

Article IX.—A REVISION OF THE LOWER EOCENE WASATCH
AND WIND RIVER FAUNAS.

BY W. D. MATTHEW AND WALTER GRANGER.

PART II. ORDER CONDYLARTHRA, FAMILY HYOPSODONTIDÆ.

BY W. D. MATTHEW.

In the present revision the Condylarthra were assigned to Mr. Granger, the Insectivora, including Hyopsodontidæ to Dr. Matthew. The transfer of this family to the Condylarthra was not decided upon until after the detailed studies were completed; it appeared advisable therefore to place it in a separate section from the Phenacodontidæ and Meniscotheriidæ revised by Mr. Granger.

Following is the diagnosis of the order as here understood:

Order Condylarthra. Herbivorous or omnivorous placentals with complete dentition, five-toed feet, ball-and-socket ankle joint and small brain. Upper molars low-crowned, rounded trigonal or quadrate with five or six principal cusps, the para- and metaconule distinct or strong; lower molars with four principal cusps, trigonid not elevated; third lobe of m_3 short or absent. Posterior premolars simple or progressively molariform; anterior premolars, canine and incisors simple, little differentiated, usually in continuous series. Humerus with supratrochlear vacuity and entepicondylar foramen. Ulnar shaft wide and stout; a third trochanter on femur; fibula complete, wholly separate from tibia. Carpal bones moderately displaced (becoming nearly serial in *Phenacodus*); tarsals serial. Astragalus with distinct neck and ball-head, astragalar foramen present except in later Phenacodonts. Manus and pes mesaxonic, pollex and hallux not opposable. Phalangeal joints more or less distinctly of hinge type; unguals narrow, claw-like, or broadened into flat hoofs.

Five families are at present included, the fifth provisionally.

1. *Mioclanidæ*. Bunodont; hypocones of upper molars absent or rudimentary; premolars simple. Unguals unknown. *Paleocene*.

2. *Hyopsodontidæ*. Bunodont, cusps round-conic, hypocones of upper molars progressively strong, lower molar cusps alternating; posterior premolars progressively complex. Unguals claw-like. *Lower to Upper Eocene*.

3. *Phenacodontidæ*. Bunodont, with tendency to polybun, or sublophodont. Hypocones of upper molars strong, cusps of lower molars opposite; posterior premolars progressively complex. Unguals progressively broadened into hoofs. *Paleocene and Lower Eocene*.

4. *Meniscotheriidae*. Lophoselenodont; first two upper molars quadrate, hypocones united with metaconules into a crest, remaining cusps crescentic; last upper molar triangular; no third lobe in last lower molar; premolars progressively molariform. Unguals narrow hoofs. *Lower Eocene*.

5. *?Pleuraspidotheriidae*. Bunoselenodont with two conical outer cusps and two crescentic inner cusps, conules vestigial; premolars progressively molariform. Astragalus with broad trochlea and short neck; unguals narrow hoofs. *Paleocene*. Systematic position doubtful; placed here on Schlosser's authority.¹

A number of South American genera, mostly from the Notostylops beds, have been referred to the Condylarthra by Ameghino and other authorities. Some of them may belong to this order, but their family reference is uncertain.

Family HYOPSODONTIDÆ.

The position of this family was discussed at some length by Matthew in 1909.² The family was not then removed from the Insectivora, where it had been placed by Wortman³ and Loomis,⁴ but the discussion of its relationship concluded with the statement: "Nevertheless I believe that its affinities are in reality closer to the Condylarthra than to the more typical Insectivora."

Additional skeleton material of *Hyopsodus*, including a well preserved hind foot, serves to confirm the above somewhat tentative conclusion, and makes it advisable to remove the family to the Condylarthra. Its position in the Insectivora has always been anomalous, and could only be defended by regarding this order as a sort of catch-basket for primitive unspecialized placentals that could not be placed elsewhere. It also involved difficulties as to the position of the Mioclænidae, which while generally regarded as primitive Condylarthra appeared to be nearly allied to the Hyopsodontidae.

The astragalus, while very primitive, is distinctly of the type peculiar to primitive Carnivora and Condylarthra, as opposed to the characteristic form of the Insectivora or that of the primitive Primates. The teeth exclude it from the Creodonta. In teeth, skull and skeleton characters it compares best with the most primitive among the Condylarthra, and the ungual phalanges, while they are claws rather than hoofs, are but little different in type from those of *Tetraclænodon*. The only character somewhat difficult to reconcile with condylarthrous affinities is the short pubic symphysis.

¹ See Schlosser, 1911, in Zittel's Grundzüge der Paläontologie, zw. Anfl., II Abth., s. 439.

² Matthew, 1909, Mem. A. M. N. H., Vol. IX, pt. vi, pp. 508-516.

³ Wortman, 1903, Amer. Jour. Sci., Vol. XV, p. 162.

⁴ Loomis, 1907, *ibid.*, Vol. XIX, p. 417.

Haplomylus gen. nov.

Fam. ?Hyopsodontidæ.

Type, Microsyops speirianus COPE, probably from the Lower Wasatch of the Bighorn basin, Wyo.

This imperfectly known species was described by Cope from a lower jaw fragment with m_{1-3} and provisionally referred to *Hyopsodus* and subsequently to *Microsyops*. Numerous additional specimens have been secured from the Bighorn basin, and show that it represents a distinct genus.

The lower molars consist of four cusps, somewhat obliquely set, but less so than in *Hyopsodus*, lower, and with a distinctly basined heel. The last molar is considerably reduced. The fourth premolar is more compressed and elongate than in *Hyopsodus*, with the principal cusp distinctly twinned, and a sharp narrow heel, and small anterior basal cusp.

The upper teeth are of ovate-trigonal outline, with hypocone well developed but from the posterior wing of the protocone, so that it does not project postero-internally. The external cusps are rather small, with distinct para-, meso- and metastyles; the conules are small but distinct. The fourth premolar is triangular with the principal cusp central, and three minor cusps at the internal, postero-external and antero-external angles. The last upper molar is greatly reduced and simplified.

The affinities of the genus appear to be with *Hyopsodus* and *Miocænus*. Tarsiid relationship is improbable, judging by the compressed premolar and the general set of the molar cusps.



No. 16107
A.M.

$\frac{3}{1}$



Fig. 1. *Haplomylus speirianus* Cope, No. 16107, Upper jaw and lower premolar, enlarged three diameters. Sand Coulée beds, Clark Fork basin, Wyoming.

Haplomylus speirianus (Cope 1880).

Hyopsodus speirianus COPE, 1880, Amer. Nat., Vol. XIV, p. 908; (*Microsyops*) 1885, Tertiary Vertebrata, p. 216, pl. xxva, fig. 8; ("Microsyops") OSBORN, 1902, Bull. Am. Mus. Nat. Hist., Vol. XVI, p. 210, fig. 37.

Type, Am. Mus. No. 4190, a lower jaw fragment with three molars preserved.

No. 14654.
A. M.

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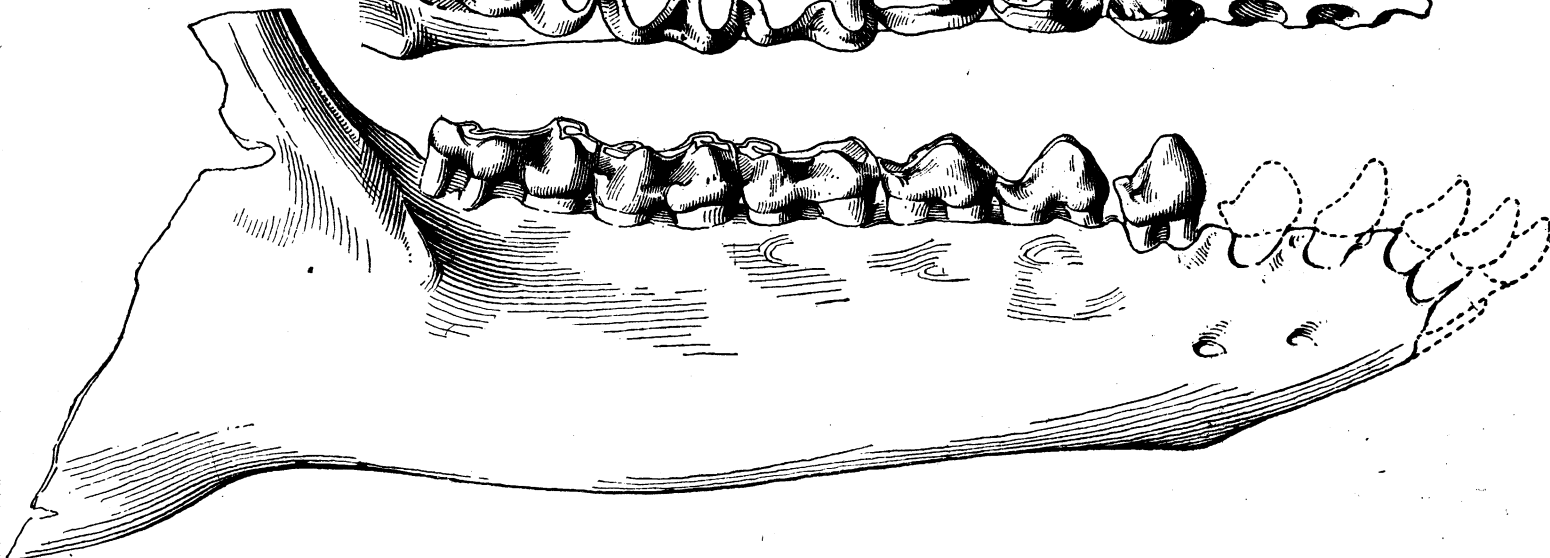
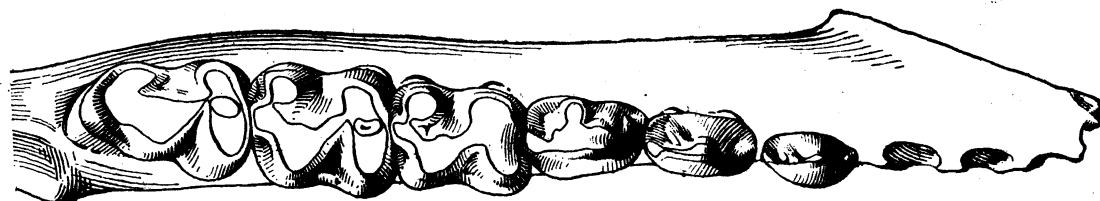
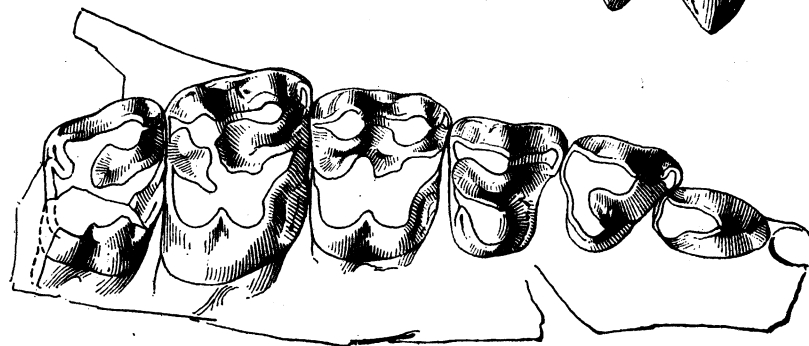
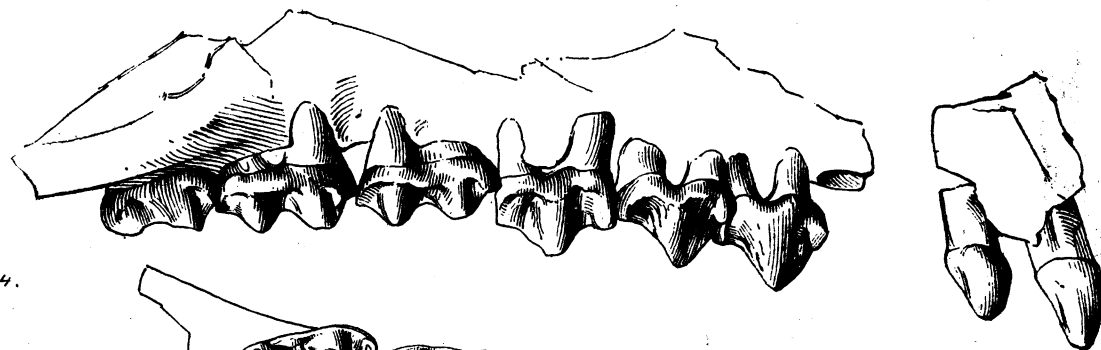


Fig. 8. *Hyopsodus walcottianus*, type, No. 14654, upper and lower jaws three times natural size. Lost Cabin beds, Alkali Creek, Wind River basin, Wyoming.

The type was originally described with other fossils as from the Wind River basin, but in 1885 the locality was definitely stated as Bighorn Valley. In cataloguing the Cope Collection in 1896 I referred this discrepancy to

the collector, Dr. Wortman, who informed me that although most of his collections of 1880 came from the Wind River Valley and of 1881 from the Bighorn basin, he did obtain a few specimens in 1880 from the Bighorn which were at first wrongly supposed by Professor Cope to have come from the Wind River Valley, the error being subsequently corrected. I cite these circumstances, because later collecting indicates that this genus is wholly limited to the lower part of the Wasatch, and is a valuable horizon-indicator (leitfossil). This is equally true of *Didymictis leptomylus*, described in the same notice as *H. speirianus*, as from the Wind River. It is abundant in the lower part of the Wasatch but has not been found in the Upper Gray Bull, Lysite or Lost Cabin, where it is replaced by larger

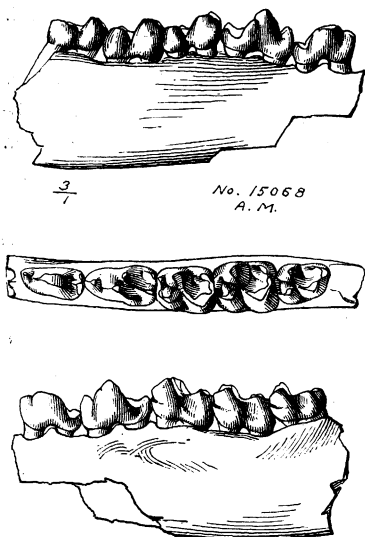


Fig. 2. *Haplomylus speirianus* Cope, No. 15068, lower jaw, enlarged three diameters. Lower Gray Bull beds, Elk Creek, Bighorn basin, Wyoming.

and more progressive species. The type specimens of these two species have more the appearance of specimens from the Lower Wasatch of the Bighorn basin than of specimens from the Lost Cabin or Lysite beds of the Wind River Valley.

It appears reasonably certain therefore that the true horizon of the type of *Haplomylus speirianus* is Lower Wasatch. Of the referred specimens thirty-two are recorded from the lower Gray Bull, six from the Sand Coulée, two from the Clark Fork beds, of the Bighorn and Clark Fork basins; none from the Wind River basin. They are all parts of upper or lower jaws with more or less of the premolar and molar dentition preserved; in No. 16107 upper and lower teeth of the same individual are associated. The skull and skeleton are unknown.

Hyopsodus Leidy 1870.¹

Type, H. paulus from the Lower Bridger (Orohippus zone) of Wyoming.

¹ Leidy, 1870, Proc. Acad. Nat. Sci. Phila., Vol. 22, p. 109.

Principal diagnostic characters: *skull* mesaticephalic, occiput broad, mastoid exposure considerable, lachrymal exposed upon face, lachrymal foramen within orbital rim, zygomatic arches deep, nasals not expanded posteriorly, palate not fenestrated nor extended backward nor crested on posterior margin; *incisors* unreduced, pointed, subspatulate, *canines* small, incisiform, *premolars* progressively complex, the anterior premolars, canines and incisors in both upper and lower jaw similar in size and character without diastemata, posterior premolars progressively complex in cusp constitution, submolariform; molar cusps tending to be round conical, *upper molars* six-cusped, conules prominent, hypocone progressively developed, no external styles, *lower molars* with four principal cusps partly alternating (the inner pair not opposite the outer pair), heels not basined, hypoconulids small median, heel of m_3 comparatively short; *humerus* moderately expanded distally with entepicondylar foramen and supratrochlear vacuity, shaft of *ulna* wide but thin, olecranon large, *radius* with flattened oval head; *carpals* separate, lunar-unciform contact considerable; in *pelvis* iliac bar trihedral, ischium takes little or no part in symphysis, *femur* rather short, third trochanter prominent and situated well down on shaft, tibia separate from fibula; in pes, *astragalus* with short distinct neck, flattened head, tibial facet oblique, little grooved, no inner malleolar crest, foramen distinct, *calcaneum* with slight fibular facet, *cuboid* with distinct astragalar facet facing chiefly internal, five *metatarsals*, the lateral digits unreduced, distal ends hinge-jointed, *phalanges* short, unguals claw-like, fissured, not compressed.

This genus is abundant in all the Eocene horizons above the Clark Fork. In the Clark Fork it is not found.

Although skulls and skeleton parts are rare the species are represented in our Wasatch and Wind River collections by great numbers of jaws and parts of jaws, about one thousand altogether. The chief specific distinctions are: size, length of teeth, differentiation of entoconid from hypoconulid on m_3 ; development of hypocone on upper molars, size of m^3 and of heel of m_3 , form of p_{3-4}^{3-4} and disappearance of the basined talonid. In these characters the oldest species approach near to *Haplomylus*, while the latest species approximate those of the Middle Eocene.

The true horizons of the several Lower Eocene species have not heretofore been understood correctly, but the abundant comparative material makes them clear. The described species are as follows:

<i>H. miticulus</i> (Cope, 1874)	Wasatch	New Mexico.
<i>H. mentalis</i> (Cope, 1875)	"	" "
<i>H. lemoinianus</i> Cope, 1882	Bighorn basin	Wyoming.
<i>H. powellianus</i> Cope, 1885	" "	"
<i>H. wortmani</i> Osborn, 1902	Wind River basin	"
<i>H. simplex</i> Loomis, 1905	Bighorn basin	"
<i>H. minor</i> Loomis, 1905	Wind River basin	"
<i>H. browni</i> Loomis, 1905	" " "	"
<i>H. jacksoni</i> Loomis, 1905	" " "	"

All these are nearly allied to each other and to the Bridger species. *H. lemoinianus* appears to be a synonym of *H. mentalis*, and *H. jacksoni*

of *H. browni*. The others are retained as species or subspecies and two new forms are added.

Osborn in 1902 pointed out the evolutionary progress observable in the species of *Hyopsodus* from successive stages of the Lower and Middle Eocene; this is in general confirmed and extended by the far larger collections now available and the somewhat wider geologic range of the genus; but it is evident that not one but three or four phyla are present in each horizon; the relations of the Lower Eocene species to those of the Middle Eocene are not wholly clear, and the geological overlap of stages of each structural phylum suggests rather progressive displacement of older by newer stages coming in from some other region, than gradual evolution *in loco*. It might equally well be interpreted as the displacement of older by newer "mutants", in the DeVriesian sense of this term.

However this may be, the Lower Eocene species are distinguished from those of the Middle Eocene by the less molariform premolars, and this is most noticeable in *H. simplex* from the lowest horizon, while the Lost Cabin species approach nearest to those of the Bridger. In *H. simplex* the hypocones of the upper molars are smaller, the lower molar heels are more distinctly basined, m^3 is small and the entoconid of m_3 is not distinct from the hypoconulid, characters lost in the later species and indicating affinities with the Paleocene Mioclænidae, and with the more or less intermediate genus *Haplomylus*.

Ameghino¹ has referred to the Hyopsodontidae the genus *Selenoconus* of the Notostylops horizon in Patagonia, considering it as a separable with difficulty from *Hyopsodus*. His figures and descriptions indicate, however, that the lower molars in this genus had the characteristic and peculiar construction of the Notoungulata, which I will have occasion to discuss in a later section of this revision. Schlosser² refers *Selenoconus* to the Archæopithecidae, and figures the upper and lower teeth of *Oldfieldthomasia*, a closely related if not identical genus. Such resemblances as appear between this genus and the Hyopsodontidae may perhaps indicate common descent from the Mioclænidae but probably not any closer relationship.

Key to Species of *Hyopsodus*.

- A. Hypocone small on m^{1-2} , absent on m^3 .
 - a. M^3 and heel of m_3 very small, no entoconid on m_3 .
 - 1. $M_{1-3} = 10$ mm. *H. simplex*.
- B. Hypocone well developed on m^{1-2} , small on m^3 .

¹ Ameghino, 1906, Anal. Mus. Nac. Buenos Aires, t. XV, (3^e sér, t. VI) p. 291, figs. 72-3.

² Schlosser, 1911, in Zittel's Grundzüge d. Pal., Vertebrata, p. 517.

- b. M^3 and heel of m_3 small, entoconid of m_3 imperfectly separate from hypoconulid
 - 2. $M_{1-3} = 11$ mm. *H. miticulus*
- c. M^3 and heel of m_3 large, entoconid of m_3 distinct from hypoconulid
 - 3. $M_{1-3} = 10$ mm. *H. wortmani*
 - 4. $M_{1-3} = 12$ mm. *H. mentalis*
- c. Hypocone strong on m^{1-2} , p^4 subquadrate
 - d. M^3 and heel of m_3 large, elongate, entoconid of m_3 distinct
 - 5. $M_{1-3} = 18$ mm.; p^3_3 simpler. *H. powellianus*
 - 6. $M_{1-3} = 20$ mm.; p^3_3 more complex. *H. walcottianus*
- d. Hypocone strong on m^{1-2} , variable on m^2 , p^4 subquadrate
 - e. M^3 and heel of m_3 large, entoconid of m_3 distinct
Premolars more crowded, p_4 quadrangular, roots of p_2 connate or completely united. All from Middle Eocene.
 - 7. $M_{1-3} = 13$ mm. *H. paulus*
 - 8. $M_{1-3} = 11$ mm. *H. minusculus*
 - 9. $M_{1-3} = 12$ mm. *H. lepidus*
 - 10. $M_{1-3} = 14$ mm. *H. despiciens*
 - 11. $M_{1-3} = 15$ mm.; deuterococone on p^2 *H. marshi*

***Hyopsodus simplex* Loomis 1905.**

Hyopsodus simplex LOOMIS 1905. Amer. Jour. Sci., 1905, Vol. XIX, p. 419, fig. 2, type only.

Type, a lower jaw fragment in the Amherst Museum.

This species is characteristic of the red-banded basal zone (Sand Coulée beds) of the Wasatch, although the type is from the later Gray Bull horizon and does not display the primitive characters so clearly as the older specimens.

M^3 and the heel of m_3 are much reduced, hypocone weak on m^{1-2} , absent

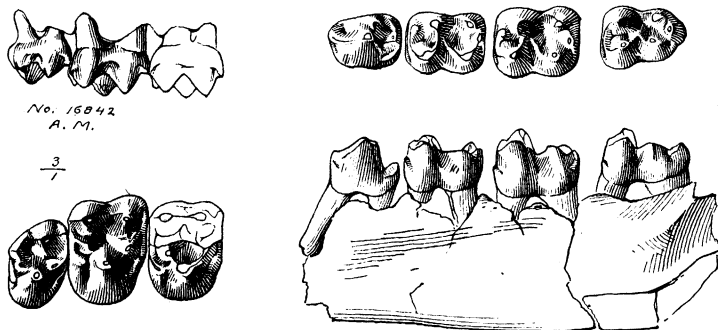


Fig. 3. *Hyopsodus simplex* Loomis, No. 16842, upper and lower jaw fragments. Sand Coulée beds, Clark Fork basin, Wyoming. Upper molars, lower molars and p_4 , crown and external views, three times natural size.

on m^3 , deuterococone of p^4 more triangular than in *H. miticulus* with weaker cingula on its anterior and posterior faces.

Referred specimens in Amer. Mus. Coll., Nos. 16081, anterior half of skull, 16082-7 upper and lower jaw fragments. All from Sand Coulee beds of Clark Fork basin. Length, $m_{1-3} = 10-11$ mm.

This species shows a marked approach to *Haplomylys*, and through that genus to the Mioclenidae and the smaller Periptychidae.

***Hyopsodus miticulus* (Cope 1874).**

Esthonyx miticulus COPE, 1874, Rep. Vert. Foss. New Mex., p. 8; (*Hyopsodus*) 1875, Syst. Cat. Eoc. Vert. New Mex., p. 8; 1877, Rep. Vert. Foss. New Mex., p. 150, pl. xlv, figs. 10-12.—OSBORN, 1902, Bull. A. M. N. H., Vol. XVI, p. 183, fig. 6.

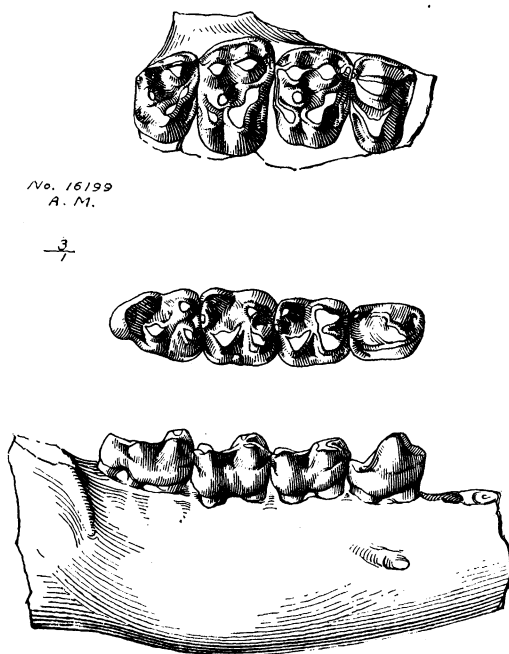


Fig. 4. *Hyopsodus miticulus*, topotype, upper and lower jaws, No. 16199. Crown views of upper and lower teeth p^4-m^3 , p_4-m_3 and external view of lower jaw, all enlarged to three diameters. Almagre beds, Arroyo Blanco, Wasatch of New Mexico.

Type, a lower jaw fragment with m_{1-3} , fig. 10 of Cope's 1877 report. Not found in National Museum collection.

The species is distinguished by small size, short wide molars, short and small fourth premolar. Hypocone strong on m^{1-2} but smaller than protocone; a small hypocone on m^3 . M^3 smaller than m^1 , metacone usually small. Deuterocones of p^{3-4} relatively small. Entoconid imperfectly separated from hypoconulid. Length of $m_{1-3} = 10.5$ to 12 mm.

No. 16199, upper and lower jaws from the Almagre horizon of New Mexican Wasatch,

agrees with Cope's figure and description and may serve as topotype. No additional specimens from this region, but it is very abundant in the Gray

Bull horizon of the Bighorn Wasatch. Several hundred specimens are at hand for comparison showing a considerable range in size, and variation in various characters, but fairly constant in those cited above.

***Hyopsodus mentalis* Cope 1875.**

Antiacodon mentalis COPE, 1875, Syst. Cat. Eoc. Vert. New Mex., p. 17; (*Sarcolemur*) 1877, Rep. Vert. Foss. New Mex., p. 149, pl. xlv, fig. 15.

Syn., *Hyopsodus lemoinianus* COPE, 1882, Proc. Am. Phil. Soc., Vol. XX, p. 148; Tertiary Vertebrata, p. 236, pl. xxive, fig. 9.— OSBORN, 1902, Bull. A. M. N. H., Vol. XVI, p. 183, fig. 7.— LOOMIS, 1905, Am. Journ. Sci., Vol. XIX, p. 420, fig. 3.

Type, a lower jaw fragment with m_{1-2} , figured by Cope in 1877. Not found in National Museum collection.

No. 16194, upper and lower jaws, from the upper horizon (Largo beds)

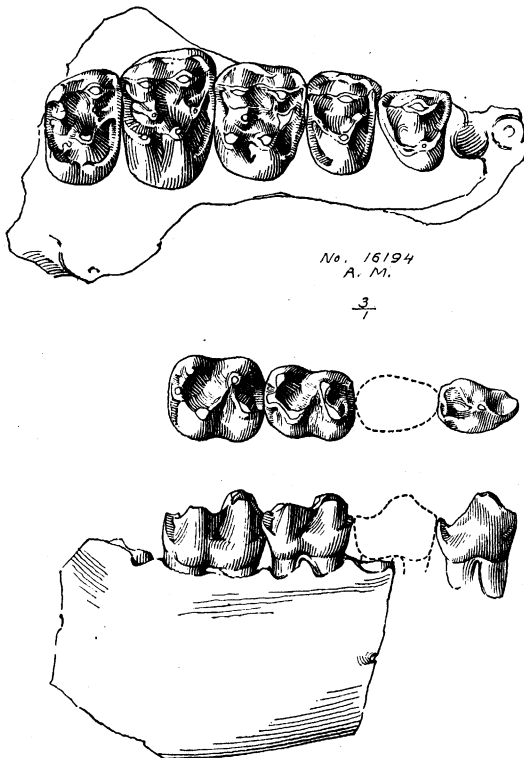


Fig. 5. *Hyopsodus mentalis* Cope, topotype, upper and lower jaws, No. 16194. Crown views of upper and lower teeth and external view of lower jaw fragment all enlarged to three diameters. Largo beds, Ojo San Jose, Wasatch of New Mexico.

of the New Mexican Wasatch, agrees with Cope's figure and description and may serve as topotype.

The species is larger than *H. miticulus*, the lower molars more elongate, the fourth premolar decidedly larger, longer and more trenchant. The hypoconulid and entoconid of m_3 are clearly distinct. M^3 almost or quite as large as m^1 , hypocone distinct, and on m^{1-2} subequal with protocone. Deuterocone of p^4 as wide as protocone, on p^3 large with strong connecting crests. Length of lower molars, $m_{1-3} = 14-15$ mm.

A number of jaws from the upper and lower levels of the New Mexican Wasatch agrees very nearly with this species. There would appear to be considerable variation in certain characters. In three specimens the last upper molar has the metacone greatly reduced, in the others, as in the topotype, it is normal. In the topotype, as in Cope's type, the metaconid is indistinctly twinned, but in other specimens it is simple.

Hyopsodus lemoinianus Cope does not differ in any way from this species. The type is from the Bighorn Wasatch, horizon unknown. Loomis records the species as from the Gray Bull River, but all our typical material comes from the Lost Cabin horizon, and some if not all of his Gray Bull specimens may be from this level, others are perhaps large individuals of *miticulus*.

In the Lost Cabin horizon this species is abundant both in the Bighorn basin and in the Wind River Valley. It is represented by the smaller mutant *lysitensis* in the Lysite of both basins.

***Hyopsodus mentalis lysitensis* subsp. nov.**

Hyopsodus lemoinianus Cope OSBORN, 1902, Bull. A. M. N. H., Vol. XVII, p. 183, fig. 7a. Not the type specimen of *H. lemoinianus*.

Type, No. 15621, left ramus of jaw with p_2-m_3 ; Lysite beds, 15 Mile Creek, Bighorn basin, Wyo. Exp. 1911.

While the typical *mentalis* appears to be strictly limited to the Lost Cabin zone, a smaller form is abundant in the Lysite both in the Wind River and Bighorn basins. I regard it as a subspecies of *mentalis*.

This subspecies lies intermediate between *H. mentalis* and *H. miticulus*, both in size and progressiveness. Although chiefly found in the Lysite, it occurs more sparingly in the Lost Cabin horizon.

***Hyopsodus powellianus* Cope 1885.**

Phenacodus zuniensis COPE, 1882, Proc. Amer. Phil. Soc., Vol. XX, p. 179. Not *P. zuniensis* Cope, 1881.

Hyopsodus powellianus COPE, 1885, *Tertiary Vertebrata*, p. 235, pl. xxiii, fig. 3-4; OSBORN, 1902, *Bull. A. M. N. H.*, Vol. XVI, p. 184, fig. 9.
Phenacodus laticuneus COPE, 1882, in part, see *infra*, p.?

Type (lectotype), No. 4147, lower jaw with m_{1-3} . Horizon unrecorded, Bighorn basin, Wyoming.

Characters: $M_{1-3} = 18$ mm. M_3 with long heel, entoconid distinct. Hypocones of m^{1-3} strong, antero-internal cingula heavy, p^4 subquadrate. P_4 with well developed deutoconid.

This species is very abundant in the Lysite horizon, in the Bighorn basin. So far as our material shows it is wholly confined to this level, although Loomis records two specimens from the Gray Bull (but possibly these are

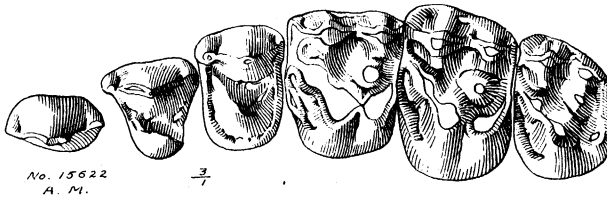


Fig. 6. *Hyopsodus powellianus* Cope, topotype, upper jaw, No. 15622. Crown view of upper teeth, left side enlarged three diameters. The premolars are reversed from the right maxilla. Lysite beds, Coyote Cañon, Bighorn basin, Wyoming.

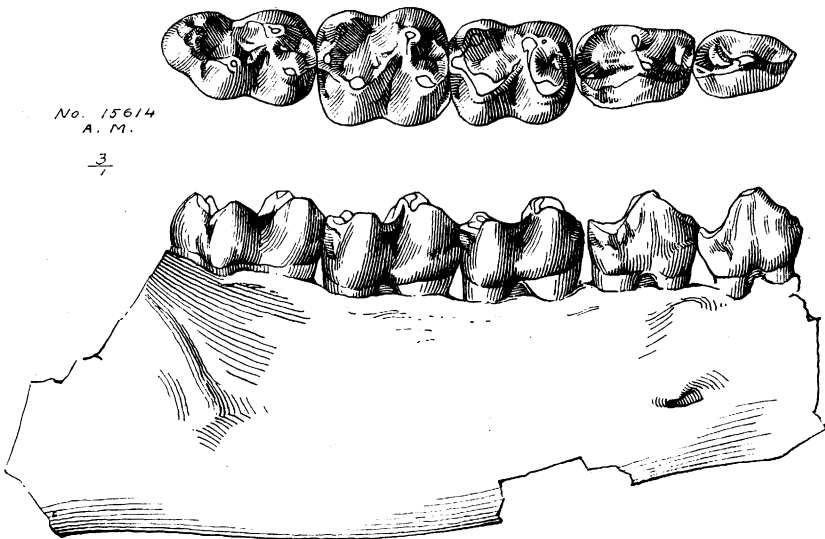


Fig. 7. *Hyopsodus powellianus*, topotype, No. 15614, lower jaw, three diameters. Lysite beds, Fifteen-mile Creek, Bighorn basin, Wyoming.

also from the Lysite). It has not been found in New Mexico. In the Wind River basin it is represented in the Lysite horizon by a nearly related but uniformly smaller variant *H. browni*.

***Hyopsodus powellianus browni* Loomis.**

Hyopsodus browni LOOMIS, 1905, Am. Journ. Sci., Vol. XIX, p. 422, fig. 7.
Syn., *H. jacksoni*, *H. lawsoni* loc. cit., p. 423, fig. 8.

Type, a lower jaw fragment in the Amherst Museum.

The fourth premolar of Dr. Loomis's type is altogether exceptional in the lack of any strong deutoconid. This is not the normal character of the species as shown by a large series of topotypes in the American Museum collection. The supposed third premolar of *H. jacksoni* ("*lawsoni*" in figure) appears to be the fourth premolar of a smaller individual. While the topotype series shows some variability in the form of m^3 and a few other characters they run fairly constant in size and in most characteristics and there is no indication of the peculiar features on which Dr. Loomis characterized these two species, and which are not normally present in any species of this genus, although they occur occasionally as abnormalities. I regard the series as representing a single subspecies intermediate in size between *H. powellianus* and *mentalis* and somewhat more primitive than either. The heel of the last molar is more elongate than in *H. mentalis*, the heel of p_3 has no inner cusp, and the size is larger. These characters ally it with *powellianus*. It is abundant in the type locality, Cottonwood Draw (Bridger Creek) in the Wind River basin, and found more rarely in the Lysite of the Bighorn basin. A few doubtful specimens are found in the Lost Cabin horizon.

***Hyopsodus walcottianus* sp. nov.**

Type, No. 14654, upper and lower jaws, parts of limb bones and hind foot, from Lost Cabin beds, Wind River basin.

Distinctive Characters. Larger than *H. powellianus*, deutocones of p^{3-4} more conical with no anterior crescent-wing, deutoconid of p_4 more posterior in position, p_3 more robust, less spatulate, basal cusps of lower premolars and external styles of upper premolars more distinct. Length $m^{1-3} = 18$; $m_{1-3} = 21$ mm.

This is the largest known species of the genus, and appears to be the Lost Cabin successor of *H. powellianus* of the Lysite beds. It has therefore seemed appropriate to name it after the distinguished palaeontologist who was Major Powell's successor as director of the Geological Survey.

In addition to the type, two lower jaws are referred here, one from the

Lost Cabin horizon, at Beaver Creek divide, south of the Wind River basin, No. 14967, the other from the typical Lost Cabin beds, No. 14617. The latter is smaller but otherwise shows the progressive character of the species. Other fragmentary specimens are of doubtful reference.

The characters of limb and foot bones have been indicated in the generic diagnosis of *Hyopsodus*. Except in size and robustness I do not observe any specific distinctions in the skeleton parts from *H. paulus* as described in the Bridger memoir.

***Hyopsodus wortmani* Osborn 1902.**

Hyopsodus wortmani OSBORN, 1902, Bull. A. M. N. H., Vol. XVI, p. 185, fig. 11; LOOMIS, 1905, Am. Journ. Sci., Vol. XIX, p. 421, fig. 5.

Type, No. 4716, upper and lower jaws from the Wind River basin, Wyoming.

The lower molars are narrow and elongate, the heel of m_3 long, with entoconid well separated from metaconulid, and the last upper molar is larger than in *H. miticulus*, the size of its hypocone varying but more frequently large. The premolars are distinctly more progressive, p_4 more quadrate in outline, with deutoconid and deutocone relatively larger than in the older species. From *H. mentalis* it is distinguished by smaller size and less robust form of teeth.

This form is common in the Lost Cabin horizon of the Wind River basin, while in the Lysite a smaller form, probably a subspecies, is found, and has been named *H. minor* by Dr. Loomis.

This species and *H. mentalis* are closely related to the Bridger species, *H. minusculus* and *H. paulus* respectively. The distinctions are not clear, although the Middle Eocene species average more progressive.

***Hyopsodus wortmani* ?*minor* Loomis 1905.**

A lower jaw from the Lysite level in the Wind River Valley and another from the same horizon in the Bighorn basin indicate a little *Hyopsodus* close to *H. wortmani* in tooth characters, but of smaller size, the molars only 10 mm. In its relatively narrow, high cusped teeth, long heel of m_3 and well separated metaconid it is very different from *simplex* with which it agrees in size.

Loomis's type of *Hyopsodus minor* came from the same locality and level as these Wind River specimens and agrees in size; but Loomis describes the teeth as "short," whereas in these specimens, as in *wortmani*, they are unusually long. The identification is therefore questionable.

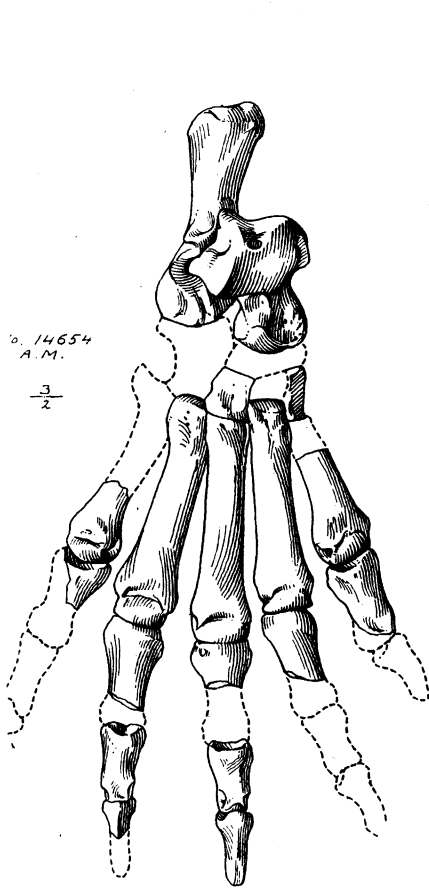


Fig. 9.

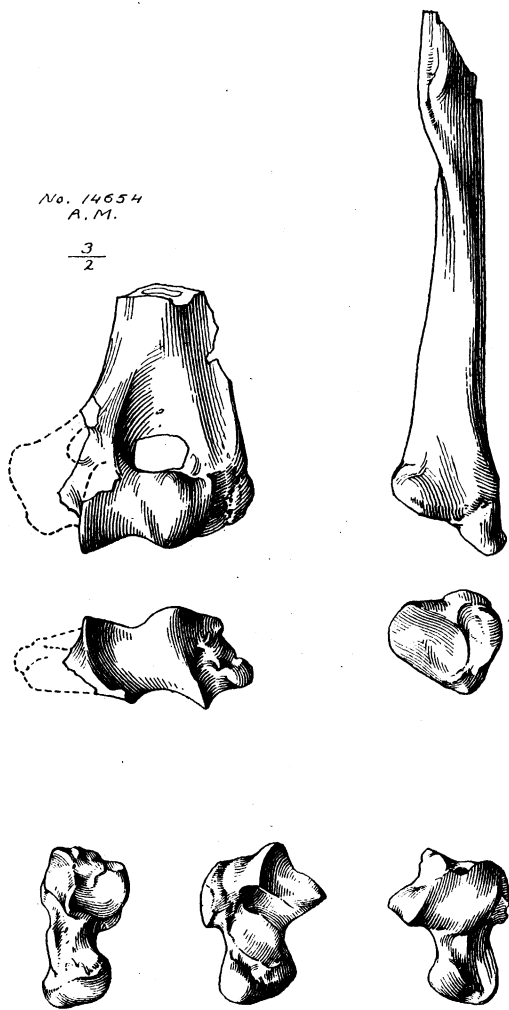


Fig. 10.

Figs. 9 and 10. *Hyopsodus walcottianus*, type, hind foot, humerus, tibia and astragalus, all one and a half times natural size. No. 14654, Lost Cabin beds, Wind River basin, Wyoming.

Geological Level and Localities of Species of Hyopsodus.

On account of their great abundance the species of *Hyopsodus* afford valuable data for correlation of the Lower Eocene formations.

Their occurrence in our collections so far as identifiable is as follows:

I. Clark Fork basin.			
C. Gray Bull beds (Systemodon zone)			
	<i>H. miticulus</i>	24	specimens
B. Sand Coulée beds			
	<i>H. simplex</i>	18	"
A. Clark Fork beds			
No <i>Hyopsodus</i>			
II. Bighorn basin.			
C. Lost Cabin			
	<i>H. walcottianus</i>	2	"
	<i>H. powellianus browni</i>	1	"
	<i>H. mentalis lysitensis</i>	3	"
	<i>H. wortmani</i>	2	"
B. Lysite			
	<i>H. powellianus</i>	114	"
	<i>H. powellianus browni</i>	2	"
	<i>H. mentalis lysitensis</i>	96	"
	<i>H. wortmani minor</i>	2	"
A. Gray Bull beds.			
	<i>H. miticulus</i>	about 450	"
III. Wind River basin.			
B. Lost Cabin			
	<i>H. walcottianus</i>	3	"
	<i>H. mentalis</i>	50	"
	<i>H. " lysitensis</i>	17	"
	<i>H. wortmani</i>	14	"
A. Lysite			
	<i>H. powellianus</i>	4	"
	<i>H. " browni</i>	92	"
	<i>H. mentalis</i>	1	"
	<i>H. mentalis lysitensis</i>	32	"
	<i>H. wortmani minor</i>	1	"
IV. New Mexican Wasatch.			
B. Upper zone (Largo beds)			
	<i>H. mentalis</i>	27	"
A. Lower zone (Almagre beds)			
	<i>H. mentalis</i>	15	"
	<i>H. " ?lysitensis</i>	120	"
	<i>H. miticulus</i>	1	"

¹ Mostly from top of lower beds.

Species of <i>Hyopsodus</i>	Sand Coulée	Gray Bull		Lysite			Lost Cabin		
	Clark Fork	Clark Fork	Bighorn	Lower Wasatch of New Mexico	Wind River	Bighorn	Bighorn	Wind River	Upper Wasatch of New Mexico
simplex	18	..	1	..	..	...	..	..	..
miticulus	..	24	450	1	..	...	..	..	..
lysitensis	20	32	96	3	17	..
minor	1	2	..	..	..
wortmani	2	14	..
mentalis	5	1	...	..	50	27
browni	92	2	1	..	..
powellianus	4	114	..	..	..
walcottianus	2	3	..
(Total)	18	24	451	26	130	214	8	84	27

The Status of the genus Diacodexis Cope 1882.¹

(Type *Phenacodus laticuneus* Cope 1882.²) The type species of this genus was based upon a specimen, No. 4202, Am. Mus. Coll., consisting of three jaw fragments with teeth supposed to belong to one individual. It now appears that these three fragments pertained to animals of three different orders of mammalia, as follows:

- (a) Upper premolars of *Eohippus* sp.
- (b) Upper molars of *Hyopsodus* sp.
- (c) Last lower molar of an Artiodactyl related to *Trigonolestes*.

When the Cope collection was acquired by the American Museum this type was reëxamined by Professor Osborn and Dr. Wortman, and recognized as a composite of *Eohippus* and *Hyopsodus*. As a result of this examination in 1899 the upper premolars were removed from the type by Matthew³ and the species referred to *Hyopsodus*. The characters of the upper molars were the substantive basis of this reference, the lower molar being recognized as abnormal for *Hyopsodus* although its true character was not suspected. The new collections from the Wasatch beds of the

¹ Amer. Nat., Vol. XVI, p. 1029.
² Proc. Am. Phil. Soc., Vol. XX, pp. 179, 181.
³ Bull. A. M. N. H., Vol. XII, p. 30.

Bighorn Valley include remains of a number of genera and species of *Trigonolestidae*, comparison of which with the lower molar of *Diacodexis* enabled Mr. Granger to recognize its real relationship.

The upper molars are unquestionably *Hyopsodus* and agree with specimens referred to *H. powellianus* Cope 1885. (*P. zuniensis* Cope,¹ 1882, *l. c.*)

Of the three specimens, No. 4202, a., b. and c. which constitute co-types of *Diacodexis laticuneus*, the jaw fragment with m_3 must apparently be taken as lectotype. It is the first described specimen, as its characters form the basis of the specific distinctions given in the key to the species of *Phenacodus* on p. 12 and a reference to this characterization precedes the description of the upper molars in the species description on p. 19. It is the specimen upon which the species name is obviously based. And it is a corresponding part to the type specimen of *P. primævus* which Cope had described in 1873, on the evidence of a last lower molar. The m_3 of "*Phenacodus*" *laticuneus* agrees sufficiently with the type m_3 of *P. primævus* to suggest its belonging to the same genus; this suggestion was evidently confirmed in Professor Cope's mind by comparison of the upper molars, No. 4202b, with those of other species of *Phenacodus*, *P. primævus* and *P.* (now *Tetracænodon*) *puercensis*.

The lower jaw fragment therefore was the primary basis of the specific distinctions and in part the basis of the generic reference of the original description of *P. laticuneus*, and is the first of the cotype specimens to be described. Following the intent of the author so far as ascertainable² it should therefore be selected as the lectotype.

Diacodexis thus stands as a genus of Eocene Artiodactyla, not as a synonym of *Hyopsodus*, and the name has been so used by Dr. Sinclair,³ preoccupying *Trigonolestes* of later date.

¹ This is not *P. zuniensis* Cope 1881 (Proc. Am. Phil. Soc., XIX, 492), which was referred by Matthew in 1897 to *Tricentes subtrigonus*.

² See Catalogue of Type Specimens U. S. National Museum, Introduction, p. 12.

³ Sinclair 1914, Bull. A. M. N. H., Vol. XXXIII, p. 289.