The Chico Springs locality, Nacimiento Formation, San Juan Basin

Thomas E. Williamson and Spencer G. Lucas

in:

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INTRODUCTION

The first early Paleocene mammal faunas were discovered in New Mexico through the collecting efforts of David Baldwin. Baldwin had worked with Lieutenant W. L. Carpenter for the Wheeler Survey in 1875, collecting fossils from Eocene strata in northwestern New Mexico (Simons, 1981). Baldwin later sent the first early Paleocene mammals from the Nacimiento Formation to O. C. Marsh at Yale University in 1879 (Simons, 1963). Marsh did not realize the significance of these fossils, and, after disputes about payment, Baldwin began sending his collections to Marsh’s rival, E. D. Cope, in Philadelphia. Baldwin collected many Paleocene mammals for Cope from 1880–1886 (Lucas, 1982). Cope went on to describe the first early Paleocene vertebrate faunas in 41 articles published between 1881 and 1888. Cope named numerous genera and species of early Paleocene vertebrates from the Nacimiento Formation. His collection was sold to the American Museum of Natural History (AMNH) in the 1890s. Unfortunately, many specimens Baldwin collected for Cope lack precise locality information.

Many of Baldwin’s specimens are labelled as having come from “Chico Springs” or the head of “Gallegos Arroyo.” These specimens often have a distinctive preservation, being fairly complete but heavily concreted. Matthew (1937, p. 288) noted that many specimens collected by Baldwin bear the label “Collected 11-26-‘83;” evidently Baldwin discovered a rich fossil locality on that date in Gallegos Canyon, as a large number of specimens of various Torrejonian mammal species bears that date, sometimes with, sometimes without, the locality. It was this shipment of new material that was described in Cope’s “Second addition to the Puerco fauna.” In that publication, Cope (1884, p. 309) noted “skulls of several species in calcareous concretions were received, so that their characters can be developed more fully than heretofore. I mention especially Delatherium fundatum; Periptychus rhabdoson and P. coarctatus; Haplocosus lineatus; H. entoconus; Anisonchus sectorius; Protoconus plicifera; Mioclaenus turgidus, M. ferox, M. subtrigonus and M. cuspidatus, sp. nov.”

The AMNH sent expeditions to collect from Baldwin’s localities in 1892, 1896, 1904, 1912, 1913 and 1916 (Williamson, 1996). J. L. Wortman, O. A. Peterson and T. Rafferty collected from the Nacimiento Formation in 1892, Thomas Rafferty apparently had been a partner of Baldwin and acted as guide and teamster for this first expedition (Sinclair and Granger, 1914). Much of that expedition’s collection came from the vicinity of Chico Springs, the head of Coal Creek and in Kimbetoh Arroyo. Later expeditions from the AMNH recollected these localities and also collected from localities farther south at the head of Torreon Wash (1904, 1912 and 1913), and later from Kutz Canyon and the Animas River Valley (Granger, 1916, 1917).

Numerous field parties from many institutions subsequently collected Paleocene vertebrates from the Nacimiento Formation (Williamson, 1996). However, the Chico Springs locality has largely been neglected. The most recent verified record of collecting from this locality is by a party from the AMNH in 1928 led by George Gaylord Simpson (Simpson, 1928). The location of Chico Springs is not noted on USGS topographical maps and, although the locality is approximately plotted in several publications (e.g., Sinclair and Granger, 1914; Matthew, 1937; Sloan, 1987), the precise location of the fossil site has long since been lost. In 1991, we relocated Chico Springs by using the unpublished field notes of W. J. Sinclair (1913) and W. Granger (1913).

On June 24, during the 1913 expedition, Sinclair and Granger (and team) camped at “Camp IV” near the trading store at Chico Springs in Chico Arroyo and collected from two localities, a small butte about 0.25 mi from the nearest bluffs to the south and from strata exposing the same horizon as exposed at a small butte. The group stayed through June 26 and collected numerous fossil specimens. In his field notes, Sinclair plotted the bearings from the fossil localities to two distinctive landmarks: Angel Peak, rising above Kutz Canyon and El Huerfano, a high mesa rising above Canyon Largo.

THE CHICO SPRINGS LOCALITY

The Chico Springs locality (“Gallegos Canyon” of Baldwin; “AMNH locality 1” and “two miles above Chico Springs” of Sinclair and Granger, 1914; “locality 10” of Williamson, 1996) includes New Mexico Museum of Natural History and Science (NMMNH) localities 2251, 2513, 2544, 2545, 2546, 2547, 2548 and 15249 (Fig. 1, Table 1). Sinclair (1913) located Chico Springs with two compass bearings—N23°E to Angel Peak and N63°E to El Huerfano. Using these bearings, we identified an amphitheater of badlands in secs. 22-23 and 26-27, T25N, R11W. These badlands are at the head of a north-south tributary to Gallegos Canyon. The north-south tributary to the east, in secs. 12, 13 and 24, T25N, R11W is “Chico Arroyo” of earlier workers, and “Reider’s Store” (Sinclair and Granger, 1914, fig. 1) must have been located near the corner of secs. 1, 11 and 12, T25N, R11W. In secs. 22-23, 26-27, T25N, R11W, about 55 m of the Ojo Encino Member of the Nacimiento Formation are exposed. Stratigraphically low, in yellowish gray and brownish gray mudstones, numerous fossil vertebrates occur at various locations along the outcrop belt. Nearby outcrops of the Nacimiento Formation are essentially barren of fossil vertebrates, except for the Puercan interval at the head of the West Fork of Gallegos Canyon, about 8 km to the west, and Puercan and lowest Torrejonian intervals in De-na-zin Wash, about 5 km to the southwest (Kues et al., 1977; Lucas, 1984; Williamson, 1996). Given that the localities in secs. 22-23, 26-27, T25N, R11W match previous descriptions of...
the Chico Springs locality and produce numerous Torrejonian mammals similar in preservation to earlier collections, we feel certain that we have relocated Chico Springs.

**PALEONTOLOGY**

**Lower vertebrates**

Numerous specimens of lower vertebrates including the crocodylian *Leidyosuchus* sp. (NMMNH P-19320; Lucas, 1992, fig. 1J-L), and trionychid and baenid turtles have been recovered from the Chico Springs locality.

**Mammals**

Mammals are the most diverse component of the vertebrate fauna from Chico Springs, and are represented primarily as partial jaws and skulls. Specimens are often heavily concreted revealing only a few teeth protruding from the concretion.

*Eucosmodon* sp.

Referred specimen is AMNH 16534, a left maxilla with P$	ext{2}$ (Granger and Simpson, 1929, fig. 17).

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**TABLE 1. Chico Springs locality information.**

<table>
<thead>
<tr>
<th>NMMNH locality</th>
<th>Coordinates</th>
</tr>
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<tbody>
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<td>L-1226</td>
<td>SW$	ext{1}$/4, NW$	ext{3}$/4, SW$	ext{3}$/4, section 23, T25N, R12W</td>
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<td>L-2544</td>
<td>center of NW$	ext{3}$/4, section 23, T25N, R11W</td>
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</tr>
</tbody>
</table>

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**Ptilodus trovessartianus** Cope, 1882

Holotype: AMNH 3025.

Type Locality: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation.

Referred specimen is AMNH 3026 (designated the neotype of *Ptilodus trovessartianus* by Granger and Simpson, 1929, fig. 13A, 16; Matthew, 1937, fig. 78).

**Catopsalis fissidens** Cope, 1882

Referred specimen is AMNH 16534, a left maxilla with P$	ext{2}$ (Granger and Simpson, 1929, fig. 17).
Holotype: AMNH 3044.

Type locality and horizon: Gallegos Canyon, San Juan Basin, New Mexico.

Referred specimens are AMNH 3044, a right dentary fragment with M₁₂ (holotype of *Catopsalis fissidens*), AMNH 16752, a left dentary fragment with incisor fragments; from NMMNH locality L-2543, NMMNH P-19500, a concretion-covered palate with right M₁ and left M₁ (Fig. 2A) and P-19280, an incisor. Lucas et al. (1997) reviewed these specimens to docu-

ment that *C. fissidens* is the subjective senior synonym of *C. utahensis*. 

**Protictis haydenianus** (Cope, 1882) 

Type specimen: AMNH 3368. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimens are AMNH 1776; 3369a, a LP-M; 3374, a partial skull; and 3996c, a L M. MacIntyre (1966) suggested that the holotype (AMNH 3368) and several additional AMNH specimens (AMNH 3244a, 3372, 3453a, 3517, 4005, and 4060) might also be from Chico Springs, but this is not certain. A particularly unique specimen of *P. haydenianus* is AMNH 3374, a concreted rostrum with a complete dentition (MacIntyre, 1966, pl. 3, fig. 1; pl. 9, fig. 3). 

**Psittacotherium multifragum** Cope, 1882 

Holotype: AMNH 3413. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimens are AMNH 3392, a lower canine; from NMMNH locality L-2543, NMMNH P-19269, a canine fragment; and from L-2548, P-19297, a partial canine. Baldwin gave the locality of the holotype of *Psittacotherium multifragum* as “near Huerfano Peak.” This may refer to the Chicos Springs area or possibly Kutz Canyon. 

**Goniacodon levisanus** (Cope, 1883) 

Holotype: AMNH 3217. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimen is AMNH 3222, a concreted skull with LP root, P-M; RP-M; and lower jaw fragments. 

**Triisodon crassicuspis** (Cope, 1881) 

Holotype: AMNH 3352. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimen is AMNH 16559, a RM, and pes fragments. 

**Triisodon crassicuspis** (Cope, 1882) 

Holotype: AMNH 3178. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimen is from NMMNH locality L-2548, NMMNH P-19319, a LP, M (Fig. 2F-G) and concreted postcranial fragments. Matthew (1937) last reviewed *T. crassicuspis*. The holotype consists of a partial lower jaw with M, and the talonid of M. Matthew (1937) synonymized *T. rusticus* (AMNH 3178), a lower jaw fragment with damaged M,7 with *T. crassicuspis*. No other specimens have since been referred to this taxon. *T. crassicuspis* resembles *T. quivirensis* but is considerably smaller. NMMNH P-19319 is clearly a triisodontid and closely resembles the upper dentition of *T. quivirensis* but is considerably smaller (approximately 67% of the size of *T. quivirensis*) and is approximately the correct size (M length = 10.5 mm, anterior width = 12.5 mm, and posterior width = 13.8 mm; P length = 9.3 mm) to the upper teeth of *T. crassicuspis*. Therefore, we are reasonably confident that NMMNH P-19319 represents the first identified upper dentition of *T. crassicuspis*. 

Van Valen (1978) advocated referring *T. crassicuspis* to *Goniacodon*. However, the morphology of the M of NMMNH P-19319 (e.g., the well-developed hypocone and quadrate outline of M) establishes this taxon as a small species of *Triisodon*. 

**Dissacus navajovius** (Cope, 1881) 

Holotype: AMNH 3356. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimen is AMNH 3358, a RM, LP, and M. The label accompanying the specimen reads “Gallegos upper ‘85.” However, the preservation of this specimen does not resemble that of specimens recovered from Gallegos Canyon, but instead is characteristic of specimens from the stratigraphically higher “upper redbeds” in the vicinity of Torreon and Escavada Washes, suggesting a possible recording error. 

**Chriacus baldwini** (Cope, 1882) 

Holotype: AMNH 3114. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimens are AMNH 3104, a LP-M; 3369b, a RM; and 17093, a RM. 

**Mimotricentes subtrigonus** (Cope, 1881) 

Holotype: AMNH 3227. 

Type locality and horizon: San Juan Basin, New Mexico. From Torrejonian strata of the Nacimiento Formation. 

Refereed specimens are AMNH 3090, a skull with broken teeth (holotype of *Triceratops crassicollis*); 16609, a RP-M; 16608, a RM, and RP-M2; 16606, a RM; 16607, a LM3; 39077, a LM; 39073, a LP-M; LP-M; RC1; and RP-M; from NMMNH locality L-2543, NMMNH P-19262, a LP-M; and from L-2548, P-19300, a palate with RM. 

**Deuterogonodon noletii** Van Valen, 1978 

Holotype: AMNH 17078. 

Type locality and horizon: sec. 3, T27N, R11W, Kutz Canyon, San Juan Basin, New Mexico. This is in lower Torrejonian strata and correlates with the *Protoseolen opisthacus-Ellipsodon grangeri* zone of Williamson (1996). 

Refereed specimens are AMNH 95897, a maxilla and tooth, and AMNH uncataloged, a LM? and LM; also AMNH 98814, a concreted skull fragment and tooth, are tentatively referred to *Deuterogonodon*. 

**Miocolaeus turgidus** Cope, 1881 

Holotype: AMNH 3135. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimens are AMNH 829c (holotype of *Mi. zittelianus*); 3142, a RP; 3165, a LP and RP-M; 3168, a LM; and 16630, a RP-M. 

**Ellipsodon incriptionis** (Cope, 1884) 

Holotype: AMNH 3095. 

Type locality and horizon: Gallegos Canyon, Nacimiento Formation, San Juan Basin, New Mexico. 

AMNH 3095, the holotype, is a LP? RP; M. Refereed specimens are 3096, a LP-M3 and RP-M; and 3299, a LP-M1. 

**Promioclaenodon acolytus** (Cope, 1882) 

Holotype: AMNH 3308. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimens are AMNH uncataloged, a LP-M; and AMNH uncataloged, a LM; and 81875, a LP-M2. 

**Promioclaenodon lemoroides** (Matthw, 1897) 

Holotype: AMNH 2421. 

Type locality and horizon: Head of Rio Torreon, San Juan Basin, New Mexico. Probably from the “Pantolamba zone,” uppermost Torrejonian strata of the Nacimiento Formation. 

Refereed specimens are AMNH uncataloged, a LP-M; and RP-M; 16643, a LP-M; and RP-M; 16644, a LM; 16645, a RM; 17092, a RP-M; from NMMNH locality L-2548, NMMNH P-25029, a LM; from L-2543, P-19266, a LM; and from L-2549, P-19314, a LM. 

**Protoseolen opisthacus** (Cope, 1882) 

Holotype: AMNH 3275. 

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimen is from NMMNH locality L-2549, NMMNH P-19315, a LP-M. 

**Tetraclaenodon puercensis** (Cope, 1881) 

Holotype: AMNH 3832. 

Type locality and horizon: and horizon: Gallegos Canyon, San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation. 

Refereed specimens are AMNH uncataloged, a LM; and RM; 16741, a RM; 17095, a RM; and RM-M; from NMMNH locality L-2543, NMMNH P-19268, a LP-M; P-19270 (2F-H), a RP-M; 19273, a RP-M; 19282, a concreted skull with LP-M; from L-2548, P-19301, a RM; a partial skull with LP-M, RP-M and left dentary fragment with M, (Fig. 21-J) from L-2549, P-19306, a RM; P-19307, a LP-M; P-19308, a RM; and P-20743, a partial M.
**CHICO SPRINGS LOCALITY**

*Tetraclaenodon* is the most common fossil mammal from the Chico Springs area. Specimens from this fossil horizon and from correlative zones in Kutz Canyon are significantly smaller than specimens of *Tetraclaenodon* collected from higher fossil horizons (Williamson, 1996). However, because of overlap in size of specimens from both low and high stratigraphic horizons, only one species, *T. puercensis*, is recognized.

**Anisochusus sectorius** (Cope, 1881)

Holotype: AMNH 3527.

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation.

Referenced specimens are AMNH uncataloged, a LP1, M4; 3446, a P3, 3614, a Rdp, P, M; 16673, a P3-M2; 16607, a M2; 16609, a maxilla; 16670, a LP3-M3; 16671, a M3; TMM-1; from NMMNH locality L2543, NMMNH P-20746, a P, a partial LP, RM; P-20747, an LP-P-M, (Fig. 2K) and P-20882, a LP-M3 and RP-M3 (Fig. 2E).

**Haploconus angustus** (Cope 1881)

Holotype: AMNH 3477.

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation.

Referenced specimens are AMNH 3093, a LP3-M3; 3445, a LP3-M3 and concreted dentary; 3485, two concreted dentaries; 3492, a LP3-M3, LP4-M3; 3493, a LPm, RM1, a LP3-M3; 3506, a LP3, a LPm, RM3; 3507, a RP3; 3512, a RM3; 16672, two upper molars; 16692, a LP3-M3, RP3-M3; L3, a LP3-M3, RP3-M3; 16693, a LP3-M3, 16694, a LP3-RP3-M3; 93231, a LPm, from NMMNH locality L2549, NMMNH P19312, a LPm, 3512, a LP3-M3; P-19259, a LP3-M3, P-19260, a RP3-M3; P-19263, a LP3-M3 and RM3; P-19267, a RM3, P-19274, a RP3-M3; from L2548, P19296, a partial concreted skull; P-19298, a partial concreted skull; P-19299, a LP-M3, and P-19302, a concreted skull with LC1, FP3-M3 and RC3, P3.

Cope (1888) erected the species *Haploconus corniculatus* to include H. lineatus and a set of mandibles. He distinguished these from *H. angustus* (=H. angustus) primarily by their larger size. Matthew (1937) referred three additional specimens to *H. corniculatus*, AMNH 16692, 16693, and 16672 collected by Sinclair and Granger in 1913 in the Chico Springs locality. Matthew (1937) noted that the matrix surrounding these additional specimens was similar to that on Cope’s specimens of *H. corniculatus*, and that they might have been collected from the same location. Matthew also stated that some of Cope’s specimens of *H. corniculatus* are recorded as coming from “Gallego,” although others have no specific record attached to them.

Metrical analysis of *Haploconus*, including recently collected NMMNH specimens from Chico Springs, indicates a large, statistically significant size difference between *Haploconus* from low in the Torrejonian (including Chico Springs) and younger samples (see Williamson, 1996). However, there is considerable overlap in size between these samples, prompting Williamson (1996) to synonymize *H. corniculatus* with *H. angustus*.

**Periptychus carinidens** Cope, 1881

Holotype: AMNH 3620.

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation.

Referenced specimens are AMNH 856, a RP-M3, and LP-M2; 2463, a LP3-M3, M3; 3755, concreted bone fragments; 3760, a LP2, 3677, a RP3-M3 and RP3; 16713, a RP-M3; 16714, a RP3-M3; from NMMNH locality L2543, NMMNH P19277, a RM2, P-19285, a RP3, a R astragalus, L partial astragalus, and miscellaneous bone fragments; P-20745, a partial premolar; from L2546, P-20749, a LP3-M3 in concretion; and P-21652, a concreted skull fragment.

A right humerus from NMMNH locality L2548, NMMNH P19294 (Fig. 2C-D), is tentatively referred to *Periptychus carinidens*. The specimen is complete but fractured and distorted and partially covered with a concretionary matrix. It closely resembles the humerus of AMNH 17075 referred to *P. carinidens* (=P. rhabdodon) (Matthew, 1937, fig. 21).

**Deltatherium fundaminus** Cope, 1881

Holotype: AMNH 3315.

Type locality and horizon: San Juan Basin, New Mexico. Probably from Torrejonian strata of the Nacimiento Formation.

Referenced specimens are AMNH 3332, a jaw; 3342, a skull fragment; 3341, a skull; 16611, a concreted skull and skeleton; 16612, a maxilla; from NMMNH locality L2543, NMMNH P19264, a LP3-M3, M3; (Fig. 2B); P-19265, a LM1, and RM1; from locality L2548, P25027, a RP3-M3, P-25032, a concreted skull; and P-21035, a RP3-M3.

**Pantolambda sp.**

Referenced specimens are AMNH 4045, pelvis and vertebrae. A partial pelvis with associated sacral vertebrae collected by Baldwin in 1885 from Gallegos Canyon may be referable to *Pantolambda*. Specimens referred to *Pantolambda intermedi um* are known from the San Juan Basin (Williamson, 1996).

**DISCUSSION**

Topotypic material for several mammal taxa can now be identified from the new collections made at Chico Springs. The new localities can be correlated by lithostratigraphy to sections in De-na-zin Wash and Kutz Canyon, revealing that they represent a fossil horizon near the base of the Torrejonian (Fig. 3).

In the North Horn Formation of Utah, specimens of *Catopsalis fissidens* are known only from Dragon Canyon. This locality yielded the mammal fauna that defined the Dragonian land-mammal “age” of Wood et al. (1941), correlative of To1 of Archibald et al., 1987). Magnetostatigraphic of the North Horn Formation of Utah by Tomida and Butler (1980) indicates that the Dragon Canyon local fauna is from strata that straddle the boundary between the upper part of Chron 28n and the base of Chron 27r (Fig. 3).

In the San Juan Basin, *C. fissidens* occurs at only two localities, Chico Springs and Kutz Canyon. Lithostratigraphic correlation of the Nacimiento Formation between these two localities (Fig. 3; Williamson and Lucas, 1992, 1993; Williamson, 1993a, b) indicates that they are approximately at the same stratigraphic level. *Catopsalis fissidens*, therefore, has a relatively restricted stratigraphic distribution within the Nacimiento Formation of the San Juan Basin (Williamson, 1993b). Magnetostatigraphic of the Nacimiento Formation in Kutz Canyon and near De-na-zin Wash (Fig. 3; Tomida, 1981) indicates this interval is close to the base of the magnetozone correlated to Chron 27r. Comparison between the Dragon Canyon local fauna and the Torrejonian fauna from the Nacimiento Formation demonstrates the co-occurrence of many taxa at the generic and specific level, justifying subsuming the Dragon land-mammal “age” of Wood et al. (1941) within the Torrejonian land-mammal “age” (Tomida, 1981; Archibald et al., 1987; Sloan, 1987; Williamson, 1993a, b). Synonymy of *C. utahensis* and *C. fissidens* further strengthens correlation of the Dragon local fauna of east-central Utah with the Torrejonian fauna of the San Juan Basin. The occurrence of *C. fissidens* in both areas suggests a more refined correlation of the Dragon Canyon local fauna with the Chico Springs locality and certain Kutz Canyon localities low in the Nacimiento Formation. Schoch and Lucas (1981) also suggested that the presence of the taeniodont *Conoryctes pattersoni* from the Dragon Canyon local fauna and from strata low in the Nacimiento Formation exposed in Kutz Canyon demonstrated correlation between these localities.

Archibald et al. (1987) erected a three-part subdivision of the Torrejonian land-mammal “age” (To1-To3 intercalary zones), based on the first appearance of key taxa. To1 is defined as the interval between the first appearances of the periptychid *Periptychus carinidens* and of the pheneconodontid *Tetraclaenodon puercensis*. To2 is defined as the interval between the first appearance of *T. puercensis* and the pantodont *Pantolambda*. The Dragon Canyon local fauna was made the “reference fauna” for To1 (Archibald et al., 1987). Archibald et al. (1987) correlated several Torrejonian localities of the Nacimiento Formation that occur within Chron 28n with To1. However, they correlated the Kutz Canyon and Gallegos Canyon (Chico Springs) fossil localities yielding *Catopsalis fissidens* with the base of To2, based on the presence of the pheneconodontid *Tetraclaenodon*. *Tetraclaenodon* has since been recovered from lowest Torrejonian localities within Chron 28n in strata that record the lowest appearance of *Periptychus carinidens* in the San Juan Basin, indicating that To1 and To2 cannot be distinguished within the Nacimiento Formation (Williamson and Lucas, 1993; Williamson, 1993a, b; Williamson, 1996; Luca et al., 1997). Moreover, *Pantolambda intermedi um* has been recovered from low in the Nacimiento Formation from a locality that also yields *Catopsalis fissidens*. To3, therefore, as presently defined by Archibald et al. (1987), must include nearly all the San Juan Basin localities previously allocated to To2. This underscores the
Kutz Canyon Composite Section


conclusion that the divisions of the Torrejonian land-mammal “age” proposed by Archibald et al. (1987) are best replaced by the biostratigraphically-based zonation proposed by Williamson (1993a, b) and Williamson and Lucas (1992, 1993).

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