

**Article XXIII.—THE SKULL OF HYPISODUS, THE SMALLEST OF THE ARTIODACTYLA, WITH A REVISION OF THE HYPERTRAGULIDÆ.**

By W. D. MATTHEW.

A very well-preserved skull of this tiny Artiodactyl was found by the writer at Pawnee Buttes, northeastern Colorado. In connection with the fragments of the skeleton already described from the same region, it gives a fairly complete idea of the characters.

The animal was not larger than a 'cottontail' rabbit. The orbits are remarkably large, as are likewise the tympanic bullæ. The tip of the muzzle is unfortunately missing, but enough is preserved to show that it was slender and short. The whole skull is distinctly more brachycephalic than in any other White River selenodont—more so, indeed, than in any of the modern Cervidæ or Antilopidæ with which I have compared it. The molar dentition consists of five teeth in each jaw,  $p\frac{3}{3}$  —  $m\frac{3}{3}$ ;  $p\frac{2}{2}$  is present in young individuals and repre-

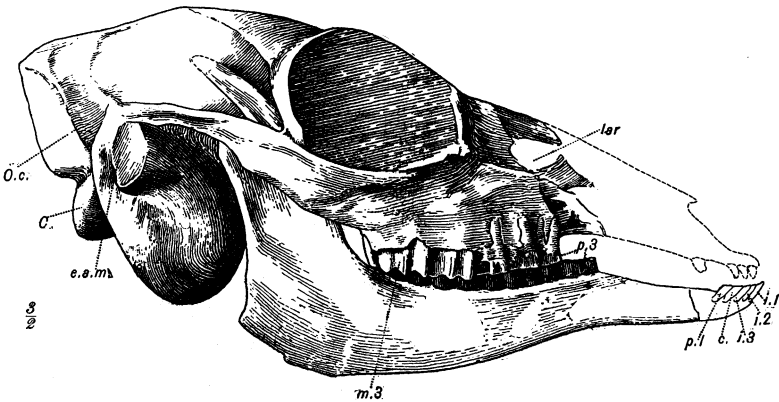


Fig. 1. *Hypisodus minimus* Cope. Skull, x  $\frac{3}{2}$ . No. 9354. White River (Cedar Creek Beds), Pawnee Buttes, Colorado.

sented by an alveolus in the older animals. A considerable diastema is in front of this alveolus in the upper jaw, and

anteriorly to this the muzzle is broken off on both sides (or is not calcified). A longer diastema precedes the alveolus of  $p_2$  in the lower jaw, and in front of that, on evidence of other specimens, it is known that there are five small subequal teeth, probably incisiform.

The antorbital foramen is double, opening above the diastema in front of the molar series. There appears to be a small prelachrymal vacuity. The postorbital bar is complete. The orbit is surrounded by a thin prominent ring, of which the inferior and anterior parts (jugal and lachrymal) are more prominent, and the superior part (frontal) less prominent than in *Hypertragulus* or *Leptomeryx*. The eye, therefore, faced much more upward than in these genera; it was more prominent and much larger in proportion. The basifacial axis is much more bent down on the basicranial axis than in other *Hypertragulidæ*. The bullæ are very large, connate anteriorly, with a long, prominent, enclosed meatus opening behind the origin of the zygoma. The occiput projects much more backward than in *Hypertragulus* or *Leptomeryx*. The paroccipital processes are slender, and are coossified with the bullæ except just at the tip.

The lower jaw is slender, its condyle set high up, and the long coronoid process is slightly curved. It does not possess the angular hook seen in certain of the *Camelidæ*.

The limbs and feet I have described in a previous article. The ulna and radius are coössified, and the distal end of the fibula is coössified with the tibia. The cuboid and navicular were coössified, the median metatarsals distinct though appressed, the laterals thread-like but still complete.

*Hyphisodus* was much less *Tragulus*-like than *Hypertragulus* or *Leptomeryx*, and superficially resembled rather the dwarf antelope *Madoqua*. Its real relationships are more nearly with *Hypertragulus* than anything else, but it is a remarkably modernized animal for the formation in which it is found. The resemblance to *Madoqua* is a striking instance of parallel adaptation.

## FAMILY HYPERTRAGULIDÆ COPE.

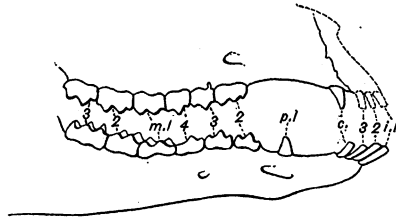
(LEPTOMERYCIDÆ Scott.)

**Leptomeryx** *Leidy.*

Dentition,  $I\frac{1}{2}$   $C\frac{2}{1}$   $P\frac{3}{2}$   $M\frac{3}{2}$ . Lower canine incisiform, first premolar small, caniniform, with a long diastema in front of it and a somewhat shorter one behind. Upper canine small or absent. Second, third, and fourth premolars in series with molars,  $p^4$  with two crescents,  $p^{2-3}$  with anterior, posterior, and internal accessory cusps. Mesostyle prominent on upper molars. Second, third, and fourth lower premolars in series with molars, trenchant, with anterior basal cusp, basin heel, and accessory ridges from the protoconid. Last molar with heel composed of a large posteroexternal crescent and a small anterointernal flattened cusp (as in *Palæomeryx*).

Skull of moderate length, muzzle slender, elongated, orbits not very prominent. Prelachrymal vacuity diamond-shaped, situated rather above than in front of the lachrymal. Bullæ small, not filled with cancellous tissue.

Ulna and radius separate; tibia and fibula separate; navicular and cuboid united. Manus of four usable digits, the lateral pair smaller, no cannon-bone. Pes with cannon-bone and no lateral digits (? the small proximal splints of metatarsals II and V fused to the cannon-bone). Hoofs small, pointed.

Fig. 2. Dentition of *Leptomeryx*.

1. **L. evansi** Leidy. White River (Oreodon Beds). S. Dak.

LEIDY, Ext. Mam. Dak. and Neb., p. 165, pl. xiv, figs. 1-8.—SCOTT, Jour. Morph., V, Dec. 1891. SCOTT, Trans. Wagn. Inst. Sci., 1899. 15.

2. **L. mammifer** Cope. White River (? Titanotherium Beds), Swift Current Creek, Canada.

COPE, Rep. Geol. and Nat. Hist. Surv. Canada, I, 1885 (1886), 84c.

One and a half times the linear dimensions of *L. evansi*. Prof. Cope distinguished it by the presence of a separate cusp between the entoconid and the heel of  $m^3$ ; this appears, however, to be only the anterointernal cusp common to all species of *Leptomeryx*.

3. "**L.**" **esulcatus** Cope. White River (? Titanotherium Beds), Swift Current Creek, Canada.

COPE, Mem. Geol. Sur. Can. III, 1891, 22, pl. xiv fig. 5.

Based on a single upper molar, which, judging from Cope's figure, is not *Leptomeryx*, suggesting rather an ally of *Palæomeryx*, so far as such slight evidence is worth consideration.

4. "**L.**" **semicinctus** Cope. White River (? Titanotherium Beds), Swift Current Creek, Canada.

COPE, *l. c.*, p. 23, pl. xiv, fig. 8.

This species is also known by a single upper molar. It has twice the linear dimensions of *L. evansi*; tooth broader transversely, with heavy cingular ridge (protostyle) internal to protocone and strong cusp (hypostyle) anterointernal to hypocone. This is clearly not *Leptomeryx*, and is distinct from any described White River genus (except possibly *Calops*, with which I am unable to compare it; Prof. Marsh states, however, that the molars of *Calops* are like those of *Protoceras*, in which case it is not "*L.*" *semicinctus*). Two upper molars in the Am. Mus. Collection from the *Protoceras* Beds of South Dakota probably represent this species.

5. **Leptomeryx** sp. indesc.

A smaller species occurs in the Leptauchenia clays in Colorado and in the *Protoceras* Beds of South Dakota distinguished by simpler premolars, narrower, more hypsodont molars. The deuterocoenid of  $p_4$  is not distinct as in *L. evansi*, but represented only by a ridge descending anterointernally from the point of the protoconid;  $p_3$  is smaller and more trenchant; the internal faces of the molar cusps are more convex. This may prove varietal when *L. evansi* is examined from more localities and regions.

6. **Leptomeryx** sp. indesc.

A larger, somewhat more brachydont species or variety, characteristic of the *Protoceras* sandstones. Premolars pro-

portionately larger, longer, and more complicated; antero-internal cusp of  $p_4$  less prominent, posterointernal (hypostylid) more so; hypoconid ridge bifid posteriorly, into a posterior branch which passes backward to the posterior margin, and a posterointernal branch projecting into the basin of the heel.  $P_1$  more anterior in position than in *L. evansi*, probably near anterior end of diastema, while in *L. evansi* it is nearer to  $p_2$  than to  $c_1$ .

### Hypertragulus Cope.

Dentition,  $I_1^1 C_1^1 P_4^1 M_3^1$ . Lower canine incisiform, first premolar large, fully caniniform, with a short diastema in front and a long one behind. Upper canine enlarged, first upper premolar two-rooted, with diastema before and behind. Second lower premolar spaced, simple, without accessory cusps; third with heel; fourth with anterior cusp and heel; but all though equally trenchant simpler than the corresponding teeth in *Leptomeryx*. Second upper premolar simple, two-rooted; third with internal cusp; fourth with two crescents. No mesostyle on upper molars. Heel of last lower molar composed of two equal opposite crescents. Molars somewhat more hypsodont than those of *Leptomeryx*.

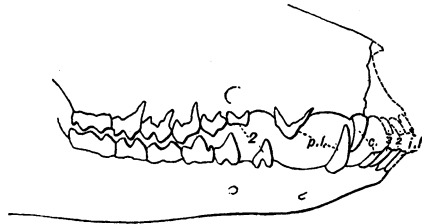


Fig. 3. Dentition of *Hypertragulus*.

Skull much like that of *Leptomeryx*, but somewhat shorter, muzzle slenderer, supraorbital ridges much more prominent. Prelachrymal vacuity as in *Leptomeryx*, bullæ somewhat larger.<sup>1</sup>

Ulna and radius coössified; tibia coössified with distal end of fibula; navicular and cuboid united. Manus of four separate usable digits; pes with two separate digits and splints representing the lateral metatarsals.

<sup>1</sup> In his recent discussion of this genus Prof. Scott interprets the dentition as  $I_1^1 C_1^1 P_4^1 M_3^1$ , the first premolar absent and lower canine caniniform. It would appear rather that, as in most other selenodonts, the canine is incisiform. The number of incisors is not certainly known; but it seems certain that both in the John Day skulls on which Prof. Scott's description and figures were based, and in the White River skulls in the Amer. Mus. collection, the inferior tooth, which Prof. Scott considers as a canine, closes behind, not in front of, the upper canine; his drawing does not agree with the specimen in this respect. The one skull from the White River in which this part is preserved shows the lower caniniform tooth shutting unmistakably behind the upper canine; it is, therefore, a premolar, and the canine is incisiform as in *Leptomeryx*.

1. **Hypertragulus calcaratus** Cope. White River, Oreodon Beds.

*H. tricostratus* COPE.<sup>1</sup> Not *H. calcaratus* "Cope" SCOTT, Trans. Wagn. Inst. Sci., 1899.

2. **Hypertragulus** sp. indesc. John Day.

*Hypertragulus calcaratus* SCOTT, Trans. Wagn. Inst., 1899, pl. i, figs. 3-4.

The John Day specimens referred by Profs. Cope and Scott to *H. calcaratus* are a larger, more brachydont species, with heavier muzzle, etc.

3. "**Hypertragulus**" **transversus** Cope. White River, Titanotherium Beds (?), Swift Current Creek.

COPE, Mem. Geol. Sur. Can. III, 1891, 22.

Twice the linear size of *H. calcaratus*, para- and metacones uniformly convex externally, small para- and metastyles and prominent hypostyle anterointernal to hypocone. It is not at all probable that this species is *Hypertragulus* or related thereto.

**Hypisodus** Cope.

Dentition,  $I_3^1 C_1^1 p_{3-4}^{2(3-4)} M_3^2$ . Lower canine incisiform, first pre-molar small, probably incisiform. Second upper and lower premolars

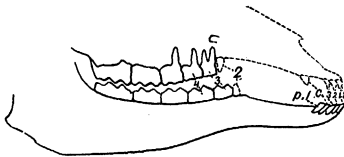


Fig. 4. Dentition of *Hypisodus*.

decadent at anterior end of grinding series. Teeth hypsodont, skull very brachycephalic, but muzzle rather long and slender. Pre-lachrymal vacuity irregular, orbits very prominent, bullæ very large. Lateral digits of pes extremely slender although still entire; no

cannon-bone; ulna and radius united.

1. **Hypisodus minimus** Cope. White River (Oreodon clays).

<sup>1</sup> ". . . I know but the one species, the *H. calcaratus* Cope."—Cope, Proc. Amer. Phil. Soc., 1884, Vol. XXII, p. 24. This statement invalidates *H. tricostratus*, and quite correctly so.