

**Revised age constraints for Late Cretaceous to early Paleocene terrestrial strata from the Dawson Creek section, Big Bend National Park, west Texas**

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**Tables DR1–DR6: See Excel file 2018042**

SYSTEMATIC PALEONTOLOGY

Infraclass METATHERIA Huxley, 1880

Family PERADECTIDAE Trouessart, 1879

Genus PERADECTES Matthew and Granger, 1921

*Peradectes* sp.

Fig. 9A-D

*Peratherium* sp., Standhardt, 1986, p. 210, fig. 68.

Material.—LSU V-895, right partial M?; and LSU V-705, left m? from TMM locality 42327.

Description.—A small metatherian mammal is represented by a partial upper molar and a lower molar, both from TMM locality 42327(Fig. 9A-D). The upper molar fragment, probably an M1 (Fig. 9A), consists of a distobuccal fragment of a molar preserving the metacone and the distal portion of the stylar shelf. It lacks any indication of an ectoflexus or a sharp indentation in the buccal margin demarcating the limits of Stylar cusp C on M2s and M3s of that taxon, supporting the conclusion that it represents an M1. M1s and M2s of *P. coproxeches* sometimes bear doubled stylar cusp Cs (Williamson and Taylor, 2011).

The lower molar (LSU V-705; Fig. 9B-D) represents either m2 or m3. The apex of the protoconid is damaged, but is larger and evidently would be taller than the metaconid. The paraconid is shorter than the metaconid and projects mesiolingually. The cristid obliqua intersects the distal wall of the trigonid buccal to the protocristid notch. The hypoconid is damaged, missing much of the enamel. The entoconid and hypoconulid are twinned, with the hypoconulid situated near the distolingual margin of the tooth and projecting distally. The entoconid is tall and blade-like. It is larger (length = 1.73; mesial width = 1.00; distal width = 0.99) than corresponding teeth of *Peradectes coproxeches* and falls within the size range of *P. minor* (Clemens, 2006; Williamson et al., 2012).

Remarks.—Unfortunately, there is insufficient material to allow a specific identification of this taxon. *Peradectes* is a wide-ranging genus present in the Puercan, early Paleocene through Eocene of western North America (Williamson et al., 2012).

Order CIMOLESTA McKenna, 1975  
Family CIMOLESTIDAE Marsh, 1889  
Genus and Species indeterminate  
Fig. 9E-G

*Gelastops* sp., Standhardt, 1986, p. 213, fig. 69.

Material.—LSU V-708, left P3; and LSU V-841, partial right M2 from TMM locality 42327.

Description.—A small cimolestid is represented by a complete crown of a poorly preserved and abraded left P3 (LSU V-708; Fig. 9E-F) and a partial M2 (LSU V-841; Fig. 9G) that includes the mesial and lingual portion of the tooth including part of the paracone and a complete parastylar lobe and the protocone and talon basin.

The P3 (LSU V-708; Fig. 9E-F) is triangular in shape in occlusal view (length = 1.95; width = 1.39), with a small parastyle and a linguallally-positioned protocone. A small, distinct cusp distal to the protocone, high on the metacrista represents the metacone.

The parastylar lobe of the M2 (LSU V-841; Fig. 9G; mesial width = 4.5) is large and projects mesiobuccally, supporting two closely appressed distinct cusps which probably correspond to a parastyle and a stylocone. A significant stylar shelf with a marked ectoflexus was evidently present. The paracristid is low, but sharp. The paracone is conical. The protocone is mesiodistally compressed. The paraconule is situated close to the protocone on the preprotocone crest and is separated from it by a deep notch. A postparaconule crista is absent. A postprotocone crest is straight. Basal cingulae are absent.

Remarks.—Standhardt (1986) referred these specimens to *Gelastops*. However, *Gelastops* is a relatively poorly known taxon and represented by few upper teeth making comparison difficult. For example, the P3 of *Gelastops* remains unknown. We find that the upper molar fragment is essentially indistinguishable from corresponding parts of *Acmeodon secans*, a taxon originally described from the Torrejonian of the Nacimiento Formation, San Juan Basin, New Mexico and which is considered to be close to *Gelastops* (Simpson, 1935). Certain identification is not possible given the fragmentary nature of the tooth. Moreover, the isolated P3 (LSU V-708) resembles that of *Acmeodon*, but differs in that the protocone is smaller and situated directly lingual to the paracone rather than distolingual to it. We are unable to identify these specimens to genus or species.

Cimolestids are usually rare components of Paleocene faunas (e.g., Williamson et al., 2011) that decreased in taxonomic diversity from the Puercan through the Tiffanian of western North America.

Legion CARNIVORAMORPHA Wyss and Flynn, 1993  
Family VIVERRAVIDAE Wortman and Matthew, 1899  
Genus BRYANICTIS MacIntyre, 1966  
*Bryanictis* new species  
Fig. 9H-L

*Protictis (Bryanictis) terlinguae*, Standhardt, 1986, p. 218, figs. 71, 72. [nomen nudum]

Material.— TMM 41400-10, left p4 from TMM locality 41400, and LSU V-709, incomplete P3 from TMM locality 42327.

Description.—A small viverravid carnivoramorph representing a new species of *Bryanictis* is represented by at least two isolated teeth, an incomplete P3 (LSU V-960; Fig. 9H-I) from TMM locality 42327 and a p4 (TMM 41400-10; Fig. 9J-L) from TMM locality 41400. Standhardt (1986) referred an additional specimen to this taxon consisting of an isolated p2 (LSU V-960). However, this specimen could not be located for this study.

The P3 (LSU V-960; Fig. 9H-I; length = 2.38; width = 1.65) is triangular in occlusal view with a large and distally-leaning paracone flanked distally by a smaller metacone. The tooth is encircled by a basal cingulum. A small protocone rises from the lingual cingulum lingual to the paracone.

The p4 (TMM 41400-10; Fig. 9J-L; length = 2.38; width = 1.65) is buccolingually narrow with a tall and slightly recurved protoconid, a low, mesially projecting, blade-like paraconid, and a relatively wide talonid. The talonid bears a low hypoconid that is in line with the paraconid and metaconid. A low hypoconulid is positioned distolingual to that line, forming a distolingual wall to a small talonid basin.

Remarks.—The p4 is similar in length, but a bit smaller than that of *Simpsonictis tenuis* and has a relatively more buccolingually expanded talonid. The p4 resembles that of *Intyriactis* from the Torrejonian of the Nacimiento Formation, San Juan Basin, New Mexico in having a relatively low protoconid and wide talonid. However, unlike *Intyriactis*, the Black Peaks carnivoramorph lacks a metaconid.

We refer these specimens to the genus *Bryanictis*, a poorly known taxon represented by two species, *B. microlestes* and *B. paulus* (Gingerich and Winkler, 1985; MacIntyre, 1966; Meehan and Wilson, 2002) from the middle Torrejonian of the Fort Union Formation, Montana and the Nacimiento Formation, New Mexico, respectively, because it shares a broadening of the p4 talonid and lacks a metaconid as is found in *Intyriactis*. The Black Peaks taxon is smaller than either species of *Bryanictis* and undoubtedly represents a new taxon.

The oldest unambiguous carnivoramorphs are Torrejonian in age. Puercan carnivoramorphs have been reported from the Puercan of Saskatchewan, Canada based on isolated teeth. However, we do not find their referral of *Ravenictis* and additional isolated lower molars to Carnivoramorpha to be certain. Regardless, these specimens do not include a P3 or p4 so direct comparison with the Black Peaks taxon is not possible.

The Dawson Creek *Bryanictis* represents a new species and represents among the smallest early Paleocene carnivoramorph. Only the putative Puercan carnivoramorph *Ravenictis krausei* is smaller.

Order Dermoptera Illiger, 1811  
Family Mixodectidae Cope, 1883  
Genus MIXODECTES Cope, 1883  
*Mixodectes malaris* Cope, 1883  
Fig. 9M

*Indrodon malaris* Cope, 1883, p. 60.

*Mixodectes malaris* Cope, 1883 [see Szalay, 1969 for synonymy]; Rigby, 1980, p. 63, table 16; Taylor, 1984, p. 147, table 10; Standhardt, 1986, p. 222, fig. 73; Williamson, 1996, p. 38.

Material.—LSU V-924, partial left M3; and LSU V-928, partial left M2 from TMM locality 41400.

Description.—The mixodectid *Mixodectes malaris* is represented by two fragmentary upper molars, a partial left M3 (LSU V-924; Fig. 9M) and a partial left M2 (LSU V-928) from TMM locality 41400. Unfortunately, the partial left M2 was not available for this study. The partial left M3 consists of the distal half of the crown. It includes a pronounced mesostyle, metacone, and the distal portion of the protocone and talon basin. The mesostyle is well developed and projects buccally as a blade shaped crest. The protocone is rounded lingually and bordered by a low distal basal cingulum.

Remarks.—The preserved portion of the tooth (distal width = 3.73) is essentially indistinguishable from the M3 of *Mixodectes malaris*, a taxon known from the middle Torrejonian of the Fort Union Formation, Washakie Basin, southern Wyoming (Rigby, 1980) and the Nacimiento Formation, San Juan Basin, New Mexico (Szalay, 1969). *Mixodectes* is easily recognized by its salient mesostyle and *M. malaris* is distinguished from *M. pungens*, which is known only from the late Torrejonian of New Mexico, by its smaller size.

Order PRIMATES Linnaeus, 1758  
Family 'PALAECHTHONIDAE' Szalay, 1969  
Genus PLESIOLESTES Jepsen, 1930  
*Plesiolestes nacimienti* Wilson and Szalay, 1972  
Fig. 9N-R

*Palaechthon nacimienti* Wilson and Szalay, 1972, p. 5, figs. 2-9; Taylor, 1984, p. 164, table 13; Standhardt, 1986, p. 225, fig. 74; Williamson and Lucas, 1993, p. 121, Williamson, 1996, p. 39. *Plesiolestes nacimienti* (Wilson and Szalay, 1972). Gunnell, 1989, p. 24; Silcox and Williamson, 2012, p. 810, fig. 4.

Material.—LSU V-921, right P4; TMM 41400-17, left M2; and LSU V-923, right m3 from TMM locality 41400.

Description.—*Plesiolestes nacimienti* is represented by three isolated teeth including a right P4 (LSU V-921; Fig. 9N), left M2 (LSU V-923; Fig. 9O), and right partial m3 (LSU V-923; Fig. 9P-R).

The P4 (LSU V-921; length = 2.18; width = 2.41; Fig. 9N) possesses a large paracone, a smaller metacone, and a minute parastyle. The protocone is subequal in size to the paracone and is positioned linguomesially. A preprotocone crest is present, but a distinct postprotocone crest is absent. Conules are absent, but a small, distinct postparaconule crest extends from the preprotocone crest to the lingual base of the paracone.

A left M2 (TMM 41400-17; Fig. 9O; length = 2.13; mesial width = 3.41; distal width = 3.13) is relatively poorly preserved and appears to be abraded. The tooth is transverse with subequal and widely-separated paracone and metacone and a small parastyle. The stylar shelf is narrow. The paraconule is positioned near the base of the paracone with short pre- and postparaconular cristae. The metaconule is similarly positioned close to the base of the metacone and small and short pre- and postmetaconular cristae are present. The protocone is large and

attended mesially by a basal precingulum that extends buccally to the base of the paraconule. A postprotocingulum extends distally from the apex of the protocone and joins the postcingulum that proceeds buccally to near the base of the metaconule.

The m3 (LSU V-923; mesial width = 1.42; distal width = 1.46; Fig. 9P-R) is broken into two fragments: one preserving most of the trigonid and the other preserving most of the talonid. It is incomplete, missing portions of the crown between the two fragments. The trigonid is short and includes the subequal protoconid and metaconid. The metaconid is positioned nearly directly lingual to the protoconid. The paraconid is small and is positioned close and mesial to the metaconid, but is separated from it by a narrow cleft. The mesial edge of the trigonid is bordered by a narrow paracristid. The talonid is wider and much longer than the trigonid. The hypoconid is the largest of the talonid cusps followed by the hypoconulid, which is unfissured, and then the entoconid. The cristid obliqua probably met the trigonid between the protoconid and metaconid. A swelling on the cristid obliqua probably represents a small mesoconid. Buccal and lingual cingulids are not present, but a distinct precingulid extends from the mesial base of the tooth to wrap partway round the buccal side of the protoconid.

Remarks.—The teeth are all similar to those referred to *Plesiolestes nacimienti* from the Nacimiento Formation, San Juan Basin, New Mexico (Wilson and Szalay, 1972; Silcox and Williamson, 2012). We follow Gunnell (1989) in including the species in the genus *Plesiolestes*.

As discussed by Silcox and Williamson (2012), *Plesiolestes nacimienti* is an exceedingly rare taxon in the Nacimiento Formation, San Juan Basin, New Mexico, but appears to have a relatively long stratigraphic ranging, extending from Tj3 to Tj6 (from near the base of chron C27r to at least the middle of chron C27n; see Silcox and Williamson, fig. 14). Gunnell (1989) also assigned two isolated teeth from the North Horn Formation, Dragon Canyon, Utah, to *P. nacimienti*, and at least one of these specimens was collected from near the top of a normal polarity zone correlated with C28n (Tomida and Butler, 1980). Thus, *P. nacimienti* has a stratigraphic range extending through most of the Torrejonian.

Order ‘CONDYLARTHRA’ Cope, 1881b

Family PERIPTYCHIDAE Cope, 1882b

Genus HAPLOCONUS Cope, 1882a

*Haploconus* sp.

Fig. 10A-E

*Haploconus inopinatus*, Standhardt 1986, p. 248, fig. 82.

Material.—LSU V-710, partial right M1; LSU V-711, partial right M2; and LSU V-835, left m2 from TMM locality 42327.

Description.—The periptychids “condylarth” *Haploconus* is represented by three partial teeth. Two isolated teeth represent a partial M1 (LSU V-710; Fig. 10A; length = 3.81\*) and a partial M2 (LSU V-711; Fig. 10B; length = 3.96) that likely come from a single individual. Both teeth are missing a portion of their crowns, buccal to the apices of the paracones and metacones. They possess the distinctive close convergence of the para- and metacone, protocone, and conules with the protocone and conules being transversely compressed to form a continuous crescentic, cuspidate arc centered on the protocone and a hypertrophied hypocone that extends lingually beyond the base of the protocone. A mesial cingulum terminates lingually in a distinct

cusplingual to the apex of the protocone: the protostyle. Small crests extend between both the bases of the protostyle and the hypocone to the base of the protocone.

A partial fragment of a lower molar (LSU V-835; Fig. 10C-E; mesial width = 3.01) preserves the trigonid, mesial to the apices of the metaconid and protoconid. The paraconid is blade-like and projects mesially as is distinctive of *Haploconus*. A strong mesiolingual cingulid is present mesial to the metaconid.

Remarks.—Standhardt (1986) referred these specimens to *Haploconus inopinatus*, a poorly known taxa from the early Torrejonian of the North Horn Formation, Dragon Canyon, Utah, based partly on the presence of a protostyle. However, a protostyle is sometimes present in other species of *Haploconus* including the middle Torrejonian *H. angustus* and *H. corniculatus* from the Nacimiento Formation, San Juan Basin, New Mexico. The Dawson Creek specimens differ significantly from the only Puercan species of *Haploconus*, *H. elachistus* in being larger and having less transverse upper molars and having less transversely-compressed trigon. All three specimens are within the size range of *H. angustus*, but we refrain from making a certain specific identification because of the incomplete nature of the available specimens.

Genus PERIPTYCHUS Cope, 1881a

*Periptychus carinidens* Cope, 1881a

Fig. 10F-H

*Periptychus carinidens* Cope, 1881a, p. 337 [see Taylor, 1984 for synonymy], Rigby, 1980, p. 111, pl. XIV, figs. 7-9, table 42, Archibald, 1998, p. 312, fig. 20.3c; Williamson and Lucas, 1992, fig. 15i-k; Williamson and Lucas, 1993, p. 125; Williamson, 1996, p. 45.

*Periptychus gilmorei* Gazin, 1939, p. 272, fig. 3; Archibald, 1998, p. 313.

*Carsiptychus coarctatus* Standhardt, 1986, p. 243, fig. 81.

Material.—LSU V-888, right m3; LSU V-873, right dentary fragment with partial m?; and LSU V-1554, right partial M? from TMM locality 42327.

Description.—*Periptychus carinidens* is represented by a dentary fragment with a partial and highly abraded lower molar, an isolated partial right upper molar (LSU V-1554), and a nearly complete m3 (LSU V-888; Fig. 10G-F; length = 11.91; mesial width = 8.18; distal width = 7.36), all from TMM locality 42327. All fragmentary teeth show highly distinctive apico-basal ridges on tooth margins or on major tooth cusps.

A complete m3 is represented by LSU V-888 (Fig. 10G-F). It is approximately rectangular in occlusal view. The talonid is slightly narrower than the trigonid and the tooth narrows distally to a rounded distal margin. The occlusal surface is highly worn through attrition, so that it is nearly flat, with the apices of all cusps removed, exposing the interior dentin. The trigonid occupies the mesial half of the tooth. It is only slightly elevated compared to the talonid. The protoconid is the largest cusp, followed by the metaconid. The metaconid is well separated from the protoconid. The paraconid is positioned mesiobuccal to the metaconid. The paracristid is weak and indistinct. A strong crest descends from the lingual side of the paracristid and curves lingodistally to the mesiolingual base of the metaconid. The postcristid is weak and V-shaped, with the legs of the V spreading mesially to attach to the distal sides of the metaconid and protoconid. The apex of the V represents the protocristid notch. The talonid supports three cuspids, the hypoconid, hypoconulid, and entoconid. The cuspids are approximately conical and well-separated. The hypoconulid and entoconid are subequal, the hypoconulid is larger and

positioned near the midline of the tooth and at the distal margin. The cristid oblique extends nearly mesially from the hypoconid to the protocristid notch. A continuous crest connects the hypoconid and hypoconulid. A crest between the hypoconulid and entoconid is thin and notched midway between the two cusps. A crest also connects the metaconid and the entoconid. A swelling is present below this crest midway between the two cusps. An ectocingulid is present between the buccal face of the protoconid and the distal margin of the hypoconulid. It consists of an irregular, cuspidate ridge. A short cuspidate ridge is also present on the lingual side of the tooth between the lingual sides of the hypoconulid and the entoconid (remnants of a lingual cingulid). A weaker cristid, with single notch, extends along a line drawn between the centers of the hypoconulid and entoconid. A strong crenulated ridge also connects the entoconid and metaconid. The perimeter of the tooth is marked by strong apicobasal plications that originate near the base of the major cusps. The enamel at the base of the tooth is crenulated with fine, apicobasally-aligned ridges around the entire basal margin of the tooth.

Remarks.—Standhardt (1986) originally identified this specimen as the Puercean taxon *Carsiptychus coarctatus*. However, we find that the fragmentary teeth are probably not certainly identifiable. The m3 (LSU V-888) however, can be confidently referred to *P. carinidens*. It is larger than the m3 of *C. coarctatus* and falls within the size range of *P. carinidens* from the Nacimiento Formation, San Juan Basin. It also resembles *P. carinidens* and differs from *C. coarctatus* in the following features: 1) the talonid is relatively longer and more rectangular in shape as seen in occlusal view with an enlarged and distally extended hypoconulid 2) the trigonid is lower relative to the talonid 3) the apices of the primary molar cusps are not strongly convergent as in *C. coarctatus*, but are generally erect as in *P. carinidens* 4) the posteristid is V-shaped, rather than straight and 5) segments of the buccal and lingual cingulids are strongly developed.

Schiebout (1974) tentatively considered all the *Periptychus* specimens from the Big Bend National Park then known to be referable to *P. superstes*. The m3 (LSU V-888) differs from that of *Periptychus superstes* in having a relatively smaller and shorter talonid with a less-expanded hypoconulid.

*Periptychus carinidens* is an index taxon for the Torrejonian Land Mammal Age (Lofgren et al., 2004) and the first appearance of *P. carinidens* is used to define the base of the Torrejonian.

Family MIOCLAENIDAE Osborn and Earle, 1895

Genus PROMIOCLAENUS Trouessart, 1904

*Promioclænus* cf. *P. lemuroides* Matthew, 1897

Fig. 10I-J

*Promioclænus* sp., Standhardt, 1986, p. 256, fig. 84.

*Ellipsodon priscus* in part, Standhardt, 1986, (in part) p. 251, fig. 83a.

Material.—LSU V-875, right P3; and LSU V-920, partial left M3 from TMM locality 41400.

Description.—An isolated P3 (LSU V-875; Fig. 10I; length = 3.28; width = 2.48) approximates a triangle with rounded apices in occlusal view with a large, central, and swollen paracone. A small parastyle is located mesially and a metastyle is present distally. A basal cingulum is not continuous around the entire margin of the tooth, but is absent from mesiolingual

side of the tooth, and is discontinuous along its buccal margin. A basal cingulum is accentuated near the lingual apex of the tooth, where it forms a low elongate ridge, representing an incipient protocone. The basal cingulum becomes more pronounced as it approaches the para- and metastyles. A ridge rises from the parastyle at the mesial side of the paracone. It is convex in buccal view. The lingodistal face of the paracone is flat to concave and recessed between ridges that ascent to the apex of the paracone from the protocone and metastyle.

A partial M3 (LSU V-920; Fig. 10J) is complete, but for the mesiobuccal, or parastylar, region and the distobuccal corners of the crown. The enamel surface is crenulated. The tooth is approximately oval in occlusal view with a large paracone. The metacone is missing, but it is clear that the tooth decreased in transverse width distally. A large protocone dominates the lingual side of the tooth. A paraconule is present approximately midway between the paracone and protocone. A short postparaconule crista extends from the paraconule to the lingual base of the paracone. The metaconule is circular and a premetaconular crista extends to near the lingual base of the metacone. A post protocingulum extends from the apex of the protocone to a postcingulum. A weak and irregular precingulum is also present.

Remarks.—*Promioclaenus* spans the Torrejonian and is widely geographically distributed in western North America where it is represented by several species. The specimens from Dawson Creek are close in size to *P. lemuroides*. However, because of their incomplete nature, they are only tentatively referred to that species.

Genus MIOCLAENUS Cope, 1881d

*Mioclaenus* new species.

Fig. 10K-U

*Nexus plexus*, Standhardt, 1986, p. 258, fig. 85. [nomen nudum]

Material.—LSU V-890, left M2; LSU V-891, left M1; LSU V-833, left P4; LSU V-703, right partial dentary with erupting m2; LSU V-839, V-840, partial right m2; and LSU V-881, left m3 from TMM locality 42327.

Description.—A small mioclaenid “condylarth” represents a new species of *Mioclaenus*, *M. lehmani*, which represents, the most complete taxon reported from TMM locality 42327.

An isolated, and poorly preserved P4 (LSU V-833; Fig. 10K-L; length = 4.49; width = 5.18) is highly pitted and discolored by weathering, but the salient features are readily visible. It is approximately triangular in occlusal view with a highly inflated and subequal paracone and protocone. A small parastyle is present mesial to the paracone and a distinct separate swelling distal to the paracone represents a metacone. A distinct metaconule is present between near the distal margin of the tooth, approximately midway between the protocone and paracone. Both a mesial and a distal cingulum is present, but these do not meet lingually. An ectocingulum appears to be absent.

An isolated M1 (LSU V-891; Fig. 10M-N; length = 4.62; mesial width = 5.91; distal width = 5.76), is well-preserved and relatively unworn. A portion of enamel is missing from the distal margin of the tooth, distal to the protocone. The tooth is roughly rectangular in shape, with subequal and widely spaced paracone and metacone and a large and inflated protocone. The surface of the enamel is smoothly-wrinkled, most evident over the wide and rounded lingual face of the protocone. The paraconule is indistinct and positioned approximately midway between the paracone and protocone and is mesial to a line drawn between the two cusps. A short



preparaconule crista is short and not contiguous with a strong precingulum that extends from the mesial side of the protocone to the parastyle. A short, but strong postparaconule crista extends buccally from the paraconule to the base of the paracone. A weak preparacrista connects the paracone and a small, but prominent parastyle, which is situated mesial and slightly buccal to the paracone. The metaconule is relatively larger than the paraconule. A thick and short premetaconule crista descends mesiobuccally towards the center of the trigon basin. Narrow and deep clefts delimit the metaconule lingually and buccally, separating the cusp from the protocone and metacone, respectively. Between the paracone and metacone is a slightly V-shaped centrocrista. It approaches, but does not intersect, the ectocingulum which forms a strong border close to the bases of the paracone and metacone. A strong postcingulum extends from midway up the distal side of the protocone (it is positioned closer to the apex of the protocone than is the precingulum) to the distobuccal corner of the tooth where it becomes confluent with the ectocingulum. A weak metacrista descends from the distal face of the metacone to the postcingulum. No hypocone is present.

An isolated left M2 (LSU V-890; Fig. 10O-P; length = 4.52; mesial width = 6.32; distal width = 5.74), resembles the M1 (LSU V-891), but is relatively wider (transversely) with a relatively large paracone and metacone and the tooth narrows distally so that the buccal margin of the tooth is obliquely angled relative to the anterior margin of the tooth. As in the M1, the centrocrista is V-shaped, but does not meet the ectocingulum. The ectocingulum is thickened between the metacone and paracone and terminates at the buccal face of the metacone. A distinct mesostyle is absent.

Lower teeth are represented only by three specimens; LSU V-703, a partial right dentary with an erupting m2, LSU V-839 (Fig. 10Q-R), LSU V-840, a partial right m2, and LSU V-881 (Fig. 10S-U), a left m3. The m2 (LSU V-703; Fig. 10Q-R) is erupting from the crypt and virtually unworn. The low, large, and inflated protoconid and metaconid are subequal in size and oriented approximately side-by-side in a transverse line. The metaconid is somewhat larger and higher than the protoconid. The paraconid is small, but distinct and closely appressed to the mesiobuccal face of the metaconid. A curved paracristid connects the protoconid and paracristid. A weak, straight protocristid connects the metaconid and protoconid. The talonid is subequal in size (both length and width) to the trigonid. The hypoconid is the largest and most distinct of the talonid cusps. The cristid obliqua is straight and intersects the posteristid below the protocristid notch. The distal and lingual wall of the talonid is formed by a continuous curved crest that extends from the hypoconid to a position at the distolingual base of the metaconid. A short postmetaconid crest is separate and distinct from the lingual wall of the talonid. A small cuspid on this crest at the distal midline appears to represent the hypoconulid. There is no distinct entoconid. The talonid basin is shallow and a low crest descends into it from the lingual side of the hypoconid.

An isolated m3 (LSU V-881; Fig. 10S-U; length = 5.18; mesial width = 3.36; distal width = 2.85), is similar to the m2 (LSU V-703). The trigonid is essentially identical to that of the m2, but the m3 possesses minor attritional wear on the protoconid and metaconid. The talonid is mesiodistally elongated and significantly longer than the trigonid. It narrows distally. The hypoconid is a prominent cusp and the only distinct cusp present on the talonid. The cristid extending from the hypoconid distally and enclosing the talonid lingually is weakly cuspidae, though no distinct hypoconulid or entoconid is visible. As in the m2, a low crest descends mesiolingually from the hypoconid into the talonid basin. A mesial cingulid is present. A short

and weak postcingulid is present distal to the hypoconid on the buccal side of the tooth and two small cusps are present within the hypoflexid.

Remarks.—The P4 of *Mioclaenus* new species (Fig. 10K-L) resembles that of *Mioclaenus turgidus* in the relative size and shape and positioning of most of the cusps. It differs from *Mioclaenus turgidus* in having less inflated cusps and a larger, more mesially-positioned metacone. The P4 metacone is variable in *M. turgidus*, and it varies from being a small cusp at the distal margin of the tooth at the base of the paracone, to a small distinct cusp, part-way up the distal slope of the paracone, mesial to, and distinct from, a distal cingulum (e.g., NMMNH P-15988), and the presence of a distal cingulum is also variable. However, in no specimens of *M. turgidus* is the P4 metacone as large, relative to the paracone, as it is in LSU V-833.

The M1-2 of the *Mioclaenus* new species (Fig. 10M-P) closely resemble those of *M. turgidus*, although they are smaller in size and have less inflated cusps. The upper molars of *M. turgidus* sometimes possesses a centrocrista between the paracone and metacone that sometimes bears a strong and distinct mesostyle or forms an acute V-shape that, in some specimens, intersects the ectocingulum. The M1 of *M. turgidus* also usually bears a small hypocone on the postcingulum, distal to the apex of the protocone. The M2 is very similar in morphology to that of *M. turgidus*. The metacone is similarly small relative to the paracone and the tooth declines in width distally. This suggests that the M3 of the *Mioclaenus* new species is similarly small in size relative to the other molars.

The lower molars of *Mioclaenus* new species (Fig. 10Q-U) are also similar to those of *M. turgidus*. Differences are: 1) The cusps in the *M. new species* but the cusps are less inflated; 2) the lower molars of *M. turgidus* similarly possess more pronounced cusps of the distal and lingual walls of the talonid; 3) the cristid obliqua of *M. turgidus* intersects the trigonid below the apex of the protoconid rather than at the more lingual position, below the protocristid notch in the Big Bend species; 4) in *M. turgidus*, there is not a distinct crest entering the talonid basin from the hypoconid as there is in the Big Bend species, though the m3 talonid of *M. turgidus* sometimes bears a distinct and isolated cusp within the basin; 5) some specimens of *M. turgidus* sometimes possess a weak, discontinuous, and cuspidae buccal cingulid; and 6) the m2 of *M. turgidus* typically possesses an enlarged basal buttress over the root that extends mesially from the mesiolingual corner of the tooth.

*Mioclaenus turgidus* is a relatively common taxon in the Torrejonian of the Nacimiento Formation, San Juan Basin, New Mexico, but has only been reported from one other area; the latest Torrejonian or early Tiffanian Grayson Ridge fauna of the Hanna Formation, Carbon Basin, Wyoming (Secord, 1998). This report, therefore documents a southern geographic range extension for the genus *Mioclaenus*.

Genus ELLIPSODON Scott, 1892  
*Ellipsodon* cf. *E. inaequidens* Cope, 1884  
Fig. 10V-Z

*Ellipsodon priscus*, Standhardt, 1986, p. 251, (in part), fig. 83B-H.

Material.—LSU V-706, left M1; and LSU V-701, right m1 from TMM locality 42327.

Description.—*Ellipsodon inaequidens* is represented by two teeth; a left M1 (LSU V-706; Fig. 10V-W), and a right m1 (LSU V-701; Fig. 10X-Z).

The left M1 (LSU V-706; Fig. 10V-W; length = 3.70; mesial width = 4.85; distal width = 4.85) in occlusal view resembles an isosceles triangular with rounded apices. The tooth is inflated and dominated by a large protocone and smaller, round and subequal para- and metacones. A small parastyle is present mesial and closely appressed to the paracone. A distinct metaconule as well as pre- and postmetaconule cristae are absent. Instead, a postprotocrista extends directly to the metacone as a notched crest. In contrast, a large and circular paraconule is present, positioned approximately midway between the protocone and paracone, and offset mesially from a line drawn between the two cusps. The preprotocrista terminates at the paraconule. The postparaconule crista is short and the paraconule and paracone are divided by a deep cleft mesially. A weak preparaconular crista curves distally and buccally and attaches to the lingual face of the paracone. Mesially, a precingulum extends from the distal side of the protocone and extends buccally and uninterrupted to the a distinct parastyle which is closely appressed to the mesial base of the paracone. A strong postcingulum extends from the distal side of the protocone to the distal base of the metacone. A hypocone is absent, though a low ridge descends from the apex of the protocone to the postcingulum. The postcingulum is higher on the protocone than the precingulum. A distinct metastyle is also absent. A paracrista is weak and directed nearly mesially. The centrocrista are straight. A short, but sharp metaacrista descends buccal to the metastyle. An ectocingulum is absent, but for a low remnant that forms a small, distinct cusp, a mesostyle, nestled between the buccal basal margins of the para- and metacones.

The occlusal surface is somewhat worn through attrition so that the apices of all the major cusps (i.e., para- and metacones, protocone, and metastyle) bear flat and circular wear facets exposing dentin bordered by relatively thick enamel. The surface of the tooth is nearly smooth with low, coarse, wavy, and apicobassally-aligned ridges.

A right m1 (LSU V-701; Fig. 10X-Z; length = 3.67; mesial width = 3.1; distal width = 3.15) is approximately rectangular in occlusal view and highly inflated and rounded. The metaconid is the largest cusp and it is swollen and broadly convex over its lingual surface. It is subequal in preserved height to the protocone, which is positioned mesial and buccal to the metacone. The two cusps are strongly conjoined at their bases and their apices are positioned close together but they are separated apically by a low and sharp, mesiodistally-aligned cleft continuous with the protocristid notch. The protocristid is low and indistinct. A low and circular paraconid is positioned mesial to the apex of the metacone, but because the metacone is highly inflated, the apex of the paraconid is well-removed from the lingual margin of the tooth. A distinct paracristid curves mesiolingually from the protoconid and is separated from the paraconid by a sharp notch. A narrow crest descends from the metaconid to the paraconid. The talonid is subequal in width to the trigonid, but shorter, occupying only about one third the length of the tooth. Only two distinct cusps can be discerned, the hypoconid and entoconid. The hypoconid is the larger of the two and it occupies the distobuccal corner of the tooth. The cristid oblique extends diagonally from the hypoconid to the apex of the metaconid, lingual to the protocristid notch. A deep hypoflexid separated the hypoconid from the protoconid and a distinct notch is present in the cristid oblique at the base of the trigonid. The entoconid is positioned at the lingual side of the trigonid, opposite the hypoconid. It is smaller and lower than the hypoconid. The distal side of the talonid is bordered by a low and curved crest which connects the hypoconid and entoconid. No distinct cuspids can be discerned within this crest. The talonid basin is smooth and concave marked only by a low ridge extending mesially and lingually from the apex of the hypoconid. A narrow and sharp postmetacristid descends from the distal side of the metaconid and it meets a short entocristid to close off the lingual side of the talonid basin. A

small sharp notch marks the intersection of the two cristids. The major cusps of the tooth (i.e., metaconid, protoconid, and hypoconid) have apical wear similar to what is present in the M1 (LSU V-706). The tooth has a similar surface ornamentation with weak, coarse, and wavy ridges that are apicobasally-aligned.

Remarks.—Standhardt (1986) originally referred these specimens to the *Ellipsodon priscus*, a taxon known with certainty only from the Puerco of the Nacimiento Formation, San Juan Basin, New Mexico (Williamson and Carr, 2007). Van Valen (1978) erected the genus *Bomburia* for “*E.*” *priscus*. However, because the name *Bomburia* was later found to be preoccupied, a new name, *Bomburodon*, was subsequently proposed as a replacement (Williamson and Carr, 2012). Regardless, the Big Bend specimens differ markedly from *B. priscus* and closely resemble species of *Ellipsodon*. The upper teeth of *Bomburodon* are unknown with certainty, but are likely represented by teeth referred to *Platymastus palantir* Van Valen, 1978, a probable subjective junior synonym of *B. priscus* (Williamson and Carr, 2007). Upper molars of *P. palantir* differ from the M1 (LSU V-706) of the Big Bend species in a number of prominent features such as presence of an ectocingulum, presence of a metaconule, and presence of a distinct hypocone. Lower molars of *B. priscus* differ from the m1 of the Big Bend taxon in being distinctly less inflated and having a relatively larger talonid. In addition, the relative positions of the talonid cusps of m1 and m2 differ between genera. In *Bomburia*, the metaconid is nearly directly lingual to the protoconid, but in *Ellipsodon*, the metaconid is positioned distal to the protoconid, a condition considered to be an autapomorphy for *Ellipsodon* by Williamson and Carr (2007).

The two teeth are here tentatively referred to the middle Torrejonian *E. inaequidens*. The M1 (LSU V-706) lacks an ectocingulum, but for a small area that forms a small mesostyle between the para- and metacones, a feature considered to be one of the diagnostic characters of *Ellipsodon* (Williamson and Carr, 2007). The m1 (LSU V-701) is also similar to that of *Ellipsodon* in being similarly inflated with a distally positioned metaconid (Williamson and Carr, 2007). Williamson and Carr (2007) recognized three species of *Ellipsodon*, *E. inaequidens* (Cope, 1884), *E. granger* (Wilson, 1956), and *E. yotankae* (Van Valen, 1978) which are distinguished by size, the relative proportions of upper molar length and width, and the relative width of the lower molar talonids (Williamson and Carr, 2007). The Big Bend taxon most closely resembles *E. inaequidens*, although both specimens fall below the size range of specimens known from the Nacimiento Formation of New Mexico. *Ellipsodon inaequidens* is extremely rare in the Nacimiento Formation, and m1 measurements are known for only two to three specimens that preserve m1. In measurements of length and width (MW and DW), Big Bend specimens are less than 11% smaller than those documented from the Nacimiento Formation. In addition, the Big Bend taxon differs from other specimens of *Ellipsodon* in that the M1 (LSU V-706) lacks a metaconule, and a metaconule is present on all other known specimens of *E. inaequidens* that preserve a relatively unworn M1, though for some specimens, it is small and relatively indistinct (e.g., NMMNH P-20680, Fig. G.2).

Standhardt referred an isolated tooth that she identified as a right P3 (LSU V-875) to “*E.*” *priscus*. This specimen does not closely resemble premolars of *Bomburodon priscus* or *Ellipsodon inaequidens*. Among other differences, LSU V-875 lacks a distinct protocone and large parastyle that is present in *B. priscus* and does not possess the distinctive, broadly convex occlusal surface mesial and lingual to the paracone and shallowly concave distally as in *E. inaequidens* (Williamson and Carr, 2007). It is tentatively referred to *Promioclænus* sp. (below).

Family 'TRIISODONTIDAE' Scott, 1892  
Genus GONIACODON Cope, 1888  
cf. *Goniacodon levisanus* Cope, 1883  
Fig. 10AA-BB

*Eoconodon* sp., Standhardt, 1986, p. 238, fig. 84.

Material.—LSU V-704, left M3 from TMM locality 42327.

Description.—An isolated left M3, LSU V-704 (Fig. 10AA-BB) is an approximately oval occlusal outline (length = 4.71; mesial width = 7.30; distal width = 5.81). The enamel surface is rugose. The paracone and metacone are conical and the metacone is smaller than the paracone corresponding to a transverse narrowing of the tooth distally. The cones are widely separated, but connected by a straight centrocrista. The paracrista and metacrista are straight and in line with the centrocrista. The buccal margin of the tooth is bordered by a narrow ectocingulum that borders a relatively wide stylar region. The parastylar region is broadly rounded in occlusal view and there is a slight ectoflexus between the para- and metastylar regions. The protocone is large and erect with strong pre- and postprotocristae. The paraconule is situated approximately midway between the metacone and protocone and is represented by an elongate expansion along the preprotocrista with at least two swellings. The premetaconule crista continues in a straight line to the mesiobuccal corner of the tooth. A postparaconule crista is lacking. The metaconule is situated on the postprotocrista. A premetaconule crista is lacking. The postmetaconule crista continues to the distal margin of the tooth where it joins a postcingulum distal to the metacone. The pre- and postcingulum are strong and wrap around the lingual base of the protocone to form a continuous lingual cingulum. The precingulum terminates buccally below and mesial to the paracone without joining the preparaconule crista.

Remarks.—Standhardt (1986) referred this tooth to the “triisodontid” “condylarth” *Eoconodon*, a taxon known only from the Puercan of western North America. However, it differs from the M3 described for any *Eoconodon* species, where known. It is too small to be referable to *E. coryphaeus*. It is closest in size to *E. gaudrianus*, which is poorly known and represented by only two M3s (e.g., AMNH 3200 and NMMNH P-72366) and differs in having a relatively larger stylar shelf. All other *Eoconodon* species are too small to be conspecific (see Clemens and Williamson, 2005; Clemens, 2011).

The tooth probably represents a “triisodontid” based on the rugose enamel texture, the large conical paracone and metacone that appear to be partially merged at their base and the alignment of their associated crests. It closely resembles the M3 of the Torrejonian “triisodontid” “condylarth” *Goniacodon levisanus*. *G. levisanus* is relatively rare and poorly known taxon and the M3 is represented by only a few specimens (e.g., NMMNH P-21906, 59393), some of which are incomplete (e.g., NMMNH P-59393). However, these are similar in size and morphology to LSU V-704, with a similar rugose enamel surface, and large, conical paracone and metacone. However, it differs somewhat from the specimens on hand to make comparison. The M3 of NMMNH P-21906 lacks a lingual cingulum. Both NMMNH P-21906 and 59393 have a paracone and metacone that are more closely appressed more completely conjoined at their base and have a narrower stylar region, without an ectoflexus. Based on the similarities and differences, we can only tentatively refer LSU V-704 to *Goniacodon levisanus*.

The genus *Goniacodon* ranges from the late Puercan to the early Tiffanian of western North America. The species *G. levisanus* is restricted to the middle Torrejonian to early Tiffanian of New Mexico, Wyoming, and Montana.

Genus TRIISODON Cope, 1881c  
*Triisodon quivirensis* Cope, 1881c  
Fig. DR1

*Triisodon quivirensis* Cope, 1881c, p. 485; Van Valen, 1978, p. 58; Williamson and Lucas, 1993, p. 123; Williamson, 1996, p. 41.

*Triisodon antiquus* Cope, 1882, p. 193 [see Taylor, 1984 for synonymy]; Tomida, 1981, p. 230, pl. 10.2, figs 1-2.

*Eoconodon coryphaeus* Standhardt, 1986, p. 232, fig. 77.

Material.—LSU V-1156, partial right M2; and LSU V-1157, partial left m1 or m2 from LSU locality VL-107.

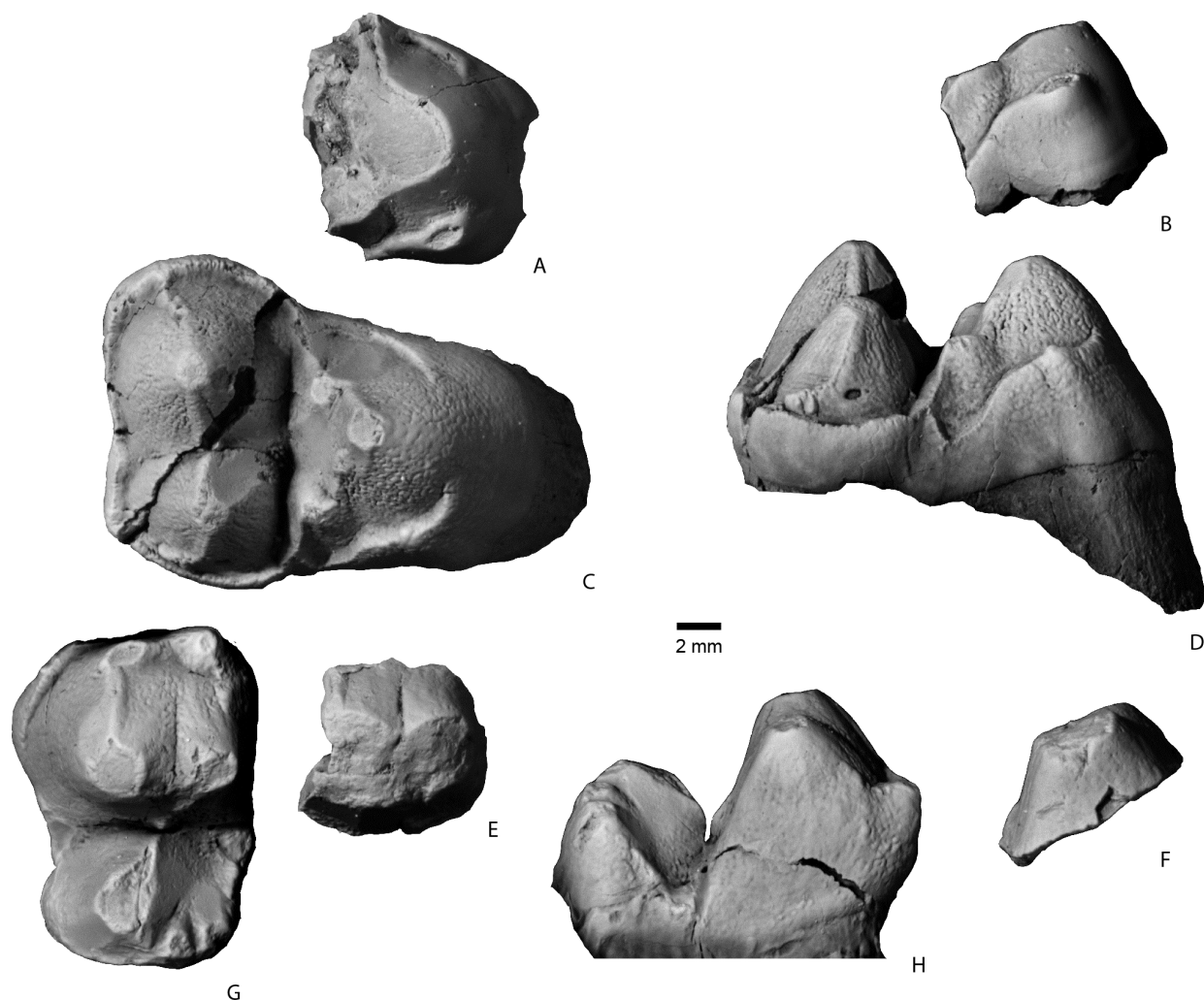
Description.—The taxon *Triisodon quivirensis* is represented by fragments of two teeth (Fig. DR1), portions of a dentary, and postcranial fragments. These were found in close association and likely represent a single individual. However, some of the individual fragments were given different specimen numbers.

A portion of a right M2, LSU V-1156 (Fig. DR1A-B), includes the occlusal surface of the protocone. It is weathered through attritional wear so that the apex of the protocone is beveled. The preparaconule crista is similarly positioned, the precingulum, the base of the metaconule is expanded distally and separated from the distal face of the protocone by a groove, the postcingulum ascends the distal face of the protocone and is at a similar position, though a hypocone is more developed in V-1156 and in that specimen, the postcingulum does not extend lingually past the hypocone. In V-1156, remnants of the original surface texture are present adjacent to the postcingulum and are similarly rugose and pebbly.

LSU V-1157 is a partial left m1 or m2 (Fig. DR1E-F). The tooth is more heavily worn, but the distinctive cleft separating the metaconid and protoconid is present. The paracristid on the mesial face of the protoconid projects mesially. The cusps are of similar size and exhibit a similar pebbly enamel surface texture.

Remarks.—Standhardt (1986) referred fragments of an edentulous left dentary with tooth roots (LSU V-1158) and postcranial fragments consisting of a right proximal radius (LSU V-1151), and a right femoral head (LSU V-1159) to “*Eoconodon coryphaeus*” (Table DR1). However, the dentary fragments exceed the depth of the dentary of any specimen of *E. coryphaeus* and closely match those of mature representatives of *T. quivirensis* from the Nacimiento Formation (e.g., NMMNH P-2676, 21982 and 44608) and is consistent with an identification of *T. quivirensis* for the other specimens from this locality.

This report of *Triisodon quivirensis* from the Big Bend National Park represents the first from outside of the San Juan Basin, New Mexico. *T. quivirensis* is restricted to the early and middle Torrejonian (To1-To2) of the Nacimiento Formation, San Juan Basin, New Mexico (*Periptychus carinidens* – *Protoselene opisthacus* zone [Tj1] through *Arctocyon ferox* – *Mixodectes pungens* zone [Tj5] and thus this represents a significant geographic range extension for this taxon.



**Figure DR1.** *Triisodon quivirensis* from LSU locality V-111 (“Glen Eleven”) compared to *T. quivirensis* from the Nacimiento Formation, San Juan Basin, New Mexico. A-B, trigonid fragment of a left m2 (LSU V-1157) in occlusal (A) and lingual (B) views; C-D, left m2 (NMMNH P-51329) in occlusal (C) and lingual (D) views; E-F, partial right M2 (LSU V-1156) in occlusal (E) and distal (F) views; G-H, right M2 (NMMNH P-20918) in occlusal (G) and distal (H) views. Specimens have been dusted with magnesium oxide to increase visibility of surface features.

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