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ABSTRACT

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C. Lewis Gazin

A New Occurrence of Paleocene Mammals in the Evanston Formation, Southwestern Wyoming

Introduction

While making a study of the Cretaceous and Tertiary deposits of the Fossil Basin in southwestern Wyoming, during the 1959 field season, Joshua I. Tracy, Jr., and Steven S. Oriel of the United States Geological Survey discovered a new locality for fossil mammal remains in beds regarded as belonging to the Evanston formation. The occurrence is at an outcrop of variegated strata between Bell and Little Muddy Creeks, near the southwestern corner of section 31, T. 19 N., R. 117 W., very close to the south boundary of Lincoln County. The Evanston is exposed here tilted up beneath the Eocene by faulting, which has brought up still older rocks along Little Muddy Creek to the east and an inlier of much older rocks a short distance to the north (Walker, 1950, map).

In the company of Tracy and Oriel, Franklin L. Pearce and I first visited the locality in 1961. Further collections were made for the Smithsonian Institution in 1963, 1964, 1965, and 1967. The exposure is of rather limited extent (Plate 1) and the fossil materials are by no means abundant, consisting for the most part of isolated teeth and indeterminate bone fragments. Representation of the fauna, moreover, appears rather meager and because of the nature of the material, certain of the identifications are necessarily tentative. Nevertheless, importance is attached to the occurrence in furnishing evidence of a faunal horizon new to the Evanston formation.

Earlier reported occurrences of fossil vertebrates in strata understood to be a part of the Evanston formation include remains of a Tiffanian Paleocene fauna encountered (Gazin, 1956b) at the forks of Twin Creek near Fossil Station, high in a sequence of beds, locally variegated, lying unconformably beneath the Wasatch. Also, a dinosaur jaw fragment found by Tracy and Oriel, reported to be from the Evanston formation,[1] was identified by G. E. Lewis as *Triceratops,* cf. *T. flabellatus* and considered to be latest Cretaceous in age (Tracy and Oriel, 1959, p. 128). These occurrences would indicate that the Evanston formation spanned a considerable length of time, including uppermost Cretaceous and most, if not all, of Paleocene time.

The Little Muddy Creek [2] occurrence is distinctly older than the Twin Creek occurrence and may well be Torrejonian or middle Paleocene, correlating more closely with the upper Lebo of the Montana Fort Union (Simpson, 1937) than with the various Tiffanian or later Paleocene occurrences of the Wyoming-Montana region.

The pencil shaded drawings of the Little Muddy Creek specimens shown in Plates 2 and 3 were made by Mr. Lawrence B. Isham, staff illustrator for the Department of Paleobiology in the United States National Museum.

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[1] R. W. Brown, late of the U.S. Geologcal Survey, who had worked with the fossil floras of the area, remained unconvinced (oral communication) that the ceratopsian specimen was actually from these beds.

[2] The locality is actually in the Bell Creek drainage area, a tributary of Little Muddy Creek, but such a designation would be too readily confused with the Dell Creek Paleocene occurrence in the Hoback Basin.

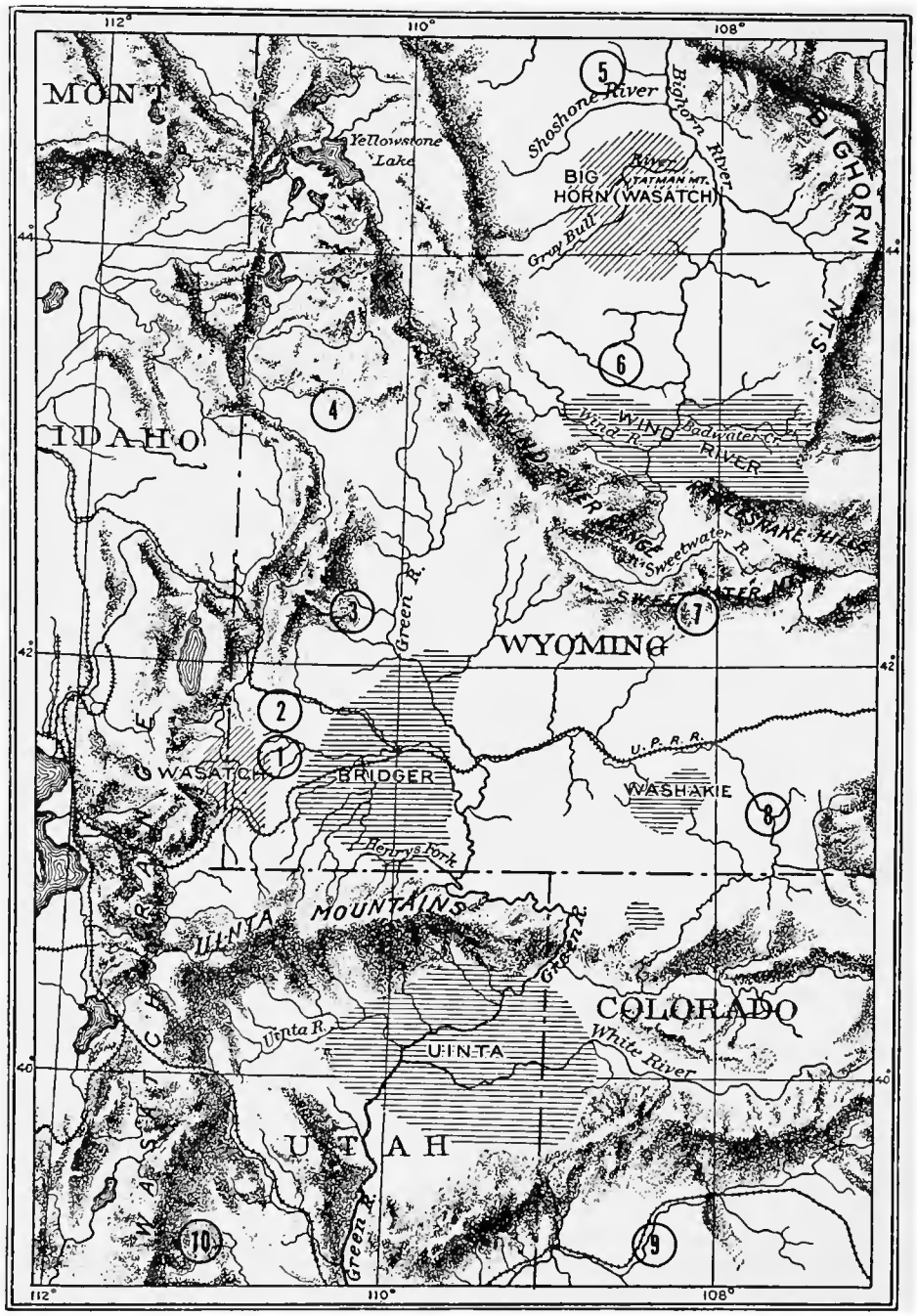

FIGURE 1.—Map of western Wyoming and portions of adjacent states showing Eocene sedimentary basins, with nearby Paleocene fossil localities numbered as follows: 1, Little Muddy Creek Torrejonian; 2, Twin Creeks fork Tiffanian; 3, Buckman Hollow Clarkforkian; 4, Hoback Basin late Torrejonian and Tiffanian; 5, Polecat Bench Puercan to Clarkforkian; 6, Shotgun Buttes Torrejonian and Clarkforkian(?); 7, Bison Basin Tiffanian; 8, Dad (Swain Quarry) Torrejonian(?); 9, Plateau Valley Tiffanian(?); 10, North Horn Puercan and Dragonian. *Map reproduced from Osborn, U.S. Geological Survey Monograph 55, Figures 9 and 49, 1929.*

This study of early Tertiary mammals was aided by grant G10686 from the National Science Foundation.

The Little Muddy Creek Faunule

The recognizable elements of the fauna may be listed as follows: [3]

Multituberculata
  Ptilodontidae
    Ptilodus, cf. *montanus* Douglass, 1908
  Neoplagiaulacidae
    Neoplagiaulax, cf. *grangeri* (Simpson), 1935
    Ectypodus, near *E. powelli* Jepsen, 1940
Insectivora
  Nyctitheriidae?
    Possibly *Leptacodon ladae* Simpson, 1935
  Pantolestidae
    Aphronorus orieli, new species
Primates
  Paromomyidae
    Cf. *Torrejonia wilsoni* Gazin, 1968
  Plesiadapidae
    Cf. *Pronothodectes matthewi* Gidley, 1923
Creodonta
  Arctocyonidae
    Chriacus, cf. *pelvidens* (Cope), 1881b
    Cf. *Chriacus truncatus* Cope, 1884
    Tricentes, cf. *subtrigonus* (Cope), 1881a
Condylarthra
  Hyopsodontidae
    Promioclaenus, cf. *lemuroides* (Matthew), 1897
    Promioclaenus, cf. *acolytus* Cope, 1882
    Cf. *Litaletes disjunctus* Simpson, 1935
    Haplaletes?, species
Condylarthra? incertae sedis

Faunal Relationships

The foregoing assemblage shows a relationship in several of the forms to the fauna of the upper Lebo in the Crazy Mountain Fort Union. This is evident in certain of the multituberculates, insectivores, and condylarths. On the other hand there is also shown some affinity to the Torrejon fauna of New Mexico. This seems most evident in the creodonts and *Ellipsodon*-like condylarths. The primates appear divided, with one showing an affinity to the northern fauna and the other to the southern, and the new pantolestid insectivore is almost intermediate in character between related forms in each. This division of relationships is perhaps not surprising considering that the Little Muddy Creek occurrence is at a latitude about halfway between the two classic occurrences. The town of Evanston, a short distance to the south and near where the type section of the Evanston formation is exposed, is in fact almost precisely intermediate in latitude between the Gidley Quarry and the Arroyo Torrejon.

Other and somewhat nearer occurrences in Wyoming of about the same age, showing a faunal relationship, include the Rock Bench level of the Polecat Bench sequence in the Big Horn Basin (Jepsen, 1930 and 1940) and that of the Battle Mountain local fauna in the Hoback Basin (Dorr, 1958). The latter is possibly the nearest Paleocene occurrence of comparable age and while the beds yielding these remains have been designated the Hoback formation, it was earlier thought that the formation involved was a northward extension of the Evanston.

In the character of the Little Muddy Creek assemblage, particularly noteworthy is the absence of the larger mammalian forms common in this stage of the Paleocene. No representation has been found of the taeniodonts, pantodonts, the larger arctocyonids, nor the phenacodonts. It is, moreover, surprising that no teeth are recognized as belonging to the periptychids, although it may be noted that most of these forms are larger than the mammals actually encountered. It is possible that the latter had become extinct by Little Muddy Creek time, but it is also possible that their niche was not represented in this area of western Wyoming. It is of further interest that no remains of fish, and, among reptiles, only indeterminate fragments of a turtle have been seen.

Order MULTITUBERCULATA

Family PTILODONTIDAE

Ptilodus, cf. *montanus* Douglass

An isolated right P_4 (USNM 25673, Plate 2: figure 1) in the collection, obtained in 1964, cannot be distinguished from this tooth in material of *Ptilodus montanus* from the Gidley Quarry (Gidley, 1909, and Simpson, 1937) in the Crazy Mountain Paleocene. A small portion from the posterior extremity is missing so

[3] The ordinal classification here followed is essentially in accordance with that outlined by Simpson (1945) and which represents the mature judgment of the profession.

that a complete count of the crests or ridges cannot be made; nevertheless, the pattern and spacing of the ridges and serrations, as well as the height and curvature of the crown, are quite as in *P. montanus*. Moreover, there seems rather little to distinguish this tooth from P_4s in *Ptilodus wyomingensis* Jepsen (1940), although possibly it is a little more arched forward, so that reference of an isolated tooth, such as this, can only be tentative.

Family NEOPLAGIAULACIDAE [4]

Neoplagiaulax, cf. *grangeri* (Simpson)

An isolated right P^4 (USNM 25674, Plate 2: figure 2) in the 1961 collection closely resembles P^4s in the Gidley Quarry material that Simpson (1937, p. 102) thought might represent *Ectypodus, possibly ?E. grangeri*. The tooth is about the same size and shows a similar curvature of the crown, as seen in profile. The posterior portion of the serrated crest, though more obscured by wear on the sides, appears to curve upward toward the base much as in the Lebo specimens. It differs in that there is evidently but a single outer cusp, in which respect a resemblance is seen to the larger P^4 from the Rock Bench Quarry that Jepsen (1940, pl. 2: fig. 5) thought might represent *Anconodon*. The outer cusp in USNM 25674 is much more reduced, possibly as a result of wear. Matthew and Granger (1921) observed that in the type-species, *Ectypodus musculus*, there may be either one or two minute tubercles in this position. The serrated crest of P^4 in *E. musculus*, as shown by Granger and Simpson (1929, fig. 35), however, is very different, with the apex of the relatively high crown at the last serration.

D. E. Russell (1964, p. 27) has noted the closeness of various *Ectypodus* materials to Cernaysian *Neoplagiaulax*, and R. E. Sloan (oral communication) assures me that the species "*?Ectypodus grangeri*," to which he would assign the P^4 in question, belongs in *Neoplagiaulax*.

[4] Neoplagiaulacidae of Ameghino, 1890, has priority over Ptilodontidae of Gregory and Simpson, 1926, but possibly two families are represented here. In any case Ectypodidae or Ectypodontidae of Sloan and Van Valen, 1965, is a synonym of Neoplagiaulacidae since *Neoplagiaulax* is there included.

Ectypodus, near *E. powelli* Jepsen

A second isolated right P_4 (USNM 25675, see Plate 2: figure 3), much smaller than that referred to *Ptilodus montanus*, shows a relatively deep anterior portion which Jepsen (1940) has indicated as one of the characteristics of *Ectypodus*. It corresponds closely in size to Tiffanian *E. powelli* but shows about 11 or 12 serrations. The number is uncertain as they are not well formed anteriorly.

R. E. Sloan has examined this tooth and believes that it represents a form he is describing as new and considers it in an ancestral position to *E. powelli*.

Order INSECTIVORA

Family NYCTITHERIIDAE?

Possibly *Leptacodon ladae* Simpson

Two portions of a right mandibular ramus, devoid of tooth crowns except for the talonid portion of M_3, represents the smallest mammal seen in the Little Muddy Creek collections. The anterior fragment exhibits root portions of premolars and evidence for a relatively large anterior tooth, presumably the canine. The talonid of M_3 in the posterior segment is about the size of that in the type of *Leptacodon ladae* but is a little more slender, with a strong hypoconulid but a weaker hypoconid and entoconid, somewhat nearer in this respect to a referred specimen of *L. ladae* (USNM 9630). The transverse width of the Little Muddy Creek talonid is about 0.7 mm.

A minute left maxillary fragment with only the outer portion of M^2 and the anteroexternal portion of M^3 (USNM 25801, Plate 2: figure 4) is possibly of the same form. It is included here because it is of a size that appears compatible with lower teeth of *L. ladae*. The molars are characterized by winglike outer angles. The anterior angle of M^2 is prominently extended anterolaterally but the shorter posterior angle is more laterally directed. There is an outer shelflike cingulum which shows a deep medial reentrant, and at the anterior extremity there is a small stylar cuspule. The anteroexternal angle on M^3 is slender and elongate but more laterally directed than on M^2 and shows a weaker outer cingulum.

A comparison of these upper molar fragments with later and slightly smaller *Leptacodon tener*, as figured by McKenna (1968, fig. 2), would indicate relatively

a little more slender and acute styles, and the cuspule at the anteroexternal extremity of M^2 is more noticeably set off in the Little Muddy Creek specimen. The anterior wall of the paracone in both M^2 and M^3 appears different with no crest extending to the tip of the parastyle, but this, no doubt, is the result of greater wear which has produced a distinct transverse groove immediately anterior to paracone in both teeth. The anteroposterior diameter of M^2 across the outer styles is 1.5 mm.

Family PANTOLESTIDAE

Aphronorus orieli,[5] new species

TYPE.—Right P_4 (USNM 23680).

HORIZON AND LOCALITY.—Middle Paleocene of Evanston formation, near southwest corner, sec. 31, T. 19 N., R. 117 W., between Bell Creek and Little Muddy Creek, Fossil Basin, southwestern Wyoming.

SPECIFIC CHARACTERS.—Much larger than *Aphronorus fraudator* Simpson (1935 and 1937), almost intermediate in size between *A. fraudator* and *Pentacodon inversus* (Cope). Anterior portion of P_4 more inflated than in *A. fraudator,* but with metaconid well defined. Talonid and basin relatively broader, with posterointernal cusp or entoconid higher and better defined, also anterior crest from hypoconid joins the trigonid more externally than in *A. fraudator,* much more so than in *A. simpsoni* Gazin (1838).

DISCUSSION.—About 18 teeth and recognizable tooth portions are found to represent a pantolestid insectivore. While no two were certainly associated, their peculiar characteristics, in form and size, clearly ally them and indicate a pentacodont in many ways intermediate between *Pentacodon* and *Aphronorus,* evidently a little closer to the latter to which it is tentatively referred. Although the name for the new species is carried by a single lower tooth, the form would appear to be defined by a representation of various teeth from both the upper and lower series.

P^4 (USNM 23678, Plate 2: figure 5) is a relatively large tooth with an inflated primary cusp forming most of the outer wall and extending over both of the strong external roots. The tritocone (or metacone) is distinct but smaller than in *A. fraudator* and its basal cingulum—in part external in *A. fraudator*—is essentially confined to the posterior wall in *A. orieli.* The possible presence of a tritocone on P^4 of *Penacodon inversus* cannot be verified because of damage or wear in the known material (Gazin, 1959, pl. 2: fig. 5). Medially P^4 is constricted anteroposteriorly in *A. orieli,* about as in *A. fraudator* and *P. inversus,* and the lingual cusp or deuterocone is high and inflated with the basal portion expanded into well rounded anterointernal and posterointernal portions, each with a distinct crest or cuspule well up on the slope of the deuterocone. This lingual development is much as in *A. fraudator,* but with the anteroposterior expansion relatively a little greater in *A. orieli.* The expansion is relatively still greater in *P. inversus* but much more shelflike and not projecting nearly so high on the deuterocone.

An upper molar, believed to be M^2 (USNM 23679, see Plate 2: figure 5), is somewhat worn but exhibits conical outer cusps much as in *A. fraudator* and has a well-defined external cingulum but with more obtuse anteroexternal and posteroexternal angles than in *A. fraudator.* The tooth is relatively wide transversely as in *A. fraudator,* though not so wide as P^4, and the protocone, hypocone, and accessory cuspules are much like those in the smaller Crazy Mountain form. In *Pentacodon* the outer portion of the anterior upper molars is more expanded anteroposteriorly and the teeth are relatively narrower transversely, with a more noticeable anteroposterior median constriction, though not so marked as in P^4. The upper molar cusps in *Pentacodon* are more inflated, except for the hypocone which is relatively smaller and more crestlike, and the accessory cuspules are obscure.

Among the fragments of teeth allocated to *A. orieli,* a somewhat larger external portion of an upper molar (USNM 25720, Plate 2: figure 5) may well belong to M^1. It shows, as may be interpreted for the $M^2(?)$, a paracone slightly stouter than the metacone and a somewhat shelflike outer cingulum. The cingulum, as in $M^2(?)$, has more obtuse anterior and posterior angles than *A. fraudator,* but these portions of the tooth are not so well rounded as in *Pentacodon.* M^3 of *A. orieli* has not been recognized in the collection.

The lower dentition includes representation of P_4 to M_3. The premolar is relatively large and the molars decrease in size from M_1 to M_3. This is slightly more evident than in *A. fraudator* but a little less noticeable than in *Pentacodon,* particularly *P. occultus.*

P_4, which is represented by three teeth, including the type (Plate 2: figure 6), has a more inflated and

[5] Named for Steven S. Oriel, who is credited with having found the first tooth at the Little Muddy Creek site.

slightly more rugose appearance anteriorly, with a relatively greater width across the trigonid as well as the talonid than in *A. fraudator*. The metaconid is well defined but possibly a little more overshadowed by the bulk of the protoconid than in *A. fraudator*. In *Pentacodon* the trigonid appears more elongate but is relatively not so broad as in *A. orieli*, and the metaconid may be relatively smaller, particularly in *P. occultus*. The broad talonid of P_4 in *A. orieli* with its better developed entoconid exhibits a somewhat higher posterior crest than in *A. fraudator*. In this respect it appears even less like *Pentacodon*, particularly *P. occultus* (see Matthew, 1937, pl. 56: fig. 3).

The lower molars (Plate 2: figure 6) are very much like those in *A. fraudator*, but I note that the paraconid is usually a little better developed in *A. fraudator*. Its reduced size in *A. orieli* is more noticeable in the posterior molars. Accompanying this, a slight anteroposterior shortening of the trigonid toward M_3 is a little more evident in *A. orieli*. On the other hand, the talonid is perhaps a little better developed, and the cusps, as in P_4, appear slightly higher and a little better defined, or perhaps a little more conical. Moreover, on the anterior slope of the entoconid on M_1 there is a small but clearly defined cuspule. In *A. fraudator* this is occasionally observed weakly developed but usually imperceptible. Apparently this cuspule is not present on the posterior molars of either form.

In *Pentacodon*, as noted above, the size of the lower molars decreases more rapidly toward M_3 and the talonid is a relatively smaller part of the tooth than in the forms of *Aphronorus*. In M_3, as seen in *P. occultus*, the talonid is surprisingly reduced.

Measurements (in mm) of teeth in Aphronorus orieli, *new species*

P^4 (23678)
- anteroposterior diameter of labial portion 4.2
- anteroposterior diameter of lingual portion..... 4.1
- greatest transverse diameter..... 5.7

M^2 (?) (23679)
- anteroposterior diameter of labial portion..... 3.1
- anteroposterior diameter of lingual portion..... 2.6
- transverse diameter perpendicular to outer wall..... 4.7

P_4 (23680, type)
- anteroposterior diameter..... 5.3
- transverse diameter of trigonid..... 3.5
- transverse diameter of talonid..... 3.0

M_1 (23681)
- anteroposterior diameter..... 3.9
- transverse diameter of trigonid..... 3.2
- transverse diameter of talonid..... 3.0

M_2 (23682)
- anteroposterior diameter..... 3.8
- transverse diameter of trigonid..... 2.7
- transverse diameter of talonid..... 2.7

M_3 (25716)
- anteroposterior diameter..... 3.6
- transverse diameter of trigonid..... 2.3
- transverse diameter of talonid..... 2.1

Order PRIMATES

Family PAROMOMYIDAE

Cf. *Torrejonia wilsoni* Gazin

A left P_4 and the trigonid of a lower molar, probably M_2, collected at the Little Muddy Creek locality in 1964 and 1961 respectively, correspond very closely to the type material of the recently (Gazin, 1968) described middle Paleocene primate from New Mexico. These fragments were suspected as being primate but their relationships were not understood until the Torrejon form was recognized in the San Juan Basin materials.

P_4 (USNM 25721, Plate 2: figure 8) is nearly identical in size to this tooth in the type of *Torrejonia wilsoni*, particularly in the length of the trigonid and talonid portions, although the width is slightly greater. The greatest width of the tooth, as in *T. wilsoni*, is just ahead of the talonid, not across it as in *Paromomys maturus*. The primary cusp has the same form as in *T. wilsoni*, but differs in exhibiting an incipient metaconid rather than the weak crests seen in this position in the latter. *Paromomys maturus* also lacks the metaconid, but it is seen in the very small paromomyid *Palaechthon alticuspis*. Moreover, the entoconid on the Little Muddy Creek tooth, though slightly better separated from the hypoconid, is a little less pronounced than in *T. wilsoni* and the basin appears relatively a little wider.

The molar trigonid (USNM 25722, Plate 2: figure 7), clearly not M_1, corresponds closely in size to this portion of M_2 in *T. wilsoni*. M_3 is not known in *T. wilsoni*, but the distinctly narrower trigonid of M_3 relative to that of M_2 in related *Paromomys maturus* and *Palaechthon alticuspis* suggests that the Little Muddy Creek fragment may well represent M_2. The crown surface shows the three parallel transverse crests quite as in *T. wilsoni*. The middle and posterior crests are notched as in the *T. wilsoni* type, but the anterior crest is more distinctly continuous, high across the front of the tooth as in the referred Torrejon molar (25257).

Measurements (in mm) of teeth in cf. Torrejonia wilsoni

P_4 (25721)	
anteroposterior diameter	3.3
greatest transverse diameter	2.1
transverse diameter of talonid	1.9
M_2 (25722)	
transverse diameter of trigonid	2.5

Family PLESIADAPIDAE

Cf. *Pronothodectes matthewi* Gidley

Two upper molars of a plesiadapid primate, both believed to be M^2, are only slightly larger than in the type of *Pronothodectes matthewi* Gidley (1923), distinctly smaller than in any of the known species of *Plesiadapis,* or than they would be in *Pronothodectes simpsoni* Gazin (1956). One of these teeth is shown in Plate 2: figure 9. The crests in both, and perhaps the cingula, are a little better defined than in the type of *P. matthewi,* but this, no doubt, is to be attributed to slightly greater wear in the latter. There is a very small cuspule midway on the external cingulum, probably no larger, however, than in the type, which seems worn at this point, as noted by Simpson (1937, p. 167). There is no mesostyle spur from the low crest between the paracone and metacone, such as seen in *Plesiadapis gidleyi* (Matthew, 1917). The lingual slope of the protocone appears slightly longer than in *P. matthewi,* but this cusp is not so inflated as is usual in species of *Plesiadapis.* The well-defined posterior crest from the protocone of the Little Muddy Creek molars is slightly longer than in the *P. matthewi* type and although there is no definable hypocone, the posterior crest is separated from the posterior cingulum by a slight notch, possibly, but not certainly, as in the type. The accessory cuspules are comparatively small but clearly defined on the lateral crests from the protocone. They are equally evident on M^2 of the Crazy Mountain specimen, but the protoconule in the latter is worn away so that the dentine is exposed.

The anteroposterior diameter (externally) of one of the M^2s (USNM 25725) is 2.4 mm. Its transverse width is 3.4 mm. The other (USNM 25726) is 2.5 (estimated) by 3.7 mm. The M^2 in the type of *P. matthewi* measured the same way is 2.2 by 3.4 mm.

A fragment of a lower molar, part of a trigonid, from the Little Muddy Creek locality, though much worn, seems to be of a plesiadapid type but is much too large to represent the same form as above. A more precise identification does not seem feasible.

356-613 O—69——2

Order CREODONTA

Family ARCTOCYONIDAE

Chriacus, cf. *pelvidens* (Cope)

Five upper molars, only three of which are complete, and a single lower molar can be closely matched in size and form with corresponding material of *Chriacus pelvidens* from the New Mexico Torrejon. The three complete upper teeth all appear to be M^1s, and two of these (right and left) found in 1959 are so nearly identical that they must surely represent the same individual (USNM 25731, Plate 3: figure 1). The upper molars have moderately high, conical external cusps, and a large, nearly crescentic protocone with well-defined accessory cuspules. The median basin is large and decidedly smooth, not so irregularly shaped and rugose as in small *Metachriacus.* The cingulum is prominent and regularly formed externally, and continuous across the protocone lingually in USNM 25731. In USNM 25732, however, there is a ridgelike mesostyle from the crest between the paracone and metacone to the external cingulum, and the internal cingular crest is discontinuous across the protocone. The hypocone is well developed on the cingulum but there is no distinct anterointernal cuspule on either specimen.

The lower molar (USNM 25733, Plate 3: figure 2) is possibly M_1 as suggested by the slightly narrower trigonid and medially placed paraconid, although the tall trigonid is anteroposteriorly somewhat shorter and relatively not so narrow as common in *C. pelvidens,* or as seen in the type. The position of the paraconid appears somewhat variable in the New Mexico material but is usually a little more lingual in position, except in M_3. The cingulum on the Little Muddy Creek tooth is well developed across the anterior surface, and laterally and downward from the prominent hypoconulid. The large talonid basin, moreover, is relatively free of rugae.

Measurements (in mm) of teeth in Chriacus, *cf.* pelvidens

M^1 (25731)	
anteroposterior diameter externally	7.0
anteroposterior diameter lingually	5.3
transverse diameter perpendicular to outer wall	8.3
M_1(?) (25733)	
anteroposterior diameter	7.5
transverse diameter of trigonid	4.9
transverse diameter of talonid	5.3

Cf. *Chriacus truncatus* Cope

A third upper molar, two incomplete lower molars, and possibly a jaw fragment with badly worn teeth, including P_3, P_4 and part of M_1 and M_2, would appear *Chriacus*-like, but much smaller than the foregoing species. In size they compare more favorably with *C. truncatus.*

The M^3 (USNM 25796, Plate 2: figure 10) is somewhat triangular in outline with a prominent paracone and evidently a moderately developed metacone, although the latter is nearly obliterated by wear. The protocone is low and broadly crescentic, and the accessory cuspules are distinct but rather weak. The external cingulum is well developed anteriorly and is joined by an anterior crest from the paracone, but shows very little evidence of a distinct parastyle. Posteriorly the external cingulum is much reduced. The cingulum is continuous lingual to the protocone and shows a small cuspule at the anterolingual angle, as often seen on M^2 in this genus. Posteriorly the cingulum about the protocone is damaged.

One of the lower molars (USNM 25797, Plate 2: figure 11) is clearly M_1 and shows a prominent paraconid low and well forward of the metaconid, and below the paraconid a well-developed cingulum extends across the anterior surface. The protoconid and metaconid are conical, moderately high, and well separated. The talonid portion is missing lingually but the hypoconid is strongly developed with the crista obliqua extending toward the cleft between the protoconid and metaconid. The talonid portion of another lower molar that may be *Chriacus* shows both the hypoconid and entoconid strongly crescentic and enclosing a deeply basined talonid. The hypoconulid, though evidently incomplete, appears low on the posterior crest.

The jaw fragment (USNM 25798, Plate 2: figure 12) with the posterior premolars and the trigonid portions of M_1 and M_2 is only tentatively included with the above, as it may represent a different genus. The trigonid portion of M_1 is badly worn but is noticeably smaller than that of the M_1 described above. The premolars, however, are decidedly elongate and though much worn appear rather *Chriacus*-like, particularly in the development of a transversely deflected paraconid crest near the base of the tooth. In P_3 this curves inward enclosing a small anterointernal basin, but in P_4 the anterior crest from the primary cusp turns sharply inward at the base to form a strongly developed transverse crest across the anterior margin of the tooth. Both teeth exhibit a short, broad talonid with an elevated posterior crest, relatively better developed on P_4. The primary cusp on P_4 is too well worn to show evidence of a metaconid, but an isolated P_4 closely resembling this tooth shows a very weak and low metaconid. The two teeth correspond well in size to lower premolars of *Spanoxyodon latrunculus* Simpson (1937) but are relatively a little broader anteriorly. The bone anterior to P_3, however, is not preserved in the Little Muddy Creek specimen so that the number of premolars cannot be determined. Also M_1 appears too small, as it does in a comparison with *Chriacus truncatus.*

Measurements (in mm) of teeth in cf. Chriacus truncatus

M^3 (25796)	
anteroposterior diameter perpendicular to anterior margin	3.5
greatest transverse diameter	5.7
M_1 (25797)	
anteroposterior diameter	5.7
transverse diameter of trigonid	3.6
P_3 (25798)	
anteroposterior diameter : greatest transverse diameter	4.2 : 2.2
P_4 (25798)	
anteroposterior diameter : greatest transverse diameter	4.5 : 2.8
M_1 (25798)	
transverse diameter of trigonid	3.1
M_2 (25798)	
transverse diameter of trigonid	3.6

Tricentes, cf. *subtrigonus* (Cope)

Four isolated upper teeth, including representation of all molars, a lower jaw portion with M_2 and part of M_3, and some fragments of lower teeth are recognized as belonging to *Tricentes.* Most of these appear a little smaller than average in *T. subtrigonus,* but within the size range of the New Mexico material. Also, both upper and lower teeth are relatively narrower transversely in relation to their length, but again this is variable in *T. subtrigonus.* In M^1 (USNM 25749, Plate 3: figure 3) the cingulum is discontinuous around the protocone and external to the paracone, as common in *T. subtrigonus,* although in certain New Mexico specimens it is continuous around the protocone in this tooth. In M^2 (USNM 25750, Plate 3: figure 3) the cingulum is continuous lingually, as usual in *T. subtrigonus,* but shows a slight interruption outside the paracone. This latter feature is less frequently seen in

M^2 of *T. subtrigonus* but is not necessarily indicative of *Mimotricentes*. In the two M^3s preserved, the cingulum on one (USNM 25751, Plate 3: figure 3) is slightly discontinuous lingually but in the other (USNM 25753) there is no interruption. Both of these teeth are little worn and decidely rugose.

The lower jaw portion can be closely matched among some of the smaller specimens of *T. subtrigonus*. The position of the paraconid in M_2 is low and well forward, not so closely appressed to the metaconid as in *Mimotricentes latidens*. The position of the paraconid is rather variable in the material of *T. subtrigonus* although usually better separated from the metaconid than in *M. latidens*. In this respect *Mimotricentes angustidens*, the smaller of the Crazy Mountain species, is perhaps a little more like *Tricentes*. Unfortunately, the anterior part of the jaw for the Little Muddy Creek form is not represented so that the number of premolars is not known.

Comparison of the posterior lower molars with material of *Tricentes fremontensis* from a later Paleocene stage represented at the early Tiffanian horizon in the Bison Basin (Gazin, 1956a) shows rather little of distinctive value. *Tricentes fremontensis* is characterized by smaller premolars and a relatively narrow trigonid on M_1, so that comparison in this respect cannot be made. In *Tricentes fremontensis* it should be noted that the paraconid of the lower molars is placed low, well separated forward from the metaconid, and is no more lingual in position than in much of the New Mexico material. Moreover, a broken jaw fragment (USNM 20584) with P_3 and P_4 shows root portions of P_2 about the size of those for P_3, but there is no evidence for P_1, so the form represented would not appear likely to be *Mimotricentes*,[6] according to Simpson's definition (1937, p. 203).

Measurements (in mm) of teeth in Tricentes, *cf.* subtrigonus

M^1 (25749)	
anteroposterior diameter externally	5.2
transverse diameter across anterior portion	5.9
M^2 (25750)	
anteroposterior diameter externally	5.8
transverse diameter across anterior portion	7.2
M^3 (25751)	
anteroposterior diameter medially from anterior surface across metacone	4.0
greatest transverse diameter	5.9
M_2 (25752)	
anteroposterior diameter	6.0
transverse diameter of trigonid	4.3
transverse diameter of talonid	4.3
M_3 (25752)	
transverse diameter of talonid	3.3

[6] L. Van Valen (in Russell, 1967, p. 82) has implied that *T. fremontensis* represents *Mimotricentes*.

Order CONDYLARTHRA

Family HYOPSODONTIDAE

Promioclaenus, cf. *lemuroides* (Matthew)

In addition to about a half dozen, mostly complete, isolated lower teeth and a fragment of an upper molar, a lower jaw portion with M_2 andM_3 is preserved, representng the hyopsodontid condylarth *Promioclaenus*. The form is much larger than the Crazy Mountain species *P. aquilonius*. The teeth appear close in size to the New Mexico material of *P. lemuroides* but are relatively a little narrower transversely, in which respect the molars make a closer approach to the early Tiffanian form *P. pipiringosi* from the Bison Basin. The premolars, however, as indicated by P_4 (USNM 25784), though also somewhat slender, are evidently not so reduced as in the latter. M_3 is moderately reduced in size, much as in *P. lemuroides*, not nearly so reduced or simplified as in *Ellipsodon inaequidens* (for generic distinction see Wilson, 1956).

In the lower jaw portion (USNM 25783, see Plate 3: figure 6) the paraconid of M_2 is well defined but low on the anterior slope of the metaconid. The trigonid portion is slightly longer and broader than the talonid, and its anterior surface is wide and relatively straight transversely, and exhibits a well-defined cingulum. The cingulum is missing elsewhere, except for a short distance on the posterior surface of the hypoconid. The talonid is characterized by a well-developed hypoconid, but the hypoconulid and entoconid are not separately so clearly distinguished, however, forming a prominent crest extending around the basin posterolingually, which on the lingual side becomes reduced anteriorly.

In the reduced M_3 the trigonid is much as in M_2 with a low but distinct paraconid anterior to the metaconid, and a similarly developed anterior cingulum. The talonid basin is relatively elongate and the hypoconulid and entoconid as well as the hypoconid are clearly defined on the high crest around the basin.

Measurements (in mm) of lower teeth in Promioclaenus, *cf* lemuroides

P_4 (25784)
- anteroposterior diameter : transverse diameter ... 4. 3 : 2. 9

M_2 (25783)
- anteroposterior diameter ... 4. 3
- transverse diameter of trigonid ... 3. 5
- transverse diameter of talonid ... 3. 3

M_3 (25783)
- anteroposterior diameter ... 4. 5
- transverse diameter of trigonid ... 2. 9
- transverse diameter of talonid ... 2. 5

Promioclaenus, cf. *acolytus* (Cope)

It is surprising to find that, with the exception of a single molar fragment, possibly representing *P. lemuroides,* all of the *Promioclaenus* upper teeth encountered in the collection are much too small for that species. Their size is entirely comparable with the corresponding teeth in the New Mexico species *Promioclaenus acolytus* or compare equally well with the Crazy Mountain form *P. aquilonius.* I have tentatively referred the Little Muddy Creek specimens to *P. acolytus* because they do not show the rather distinctive stylar development, particularly the parastyle, seen in *P. aquilonius.*

Two isolated M^1s (USNM 25790, see Plate 3: figure 5; and USNM 25789) show well-developed anterior and posterior cingula, but externally the cingulum is rather weak, except about midway. The outer margin is gently convex, not bilobed as generally seen in *P. aquilonius,* and the angles are blunt or well rounded with little or no stylar development. These teeth are slightly worn, but there is no certain evidence of a hypocone although the posterior cingulum is well developed. In one (USNM 25790), though somewhat more worn, the posterior cingulum rises a little higher on the protocone. This tooth also shows a slight cuspule on the shorter anterior cingulum at its lingual extremity. The primary cusps are conical with the large protocone slightly crescentic and there is a low crest joining the outer cusps. The accessory cuspules are present, although the protoconule is not so well defined as the metaconule.

M^2 (USNM 25791, Plate 3: figure 5) is relatively a little wider transversely than M^1 but like it shows strong anterior and posterior cingula. Externally the cingulum, as in M^1, is less prominently developed, and the outer margin, much as in material of *P. acolytus* at hand, shows almost no median deflection. The angles are rounded, and although a weak crest extends down the anteroexternal slope of the paracone to the cingulum there is no parastyle cuspule as seen so prominently developed in *P. aquilonius.* It should be noted, however, there may be a much smaller cuspule in this position in *P. acolytus* also. There is no lingual cuspule on the anterior cingulum and the posterior cingulum rises lingually toward, but not quite to, the apex of the protocone. Although the latter crest is worn, there would appear to be no certain evidence for a hypocone.

M^3 (USNM 25792, Plate 3: figure 5) is reduced in size and somewhat oval in shape, not nearly so triangular as in *P. aquilonius.* This is effected largely by the broader (anteroposteriorly) protocone, as seen in a specimen of *P. acolytus* at hand. The metaconid is defined, but possibly a little more reduced with respect to the paracone than in either *P. aquilonius* or *P. acolytus.* The anteroexternal crest from the paracone to the cingulum is not so externally directed and this angle of the tooth is less acute than in *P. aquilonius.* The protoconule is defined but wear has apparently obliterated evidence for a distinct metaconule. Both cuspules may be seen in specimens of *P. acolytus,* possibly a little more clearly than in *P. aquilonius.*

Measurements (in mm) of upper teeth in Promioclaenus, cf. acolytus

M^1 (25790)
- anteroposterior diameter perpendicular to anterior margin ... 3. 5
- transverse diameter across anterior portion, to base of enamel lingually ... 4. 7

M^2 (25791)
- anteroposterior diameter perpendicular to anterior margin ... 3. 4
- transverse diameter across anterior portion, to base of enamel lingually ... 5. 2

M^3 (25792)
- anteroposterior diameter at right angle to greatest diameter ... 2. 5
- greatest transverse diameter ... 3. 7

Cf. *Litaletes disjunctus* Simpson

The talonid portion of an anterior lower molar (USNM 25799) corresponds very closely in size to this portion of M_1 in the type of *Litaletes disjunctus.* The development of the cusps forming the crest surrounding the basin is almost identical, including evidence of the small cuspule anterior to the entoconid. I suspect, however, that the tooth is actually M_2, which is somewhat larger in the type, inasmuch as the inner and outer

margins of the talonid diverge forward slightly, suggesting that the missing trigonid was wider, not narrower than the talonid as would be the case in M_1. The transverse diameter of the talonid fragment is 3.3 mm.

Haplaletes?, species

Five isolated upper molars, three of which are complete, evidently represent a hyopsodontid that appears closer to *Haplaletes* than other genera in this family. No lower teeth were encountered of an appropriate size. The upper molars (Plate 3: figure 7) are about intermediate in size between *Haplaletes disceptatrix* and *Litomylus dissentaneous,* but show an outer wall configuration which more nearly resembles that in *Haplaletes,* not so straight as in larger *Litomylus.* The hypocone, however, is larger and more lingually placed, again about intermediate in this respect between *Haplaletes* and *Litomylus.* It may be noted that there is a definite resemblance in the outer portion of the teeth to the somewhat larger molars that I have included in *Aphronorus orieli,* but the transversely elongate pentacodont upper molars are much different lingually.

Order CONDYLARTHRA?, incertae sedis

A single upper molar (USNM 25805, see Plate 3: figure 8), comparable in size to those cited above as *Haplatetes*? species, exhibits a rather distinctive cusp arrangement. The tooth is either M^1 or M^2, almost certainly not a Dp^4, and exhibits decidedly conical cusps with only very weak development of crests. The paracone and metacone are nearly circular cones, with the latter very slightly larger. The protocone is about the same height as these but a little more inflated. The hypocone is prominent but well separated from the larger protocone. The accessory cuspules are distinct with the protoconule rounded and situated low and close to the protocone at the anterior extremity of a weak anteroexternal crest. There is no posterointernal crest from the protocone, and the metaconule, slightly elongate toward the median basin, is joined instead with the hypocone, giving the tooth a somewhat perissodactyl-like appearance. There is a strong anterior cingulum which does not extend around the protocone and a weaker posterior cingulum which terminates lingually at the hypocone. There is a slight cingulum lingually between the protocone and hypocone. Externally the cingulum is distinctly bilobed. It is evenly developed around the metacone, but anteroexternally it is broken away so that the possible development of a parastyle cannot be determined.

One may speculate on the possibility of this tooth representing a forerunner of Eocene perissodactyls, and if this is the case it is a rare occurrence for the environment of the Rocky Mountain region in Paleocene time. Its potential in this relationship is much greater than that of rather differently specialized teeth of *Tetraclaenodon* and its allies. It is, moreover, distinctly more primitive than the very Eocene-like forms of *Hyracotherium* reported to be from the later Paleocene.

The tooth measures approximately 3.2 mm anteroposteriorly by 4.1 mm transversely.

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PLATE 1

Little Muddy Creek locality, Evanston formation, Fossil Basin, Wyoming. Above, view northward over essentially the entire outcrop. Below, near view of fossiliferous spur and small hill in foreground.

PLATE 2

(All scales are approximate.)

Ptilodus, cf. *montanus* Douglass:

1. Right P_4 (USNM 25673), lateral view, ×5.

Neoplagiaulax, cf. *grangeri* (Simpson):

2. Right P^4 (USNM 25674), lateral view, ×5.

Ectypodus, near *E. powelli* Jepsen:

3. Right P_4 (USNM 25675), lateral view, ×5.

Possibly *Leptacodon ladae* Simpson:

4. Left maxillary fragment with portions of M^2 and M^3 (USNM 25801), occlusal view, ×10.

Aphronorus orieli, new species:

5. Composite right upper cheek tooth series, P^4, M^1(?), and M^2(?) (right to left: USNM 23678, 25720, and 23679), occlusal view, ×5.
6. Composite right lower cheek tooth series, P_4–M_3 (right to left: USNM 23680, type specimen; 23681; 23682; and 25716), occlusal (above) and lateral views, ×5.

Cf. *Torrejonia wilsoni* Gazin:

7. Trigonid of left M_2(?) (USNM 25722), occlusal view, ×5.
8. Left P_4 (USNM 25721), occlusal (above) and lateral views, ×5.

Cf. *Pronothodectes matthewi* Gidley:

9. Left M^2(?) (USNM 25725), occlusal view, ×5.

Cf. *Chriacus truncatus* Cope:

10. Left M^3 (USNM 25796), occlusal view, ×5.
11. Right M_1 (USNM 25797), occlusal view, ×5.
12. Fragment of right ramus of mandible with P_3, P_4, and part of M_1 (USNM 25798), occlusal (above) and lateral views, ×5.

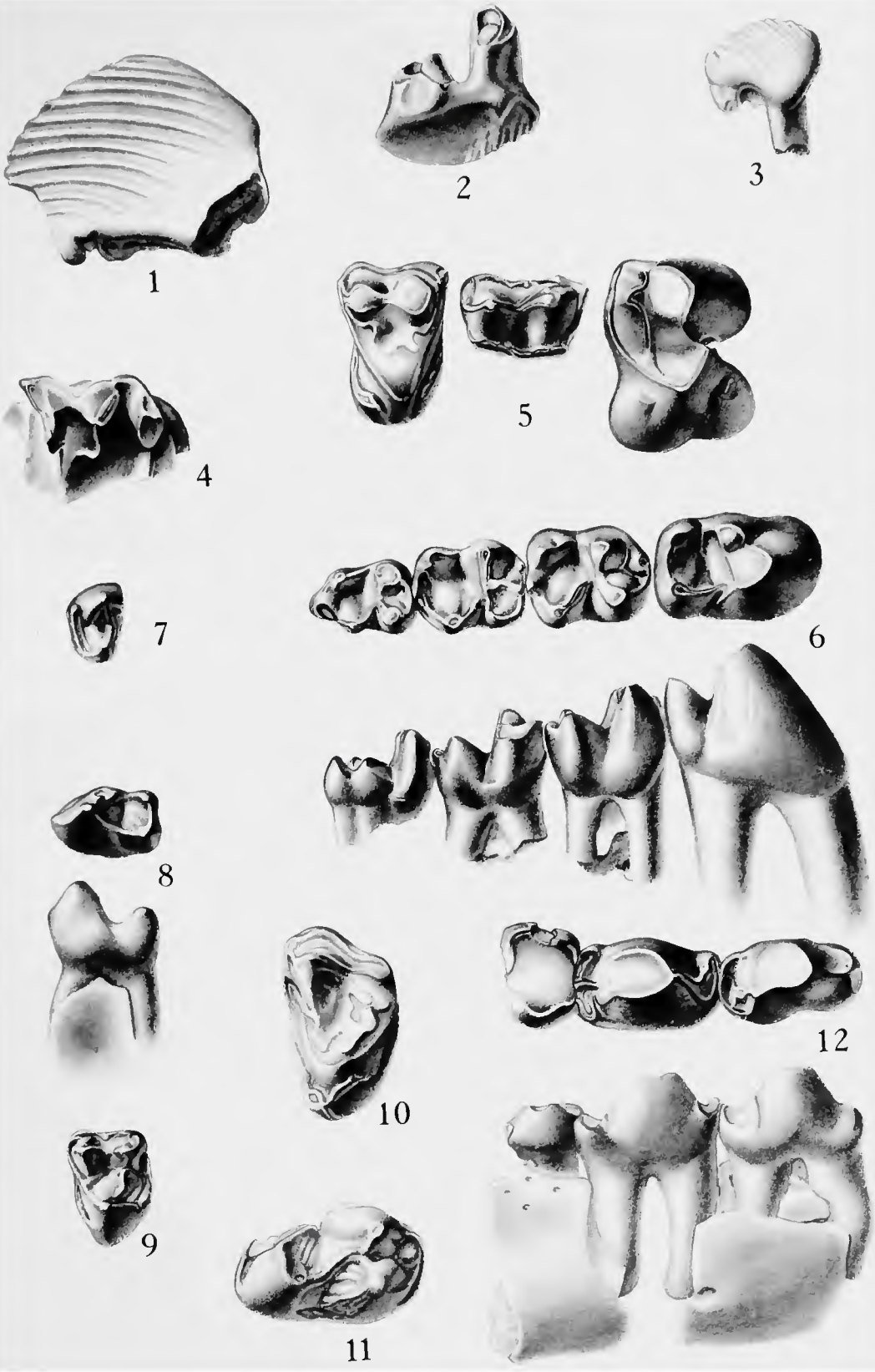
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PLATE 3

(All scales are approximate.)

Chriacus, cf. *pelvidens* (Cope):

1. Left M^1 (USNM 25731), occlusal view, ×5.
2. Left M_1(?) (USNM 25733), occlusal view, ×5.

Tricentes, cf. *subtrigonus* (Cope):

3. Composite right upper molar series, M^1–M^3 (right to left; USNM 25749, 25750, and 25751), occlusal view, ×5.
4. Right ramus of mandible with M_2 and part of M_3 (USNM 25753), occlusal (above) and lateral views, ×5.

Promioclaenus, cf. *acolytus* (Cope):

5. Composite right upper molar series, M^1–M^3 (right to left; USNM 25790, 25791, and 25792), occlusal view, ×5.

Promioclaenus, cf. *lemuroides* (Matthew):

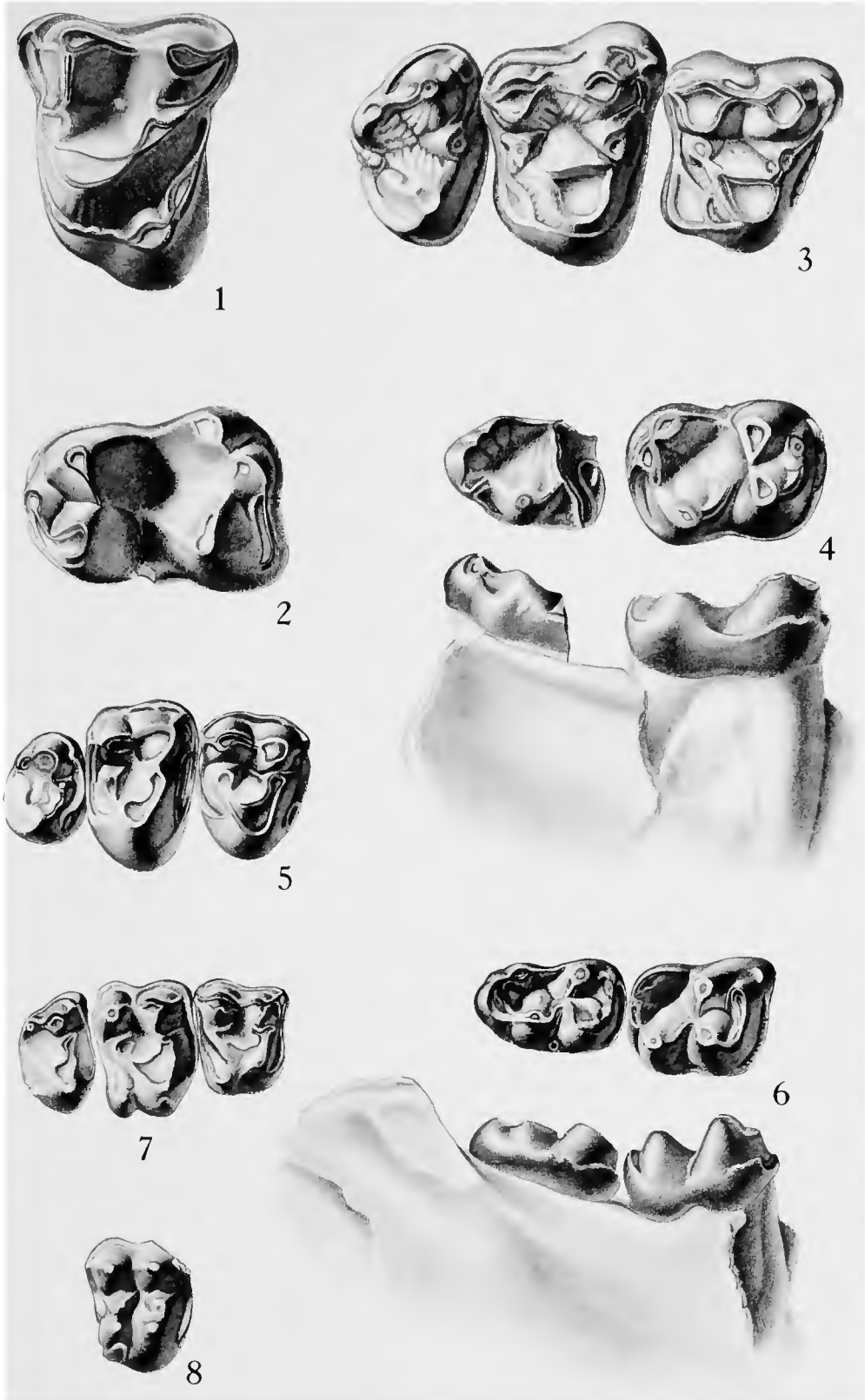
6. Left ramus of mandible with M_2 and M_3 (USNM 25783), occlusal (above) and lateral views, ×5.

Haplaletes?, species:

7. Composite right upper molar series, M^1 (reversed from left), M^2, and M^3 (right to left: USNM 25802, 25803, and 25804), occlusal view, ×5.

Condylarth?, incertae sedis:

8. Right upper molar (USNM 25805), occlusal view, ×5.



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