

Article XXXIV.—A REVISION OF THE EOCENE PRIMATES OF THE GENUS *NOTHARCTUS*.

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PLATES CIII–CVII.

In 1902 Professor Osborn¹ referred to the genus *Notharctus* Leidy a number of Middle Eocene primates which had been placed in distinct genera by Marsh and by Cope; he traced the successive stages in the evolution of the dentition from the very primitive *Pelycodus frugivorus* of the Wasatch, with tritubercular upper molars, to the very advanced *Notharctus* (*Telmatolestes*) *crassus* of the Bridger; he defined the genera *Pelycodus* and *Notharctus* as follows:

Pelycodus.

Jaw elongate. Mandibular symphysis uncoössified. Superior molars triangular with rudimentary hypocone; no mesostyle.

Notharctus.

Jaw stout. Symphysis typically coössified. Superior molars quadrate with pronounced hypocone; a mesostyle.

In 1903 and 1904 the American Museum expeditions to the Bridger Basin, in charge of W. Granger, discovered much additional material of *Notharctus*, including a large number of jaws and teeth, a nearly perfect skull and two incomplete skeletons. The dentition, skull and skeletons will shortly be described from the morphological and phylogenetic viewpoint in the 'Studies on the Evolution of the Primates' by W. K. Gregory; the jaws and teeth of the Bridger *Notharctinae* are studied with reference to their generic and specific characters in the present paper.

In 1905 and subsequent years the American Museum expeditions to the Lower Eocene formations of Wyoming and New Mexico, in charge of W. Granger, secured large collections of primate jaws and teeth from ascending horizons; this material was described in 1915 by Dr. Matthew,² who revised all the Lower Eocene species of *Pelycodus* and *Notharctus* and added the new and very primitive species *Pelycodus ralstoni* and *P. trigonodus*. He also catalogued and partly identified the new material from the Middle Eocene formation and suggested that the present writers should prepare a detailed report upon it.

¹ Bull. Amer. Mus. Nat. Hist., Vol. XVI, 1902, pp. 190–199.

² Bull. Amer. Mus. Nat. Hist., Vol. XXXIV, 1915, pp. 433–483.

Through the generosity of Professor Lull of the Peabody Museum at Yale University we are enabled to figure for the first time Marsh's types of the species *tyrannus*, *affinis*, *anceps* and *crassus*, and to describe and figure the skull of an apparently new genus and species of Middle Eocene primate. The United States National Museum, through the courtesy of Doctor Rathbun, permitted the writers to obtain and publish photographs of Leidy's types of *Hipposyus formosus* and *H. robustior*.

The photographs for the present paper have been prepared by Mr. A. E. Anderson.

The leading specific characters of the lower teeth are summarized in Table I, p. 843. The geological succession and probable relationships of the species of *Pelycodus* and *Notharctus* are summarized in Table II, p. 844.

Order PRIMATES.

Suborder LEMURIFORMES.¹

Family ADAPIDÆ.²

Subfamily NOTHARCTINÆ.

Lower and Middle Eocene, North America. Posterointernal cusp of upper molars (pseudo-hypocone) progressively arising from a ridge connected with the protocone; cingulum-hypocone not developed; m^1 - m^3 progressively acquiring a mesostyle. First lower molars primitively with true paraconids located immediately in front of the metaconids; these are frequently lost, while a central median cusp (pseudo-paraconid) is frequently present; hypoconulid on m_{1-3} , no metacristid (cusp on crest behind metaconid); ramus of mandible elongate, angle not expanded, coronoid high, nearly vertical; incisors truncate spatulate; canines caniniform, high, not compressed; premolars p_1 , p_2 typically spaced, p_2 , p_3 not compressed; entoconid progressive on m_1 , m_2 ; symphysis of mandible not coössified or suture distinct. Fourth upper premolar with retarded evolution of the postero-external cusps, which is distinct only in the later species. Lower incisors with small crowns not widely expanded; canines progressively stout and caniniform, especially in males.

¹ Gregory, W. K. Bull. Geol. Soc. Amer., Vol. 26, 1915, p. 432.

² *Ibid.*, p. 422.

Table I. *Comparison of the species of Notharctus.*

	WIND RIVER		BRIDGER							
	N. numenius	N. venticolus	N. matthewi	N. osborni	N. anceps	N. affinis	N. tyrannus	N. tenebrosus	N. pugnax	N. crassus
M ₁ -m ₃	15.5	19.4	15.	16.6	17.5	18.	18 (est.)	18.5	20.7	23.5
M ₁ -m ₂	9.	11.8	9.	10.	10.7	11.	11.	11.3	13.	14.
Depth of ramus below center of m ₂	8.5	13.	8.	10.5	8.5	8.3	11.2	11.8	10.5	12.3 (ref.)
Width of talonid of m ₂	4.1	5.5	3.6	4.1	4.4	4.4	4.7 est.	4.5	5.	6.2
Condition of paraconids	Strong on m ₁ Weaker " m ₂ Weak " m ₃	Pres. on m ₁ " " m ₂ " " m ₃	Pres. on m ₁ Small " m ₂ Vest. " m ₃	Small on m ₁ Vest. " m ₂ Abs. " m ₃	Pres. on m ₁ Vest. " m ₂ Abs. " m ₃	Pres. on m ₁ Vest. " m ₂ Abs. " m ₃	Low on m ₁ Abs. " m ₂ " " m ₃	Strong on m ₁ Weak " m ₂ " " m ₃	Pres. on m ₁ Abs. " m ₂ " " m ₃	Strong on m ₁ Weak " m ₂ Incip. " m ₃
Accessory cusps in entoconid region of m ₃	HI'd double	Strong	None	Reduced	Present	Present	Present	Present	?	Strong
External cingulum extending onto talonid	Absent on m ₁ , m ₂ ; weak on m ₃	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Variable
P ₁ , P ₂ , diastemata	P ₁ diast. P ₂ not	P ₁ diast. P ₂ not	P ₁ diast. P ₂ not	Pronounced	Present	Absent	Present	Present	?	Present

Table II. Progressive increase in the length of the lower molars (m_{1-3}) in Lower and Middle Eocene lemuroids of the family Adapidae (subfamily Notharctinae).¹

MIDDLE EOCENE	Horizons								
	UPPER BRIDGER Bridger Basin, Wyo.		p ⁴ with 2 subequal external cusps m ¹⁻¹ with large mesostyle <i>N. crassus</i> molars quadritubercular 20.7-23.5 mm.						
	LOWER BRIDGER Bridger Basin, Wyo.		<i>N. mat-</i>	<i>os-</i>	<i>an-</i>		<i>tyran-</i>	<i>tene-</i>	<i>pug-</i>
			<i>thewi</i>	<i>borni</i>	<i>ceps</i>	<i>affinis</i>	<i>nus</i>	<i>brozus</i>	<i>nax</i>
			15	16.6	17.5	18	18 est.	18.6-19	20.7
LOWER EOCENE	LOST CABIN Bighorn Basin } Wyo. Wind River Basin }		<i>Nothartus nunienus</i> 15.5				<i>N. venticolus</i> 18-19.2		
	ALMAGRE ² N. Mex.						<i>P. tutus</i> 19		
	LYSITE Bighorn Basin } Wyo. Wind River Basin }		<i>Pelycodus frugivorus</i> 14-16				<i>P. jarovii</i>		
	UPPER GRAY BULL Bighorn Basin, Wyo.		<i>P. frugivorus</i>				<i>P. jarovii</i> 16-18		
	LOWER Wyo.		<i>P. trigonodus</i> 15				<i>P. jarovii</i>		
			<i>P. ralstoni</i>						
	SAND COULEE Clark Fork Basin, Wyo.		<i>Pelycodus ralstoni</i> 11-14 mm.				p ⁴ with 1 external cusp, m ¹⁻³ without mesostyle, molars tritubercular		

If it were not for the annectant characters of *N. anceps*, *affinis* and *tyrannus* the genus *Nothartus* might be divided into two subgenera, typified by *N. matthewi* and *N. crassus*.

¹ Data for Lower Eocene species compiled from Matthew, 'A Revision of the Lower Eocene, Wasatch and Wind River Faunas.'

² The upper levels of the Almagre of New Mexico are perhaps equivalent to the Lysite. Granger, Bull. Amer. Mus. Nat. Hist., Vol. XXXIII, 1914, p. 207.

Genus **Notharctus** Leidy 1870.

Type, *Notharctus tenebrosus* LEIDY, Proc. Acad. Nat. Sci. Phila., 1870, p. 114.

(Defined as above, p. 841).

Limnotherium MARSH, Amer. Jour. Sci., Vol. II, "June 5th, 1871," pp. 11, 12.

Thinolestes MARSH, Amer. Jour. Sci., Vol. IV, "Aug. 7th, 1872," p. 13.

Telmatolestes MARSH, Amer. Jour. Sci., Vol. IV, "Aug. 7, 1872," p. 14.

Tomitherium COPE, Palæont. Bull. No. 3, "Aug. 7th, 1872," Proc. Amer. Phil. Soc., Vol. XII, p. 470.

Hipposyus LEIDY, Proc. Acad. Nat. Sci. Phila., 1872 (June 25), p. 37.

The types of the type species of the genera *Notharctus*, *Hipposyus*, *Limnotherium*, *Thinolestes*, *Tomitherium* were carefully studied by the present writers, comparisons also being made with referred material in the American and Yale Museums. We were unable to perceive generic distinctions between these types and we therefore follow Osborn (1902, pp. 195-198) and Matthew (1899, p. 37) in regarding *Limnotherium*, *Thinolestes*, *Tomitherium* and *Hipposyus* as synonyms of *Notharctus*. Even the large and progressive Upper Bridger form described by Marsh as *Telmatolestes crassus* falls within the generic definition of *Notharctus* and is connected with the more typical species by the new species, *N. pugnax*, described below.

Although *Notharctus* is characteristic of the Middle Eocene two species (*N. nunienus*, *N. venticolus*) occur in the Lost Cabin formation in the Wind River Basin at the summit of the Lower Eocene.

Notharctus nunienus (Cope).

MATTHEW, 1915, Bull. Amer. Mus. Nat. Hist., Vol. XXXIV, pp. 444-445, Fig. 19.

"*Type*, [Amer. Mus.] No. 4734, lower jaw with p_3 - m_3 r. from Lost Cabin beds of Wind River basin, Wyoming.

Distinctive characters: M_{1-3} = 15 mm.; heel of m_3 bicuspid; symphysis of jaw not coössified." (Matthew.)

"...a little larger than *P[elycodus]*. *frugivorus* and distinguished by the more strongly developed hypocones — not as strong, however, as in *N. venticolus*. The species would be considered a mutation of *frugivorus* except that the one is referable to *Notharctus* and the other to *Pelycodus*, according to the distinctions established by Osborn." (Matthew.)

This species somewhat resembles *N. osborni* of the Lower Bridger in its narrow molars; but it is distinctly smaller and has two prominent cusps on the heel of m_3 ; true paraconids distinct, placed internally, immediately

in front of metaconids; molars m_1 , m_2 relatively shorter and wider, ramus shallow; p_2 compressed with two very distinct roots; p_4 with higher protoconid.

Notharctus venticolus Osborn.

OSBORN, 1902, Bull. Amer. Mus. Nat. Hist., Vol. XVI, p. 195; MATTHEW, 1915, *ibid.*, Vol. XXXIV, pp. 443-444, figs. 16, 17.

"Type, [Amer. Mus.] No. 4715b, parts of upper and lower jaws, from the Lost Cabin zone in the Wind River basin, Wyoming.

Distinctive characters: $M_{1-3} = 18$ mm.; symphysis of jaw not coössified." (Matthew.)

Differs from *N. tenebrosus* type in larger molars, especially m_3 , and well spaced p_1 ; jaw longer, lower canine larger. Small true paraconid on m_1 , m_2 , placed very close to metaconids, fainter on m_3 ; m_3 with two very small cusps in entoconid region. External cingulum of molars delicate; p_4 with distinct metaconid, p_2 with two roots. Root at p_1 with external groove indicating an incipient tendency to divide the single root into two. Upper premolars and molars with internal cingula faint or absent, hypocones of m^1 , m^2 not large, mesostyles small, external cingula delicate; $m^1-m^3 = 15$ mm.

Measurements.

(From Amer. Mus. No. 14655).

	mm.
P_1-m_3	35.
P_1-m_2	27.
M_1-m_3	19.4
M_2 ap. \times tr.....	5.5×5.5
M_3 ap.....	7.6

Notharctus sp.

From the Huerfano Basin, Colo., there is a single specimen (No. 17020, Coll. of 1916) referable to the Notharctinae; it consists of two fragments of the right ramus of the lower jaw supporting p_3 , p_4 and m_3 and has the alveoli of the canine and anterior premolars. This individual comes from the upper levels of the Huerfano where it was associated with *Tillotherium*, *Hyrachyus* and other Lower Bridger genera. The exact position of the fauna of the upper Huerfano has not yet been determined but from the collections and studies made to date it appears to be intermediate between the Bridger and the Wind River (Lost Cabin) faunas with, however, more resemblance to the former than to the latter. For this reason this specimen may properly be considered as belonging to the genus *Notharctus* rather

than to *Pelycodus* although it presents no characters to definitely place it in either genus. In size it is about equal to *P. ralstoni*, from the base of the Wasatch, and is therefore smaller than any Wind River or Bridger species of the Notharctinae. The m_3 has a double hypoconulid as in *N. nunienus* but differs from it in the much smaller size and in lack of the paraconid. The Bridger form which approaches it most closely in size is *N. matthewi* but this has a single hypoconulid on m_3 and a larger p_3 with a better developed talonid as well as a much deeper ramus anteriorly. In the slenderness of the symphyseal region and in the reduction and simplicity of the p_3 this Huerfano specimen is hardly equalled even in *P. ralstoni*, the most primitive species of this subfamily. The p_4 of the present form shows a strong well separated metaconid and a moderate talonid, a tooth, on the whole, rather closer to the *Notharctus* than to the *Pelycodus* stage of development.

Measurements of No. 17020.

	mm.
P_1-m_3	25. est.
M_{1-3}	14.5 est.
M_3 ap. \times tr.....	5.5 \times 3.
Depth of ramus at m_2	7.5

***Notharctus matthewi* sp. nov.**

Plate CIII, Fig. 1; Plate CIV, Fig. 1; Plate CVI, Fig. 1.

Type, Amer. Mus. No. 12011, lower jaw and p^3-m^1 right, from Grizzly Buttes, East, Bridger Basin, Wyoming, level B 2.

Distinctive characters: $m_{1-3} = 15$ mm.; symphysis not coössified; no true paraconids; pseudo-paraconid present on m_1 , centrally placed, small on m_2 , vestigial on m_3 ; external cingulum well defined on p_4-m_3 ; hypoconulid of m_3 single. P_4 with metaconid indistinct, low, not constricted from protoconid; p_1 spaced in front and behind; p_2 not spaced; p_1, p_2 with a single root. Canine delicate, erect, not caniniform, but much like p_1 . Ramus fairly deep, about as in *N. osborni*. Upper molars: posterointernal cusp small on m^1 , a little stronger on m^2 , barely differentiated from the protocone ridge; small mesostyle; contour of molar crown more quadrate internally than in Lower Eocene forms; p^4 without tritocone (outer cusp single).

Recognized as a distinct species by Dr. Matthew who noted its primitive features.

Amer. Mus. No. 13030, upper and lower jaws with fragmentary skeleton, from Lower Cottonwood Creek, Bridger Basin, level B3, agrees with *N. matthewi* in the retarded state of the hypocones, in the uncoössified symphysis, in the single outer cusp on p^4 and in the absence of true paraconids, but is somewhat more progressive in the development of the mesostyle.

Measurements.

	mm.
P ₁ -m ₃	26.2
M ₁₋₂	9.
M ₁₋₃	15.
M ₂ ap. × tr.....	4.7 × 3.6
M ¹⁻²	8.5
M ² trans.....	5.3

In the lower teeth this species closely resembles *N. osborni*, differing only in the smaller size, lack of diastema behind p₂, weaker metaconid on p₄, pseudo-paraconids present. It agrees with *Pelycodus* in the following characters: symphysis not coössified, postero-internal cusps very weak on m¹, m², metaconid on p₄ weak. It resembles *Notharctus* in having mesostyles on the upper molars and in their quadratè character. It is evidently a persistently primitive survival of the older genus *Pelycodus*, which has acquired only a few of the progressive *Notharctus* characters.

Referred material: Amer. Mus. No. 12566, Middle Cottonwood Creek, level B3, lower jaw and upper molars (posterointernal cusps more advanced than in type).

Notharctus osborni.

Plate CIII, Fig. 2; Plate CIV, Fig. 2.

Notharctus formosus GREGORY, 1916, Bull. Amer. Mus. Nat. Hist., Vol. XXXV, p. 262. Nec *Hipposyus formosus* LEIDY.

Type, Amer. Mus. No. 11466, nearly complete skull and lower jaw, from Grizzly Buttes, West, horizon B2, Bridger Basin, Wyoming.

Distinctive characters: Differs from *tyrannus*, *anceps* and *affinis* Marsh in the smaller and more slender lower molars with narrower talonids; m₃ has the two cusps of the entoconid region very small; true paraconids absent on m₁, m₂; a small paraconid (?pseudo-paraconid on m₂, m₃). External cingula not extending on talonid. Ramus of lower jaw deep in type (10.5 mm. below center of m₂), shallow in referred specimen (A. M. 11474, skel. A, 9.3 mm.). Lower canines small, with low crown (?a female character). P₁, p₂ spaced (diastemata closed in *affinis*); p₃ shorter than in *anceps*, with small talonid; p₄ with metaconid smaller than in *anceps*; p⁴-m³ with internal cingula weak (well defined in *anceps*); p⁴ less progressive than in *affinis*; internal cingulum weak.

Measurements of type.

	mm.
P ₁ -m ₃	31.4
M ₁ -m ₃	16.6
M ₁ -m ₂	10.
M ₂ tr.....	4.1
M ₃ ap.....	6.4
P ¹ -m ³	27.3
M ¹ -m ²	13.7
M ¹ -m ²	10.
P ³ -m ²	17.3

Referred specimens: Paratype, Amer. Mus. No. 11474, from Little Dry Creek, Bridger, Lower beds, Bridger Basin, Wyoming, lower jaws (incomplete in front) and fragments of skull associated with the greater part of the skeleton; Amer. Mus. No. 12569, from Grizzly Buttes, East, Bridger Basin, level B2, upper jaws associated with right and left periotic.

Notharctus anceps (Marsh).

Plate CIV, Fig. 3; Plate CVI, Figs. 2, 2a.

Thinolestes anceps MARSH, Amer. Jour. Sci., Vol. IV, "Aug. 7, 1872," p. 13.

Cotypes, 11786 A (lectotype) and 11786 B Yale Mus., from Grizzly Buttes, Wyo. Two individuals both with upper and lower teeth. Description and measurements taken from 11786 A (lectotype) consisting of lower jaws with m₁ right and roots or alveoli of anterior teeth including (right) canine, p₁-m₃ left and alveolus of canine (left, Plate II, fig. 3); m¹-m³ left and p¹-p⁴ right (Plate IV, Figs. 2, 2a). Teeth unworn; outer surface of p⁴ broken. This is the specimen upon which Marsh's description and measurements are based.

Distinctive characters (lectotype); m₁, m₂ very similar to type of *affinis*, m₃ differing in having two accessory cusps in entoconid region more distinct; paraconid (?pseudo-paraconid) present in m₁, vestigial in m₂, as in *affinis* and other lower beds forms; entoconids stronger; p₁, p₂ spaced, p₄ with high metaconid, almost as high as protoconid, and high trenchant heel. Canine much larger than p₁, p₂ with single root (as in *osborni*); ramus as in *affinis*. Upper molars as in *affinis*; p³, p⁴ less progressive than in *affinis*, i. e., p⁴ lacks tetartocone and is narrower transversely; p³ with deuterocone very small and low.

Measurements of type (lectotype).

	mm.
P ₁ -m ₃	32.7
M ₁ -m ₃	17.5
M ₁ -m ₂	10.7
Ramus below m ₂ , depth.....	8.5
M ¹ -m ³	15.
M ¹ -m ²	10.5

Differs from *tyrannus* in shallower ramus; width of talonid as in *affinis*.

Yale Mus. 11786 B (2nd cotype) consists of lower jaw fragments with m_1 , m_2 right, p_4 - m_3 left (Plate CIV, Fig. 4), p^3 - m^3 right (Plate CVI, Fig. 3), and left; all damaged.

The second cotype 11786 B differs from the lectotype (11786 A) in having the tritocone of p^4 and the deutocone of p^3 in a very early stage while that of the lectotype is a prominent cusp; also a corresponding difference in the lower p_4 , which in 11786 B has the metaconid down on the side of the crown, much below the level of the protoconid, while in the lectotype the metaconid is high, nearly on a level with the protoconid. The specific reference of the second cotype therefore is somewhat doubtful.

Notharctus affinis (Marsh).

Plate CIII, Fig. 3; Plate CV, Fig. 1.

Linotherium affine MARSH, Amer. Jour. Sci., Vol. IV, "Aug. 7, 1872," p. 14.

Type, Yale Mus. 11795. No locality given (but probably Lower Bridger). Lower jaw with m_{1-3} right and alveoli of i_1 - p_4 , symphysis and p_3 of left, with alveoli of i_1 - p_2 . Mounted separately, but apparently the same individual, a lower jaw fragment with m_{2-3} and fragment of upper maxilla, p^3 - m^2 left and p^2 - m^1 right. Young individual, last molar just wearing.

Distinctive characters: Differs from the type of *L. tyrannus* in marked shallowness of jaw and smaller canine. Trigonids and basins of m_1 , m_2 narrower; entoconids on m_1 , m_2 weaker; symphysis shallower, reaching to anterior border of p_3 . Measurements: m_{1-2} , ap. 11 mm. as in *tyrannus*, m_2 tr., 4.4 mm. slightly less than that of *tyrannus*; m_{1-3} , ap. 18 mm.; ramus below center of m_2 , 8.3. Paraconid (?pseudo-paraconid) present on m_1 practically vestigial on m_2 , absent on m_3 ; hypoconulid on m_3 weak; internal accessory cusp in entoconid region slightly developed. Canine alveolus slightly larger than that of p_1 . Differs from *rostratus* in smaller size and narrow trigonids; entoconids lower; ramus shallower; symphysis shorter and shallower. Differs from *osborni* in the much larger size of the third lower molar, longer molar row, shallower ramus, thicker, p_1 , p_2 apparently without diastemata; p^3 with high conical inner cusp (deutocone); p^4 progressive with subequal outer cusps, mesostyle wanting, parastyle nearly as large as in m^1 , m^2 ; metastyle slight; deutocone large, the postero-internal cusp visible; upper molars hardly separable from those of *anceps*; m^1 - m^2 , 10.7 mm., m^2 trans., 1 mm., p^3 - m^2 , 18.5 mm.

Notharctus tyrannus (Marsh).

Plate CIII, Fig. 4, Plate CIV, Fig. 6.

Limnotherium tyrannus MARSH, Amer. Journ. Sci., Vol. II, "June 5th, 1871," pp. 11, 12.

Type, Yale Mus. 11856, from Dry Creek, Grizzly Buttes. Lower jaw with m_1 , m_2 right, roots or alveoli of all anterior teeth around to p_3 left.

Distinctive characters: Canine much larger than p_1 ; i_2 larger than i_1 . Low paraconid (?pseudo-paraconid) on m_1 , vestigial or absent on m_2 ; talonid basins wide, especially on m_2 . Ramus unusually deep; symphysis extending back to posterior border of p_3 ; small diastema in front and behind p_2 , p_1 probably spaced.

Measurements.

	mm.
M_1-m_2	11.
M_2 trans. tal ^d	4.7 est.
Depth of ramus below center of m_2	11.2

Referred specimens: Amer. Mus. 11478 (Plate CIII, Fig. 5; Plate CIV, Fig. 5), level B, associated with portions of skeleton; may be regarded as female of this species; m_1 , m_2 compare closely; differs in shallowness of jaw and probable slenderness of canine. The upper molars although weathered are distinctly larger than those of *N. osborni*; they are a little larger than those of *affinis*; the third premolar is decidedly narrower transversely than that of *N. affinis* and the same is true of m_2 ; this relative narrowness in *tyrannus* is seen in all the cheek teeth preserved. The upper premolars differ from those of *N. anceps* in being generally simpler; p^2 is single-rooted (double-rooted in *anceps*) deutocone on p^3 and p^4 less developed.

Amer. Mus. 12002, Hor. B 1, lower jaw.

Notharctus tenebrosus Leidy.

Plate CIII, Fig. 6; Plate CV, Fig. 3.

Proc. Acad. Nat. Sci. Phila., 1870, p. 114.

Hipposyus formosus LEIDY, Proc. Acad. Nat. Sci. Phila., 1872 (June 25), p. 37, Contr. to Extinct Fauna West. Terrs., 1873, p. 90, pl. vi, fig. 41.

Tomitherium rostratum COPE, Palæont. Bull. No. 3, "Aug. 7th, 1872," Proc. Amer. Phil. Soc., Vol. XII, p. 470.

Type, U. S. Nat. Mus. 3752, Black's Fork, Bridger Basin, level B. Right ramus with canine, p_2-m_3 and alveoli of incisors and p_1 , condyle; coronoid and angle wanting. F. V. Hayden Coll. 1870.

Distinctive characters: True paraconids on all three molars, strong on m_1 , weaker on m_2 , m_3 . Entoconid region with small accessory cusps. Diastema in front of p_1 and between p_2 and p_3 . On account of the worn condition of the teeth few very distinctive characters are afforded; but the dentition on the whole seems to be close to that of *N. rostratus*, differing chiefly in the presence of a paraconid on m_3 .

Referred specimens: Amer. Mus. 5009, type of *T. rostratum* (see below), Amer. Mus. 13024, Lower Cottonwood Creek, lower jaws, limb and foot bones; Amer. Mus. 14568, Grizzly Buttes B3, pair of lower jaws, with p_3 - m_3 ; Amer. Mus. 12001, Cottonwood Creek, Bridger Basin, level B4; Amer. Mus. 13022, Grizzly Buttes, Bridger B2.

Measurements (from type).

	mm.
P_1 - m_3	33.
M_2 ap. \times tr.....	5.5×4.5
M_1 - m_3	18.5
M_{1-2}	11.3
Depth of ramus below center of m_2	11.8

Type of *Hipposyus formosus* Leidy.

Plate CVI, Fig. 5.

The type consists of a fragment of a left maxilla containing parts of all three molars collected by Dr. Carter. It is preserved in the U. S. National Museum, No. 3757, "Dry Creek near Ft. Bridger, Wyoming" (Little Dry Creek of American Museum collectors, a tributary of Smith's Fork, near Grizzly Buttes, Horizon B). The specimen articulates accurately with Cope's type lower teeth of *Tomitherium rostratum* (*Notharctus tenebrosus* Leidy) from the same level.

The detailed characters of the molars are as follows:

M^1 , m^2 are rather less quadrate in outline than those of *N. pugnax* and are also smaller in all dimensions; the pseudo-hypocone on m^2 is less developed than in that species; the internal cingulum on m^2 is heavy; on the inner border of m^1 , m^2 there is no constriction between the protocone and pseudo-hypocone (strong in *pugnax*).

Measurements.

	mm.
M^1 - m^2	10.8
M^1 trans.	7.2

Type of *Tomitherium rostratum* Cope.

Plate CIII, Fig. 7; Plate CV, Fig. 2.

Tomitherium rostratum COPE, Palæont. Bull. No. 3, "Aug. 7th, 1872"; Proc. Amer. Philos. Soc., Vol. XII, p. 470.

Type, Amer. Mus. 5009, Black's Fork, Lower Bridger, lower jaw with both rami, and portion of left ascending ramus, i_1 and p_1 - m_3 right, p_4 - m_3 left; roots or alveoli of all the other teeth.

Distinctive characters: Molars larger than in *tyrannus*, *anceps*, *affinis* and much larger than in *osborni*. Talonid basins of moderate width (between *affinis* and *tyrannus*); p_1 , p_2 separated by small diastemata from each other and from the canine and p_3 . Canines small or moderate. Symphysis long and sloping, ending posteriorly opposite posterior border of p_3 . Heavy external cingulum on p_3 . True paraconids present on m_1 , m_2 .

Measurements of type.

	mm.
P_1 - m_3	35. est.
M_1 - m_3	19. est.
M_1 - m_2	11.7
M_2 trans.....	4.6
Depth of ramus below center of m_2	10.5

We are unable to distinguish this as a separate species from *N. tenebrosus* Leidy from which it differs chiefly in the slightly larger measurements of the premolar-molar series, and of the canines; the paraconid is absent on m_2 , m_3 .

Notharctus pugnax sp. nov.

Plate CIII, Fig. 8; Plate CV, Fig. 4.

Type, Amer. Mus. 11461, Millersville, Lower Bridger. Left ramus with p_3 - m_2 and roots or alveoli of c , p_1 , p_2 , m_3 .

Distinctive characters: Lower jaw and teeth larger and heavier than in any other Lower Bridger species including *rostratus*, but smaller than in the Upper Bridger *Telmatolestes crassus*, toward which the present species is apparently tending. P_4 with strong internal and external cingula; molars with external cingula sharply defined and continued around talonid. Metaconid of p_4 large. True paraconid present on m_1 (in front of metaconid), absent in m_2 . Ramus shallow (depth below m_2 , 10.5) but very stout and thick, symphysis stocky.

Paratype, Amer. Mus. 11480, a nearly complete lower jaw of an aged individual very little crushed and with dentition complete except for the p_1 right. Locality, Grizzly Buttes, Horizon B, Bridger Basin.

Measurements of paratype.

	mm.
Front of canine to m_3 incl.	42.5
M_{1-3}	21.
M_{1-2}	13.
M_2 ap. \times tr.	6.8×5.5

As far as one can judge this species appears to be ancestral to *N. crassus* of the Upper Bridger. It appears to be related to *N. tenebrosus* and may well be derived from *N. venticolus* with which it agrees in size and in the character of m_3 . It differs from *venticolus* in the weaker paraconids and shallower ramus.

Referred specimens: Amer. Mus. 11452, from Church Buttes (low down in Horizon B), ramus shallow but stocky. Amer. Mus. 12575, lower jaw and fragments of upper, Grizzly Buttes, East, B2. Amer. Mus. 14567, p^2 - m^3 Grizzly Buttes, B3. Amer. Mus. 11454, Millersville, level B.

Measurements of type.

	mm.
P_2 - m_3	34.
M_1 - m_3	20.7
M_1 - m_2	13.
M_2 trans.	5.

Notharctus crassus (*Marsh*).

Plate CIII, Fig. 9; Plate CV, Fig. 6.

Telmatolestes crassus MARSH, Amer. Jour. Sci., Vol. IV, "Aug. 7, 1872," p. 14.

Notharctus robustior LEIDY, U. S. Geol. Surv. Montana, etc.; F. V. HAYDEN, Report for 1871 [1872], p. 364.

Hipposyus robustior LEIDY, Contrib. Ext. Vert. Fauna West. Terr., pl. VI, fig. 40.

Type, Yale Mus. 11782, Henry's Fork, Bridger. Bone and teeth white (from white stratum in Upper Bridger). M^1 - m^3 , left, damaged; fragment of left ramus with alveoli of canine, p_1 p_2 ; p_3 - m_3 , right, preserved; other fragments of upper and lower teeth.

Distinctive characters: Of large size. P_4 submolariform with large paraconid, metaconid large and widely separated from protoconid; true paraconid large on m_1 ; pseudo-paraconid at end of protoconid ridge on m_1 , weaker on m_2 , incipient on m_3 ; m_1 , m_2 with wide talonids; m_3 narrow

elongate with low crenulate ridge in region of entoconid. Ridge connecting protolophid with hypoconid prominent. External cingula of molars crenulate. Ramus massive. P^1 and p_1 double rooted, p^3 with low deutocone, p^4 with tritocone nearly equal to protocone, internal lobe of p^4 wide, with low tetartocone or deep tetartocone groove; m^1 , m^2 very progressive with large hypocones on m^1 m^2 and large mesostyles on m^1 - m^3 ; m^3 subquadrate with hypocone incipient on cingulum. Metaconule distinct on all three molars.

Measurements of type.

	mm.
P_1 - m_3	40.5
M_1 - m_3	23.5
M_1 - m_2	14.3
M_2 trans.....	6.2
M_3 ap.....	.97
Depth of ramus below m_2 (referred).....	12.3
M^1 - m^3	16.6
P^4 ap. \times tr.....	4.7 \times 8.1

There is no sharp generic distinction between *Telmatolestes* and *Notharctus*. Various specimens of *N. pugnax* and *N. crassus* show transitional conditions in the development of the hypocone on m_3 , in the separation of the tritocone from the deutocone in p^4 , and in the development of the mesostyle, in the separation of the metaconid on p_4 . *N. crassus* is the only known species of *Notharctus* in the Upper Bridger where it was very abundant, the American Museum collections comprising more than 25 catalogued specimens.

Referred material: Amer. Mus. 12567, palate and skull frag'ts, Henry's Fork Hill, Bridger Basin, level D4; Amer. Mus. 13133, lower jaw from N. of Haystack Mt'n, Washakie Basin (Lower Washakie, Horizon A); Amer. Mus. 13134, Kinney Ranch, Wash. (basal beds); Amer. Mus. 12564, from Henry's Fork, Bridger Basin, level D4, upper and lower teeth; Amer. Mus. 12588, Sage Creek Spr., Bridger Basin, Horizon C; Amer. Mus. 11982, Henry's Fork, Bridger Basin, Horizon C4, upper and lower jaws.

Type of *Hipposyus robustior* Leidy.

Plate CVII, Fig. 5.

Type, a fragment of the left ramus mandibuli, containing m_2 and alveolus of m_3 . U. S. Nat. Mus. No. 3750, F. V. Hayden Coll. 1870.

Locality. Henry's Fork (Horizon C or D), Bridger Basin, Wyoming.

Although slightly smaller than the type of *Telmatolestes crassus* Marsh

Leidy's type clearly falls within the range of variation of specimens referred to the latter species.

Hayden's Report for 1871, containing the description of this species, bears a letter of transmittal dated February 20, 1872; the actual date of publication is not known to us, but very probably was not earlier than Marsh's paper containing the description of *Telmatolestes crassus* from the same level which bears the date Aug. 7. Unless the priority of *robustior* can be established it seems better to retain Marsh's name *crassus*, both because it has been generally adopted and because it was founded on a much better type.

Measurements.

	mm.
M ₂ trans.	5.7
M ₂ ap.	7.5

? *Notharctus uintensis* (Osborn).

? "*Microsyops*" *uintensis* OSBORN, 1902, p. 202, fig. 27.

Left incertæ sedis by Osborn, with the remark "Its nearer reference is either to the Anaptomorphidæ or to some member of the Notharctidæ." Provisionally referred by Dr. Matthew in Amer. Mus. catalogue to ?*Notharctus*. Examination of type and comparison with *Hemiacodon* with all other Anaptomorphidæ and all types of *Notharctus* tend to confirm the reference by Matthew.

It differs from *Hemiacodon* in the characters of the 3rd pm which is less advanced than in the older genus; talonid of p₄ not as wide as in *Hemiacodon*; trigonid of m₂ lacks pa^d (present in *Hemiacodon*). P₃, p₄ on the whole nearer to *N. crassus* but trigonids of ms smaller and talonids wider. An approach to the widening of the talonid is shown in *crassus*, but that species retains the paraconid on m₂; the external cingulum is vestigial (present in *crassus*).

On the whole the species ?*N. uintensis* seems referable to *Notharctus* and thus it represents the latest record of the family.

***Aphanolemur gibbosus* gen. et sp. nov.**

Plate CVII.

Type, a skull, lacking the dentition and the fore part of the muzzle, No. 12152 Peabody Mus. Nat. Hist., Yale University.

Locality and level: Millersville, Lower Bridger, Bridger Basin, Wyo.

Distinctive characters: Skull short and wide. Brain-case well expanded transversely, sagittal crest very short, diverging anteriorly into two sharp temporal crests.

A pair of prominent swellings on the forehead between the orbits. Muzzle apparently narrow. Orbits large, malar below orbit wide. Occiput wide, evenly rounded above. Auditory bullæ prominent, subspherical. M^3 apparently wide transversely. Greatest width of brain-case (above squamosal suture) 29.5 mm. Length of sagittal crest 7. mm.

It is extremely unfortunate that the dentition is lacking from this important skull, which in its original condition might have thrown light upon the relationships of several families of Eocene lemuroids. In the swelling form of the brain-case and fairly large orbits it suggests the Eocene Tarsiidæ (*Tetonius*, etc.), although not nearly so specialized as that older genus. It is apparently excluded from the contemporary *Hemiacodon* of that family by its distinctly larger size, and for the same reason it is hardly likely to belong to *Microsyops* of the Microsyopinæ. It is also excluded from *Microsyops* by the possession of a complete postorbital ring. It agrees with *Notharctus* in fundamental construction: first in the relation of the lacrymal which lies within the orbit and has a wide contact with the frontal; secondly it is essentially similar in the general form and relations of the postorbital processes of the malar and frontal and in the insertion of the masseter below the orbit; thirdly in the construction of the auditory bulla, and in the course of the internal artery, which passed through an ossified tube, lying upon the auditory prominence as very clearly shown on the left side of the type. The skull differs from that of *Notharctus* in its protuberant brachycephalic character, in the great width of the brain-case, in the short sagittal crest, in the slenderness of the muzzle, in the presence of prominent swellings on the forehead, and in the relative width of m^3 .

Among foreign genera it suggests *Pronycticebus* but is excluded from this genus by the short sagittal crest and lack of interorbital swelling. Among living lemurs, such diverse types as *Myoxicebus*, *Propithecus*, *Pero-dicticus* resemble the present skull in some respects.

A lower jaw, Amer. Mus. 11481, from Grizzly Buttes, West (Lower Bridger), differs from all other Notharctidæ in having a very short third lobe, surmounted by only a single cusp. There is a bare possibility that this very peculiar type may belong with the skull of *Aphanolemur*.

Measurements of No. 11481.

	mm.
M_3 ap.	5.5
M_{1-2}	10.5
M_{1-3}	16.2
M_1 ap. \times tr.	5.2 \times 3.6

EXPLANATION OF PLATES.

PLATE CIII.

Lower jaws of *Notharctus*, natural size.

Fig. 1. *Notharctus matthewi*. Lower jaw of type (left ramus, reversed), Amer. Mus. No. 12011; see page 847.

Fig. 2. *Notharctus osborni*. Lower jaw of type, Amer. Mus. No. 11466; see page 848.

Fig. 3. *Notharctus affinis*. Type of *Limnotherium affine*, Yale Univ. Mus. No. 11795; see page 850.

Fig. 4. *Notharctus tyrannus*. Type of *Limnotherium tyrannus*, Yale Univ. Mus. No. 11856; see page 851.

Fig. 5. *Notharctus tyrannus*, Amer. Mus. No. 11478; see page 851.

Fig. 6. *Notharctus tenebrosus*, U. S. Nat. Mus. No. 3752; see page 851.

Fig. 7. *Notharctus tenebrosus* (type of *Tomitherium rostratum*, reversed), Amer. Mus. No. 5009; see page 853.

Fig. 8. *Notharctus pugnax*, type, Amer. Mus. No. 1146 (left ramus reversed); see page 853.

Fig. 9. *Notharctus crassus*. Type of *Telmatolestes crassus*, Yale Univ. Mus. No. 11782; see page 854.

PLATE CIV.

Lower teeth of *Notharctus*, twice natural size.

Fig. 1. *Notharctus matthewi*, type, left ramus reversed, Amer. Mus. No. 12011; see page 847.

Fig. 2. *Notharctus osborni*, type, Amer. Mus. No. 11466; see page 848.

Fig. 3. *Notharctus anceps* (lectotype of *Thinolestes anceps*; left ramus reversed), Yale Univ. Mus. No. 11786A; see page 849.

Fig. 4. *Notharctus anceps* (second cotype of *Thinolestes anceps*; p₄-m₃ left reversed), Yale Univ. Mus. No. 11786B; see page 849.

Fig. 5. *Notharctus tyrannus*, Amer. Mus. No. 11478; see page 851.

Fig. 6. *Notharctus tyrannus*, Yale Univ. Mus. No. 11856; see page 851.

PLATE CV.

Lower teeth of *Notharctus*, twice the natural size.

Fig. 1. *Notharctus affinis* (type of *Limnotherium affine*) Yale Univ. Mus. No. 11795; see page 850.

Fig. 2. *Notharctus tenebrosus* (type of *Tomitherium rostratum*), Amer. Mus. No. 5009; see page 853.

Fig. 3. *Notharctus tenebrosus*, type, U. S. Nat. Mus. No. 3752; see page 851.

Fig. 4. *Notharctus pugnax*, type, (left ramus reversed); Amer. Mus. No. 1146; see page 853.

Fig. 5. *Notharctus crassus* (type of *Hipposyus robustior*; left m_2 reversed), U. S. Nat. Mus. No. 3750, see page 855.

Fig. 6. *Notharctus crassus* (type of *Telmatolestes crassus*), Yale Univ. Mus. No. 11782; see page 854.

PLATE CVI.

Upper molars and premolars of *Notharctus*, twice natural size.

Fig. 1. *Notharctus matthewi*, p^3-m^1 of type, Amer. Mus. No. 12011; see page 847.

Fig. 2. *Notharctus anceps*, m^1-m^2 (left reversed) of type, Yale Univ. Mus. No. 11786A; see page 849.

Fig. 3. *Notharctus anceps*, p^1-p^4 of type, Yale Univ. Mus. No. 11786A; see page 849.

Fig. 4. *Notharctus anceps* (?), p^3-m^3 of second cotype, Yale Univ. Mus. No. 11786B; see page 849.

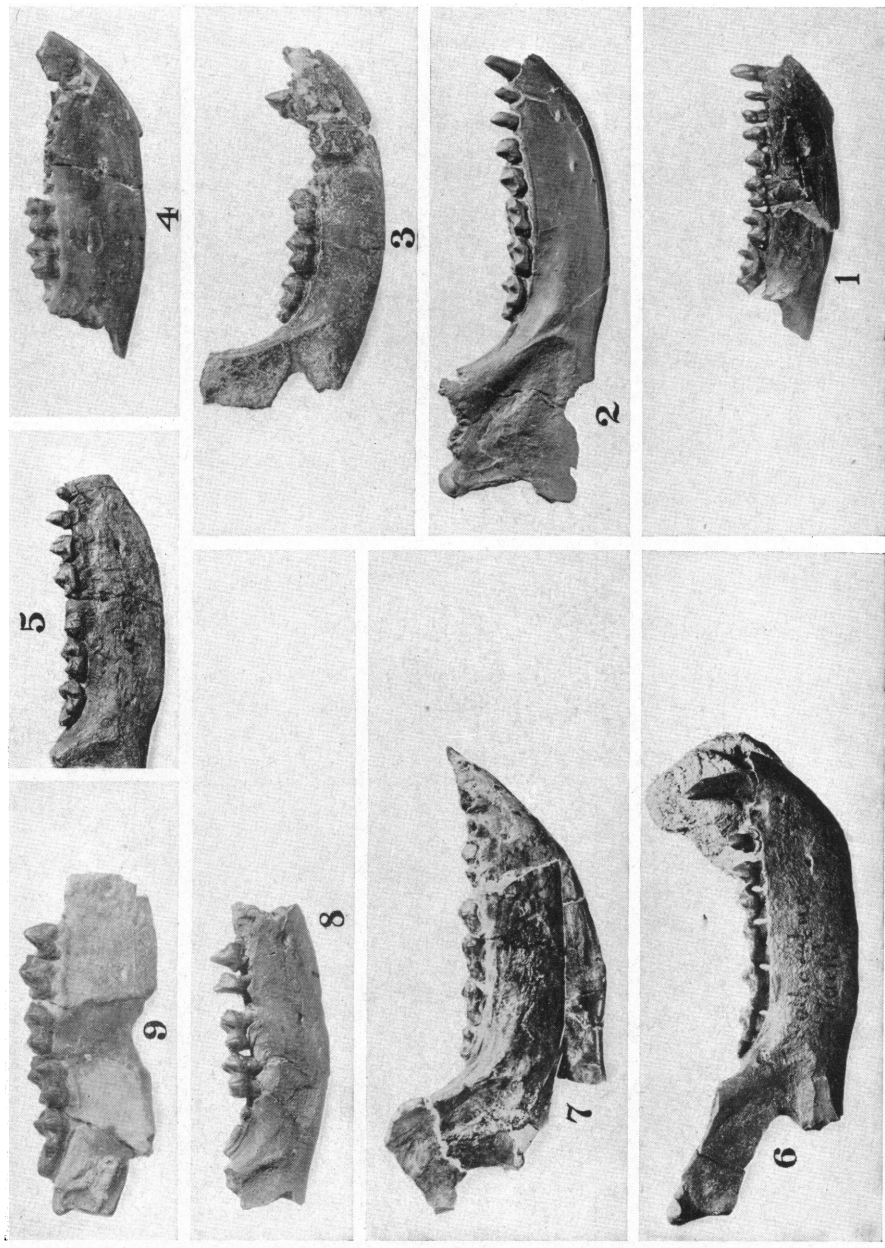
Fig. 5. *Notharctus affinis*, p^3-m^2 (left reversed) of type, Yale Univ. Mus. No. 11795; see page 850.

Fig. 6. *Notharctus tenebrosus*, m^1 , m^2 and part of m^3 , left reversed (type of *Hipposyus formosus*), U. S. Nat. Mus. No. 3757; see page 852.

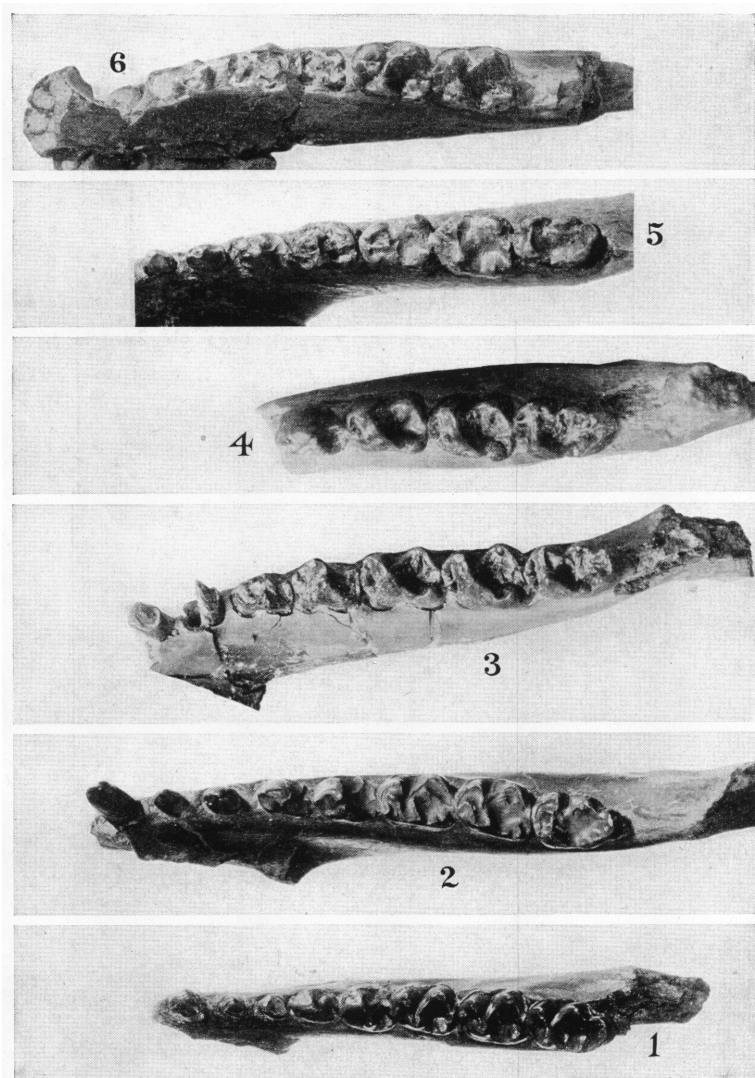
PLATE CVII.

Aphanolemur gibbosus, type skull. Yale Univ. Mus. No. 12152. Natural size. See page 856.

Fig. 1. Left side. 2. Occipital view. 3. Top view. 4. Under side.



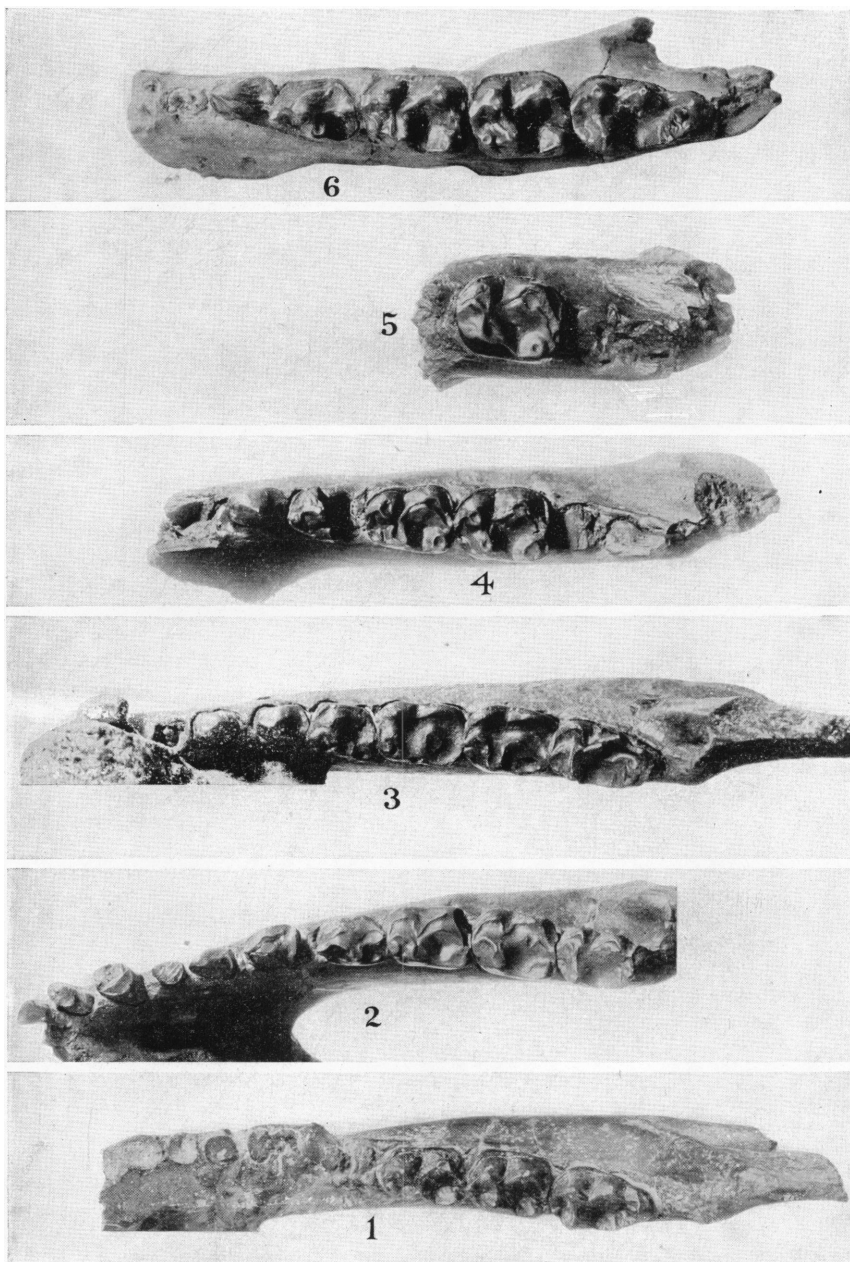
1. NOTHARCTUS MATTHEWL.
2. " OSBORN
3. NOTHARCTUS AFFINIS.
4. " TYRANNUS
5. NOTHARCTUS TYRANNUS.
6, 7. " TENEBROSUS.
8. NOTHARCTUS PUGNAX.
9. " CRASSUS.
 $\times \frac{1}{1}$.



1. NOTHARCTUS MATTHEWI.
2. " OSBORN.
3. " ANCEPS.

4. NOTHARCTUS ANCEPS.
5. " TYRANNUS.
6. " TYRANNUS.

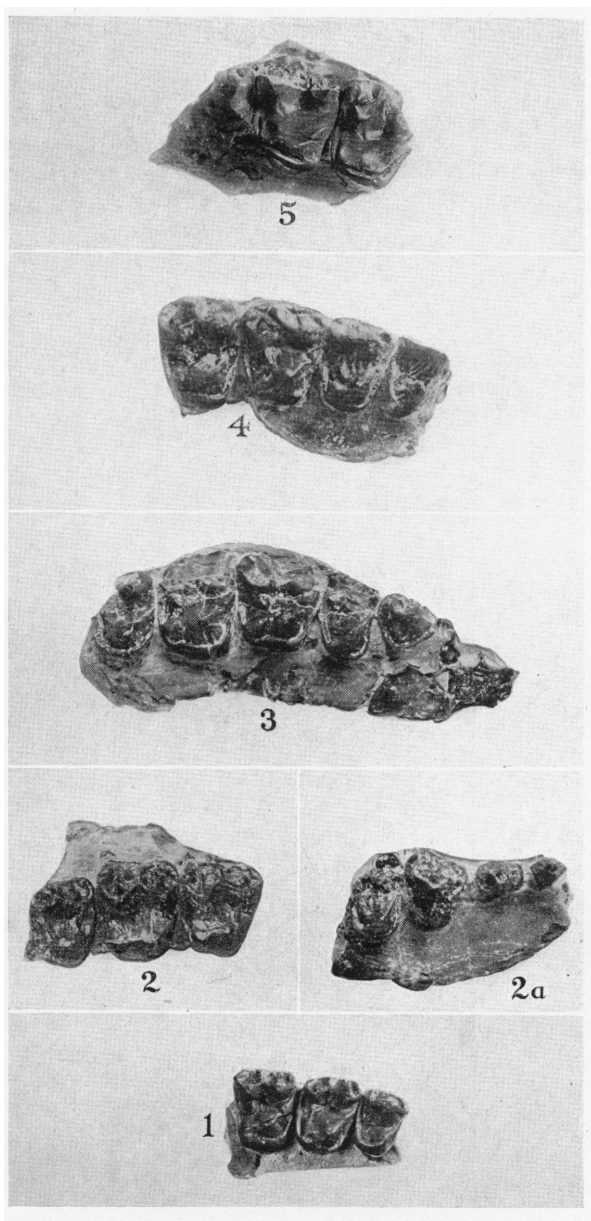
$\times \frac{2}{1}$.



1. NOTHARCTUS AFFINIS.
2. " TENEBROSUS.
3. " TENEBROSUS.

4. NOTHARCTUS PUGNAX.
5. " CRASSUS.
6. " CRASSUS.

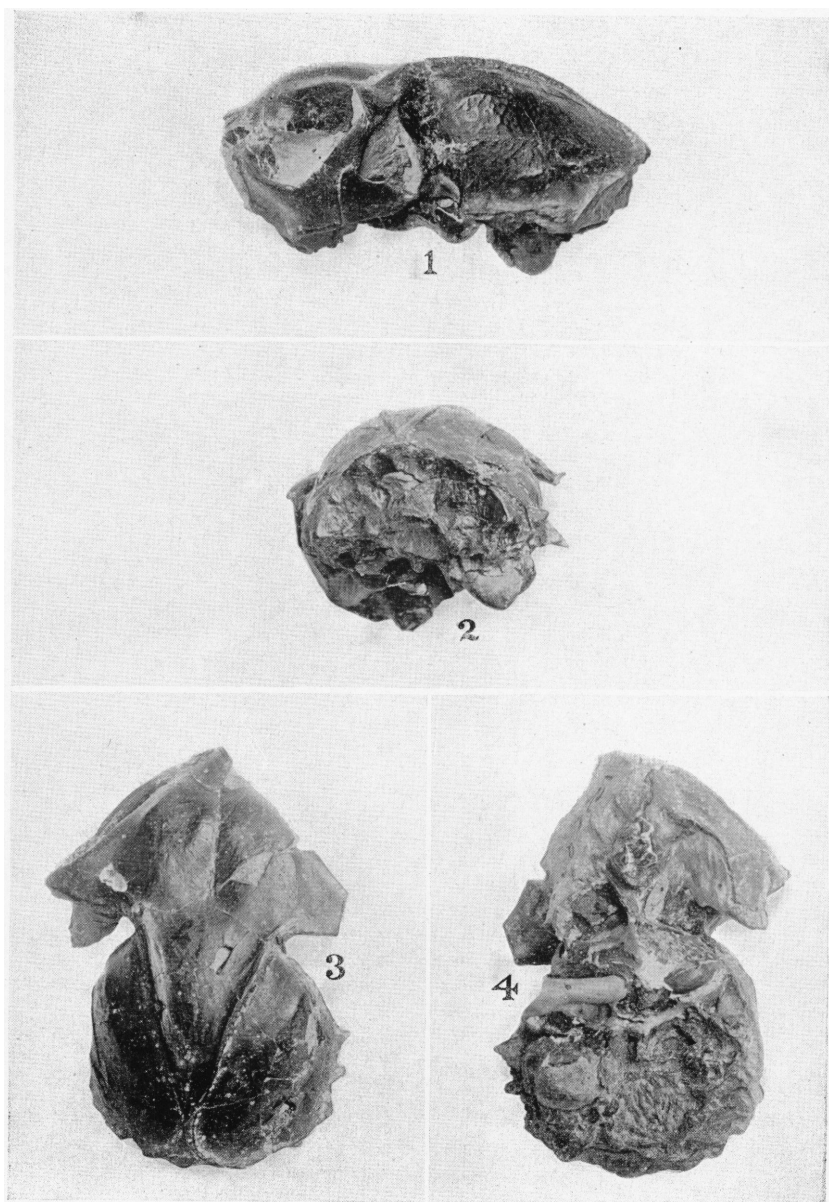
$\times \frac{2}{1}$.



1. *NOTHARCTUS* MATTHEWI.
2. " ANCEPS.
- 2a. " ANCEPS.

3. *NOTHARCTUS* (?) ANCEPS.
4. " AFFINIS.
5. " TENEBROSUS.

$\times \frac{2}{1}$.



APHANOLEMUR GIBBOSUS, type. $\times \frac{1}{1}$.

