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Early Paleocene vertebrates, stratigraphy and biostratigraphy, West Fork of Gallegos Canyon, San Juan Basin, New Mexico

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Introduction

There are only three well known areas in the San Juan Basin where early Paleocene (Puercan) vertebrates occur in the lowermost strata of the Nacimiento Formation. These areas, Betonnie Tsosie Wash, Kimbeto Wash, and the headlands of De-na-zin and Alamo Washes (Fig. 1), were already known when Sinclair and Granger (1914) published the results of two field seasons (1912–1913) of stratigraphic and paleontologic studies of the Paleocene of the San Juan Basin. However, Sinclair and Granger (1914, p. 315) did mention a fourth occurrence of Puercan vertebrates in the headlands of the West Fork of Gallegos Canyon (Fig. 1). The only vertebrates they reported from this locality (their locality 4) were two teeth of the Puercan multituberculate *"Polymastodon"* (= *Taeniolabis*). No additional vertebrates were collected from the West Fork of Gallegos Canyon until 1977 when a field party under contract with the U.S. Bureau of Land Management collected in this area (Kues and others, 1977).

This paper reports the fossil vertebrates collected by this field party, establishes their stratigraphic provenance, and discusses their biostratigraphic significance. AMNH refers to specimens in the Department of Vertebrate Paleontology, American Museum of Natural History; UNM refers to specimens in the Department of Geology, University of New Mexico.

Stratigraphy

More than 37 m (121 ft) of the Nacimiento Formation are exposed in rugged badlands at the head of the West Fork of Gallegos Canyon (Figs. 2, 3, 4). The Ojo Alamo Sandstone, which underlies the Nacimiento Formation throughout the San Juan Basin (Baltz, 1967), is not exposed here (Fig. 2). Instead, the base of the Nacimiento Formation is covered by Quaternary alluvium that consists mainly of mudstone and sandstone detritus locally derived from the Nacimiento Formation (Qal_1 and Qal_2 of Wells, 1982, fig. 101). However, the Ojo Alamo Sandstone does form the resistant bedrock under the plateau incised by Gallegos Canyon and its tributaries, and it is exposed approximately 1 km (0.6 mi) northwest of the head of the West Fork (Reeside, 1924, p. 30, pl. 1). This relationship to the Ojo Alamo Sandstone and the occurrence of Puercan mammals indicate that the Nacimiento strata exposed here are of the lower part of the formation.

The exposed Nacimiento Formation consists of mudstone (63%), sandstone (33%), silcrete (3%), and siltstone (1%). These strata can be considered in three parts (Fig. 4):

LOWER MUDSTONES AND SILCRETES—The lower 16.5 m (54 ft) of section D (Fig. 3) and correlated units of sections A–C (Fig. 3) consist of variegated bands of red, green, buff, and gray mudstone intercalated with thin, resistant silcretes. Some of these strata, especially the silcretes, are laterally continuous for more than 1 km (0.6 mi) and thus allow a secure correlation of sections B–D (Fig. 3). The silcretes are gray (but weather to yellow-brown), well-cemented, fine-grained, silica-rich layers (Rains, 1981).

MEDIAL SANDSTONE COMPLEX—A thick (up to 14 m; 46 ft) and complex sequence of sandstone and clayey sandstone forms a prominent part of the Nacimiento Formation exposed here (Fig. 3). Most of the sandstone is gray-white, trough crossbedded, fine grained, and quartzose. However, two thin but distinctive horizons of black, fine- to medium-grained sandstone are present, one near the base and the other near the top of the sequence (Figs. 3, 5). Sinclair and Granger (1914, p. 305) attributed the black color of this type of sandstone to the presence of manganese oxide, but it seems likely that iron oxide also contributes to the black color and high density. Whether the formation of these black sandstones was a syndepositional or diagenetic event is unclear, and their genesis needs further study.

The base of the entire sandstone complex is an erosional surface of low relief (Fig. 3). At or near this base, fossil logs up to 1 m in diameter are common (Fig. 6), and other fossil logs and wood fragments occur sporadically throughout the sandstone complex. All fossil vertebrate occurrences in the Nacimiento Formation at the head of the West Fork are in the sandstone complex and are associated with the black sandstone horizons (Fig. 3). In fact, many of the vertebrate fossils collected are encased within the black sandstone (Fig. 7D).

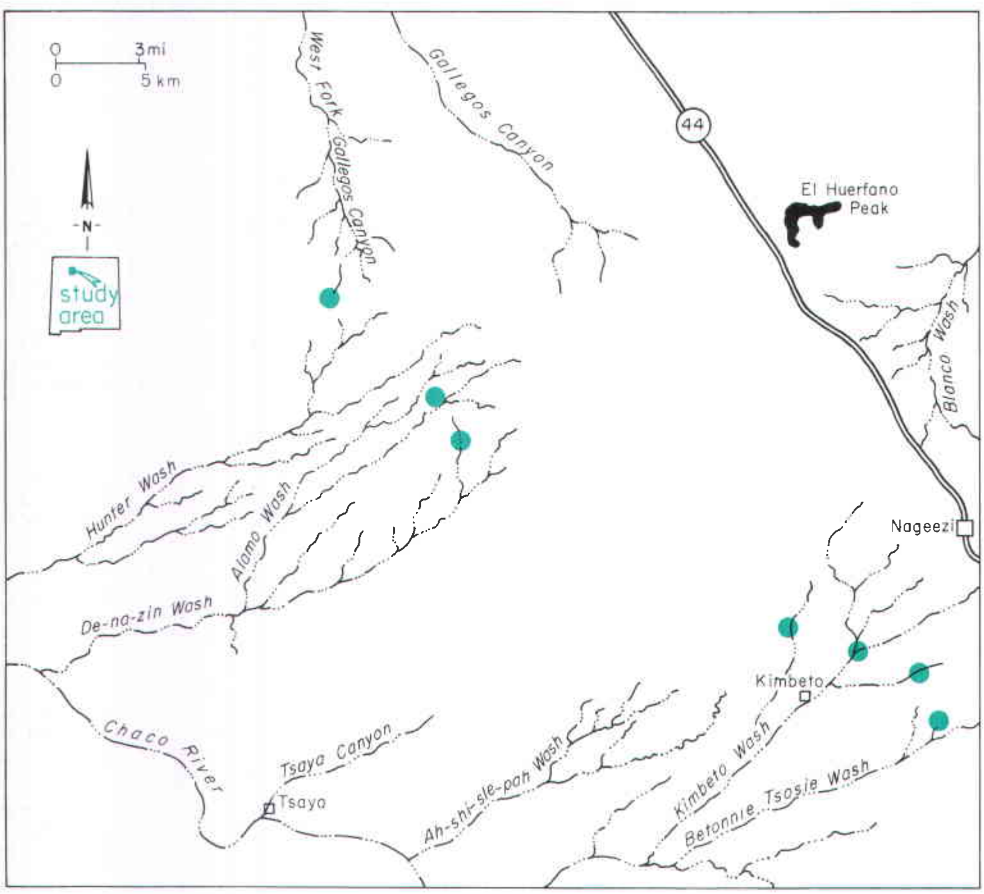

FIGURE 1—Location map of study area, San Juan County, northwest New Mexico. The colored circles indicate locations of Puercan collecting areas in the Nacimiento Formation.

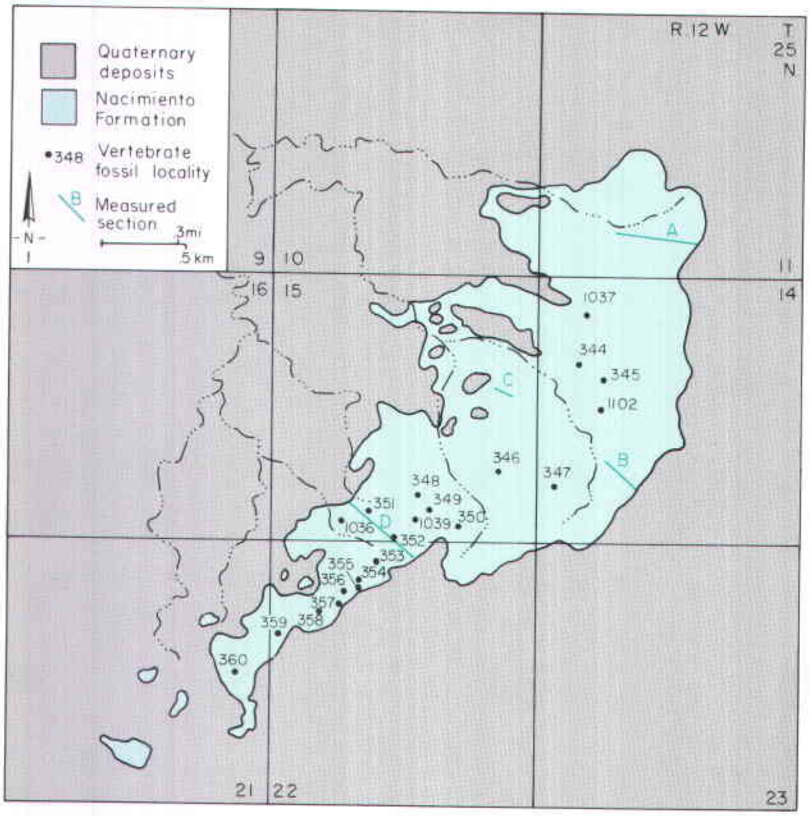

FIGURE 2—Geologic map of the headlands of the West Fork of Gallegos Canyon, San Juan County, New Mexico.

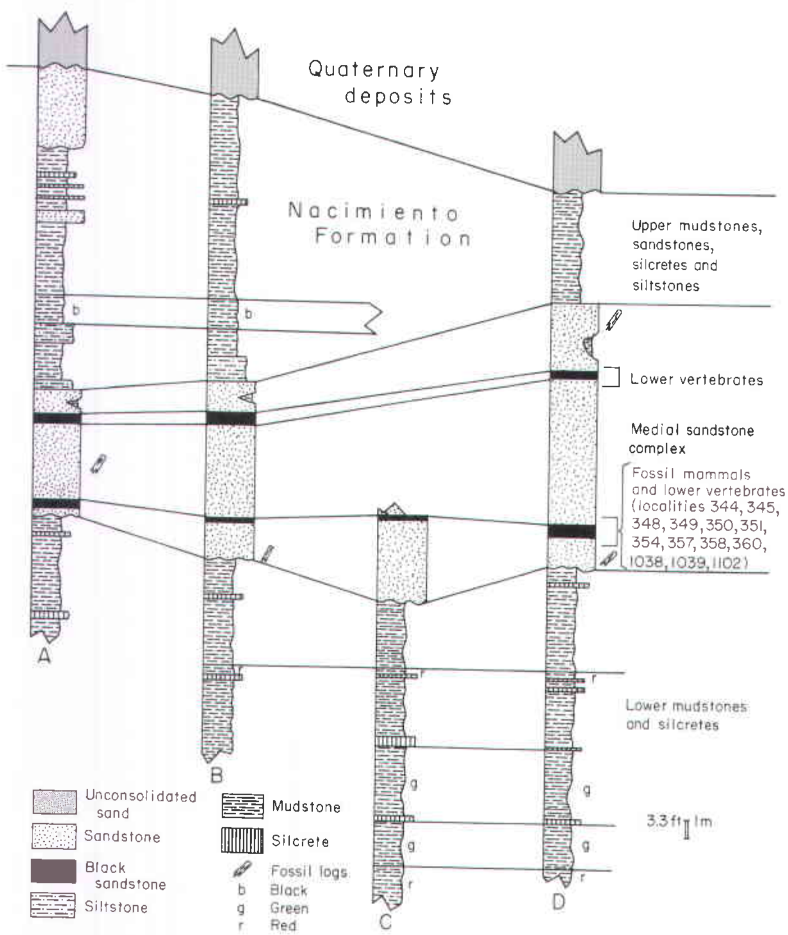

FIGURE 3—Correlation of measured stratigraphic sections of the lower part of the Nacimiento Formation in the headlands of the West Fork of Gallegos Canyon, San Juan County, New Mexico. See Fig. 2 for location of each section.

UPPER MUDSTONES, SANDSTONES, SILCRETES, AND SILTSTONES—In this area, the upper part of the Nacimiento Formation consists of deeply weathered gray, green, buff, and black mudstone and lesser amounts of sandstone, silcrete, and siltstone (Fig. 3). A thick, brown, medium-grained, and subarkosic sandstone is present at the top of the exposures in the northeast part of the headlands (Fig. 3, section A).

A prominent erosional unconformity separates Quaternary (and late Tertiary?) deposits from the underlying Nacimiento Formation. These deposits are stable pediment and terrace deposits capped by eolian sands ($QTP_{(s)}$ of Wells, 1982, fig. 101).

Vertebrate paleontology

Twenty-one localities in the Nacimiento Formation at the head of the West Fork of Gallegos Canyon (Fig. 2) have produced vertebrate fossils representing the fish, reptile, and mammal taxa discussed below.

Class OSTEICHTHYES Huxley, 1880
Family LEPISOSTEIDAE Cuvier, 1825
Genus and species indeterminate

An incomplete gar scale (UNM B–400c) and two gar scales (UNM B–388) were collected from localities 358 and 349, respectively.

Class REPTILIA Linnaeus, 1758
Order TESTUDINES Linnaeus, 1758
Genus *ASPIDERETES* Hay, 1904
Aspideretes sp.

UNM B–385, a nearly complete but fragmented carapace (locality 347) is assigned to *Aspideretes* because it has eight pairs of costals and the ridge-and-pit ornamentation characteristic of this genus. Six species of *Aspideretes* are recognized from the Puercan of the San Juan Basin (Gilmore, 1919, pp. 56–62; Matthew, 1937, p. 332), and the genus is in need of revision. Because of this, no species-level determination of UNM B–385 is attempted. UNM B–1082 (locality 1037) consists of shell fragments identical to those of UNM B–385.

Genus and species indeterminate

Undiagnostic turtle-shell fragments and other postcrania were observed but not collected at localities 345, 346, 347, 348, 349, 352, 353, 355, 358, 1037, 1038, and 1039.

Order EOSUCHIA Broom, 1914
Genus *CHAMPSOSAURUS* Cope, 1877
Champsosaurus sp.

UNM B–381a (locality 344) is a small, amphiplatyan vertebral centrum. This centrum has a ventral keel, a circular cross section, slightly concave sides, a large neurocentral suture on its superior surface, parapophyses that are confluent with the diapophyses, and a slight dorso-ventral compression posteriorly. Clearly, this small (length = 14 mm) centrum is an anterior dorsal centrum of *Champsosaurus*, but it is inadequate for a species-level identification (Erickson, 1972). ☞

Order Crocodilia Gmelin, 1788
Genus *Allognathosuchus* Mook, 1921
Allognathosuchus mooki Simpson, 1930

UNM B–1121 (locality 351) is a fragmentary lower jaw still bearing one globose and striated tooth. The anterior part of this lower jaw bears three alveoli followed by a much larger alveolus, which, in turn, is followed by four much smaller alveoli. The diameters of these eight alveoli (6, 4.5, 4.4, 12.5, 5.5, 5.5, 4.5, and 4.0 mm from front to back) are somewhat greater than those of AMNH 6780, the holotype of *A. mooki* (Simpson, 1930, p. 7), but otherwise the UNM and AMNH specimens are identical. Assignment of UNM B–1121 to *A. mooki* thus seems certain. Other specimens from the West Fork of Gallegos Canyon that probably pertain to *A. mooki* are: UNM B–382, teeth (locality 344); B–387, teeth (locality 349); B–396, teeth (locality 353); B–398a, partial skull (locality 354); B–400a, partial lower jaw (locality 358); and B–1086, teeth (locality 1039).

FIGURE 6—Fossil log at base of medial sandstone complex near locality 1102, lower part of the Nacimiento Formation in the headlands of the West Fork of Gallegos Canyon.

Genus *Leidyosuchus* Lambe, 1907
?*Leidyosuchus* sp.

Storrs and others (1983) described UNM B–401a (locality 360), the oldest known endocast of an eusuchian crocodilian. Based on skull fragments of UNM B–401a, they tentatively identified this specimen as *Leidyosuchus*. The bicarinate, conical teeth and skull fragments of UNM B–1083 (locality 1037) also may pertain to *Leidyosuchus*. If these identifications are correct, they represent the first report of *Leidyosuchus* from the Puercan of the San Juan Basin.

Genus and species indeterminate

Undiagnostic crocodilian remains were observed but not collected at localities 344, 345, 346, 349, 352, 353, 355, 356, 358, 359, 1037, 1038, and 1039. UNM B–394 (locality 351) is an eusuchian vertebral centrum, and UNM B–1085 (locality 1038) is the distal portion of a crocodilian tibia.

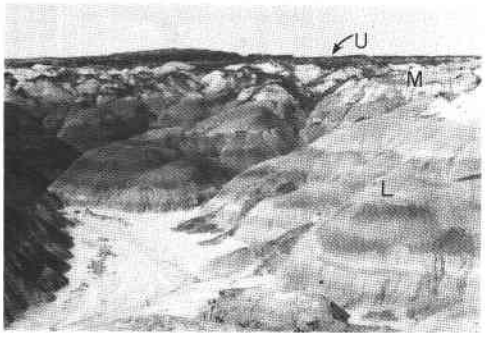

FIGURE 4—Badlands of the lower part of the Nacimiento Formation, headlands of the West Fork of Gallegos Canyon, in S$^1/_2$, sec. 15, T. 25 N., R. 12 W. **L,** lower mudstones and silcretes; **M,** medial sandstone complex; **U,** upper mudstones, sandstones, silcretes, and siltstones.

FIGURE 5—Black sandstone in medial sandstone complex at top of measured stratigraphic section C (Figs. 2, 3), lower part of the Nacimiento Formation in the headlands of the West Fork of Gallegos Canyon. Rock hammer is 28 cm long.

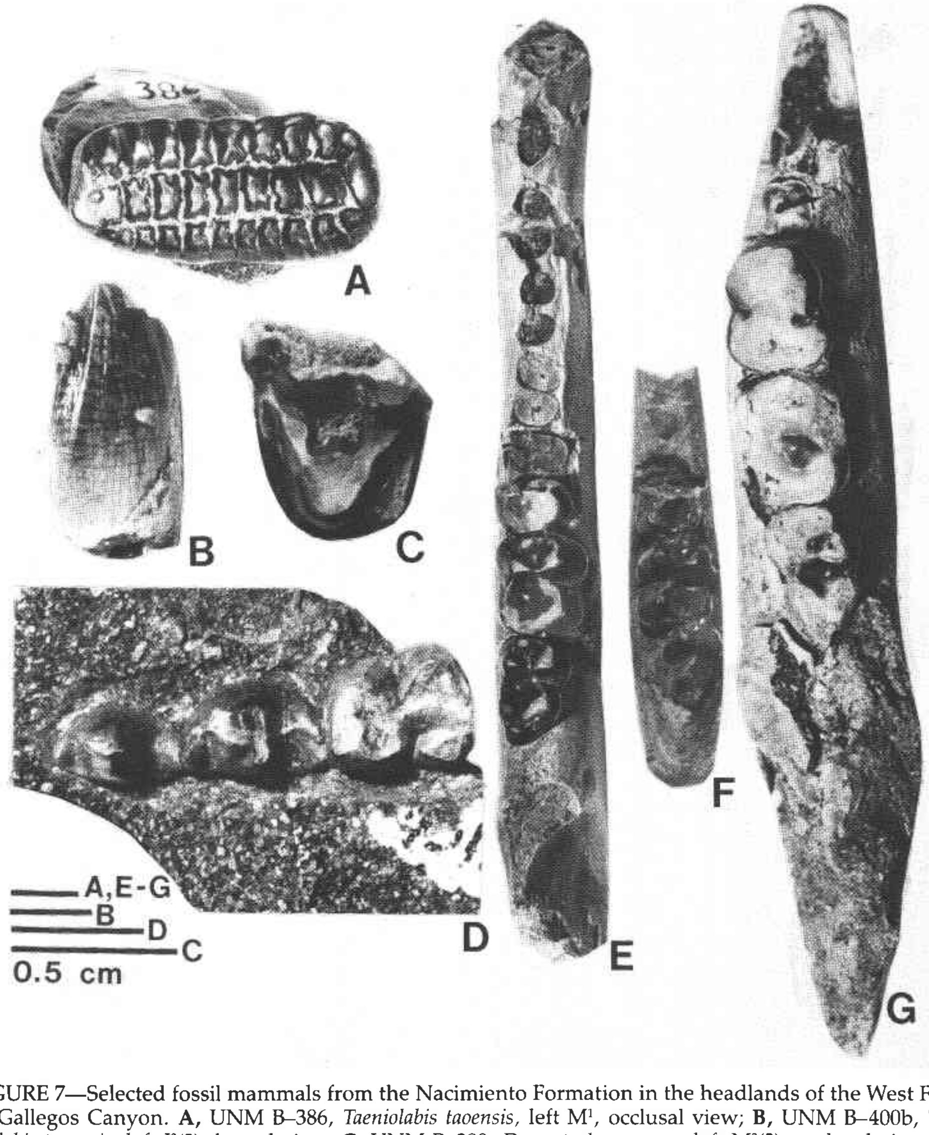

FIGURE 7—Selected fossil mammals from the Nacimiento Formation in the headlands of the West Fork of Gallegos Canyon. **A,** UNM B–386, *Taeniolabis taoensis,* left M^1, occlusal view; **B,** UNM B–400b, *Taeniolabis taoensis,* left I^2(?), lateral view; **C,** UNM B–389, *Desmatoclaenus* sp., left M^2(?), occlusal view; **D,** UNM B–401b, *Desmatoclaenus* sp., right P_3–M_1, occlusal view; **E,** UNM B–397, *Loxolophus priscus,* right dentary fragment with partial M_1 and complete M_{2-3}, occlusal view; **F,** UNM B–392, *Loxolophus hyattianus,* left dentary fragment with partial M_1, complete M_2, and nearly complete M_3, occlusal view; **G,** UNM B–1271, *Loxolophus pentacus,* left dentary fragment with M_{1-3}, occlusal view.

TABLE 1—Measurements (in mm) of lower molars of selected specimens of *Loxolophus*. **L** = maximum length, **AW** = maximum trigonid width, **PW** = maximum talonid width; * indicates an approximate measurement of a worn or damaged tooth.

Specimen	M_1 L	M_1 AW	M_1 PW	M_2 L	M_2 AW	M_2 PW	M_3 L	M_3 AW	M_3 PW
L. priscus:									
AMNH 3108 (holotype)	6.4	4.9	5.4	7.1	6.7	6.2	—	—	—
UNM B–393	6.5	4.5	5.1	—	—	—	—	—	—
UNM B–397	—	—	5.7	7.6	6.9	6.3	8.5	5.7	4.7
L. hyattianus:									
AMNH 16343	5.5	3.7	4.3	5.8	4.6	4.7	6.1	3.8	3.6
UNM B–392	—	—	4.6	6.2	5.5	5.4	6.5*	4.3	—

Class MAMMALIA Linnaeus, 1758
Order MULTITUBERCULATA Cope, 1884
Genus *TAENIOLABIS* Cope, 1882
Taeniolabis taoensis (Cope, 1882)

Sinclair and Granger (1914, p. 315) noted that at the head of the West Fork of Gallegos Canyon "only two specimens were found (both *Polymastodon* [=*Taeniolabis*] teeth)." However, only one AMNH specimen, 16317, a right dentary bearing M_2 of *T. taoensis*, is labelled as having come from the West Fork of Gallegos Canyon. Also, the record of specimens collected by Sinclair and Granger only lists AMNH 16317 from "ab't. 5 mi. N.W. of Ojo Alamo Head of West Fork of Gallego [*sic*] Wash" (Granger and others, 1913, p. 28).

Three specimens of *T. taoensis* in the UNM collection were found in the West Fork of Gallegos Canyon. UNM B–381 (locality 344) is the posterior third of a left M_2 nearly identical in size and morphology to AMNH 3046 (Granger and Simpson, 1929, fig. 8A). UNM B–386 (Fig. 7A), from locality 348, is a left M^1 that is about the same size (length = 23.5 mm; width = 11.7 mm) as AMNH 16305 (Granger and Simpson, 1929, p. 619). UNM B–386 has 10 labial, nine medial, and 11 lingual cusps, as does AMNH 970 (Granger and Simpson, 1929, fig. 8B) and is between the "young" and "adult" stages of wear defined for *Taeniolabis* by Granger and Simpson (1929, figs. 3A–B). Finally, UNM B–400b (Fig. 7B), from locality 358, is a left I^2(?) fragment with two accessory cuspules on its posterior edge. It probably pertains to *Taeniolabis*, although it differs slightly from AMNH 16319 (Granger and Simpson, 1929, fig. 2A), which has only one accessory cuspule on its posterior edge.

Order CONDYLARTHRA Cope, 1881
Genus *PERIPTYCHUS* Cope, 1881
Periptychus coarctatus Cope, 1883

UNM B–398b (locality 354) is a maxillary fragment bearing partial right M^{1-2}. It clearly pertains to *Periptychus*, and the following features justify assignment to *P. coarctatus:* M^{1-2} are relatively wide linguolabially, their hypocones and protostyles are lingual to their protocones, and their conules are very small (*see* Matthew, 1937, p. 123).

Genus *GILLISONCHUS* Rigby, 1981
Gillisonchus gillianus (Cope, 1882)

UNM B–1088a (locality 1039) is a right M_2. In size (length = 4.1 mm, trigonid width = 3.2 mm, talonid width = 3.1 mm) and morphology it is identical to the M_2 of UNM B–029, a partial skeleton of *G. gillianus* described by Rigby (1981).

Genus *LOXOLOPHUS* Cope, 1885
Loxolophus pentacus (Cope, 1888)

UNM B–1271 (Fig. 7G), from locality 1102, is a left dentary fragment bearing roots of P_4 and heavily worn M_{1-3}. Its size (M_1 length = 9.1 mm, trigonid width = 7.3 mm, talonid width = 8.2 mm) and morphology are very close to those of AMNH 3192 (M_1 length = 9.3 mm, trigonid width = 7.5 mm, talonid width = 8.5 mm), the holotype of *L. pentacus* (Matthew, 1937, fig. 2E, pl. 11, fig. 2). UNM B–1087 (locality 1039) is a large (length = 7.1 mm, width = 10.3 mm), right M^3 that closely resembles the M^3 of AMNH 954, a specimen that Matthew (1937, pl. 13, fig. 3) referred to as *L. pentacus*.

Loxolophus priscus (Cope, 1888)
and
Loxolophus hyattianus (Cope, 1885)

Without documentation, Van Valen (1978, p. 56) considered *L. priscus* to be a synonym of *L. hyattianus*. However, my examination of AMNH and UNM specimens referable to these taxa reveals consistent differences in size (Table 1) and morphology that justify Matthew's (1937, pp. 43, 53) conclusion that these species are distinct. The distinctions between *L. priscus* and *L. hyattianus* are revealed well by considering the three relevant specimens from the West Fork of Gallegos Canyon in the UNM collection. UNM B–397 (locality 354) is a right dentary fragment with partial M_1 and complete M_{2-3} (Fig. 7E) assigned here to *L. priscus*, as is UNM B–393 (locality 351), a right dentary fragment bearing M_1 and part of M_2. UNM B–392 (locality 351), on the other hand, is a left dentary bearing partial M_1, complete M_2, and nearly complete M_3 (Fig. 7F) assigned here to *L. hyattianus*. B–397 and B–393 are larger than B–392 (Table 1), their molar cusps are lower and more massive, their molars are broader (Table 1), and, on B–397, the M_3 is longer and broader ("less reduced") than is the M_3 of B–392.

UNM B–391 (locality 350) is the lingual half of a right M^1 that closely resembles the corresponding portion of the M^1 of AMNH 3121, the holotype of *L. hyattianus*, and AMNH 16343, a specimen referred to *L. hyattianus* by Matthew (1937, p. 44, fig. 1B). UNM B–399 (locality 357) is a right dentary fragment with roots of M_{1-3}; its close resemblance to UNM B–397 supports provisional referral to *L. priscus*.

Genus *DESMATOCLAENUS* Gazin, 1941
Desmatoclaenus sp.

UNM B–401b (locality 360) is a right P_3–M_1 (Fig. 7D). This relatively small specimen (M_1 length = 6.0 mm, trigonid width = 4.5 mm, talonid width = 4.9 mm) appears to be an arctocyonid with unusually molariform premolars. Thus, the presence of low but strong paraconids and metaconids and small talonids on the P_{3-4} of UNM B–401b preclude assignment to *Oxyclaenus simplex*, *O. cuspidatus*, and *Loxolophus hyattianus*—arctocyonids in its size range. The only arctocyonid I have examined with premolars as molariform as those of UNM B–401b is *Desmatoclaenus hermaeus* from the Dragon local fauna of Utah (Gazin, 1941, fig. 19), which is much larger than UNM B–401b. It is possible that the UNM specimen is a partial lower dentition of the smaller, Puercan species of *Desmatoclaenus*, *D. dianae* (Van Valen, 1978, p. 57). Nevertheless, until the lower dentition of *D. dianae* is adequately described, I only refer UNM B–401b to *Desmatoclaenus* sp.

UNM B–389 (locality 349) is a left M^2(?) missing its labial edge (Fig. 7C). Like UNM B–401b, it appears to be an arctocyonid, but it is difficult to identify because of its unusually large hypocone and complete lingual cingulum. In size and morphology it most closely resembles specimens of *Desmatoclaenus protogonioides* (compare with AMNH 3253; Cope, 1884, pl. 25F, fig. 17), although I have not seen a specimen of *D. protogonioides* that combines a complete lingual cingulum with as large a hypocone as is present on UNM B–401b. Thus, identification of the UNM specimen as *Desmatoclaenus* sp. seems reasonable.

Genus and species indeterminate

UNM B–1084 (locality 1038) is a fragmentary but edentulous maxillary about the size of *Periptychus*. UNM B–1088b (locality 1039) is root and enamel fragments of a smaller mammal, and UNM B–384 consists of postcrania fragments, including a partial tibia comparable in size to the tibia of *Periptychus*.

Biostratigraphy

The occurrence of *Taeniolabis taoensis*, *Periptychus coarctatus*, *Gillisonchus gillianus*, *Loxolophus pentacus*, *L. priscus*, and *L. hyattianus* supports assignment of the mammal-producing interval of the Nacimiento Formation in the headlands of the West Fork of Gallegos Canyon to the Puercan land-mammal "age" (Wood and others, 1941; Russell, 1967). A second vertebrate-producing interval is present 7–9 m (23–29 ft) above this interval (Fig. 3), but has only produced lower vertebrates. Although assigning this upper interval to the Puercan might be doubted, data (Lucas and

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Schoch, 1982) indicate that Torrejonian (including "Dragonian") horizons in the Nacimiento Formation are at least 50 m (164 ft) above Puercan horizons (Sinclair and Granger, 1914; Lindsay and others, 1981; Tomida, 1981), so it is likely that the upper vertebrate-producing interval along the West Fork of Gallegos Canyon is Puercan.

Historically, the occurrence of *Taeniolabis* in the mammal-producing interval would be accepted as evidence that this interval pertains to the *Taeniolabis*, or upper, "zone" of the Puercan. However, in the headlands of the West Fork of Gallegos Canyon, there is no mammal-producing interval to correspond to the *Ectoconus*, or lower, "zone" of the Puercan. In Kimbeto and Betonnie Tsosie Washes the reverse is the case: an *Ectoconus* "zone" mammal-producing interval is not overlain by a *Taeniolabis* "zone" interval. Only in the headlands of De-na-zin and Alamo Washes are mammal-producing intervals representing both "zones" present in a single stratigraphic sequence.

There are two alternate explanations for the distribution of these Puercan "zones" in the San Juan Basin:

1) The *Taeniolabis* and *Ectoconus* "zones" do represent successive intervals of Puercan time. The absence of fossil mammals representing one or the other zone in Kimbeto Wash, Betonnie Tsosie Wash, and the West Fork of Gallegos Canyon reflects inadequate sampling, biased preservation, or stratigraphic differences in the lower part of the Nacimiento Formation in these areas.

2) These "zones" do not represent successive time intervals. Instead, sampling biases or facies differences have controlled the occurrence of certain mammal taxa (notably *Taeniolabis*).

Sinclair and Granger (1914) and, most recently, Lindsay and others (1981) favored the first explanation. Matthew (1937) and, most recently, Van Valen (1978) favored the second explanation.

However, I find it difficult to choose between the two alternatives. More detailed taxonomic and phylogenetic studies of Puercan mammals, more intensive collecting in the lower part of the Nacimiento Formation, and more detailed stratigraphic study of these rocks with the aim of arriving at a correlation of Puercan strata of the Nacimiento Formation independent of the fossil mammals seem necessary in order to determine fully the validity of the Puercan "zones."

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Geographic names

U.S. Board on Geographic Names

Crystal Creek—stream, 32 km (20 mi) long, heads in the Chuska Mountains in New Mexico near Washington Pass at 36°05′04″ N., 108°51′22″ W., flows west into Arizona to join Cattail Wash at the head of Coyote Wash 12.9 km (8 mi) west of Crystal, NM; Apache County, AZ, and San Juan County, NM; 36°04′52″ N., 109°08′56″ W.; 1959 description revised; *not:* Coyote Wash, Simpson Creek (BGN 1915).

Maverick Spring—spring, in the Peloncillo Mountains, 3.5 km (2.2 mi) north of Mount Baldy and 9.9 km (6.1 mi) west of Eakins; Hidalgo County, New Mexico; 31°43′10″ N., 108°55′50″ W.; *not:* Mavarick Spring.

Spring Creek—stream, 12.9 km (8 mi) long, heads at the junction of Estufa and Las Cuatas Creeks on the south side of Stove Ridge in New Mexico at 36°58′35″ N., 106°44′20″ W., flows west–northwest to the Navajo River at Chromo, Colorado; Archuleta County, Colorado, and Rio Arriba County, New Mexico; sec. 9, T. 32 N., R. 1 E., NMPM; 37°01′58″ N., 106°50′45″ W.; *not:* Stove Creek.

Stove Creek—stream, 5.6 km (3.5 mi) long, heads in Colorado on the north slope of Stove Ridge at 36°59′35″ N., 106°44′35″ W., flows west–northwest through New Mexico to Spring Creek 5.6 km (3.5 mi) southeast of Chromo, Colorado; Archuleta County, Colorado, and Rio Arriba County, New Mexico; 37°00′13″ N., 106°47′20″ W.

Tanbark Canyon—canyon, 3.2 km (2 mi) long, heads at 33°29′34″ N., 105°47′16″ W., trends south to Bonito Creek, 19 km (12 mi) northwest of Ruidoso; Lincoln County, New Mexico; sec. 3, T. 10 S., R. 11 E., NMPM; 33°28′02″ N., 105°47′06″ W.

Taylor Draw—ravine, 6.4 km (4 mi) long, heads at the base of the Animas Mountains at 31°31′15″ N., 108°48′40″ W., trends southwest then northwest to join Foster Draw at the head of Animas Creek 0.48 km (0.3 mi) northeast of Gray Ranch; Hidalgo County, New Mexico; sec. 16, T. 32 S., R. 20 W., NMPM; 31°30′28″ N., 108°52′07″ W.

Valle Largo—meadow, in the Sangre de Cristo Mountains, 1.5 km (0.9 mi) northwest of Osha Pass and 20.9 km (13 mi) east–southeast of Taos; Taos County, New Mexico; sec. 3, T. 24 N., R. 15 E., NMPM; 36°20′54″ N., 105°20′25″ W.

White Place—locality, in Playas Valley 18.8 km (11.7 mi) east of Animas; Hidalgo County, New Mexico; 31°58′15″ N., 108°36′40″ W.; *not:* Playas.

Wind Canyon—canyon, 2.4 km (1.5 mi) long, heads in the Sierra Blanca on north slope of the Double Diamond Peaks at 33°34′09″ N., 105°47′40″ W., trends northeast to open out 9.7 km (6 mi) southeast of Carrizozo; Lincoln County, New Mexico; sec. 27, T. 8 S., R. 11 E., NMPM; 33°35′10″ N., 105°47′00″ W.

Ysletaño Canyon—canyon, 12.9 km (8 mi) long, heads in the Sacramento Mountains at 33°03′52″ N., 105°51′ W., trends northwest to Tularosa Canyon 9.7 km (6 mi) northeast of Tularosa; reported to have been named for the mission and Tiwa pueblo called Corpus Christi de la Isleta (Ysleta) del Sur, on the Rio Grande southeast of El Paso, Texas, because timber used for the mission was cut in this canyon about 1682; Otero County, New Mexico; sec. 12, T. 14 S., R. 10 E., NMPM; 33°06′41″ N., 105°56′17″ W.; *not:* Ranchario Canyon.

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