurus* (= *Caulodon*) teeth. (2) The external surface of the tooth is convex, both in vertical and horizontal directions. The internal surface is slightly concave vertically, and near the tip horizontally as well. For two-thirds of its length, however, the concavity of the internal surface is interrupted by a low vertical ridge which disappears near the tip of the crown; this ridge is not as prominent as similar ridges in the type teeth of Cope's *Camarasaurus* (= *Caulodon*); it is faintly striated vertically. Anteroposteriorly the crown is somewhat asymmetrical, but less so than in *Camarasaurus*. The summit of the tooth is imperfect, but the portion preserved exhibits a considerable amount of wear surface on the external side of the tooth; a small, smooth surface on each inner edge may indicate wear. The great extent of worn surface on the external side of the tooth indicates that this is a lower tooth, and its large size and robust proportions indicate that it was situated near the anterior end of the jaw.

Amer. Mus. 6532. Another tooth referable to *Asiatosaurus* was found in the Oshih Basin, August, 1923 (Field No. 378). A sauropod tooth fragment also from the Oshih Basin bears the same field number, i.e., 378.

#### SAUROPODS OF THE OSHIH AND ONDAI SAIR FORMATIONS

In all, the remains of eight individual sauropods were found in the Oshih and Ondai Sair formations, of slightly different geologic ages and at different levels, indicating that this was an important center of sauropod distribution, as follows:

OSHIH FORMATION, PSITTACOSAURUS MONGOLIENSIS LIFE ZONE, EAST END OF RED MESA.

1. Type of *Asiatosaurus mongoliensis* (Amer. Mus. 6264).
2. Paratype of *Asiatosaurus mongoliensis* (Amer. Mus. 6294); same level as type, 200 yards distant.
3. Several limb bones, weathered, broken, and not collected; same level as type and paratype teeth, not far distant.

<sup>1</sup>The term "anteroposterior" here refers to the direction parallel to the toothrow, and "transverse" at right angles to this direction. These directions may or may not correspond with the general directions of the skull, depending upon the position of the tooth.

4. Referred tooth of *Asiatosaurus* (Amer. Mus. 6532), Field No. 378.
5. A sauropod tooth fragment (Field No. 378).

THREE MILES EAST OF RED MESA, FROM A HIGHER LEVEL, ABOUT 600 FEET.

6. Amer. Mus. 6533, two anterior dorsal vertebræ, badly weathered, several ribs, and one chevron; three ribs and chevron collected (Field No. 106); see photograph, Fig. 4.
7. Single dorsal vertebra, badly weathered, not collected. Found 100 feet from vertebræ (Amer. Mus. 6533) possibly belonging to the same individual.

ONDAI SAIR FORMATION, MT. USKUK.

8. One rib (Amer. Mus. 6258).



Fig. 4. Two anterior dorsal vertebræ, several ribs, and a chevron of a sauropod dinosaur *in situ*. Oshih (Ashile) formation, Oshih Basin, August, 1923; Albert F. Johnson, collector. Owing to their much weathered and disintegrated condition, the two vertebræ were not taken.

CONCLUSION.—Awaiting the evidence afforded by more perfect material, *Asiatosaurus* seems to resemble *Camarasaurus* in the subspatulate form of the summit of the crowns, in its large anterior teeth diminishing gradually to the smaller posterior teeth of similar general spatulate pattern. We await with interest comparison of these teeth with those of the analogous African genera.

A.M. 6265  
TYPE

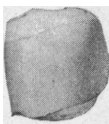


Fig. 5. Type of *Prodeinodon mongoliensis* (Amer. Mus. 6265), Oshih (Ashile) formation, Oshih Basin, Mongolia; collected by Walter Granger. Natural size.

***Prodeinodon mongoliense*, new genus and species**

TYPE.—Amer. Mus. 6265. Upper section of a carnivorous dinosaur tooth, Oshih (Ashile) formation, Mongolia (Fig. 5). Collected by Walter Granger.

PARATYPE.—Complete carnivorous dinosaur tooth (Amer. Mus. 6531), Oshih (Ashile) formation, Mongolia. Collected by Walter Granger.

HORIZON AND LOCALITY.—Oshih (Ashile) formation, Psittacosaurus mongoliensis life zone, Red Mesa, Oshih Basin, Mongolia.

GENERIC CHARACTERS.—A theropod or carnivorous dinosaur, tooth crown with flattened sides, rounded anterior border, compressed posterior border terminating in a serrate ridge. Diameters: ap. 134 mm., tr. 82 mm. Closely minute serrations of posterior edge.

The Theropoda or carnivorous dinosaurs of the period, contemporaries of *Psittacosaurus* and *Asiatosaurus*, are represented by a single tooth fragment (Amer. Mus. 6265) which is shown natural size in figure 5, as collected by Granger in 1922.

As *Asiatosaurus* may prove to be close to *Brachiosaurus* or to *Camarasaurus*, so this carnivorous dinosaur tooth may prove to belong to an Old World or New World genus such as *Megalosaurus* Buckland, *Dryptosaurus* or *Allosaurus* Marsh. Meanwhile it is provisionally given the name *Prodeinodon*, referring to its greater geologic age than *Deinodon* Leidy of the Judith River, Upper Cretaceous.

In the type of *Megalosaurus* (Buckland, 1824, Owen, 1860, p. 260, fig. 75) both the anterior and posterior edges of the teeth are serrate; the teeth so far as preserved are similar or homodont.) The teeth of *Deinodon* are also sharpened on both edges (Leidy, 1860, Pl. ix, figs. 21–48); they are heterodont, the anterior teeth (named *Aublysodon* by Leidy) being rounded in front and flattened behind with double serrations on the two posterior borders. The present type of *Prodeinodon* agrees most closely with the tooth figured by Leidy (Leidy, 1860, Pl. ix, figs. 33

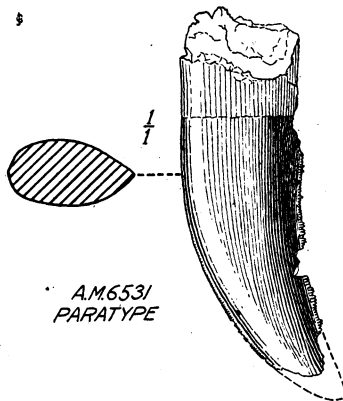


Fig. 6. Paratype of *Prodeinodon mongoliensis* (Amer. Mus. 6531), Oshih (Ashile) formation, Oshih Basin, Mongolia; collected by Walter Granger, August, 1923 (Field No. 378). Natural size.

and 34, described on p. 144). Leidy observed that *Deinodon* was probably heterodont; the same may be true of *Prodeinodon*. A closer resemblance to the *Prodeinodon* type is seen in Lambe's figure of *Deinodon explanatus* Cope (Lambe, 1902, p. 49, Pl. xv, figs. 11 and 12, Fig. 7 of this article). Consequently the generic name *Prodeinodon* is selected for this Oshih type of Mongolia. The tooth differs in its more rounded and less laterally compressed section from the tooth referred to *Deinodon explanatus* Cope.

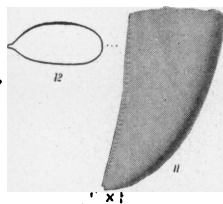


Fig. 7. Referred tooth of *Deinodon explanatus* Cope. After Lambe, 1902, Pl. xv, Figs. 11 and 12. Twice natural size.

