

LATE TORREJONIAN (MIDDLE PALEOCENE) MAMMALS FROM SOUTH CENTRAL ALBERTA, CANADA

CRAIG S. SCOTT

Laboratory for Vertebrate Paleontology, Department of Biological Sciences, University of Alberta, Edmonton T6G 2E9, Canada
<cscott@ualberta.ca>

ABSTRACT—The Paskapoo Formation in central and south central Alberta, Canada, preserves continental sediments of Paleocene age. Outcrops of the formation on Nose Creek in northeast Calgary, at a locality called Who Nose?, have yielded fossil mammals from the middle part of the epoch. To date, some 400 dental specimens representing eight mammalian orders have been recovered, among them numerous well-preserved jaws. Newly named taxa include new species of *Parectypodus* and *Baiotomeus* (Multituberculata); new species of *Parectypodus*, *Litomylus* (Condylarthra), and *Cyriacotherium* (Pantodonta) are left unnamed. Biostratigraphic correlation indicates a late Torrejonian age for the local fauna based on the presence of the plesiadapid primate *Pronothodectes matthewi*. Faunal comparisons suggest a close similarity to the penecontemporaneous Gidley Quarry fauna, Montana, with a taxonomic diversity consistent with other co-eval faunas in the Western Interior of the United States. The specimens from Who Nose? constitute the largest collection of Torrejonian mammals from Canada, offering a unique perspective on mammalian diversity from an otherwise poorly represented interval in western Canada.

INTRODUCTION

PALEOCENE MAMMALS from Alberta have been known since the early twentieth century and have figured prominently in the understanding of local and regional geology, stratigraphy, mammalian evolution, and paleofaunal composition (Fox, 1990; Jerzykiewicz, 1997). The widespread distribution of Paleocene mammal localities across the province has permitted intrabasinal correlations, allowed reconstruction of the geometries of the depositional units within the Alberta Basin, the identification of local and regional unconformities, and fine-scale biostratigraphic analyses (Jerzykiewicz, 1997).

The biostratigraphy of the Calgary and Foothills regions has received comparatively little attention, although some of the earliest discovered fossil mammal sites in Canada are in this area. L. S. Russell, while working in the vicinity of Calgary and Cochrane in the early 1900s, discovered many of what were to become important fossil mammal sites (Russell, 1926, 1929, 1932, 1948, 1958; Russell *in* Rutherford, 1927; Fox, 1990). His pioneering fieldwork, descriptions, and subsequent attempts at biocorrelation using fossil mammals provided a basis for later understanding of local and regional geology and stratigraphy.

This study documents a new fossil mammal local fauna of late Torrejonian (middle Paleocene) age from the Paskapoo Formation in Calgary, Alberta. The locality was discovered in 1989 by D. Brinkman, Royal Tyrrell Museum of Palaeontology, and subsequently brought to the attention of R. C. Fox, Laboratory for Vertebrate Paleontology, University of Alberta. The locality, christened Who Nose?, was first quarried in the summer of 1989 by Fox and field parties from the University of Alberta. Subsequent trips in 1991 and 1996 through 1999 by field parties from the University of Alberta resulted in a modest collection of mammal fossils. At present, approximately 400 specimens have been recovered, including over 10 well-preserved jaws. Additionally, the locality has yielded fragmentary remains of non-mammalian vertebrates including fish, amphibians, lizards, and crocodylians.

REGIONAL GEOLOGICAL SETTING AND LOCATION

Upper Mesozoic and lower Tertiary paralic and continental sediments of western Canada were deposited as a series of transgressions and regressions associated with two depocentres: the Alberta Basin in the west and the Williston Basin farther east; the two are separated in southeastern Alberta by the Bow Island Arch (Dawson et al., 1994). The Alberta Basin is a segment of a large foreland basin extending from Alaska to New Mexico that was

filled by clastic debris derived from erosion of the orogenic highlands to the west (Jerzykiewicz, 1997). Uppermost Cretaceous and Paleocene strata within the basin form eastward-thinning clastic wedges deposited during the final stages of the Laramide Orogeny and subsequent Tertiary tectonic quiescence (Dawson et al., 1994). These rocks form the bedrock in the Interior Plains of southern Alberta and extend throughout the Foothills to the Front Ranges of the Rocky Mountains (Bally et al., 1966).

Strata of the Paskapoo Formation are extensive throughout the central Alberta Plains, comprising most of the surface bedrock (Demchuk and Hills, 1991). McLean (1990, p. 481) described the Paskapoo Formation as displaying “. . . interbedded hard to soft mudstone, siltstone and sandstone, with subordinate limestone, coal, pebble conglomerate and bentonite.” Prominent massively-bedded or disturbed to cross-bedded, buff-weathering, medium- to coarse-grained sandstones characterize the majority of Paskapoo strata (McLean, 1990; Demchuk and Hills, 1991), with subordinate brown to greenish-grey siltstone and mudstone, shale, and coal. Primary sedimentary structures are few, with the exception of minor trough cross-bedding and rare planar and ripple cross-lamination (Demchuk and Hills, 1991). Paskapoo strata unconformably overlie strata of the Scollard Formation in central Alberta, and are believed to be laterally equivalent to those of the Porcupine Hills Formation in southwestern Alberta, and the Ravenscrag Formation in southeastern Alberta and southwestern Saskatchewan (Demchuk and Hills, 1991; Jerzykiewicz, 1997; Lerbekmo and Sweet, 2000).

Who Nose? is exposed as a cutbank on the east side of West Nose Creek in SW¼ S23, T25, R1, W5 in the City of Calgary, south central Alberta, approximately 1,065 m asl (Scott, 1997; Lerbekmo and Sweet, 2000). The locality is 300 m north and upstream of the confluence of the west and north branches of Nose Creek (Fig. 1).

TECHNIQUES OF STUDY

Methods.—Fossils from the Who Nose? locality were collected by hand quarrying to preserve delicate and possibly articulated specimens. The residual matrix was sacked and returned to the laboratory for underwater screening, following Krause's method (Johnson et al., 1994). Resistant matrix was immersed in 10 percent industrial detergent and re-screened in order to increase fossil yield. After drying, the concentrate was sorted and identifiable elements were removed for study.

Dental measurements, terminology, and abbreviations.—All measurements were made by the author using a Wild M3 Zoom

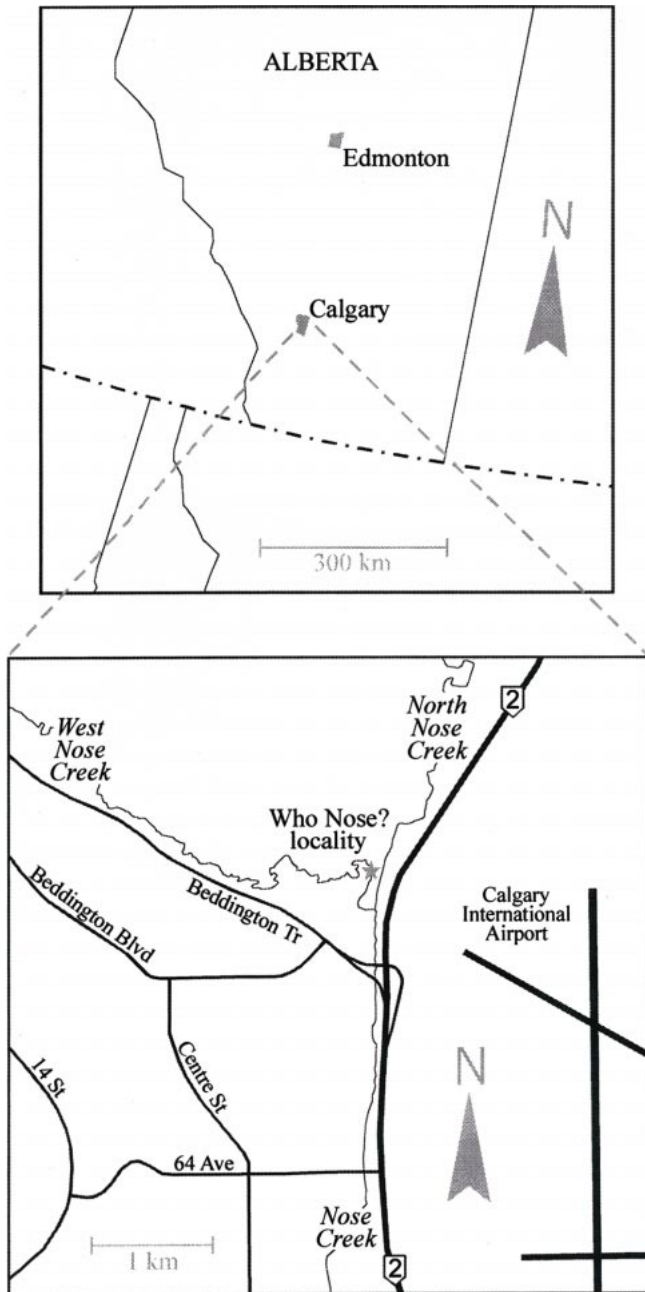


FIGURE 1—Map showing the location of Who Nose? along Nose Creek, Paskapoo Formation, Alberta.

binocular microscope with 10× oculars fitted with a micrometer calibrated against a millimeter scale. Measurements were estimated to the nearest tenth of a millimeter, the finest degree of accuracy that could be reproduced consistently. Multituberculate dental nomenclature and measurements follow Krause (1977). The blade-like lower teeth of multituberculates are considered p4s and not “m_bs” of Schiebout (1974), Rigby (1980), Sloan (1981), and Secord (1998). Therian dental nomenclature follows Van Valen (1966) and Szalay (1969). Therian incisor nomenclature follows Gingerich (1976). Carnivoran dental nomenclature follows MacIntyre (1966) and Fox and Youzwyshyn (1994). Therian dental measurements follow Clemens (1966). The terms premolariform, semimolariform, and submolariform are used as per Krishtalka

(1976a). I, i = Upper and lower incisor, respectively; C, c = Upper and lower canine, respectively; D, d = Upper and lower deciduous tooth, respectively; P, p = Upper and lower premolar, respectively; M, m = Upper and lower molar, respectively; X, x = Tooth unidentifiable as to position; L, R = Left and right, respectively.

Multituberculate cusp formulae.—Cusp number and their expression in formulae follow the methods and rationale of Krause (1977). P4 formulae of the form (w)x:y:z designate cusps of the external (x), middle (y), and internal (z) rows, respectively. Cusps on the anterolabial lobe (w) are hypothesized neomorphs and are listed prior to cusps of the external row. Upper molar cusp formulae of the form x:y:z designate cusps of the external (x), middle (y), and internal (z) rows, respectively. Lower molar cusp formulae of the form x:y designate cusps of the external (x) and internal (y) rows, respectively.

Measurements and statistics.—H = Height of crown of multituberculate p4s, recorded as the “perpendicular distance between [the first serration] and the baseline” (Krause, 1987, p. 596) (Fig. 2); L1—A measure of length of multituberculate p4s along the baseline between perpendiculars drawn from the anterior crown margin and from the first true serration (Fig. 2); L = Maximum anteroposterior length of crown; TaW = Maximum labiolingual width of talonid; TrW = Maximum labiolingual width of trigonid; W = Maximum labiolingual width of crown; CV = Coefficient of variation; M = Mean; N = Sample size; OR = Observed range; P = Parameter; SD = Standard deviation.

Institution and locality abbreviations.—CMNH = Carnegie Museum of Natural History, Pittsburgh; KUVN = Museum of Natural History, The University of Kansas, Lawrence; NMC = National Museum of Natural Sciences, Ottawa; UALVP = Laboratory for Vertebrate Paleontology, University of Alberta, Edmonton; Rav W-1 = Medicine Hat Brick and Tile Quarry, Ravenscrag West-1 horizon; DW-2 = University of Alberta, Dennis Wighton Locality 2.

Symbols.—*Indicates the value is an estimate.

SYSTEMATIC PALEONTOLOGY

Class MAMMALIA Linnaeus, 1758

Subclass ALLOThERIA (Marsh, 1880)

Order MULTITUBERCULATA Cope, 1884a

Suborder CIMOLODONTA McKenna, 1975

Superfamily PTILODONTOIDEA (Sloan and Van Valen, 1965)

Family NEOPLAGIAULACIDAE Ameghino, 1890

Genus MESODMA Jepsen, 1940

MESODMA PYGMAEA Sloan, 1987

Figure 3.1–3.5, Table 1

Material examined.—UALVP 44051, P4; UALVP 44049, 44050, p4s.

Occurrence.—Late Torrejonian to late Tiffanian of North America.

Description and discussion.—P4 cusp formula (0)2:6:0, p4 low-crowned with nine or ten serrations, and a single incipient serration. The Nose Creek specimens are virtually identical in both qualitative and quantitative characters to the type material from Gidley Quarry, Fort Union Formation, Montana (Sloan, 1987) and to specimens from Cochrane 2, Paskapoo Formation, Alberta (Youzwyshyn, 1988), differing only in being slightly smaller and in having fewer serrations on p4. *M. pygmaea* is broad ranging, both stratigraphically (late Torrejonian to late Tiffanian) and geographically (Alberta to Texas). The Who Nose? occurrence is the earliest of the taxon in western Canada.

Genus XYRONOMYS Rigby, 1980

XYRONOMYS sp.

Figure 3.6–3.11

Description.—P4 cusp formula (0)4:6; P4 low crowned, posterior margin straight, apogee at ultimate or penultimate cusp; p4

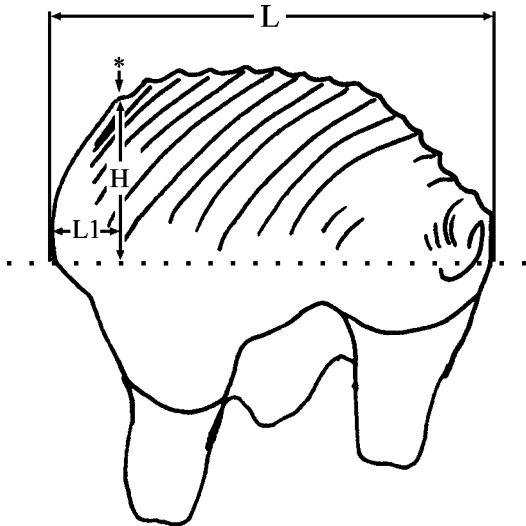


FIGURE 2—Orientation for standard measurements of multituberculate p4s, labial view (anterior to left). Hatched line represents the baseline. H = height, L = length, L1 = length 1. Asterisk points to the first serration. Diagram adapted from Sloan (1981).

uniformly low crowned; cutting edge with single incipient serration and estimated 10–13 serrations that are stouter posteriorly; anterior crown margin smoothly arcuate; posterolabial shelf weak; exodaenodont lobe shallow and peaked ventrally, anterobasal concavity notched.

Material examined.—UALVP 44055, P4 (L = 1.6; W = 0.7); UALVP 44056, 44057, 44058, p4 fragments.

Discussion.—The Nose Creek p4s compare favourably with those of *X. swaini* Rigby, 1980 from Swain Quarry, Fort Union Formation, Wyoming (Rigby, 1980) and with material of *Xyronomys* sp. from Rav W-1, Ravenscrag Formation, Saskatchewan (Johnston and Fox, 1984), especially in the low profile, weak posterolabial shelf, and similar serration count. The p4s from Who Nose? differ from the Swain Quarry and Rav W-1 specimens, however, in having a stronger, ventrally peaked exodaenodont lobe, and a lower posterior margin; additionally, the anterobasal concavity is shallower and the labial ridges run at a more acute angle from the horizontal. Although these differences in p4 structure are slight, they may prove taxonomically significant upon additional sampling. P4s of *Xyronomys* are undiscovered [Rigby (1980) and Johnston and Fox (1984) discussed the probability of confusing P4 of *Xyronomys* with those of other small neoplagiaulacids]; hence, UALVP 44055 is referred tentatively, in that future sampling may result in an alternative identification. *Xyronomys* sp. from Who Nose? marks the first known occurrence of the taxon in Alberta.

Genus MIMETODON Jepsen, 1940

MIMETODON SILBERLINGI (Simpson, 1935)

Figure 3.12–3.17, Table 2

Material examined.—UALVP 44060, 44061, P4s; UALVP 44062–64 (total:3), M1s; UALVP 44065–67 (total:3), p4s.

Occurrence.—Late Torrejonian to latest Tiffanian of North America.

Description and discussion.—P4 cusp formula (0)2:7–8:0; M1 cusp formula 7–9:10–12:5–6; p4 with 10–11 serrations. The coronal morphology of p4 is virtually identical to that in *M. silberlingi* from Gidley Quarry, Montana (Simpson, 1935, 1937) and from Cochrane 2, Alberta (Youzwshyn, 1988), differing from those of later Tiffanian *M. silberlingi* [e.g., from Roche Percée,

Ravenscrag Formation, Saskatchewan (Krause, 1977)] in being lower crowned and slightly smaller. *Mimetodon silberlingi* is broad ranging, both stratigraphically (late Torrejonian to latest Tiffanian) and geographically (Alberta to Texas). The Nose Creek occurrence is the earliest known of *M. silberlingi* in western Canada.

Genus ECTYPODUS Matthew and Granger, 1921

ECTYPODUS CF. E. SZALAYI Sloan, 1981

Figure 3.18–3.19, Table 3

Description.—p4 symmetrically arcuate in lateral profile; cutting edge with 11 serrations that are more prominent posteriorly; crown apogee at third or fourth serration; ultimate and penultimate serrations lack ridges labially and lingually; exodaenodont lobe anteroposteriorly elongate and rounded ventrally, posterolabial shelf prominent, anterobasal concavity deep and notched.

Material examined.—UALVP 44072, 44073, p4s.

Occurrence.—Middle Torrejonian to middle Tiffanian of North America.

Discussion.—The Who Nose? p4s are within the size range of the type material (Sloan, 1981, 1987), and closely resemble descriptions and figures in Sloan (1981) and Gambaryan and Kielan-Jaworowska (1995). Additionally, the Nose Creek p4s are nearly identical to a single undescribed p4 from Cochrane 1, Paskapoo Formation, Alberta, also referred to *E. cf. E. szalayi*. The Who Nose? sample is the earliest discovered occurrence in western Canada of this geographically extensive taxon.

Genus PARECTYPODUS Jepsen, 1930

PARECTYPODUS CF. P. SYLVIAE (Rigby, 1980)

Figure 3.20–3.24, Table 4

Description.—P4 cusp formula (0)5–6:7:0; crown nearly straight anteroposteriorly in occlusal aspect, with little labiolingual flexion of cusp rows, anterior slope slightly convex and posterior slope straight; penultimate cusp in medial row highest above base of enamel; anterolabial lobe faintly developed, containing no cusps external to labial row; p4 profile high and evenly arcuate; crown apogee at third or fourth serration; distances between ridges subequal throughout length of crown; posterolabial shelf vertically oriented, extending to baseline of crown, with large, prominent wear facet; exodaenodont lobe ventrally peaked and anteroposteriorly long; m1 cusp formula 8–9:5; crown subquadrate in occlusal view; labial cusps subcrescentic, lingual cusps massive and subpyramidal, both rows wearing flat apically; bases of first two lingual cusps connate.

Material examined.—UALVP 44235, 44075, P4s; UALVP 44077, incomplete dentary with p4–m1; UALVP 44078, 44079, m1s.

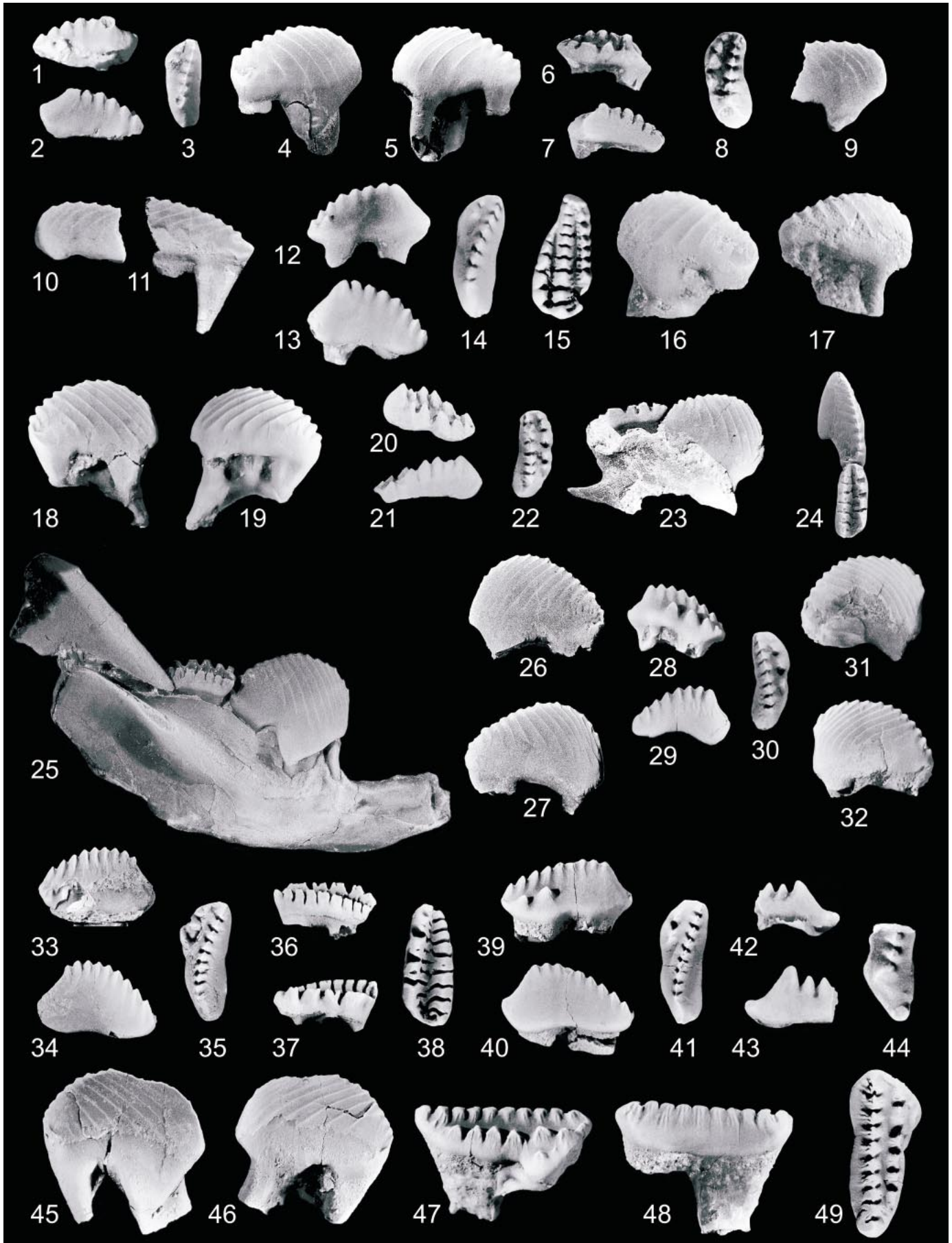
Occurrence.—Middle Torrejonian to earliest Tiffanian of North America.

Discussion.—The referred specimens from Who Nose? are similar to material described by Rigby (1980) from Swain Quarry, differing only in p4 having a smoother, more arcuate anterior profile. The P4s of *P. cf. P. sylviae* from Who Nose? are virtually identical to those from Swain Quarry; collectively, they differ from teeth of *P. sylviae* from Medicine Rocks Site I, Tongue River Formation, Montana, (Sloan, 1987) in having a steeper posterior slope with the crown apogee at the penultimate cusp. The Nose Creek sample is the earliest discovered occurrence of the taxon in western Canada.

PARECTYPODUS CORYSTES new species

Figure 3.25–3.27, Table 5

Diagnosis.—Medium-sized *Parectypodus* distinguished from all other species of the genus by unique, highly-arched, asymmetrical p4 profile; p4 larger than that of *P. vanvaleni* Sloan, 1981



and *P. sloani* Schiebout, 1974, and much smaller than that of *P. trovessartianus* (Cope, 1882) and *P. armstrongi* Johnston and Fox, 1984; differing further from p4 of *P. vanvaleni* and *P. sloani* in having steeper anterior and posterior crown margins and greater serration count; differing from p4 of *P. clemensi* Sloan, 1981 in larger size and greater serration count; differing from Eocene *Parectypodus* in retaining p3.

Description.—p3 short, peg-like; p4 crown high and arcuate, with anterior slope forming a semi-circular arc, posterior slope descending from fifth serration at 45 degrees from horizontal; cutting edge with single incipient serration and 14–15 serrations that are larger and coarser posteriorly; second or third serration offset posteriorly; labial and lingual ridges well developed, becoming weaker and truncated posteriorly, antepenultimate through ultimate serrations lacking ridges; posterolabial shelf short and crenulated below penultimate and ultimate serrations; exodaenodont lobe shallow and elongate; anterobasal concavity moderately deep; m1 cusp formula 10–11:5; crown subquadrate in occlusal aspect; labial cusps subcrescentic and subequal in height; first lingual cusp short, nearly half the height of remaining four cusps, but appreciably longer anteroposteriorly, last four lingual cusps subequal in size.

Etymology.—*Corystes*, Greek (korystos, adjective, masculine), meaning “helmeted, crested” in reference to the distinctive lateral profile of p4.

Type.—Holotype UALVP 40679, incomplete right dentary with p3–4, m1–2, Diss Locality, late Paleocene, Paskapoo Formation, Alberta.

Other material examined.—From Who Nose?, late Paleocene, Paskapoo Formation, Alberta: UALVP 44081–83, p4s; from Cochrane 2, late Paleocene, Paskapoo Formation, Alberta: UALVP 24377, p4; UALVP 24541, m1.

Occurrence.—Late Torrejonian to earliest Tiffanian of North America.

Discussion.—Following Sloan's (1981) criteria, the p4s are assigned to *Parectypodus* based on: 1) high first serration; 2) apogee of the apical crest occurring at the fifth serration; 3) labial height of the enamel at the exodaenodont lobe greater than the standard length; 4) posterior angle between the plane of occlusion of m1 and the anterior face of p4 nearly 90 degrees. The referred p4s differ from Sloan's generic diagnosis in having a low length p4: length m1 ratio (1.38), considerably lower than his suggested 1.8–2.0 values.

Youzwyshyn (1988) described teeth from the Cochrane Site 2 locality of Alberta and referred them to *Parectypodus* new species, but deferred naming and presenting a formal diagnosis until a larger sample was obtained; similar teeth from the Diss locality of Alberta were referred to *Parectypodus* new species by Fox (1990). Comparisons between the specimens from these two localities and those from Who Nose? indicate that they are referable to the same taxon, being clearly distinct from other species of

TABLE 1—Measurements and descriptive statistics for the dentition of *Mesodma pygmaea* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P4	L	1	1.9	1.90	—	—
	W	1	0.7	0.70	—	—
p4	L	2	2.3–2.4	2.35	0.07	0.030
	W	2	0.8–0.9	0.85	0.07	0.083
	H	1	0.7	0.70	—	—
	L1	1	0.4	0.40	—	—

Parectypodus. Youzwyshyn (1988) noted the similarity of morphology between p4 of *P. corystes* and that of an unnamed species of *Parectypodus* from the Puercan Rav W-1 locality, Ravenscrag Formation, Saskatchewan (Johnston and Fox, 1984). Lower fourth premolars of these taxa are similar in length, lateral profile, serration number, and have the crown apogee occurring at the fourth serration; they differ, however, in the Rav W-1 p4 having its greatest height more anteriorly, being higher-crowned, having a higher first serration and a larger, more ventrally rounded exodaenodont lobe. These differences are probably taxonomically significant, and as such, deter referral of the Puercan p4 to *P. corystes*.

PARECTYPODUS SP.

Figure 3.28–3.32

Description.—P4 cusp formula (0)4:8:0; crown high with anterior slope gently concave, posterior slope moderately convex, penultimate cusp highest from base of enamel; labial cusp row bearing three distinct cusps and one tiny anterior cuspule; ultimate labial cusp transversely adjacent to antepenultimate lingual cusp; labial cusps strongly compressed labiolingually; p4 resembling a quarter circle with anterior margin vertically oriented, apical crest slightly convex dorsally, posterior margin descending steeply; cutting edge with single incipient and 14 true serrations; anterior ridges anteroposteriorly compressed, short, truncated ventrally; posterior ridges strong with interridge valleys wider posteriorly; posterolabial shelf weak; exodaenodont lobe dorsoventrally long and peaked ventrally; anterobasal concavity notched.

Material examined.—UALVP 44084, P4 (L = 2.1; W = 0.8); UALVP 44085, p4 (L = 2.5; H = 1.7; L1 = 0.2).

Discussion.—The arcuate lateral profile of p4, as well as a high first serration, suggests affinities with *Parectypodus* (Sloan, 1981). The referred teeth from Who Nose? likely represent a new species based on the unique morphology of p4: the coronal structure of p4 of *Parectypodus* sp. is at best only vaguely similar to that of *P. sinclairi* and *P. laytoni*, with the anterior margin of the Nose Creek p4 much more vertically oriented than on p4 of either of those species. Given the small sample and the fact that UALVP 44084 and UALVP 44085 were not found in association, their referral to the same taxon is necessarily tentative; the single P4 is assigned to *Parectypodus* based on criteria provided by Sloan

←

FIGURE 3—1–5, *Mesodma pygmaea*, UALVP 44051, RP4 in 1, labial, 2, lingual, 3, occlusal view; UALVP 44049, Rp4 in 4, labial, 5, lingual view, both $\times 11$. 6–11, *Xyronomys* sp., UALVP 44055, RP4, in 6, labial, 7, lingual, 8, occlusal view, $\times 12$; UALVP 44056, incomplete Rp4 in 9, labial, 10, lingual view; UALVP 44058, incomplete Rp4 in 11, lingual view, both $\times 4$. 12–17, *Mimetodon silberlingi*, UALVP 44061, RP4 in 12, labial, 13, lingual, 14, occlusal view; UALVP 44064, LM1 in 15, occlusal view; UALVP 44066, Lp4 in 16, labial, 17, lingual view, all $\times 10$. 18, 19, *Ectypodus* cf. *E. szalayi*, UALVP 44073, Rp4 in 18, labial, 19, lingual view, $\times 10$. 20–24, *Parectypodus* cf. *P. sylviae*, UALVP 44235, LP4 in 20, labial, 21, lingual, 22, occlusal view, $\times 11$; UALVP 44077, incomplete left dentary having p4–m1 in 23, lingual, 24, occlusal view, $\times 9$. 25–27, *Parectypodus corystes* n. sp., UALVP 40679, holotype, incomplete right dentary having p3–m2 in 25, labial view; UALVP 44081, Lp4 in 26, labial, 27, lingual view, both $\times 7$. 28–32, *Parectypodus* sp., UALVP 44084, LP4 in 28, labial, 29, lingual, 30, occlusal view; UALVP 44085, Rp4 in 31, labial, 32, lingual view, both $\times 9$. 33–38, *Neoplagiaulax hunteri*, UALVP 44088, RP4 in 33, labial, 34, lingual, 35, occlusal view, $\times 7$; UALVP 44089, Rm1 in 36, labial, 37, lingual, 38, occlusal view, $\times 9$. 39–41, *Neoplagiaulax nelsoni*, UALVP 44087, RP4 in 39, labial, 40, lingual, 41, occlusal view, $\times 7$. *Neoplagiaulacidae* gen. and sp. indet., UALVP 44094, RP4 in 42, labial, 43, lingual, 44, occlusal view, $\times 11$. 45, 46, *Ptilodus gnomus*, UALVP 44096, Rp4 in 45, labial, 46, lingual view, $\times 6$. 47–49, *Ptilodus montanus*, UALVP 44121, LP4 in 47, labial, 48, lingual, 49, occlusal view, $\times 6$.

TABLE 2—Measurements and descriptive statistics for the dentition of *Mimetodon silberlingi* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P4	L	2	2.3–2.4	2.35	0.07	0.030
	W	2	0.8	0.80	0	0
M1	L	3	2.5–2.8	2.63	0.15	0.058
	W	3	1.1–1.5	1.27	0.21	0.164
p4	L	3	2.6–2.7	2.67	0.06	0.022
	W	2	0.7–0.9	0.80	0.14	0.177
	H	3	1.0–1.1	1.03	0.06	0.056
	L1	3	0.9–1.2	1.03	0.15	0.148

(1981), including a short, steep, concave posterior slope, cuspidate external row, and antepenultimate cusp highest above the base of the enamel. The high-crowned UALVP 44084 probably occluded with a similarly high-crowned p4. The specimens here referred likely represent a new species; naming and formal diagnosis are, however, deferred until a larger sample is obtained and the extent of variability assessed.

Genus NEOPLAGIAULAX Lemoine, 1882
NEOPLAGIAULAX HUNTERI (Simpson, 1936)
Figure 3.33–3.38

Material examined.—UALVP 44088, P4 (L = 3.1; W = 1.3); UALVP 44089, m1 (L = 2.6; W = 1.1).

Occurrence.—Latest Torrejonian to late Tiffanian of North America.

Discussion.—P4 cusp formula (0)1:9:0, m1 cusp formula 9:5. The specimens from Nose Creek compare favourably with similar teeth from Roche Percée, Ravenscrag Formation, Saskatchewan (Krause, 1977), differing mainly in their slightly smaller size and fewer labial cusps on m1. UALVP 44088 further differs from P4s from Roche Percée in having the antepenultimate cusp, not the ultimate or penultimate cusps, highest from the base of the enamel (Krause, 1977; Krause and Maas, 1990). The strong resemblance between the Who Nose? specimens and those from Roche Percée argue for conspecific assignment. The Nose Creek sample is the earliest known occurrence of the taxon in western Canada.

NEOPLAGIAULAX NELSONI Sloan, 1987
Figure 3.39–3.41

Material examined.—UALVP 44087, P4 (L = 3.4; W = 1.3).

Occurrence.—Late Puercan to earliest Tiffanian of North America.

Discussion.—P4 cusp formula (0)2:9:0. UALVP 44087 resembles P4s of *N. nelsoni* from Purgatory Hill, Tullock Formation, Montana, (Sloan, 1987) in coronal structure and size; additionally, UALVP 44087 is similar to P4s referred to *N. nelsoni* from Cochrane 2 (Youzwyshyn, 1988), being only slightly larger (hence closer to the mean values given by Sloan [1987]).

Sloan (1987) hypothesized an ancestor-descendant relationship between *N. nelsoni* and *N. hunteri*, citing smaller sizes and lower cusp counts in the former, and noting that the difference in age between the two taxa was significant. The sympatry of *N. nelsoni* and *N. hunteri* at Nose Creek, and also at Cochrane 2, Alberta and Douglass Quarry, Montana (Youzwyshyn, 1988; Krause and

TABLE 3—Measurements and descriptive statistics for the dentition of *Ectypodus* cf. *E. szalayii* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
p4	L	2	2.6	2.60	0	0
	W	2	0.8	0.80	0	0
	H	2	1.1	1.10	0	0
	L1	2	1.2–1.3	1.25	0.07	0.057

TABLE 4—Measurements and descriptive statistics for the dentition of *Parectypodus* cf. *P. sylviae* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P4	L	2	2.0	2.00	0	0
	W	2	0.7	0.70	0	0
p4	L	1	2.8	2.80	—	—
	W	1	1.0	1.00	—	—
	H	1	1.4	1.40	—	—
m1	L1	1	1.0	1.00	—	—
	L	3	1.7–1.9	1.83	0.12	0.063
	W	3	0.8	0.80	0	0

Gingerich, 1983), refutes the validity of age for distinguishing these species.

NEOPLAGIAULACIDAE genus and species indeterminate
Figure 3.42–3.44

Description.—P4 antepenultimate and penultimate cusps conical and subequal in height, ultimate cusp conical and greatly hypertrophied, nearly twice the height and width of preceding two cusps; posterior margin of crown smoothly concave, flaring lingually; apical wear on lingual and dorsal surfaces of ultimate cusps in both specimens.

Material examined.—UALVP 44093, 44094, P4 fragments.

Discussion.—The structure of these teeth is unique among known neoplagaiaulacids, and likely represents a new taxon. The concave posterior margin precludes referral to *Ectypodus*, and the straight anterior slope negates referral to *Parectypodus* or *Neoplagaiaulax* (Sloan, 1981). These teeth likely occluded with a low-crowned p4, such as in *Xyronomys* or *Stygimys*; their coronal structure, however, is considerably different than that of P4s referred to *Xyronomys* sp. from Who Nose?, and from P4s of eucosmodontids.

Family Ptilodontidae Cope, 1887
Genus Ptilodus Cope, 1881a

Ptilodus gnomus Scott, Fox, and Youzwyshyn, 2002
Figure 3.45–3.46

Material examined.—UALVP 44262, P2 (L = 1.6; W = 1.4); UALVP 44260, P3 (L = 1.7; W = 1.2); UALVP 44095, M2 (L = 1.8; W = 1.8); UALVP 44096, p4 (L = 5.3; L1 = 1.0; H = 1.2); UALVP 44097, m1 (L = 2.7; W = 1.4).

Occurrence.—Latest Torrejonian to early Tiffanian of North America.

Discussion.—These specimens are nearly identical to type material from Cochrane 2, Alberta, differing in p4 being slightly smaller, with an anteroposteriorly shorter exodaenodont lobe, and a more distinct anterior prominence. Given the temporal and geographic differences between Who Nose? and Cochrane 2, these slight morphological variations are considered infraspecific rather than taxonomic. The Who Nose? sample is the earliest known occurrence of the taxon.

TABLE 5—Measurements and descriptive statistics for the dentition of *Parectypodus corystes* n. sp. from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
p4	L	5	3.5–3.8	3.61	0.10	0.028
	W	4	0.9–1.2	1.05	0.13	0.123
	H	5	1.4–1.5	1.50	0.05	0.037
	L1	5	0.4–0.6	0.50	0.07	0.141
m1	L	2	2.6–2.8	2.70	0.14	0.052
	W	2	1.0–1.1	1.10	0.07	0.064

PTILODUS MONTANUS Douglass, 1908
 Figures 3.47–3.49, 4.1–4.4, Table 6

Material examined.—UALVP 44098–101 (total:4), P1s; UALVP 44102–06 (total:5), P2s; UALVP 44107, P3; UALVP 44108, 44110, P4s; UALVP 44111, M2; UALVP 44112, i1; UALVP 44113, 44114, incomplete dentaries with p4–m1; UALVP 44115–18 (total:4), p4s; UALVP 44119–22 (total:4), m1s; UALVP 44123, 44124, m2s.

Occurrence.—Late Torrejonian of North America.

Discussion.—Thorough descriptions of the complete dentition of *P. montanus* appear in Gidley (1909), Simpson (1937), and Krause (1982). The teeth from Who Nose? are nearly identical with those of the species from Silberling and Gidley quarries, Montana (Krause, 1982). The Who Nose? specimens are closer in size to the Silberling Quarry teeth, but smaller than those from Gidley. Gunnell (1994) has recently reassigned the Tiffanian occurrences of *P. montanus* to *Ptilodus* sp. “C,” thus restricting *P. montanus* to the late Torrejonian; as such, *P. montanus* may prove useful biostratigraphically. *Ptilodus montanus* from Who Nose? is the earliest discovered occurrence of the taxon in Canada.

Genus BAIOTOMEUS Krause, 1987
 BAIOTOMEUS RHOTHONION new species
 Figure 4.5–4.9, Table 7

Diagnosis.—Smallest species of the genus, p4 length approximately 57 percent less than p4 of *B. douglassi* (Simpson, 1935), 51 percent less than p4 of *B. lamberti* Krause, 1987, 20 percent less than p4 of *B. russelli* Scott, Fox, and Youzwyshyn, 2002; L p4:L m1 = 1.61, smallest ratio for the genus; differing further from all other species of *Baiotomeus* in p4 having a more smoothly arcuate profile and fewer serrations.

Description.—P4 cusp formula (0–1):4–5:8–9:0; crown subquadrate in occlusal view, and low; external and internal cusp rows convex labially, converging anteriorly; anterolabial lobe weak to moderate; external cusps large, especially second and third cusps, decreasing in size and height posteriorly and bearing prominent anteroposteriorly directed ridges in intercusp valleys; internal cusps conical, increasing in size and height posteriorly; enamel wrinkled on labial faces of all cusps; p4 smoothly arcuate anteriorly, crown apogee at fourth serration, posterior slope relatively straight and unvaulted, unlike p4 of *Ptilodus* or *Prochetodon* Jepsen, 1940; cutting edge with one incipient serration and 11 serrations that become larger and more bulbous posteriorly; ridges spanning nearly entire length of crown, terminating progressively lower towards exodaenodont lobe; first and second lingual ridges joining anteroventral to first serration; posterolabial shelf poorly developed, terminating ventral to tenth serration, enamel wrinkled at level of shelf; exodaenodont lobe deep, pointed; anterobasal concavity deep, short, truncated dorsally with prominent overhanging of enamel; m1 cusp formula 6:4; crown dorsally flexed in lateral aspect; first and second labial cusps conical, with remaining four cusps subrescenscentic to crescentic in horizontal section; lingual cusps conical.

Etymology.—*Rhotionion*, Greek (masculine), meaning small nose, in reference to the Nose Creek adjacent to the type locality, and in reference to the diminutive size of the species.

Type.—Holotype UALVP 44132, left p4, Who Nose? Locality, Paskapoo Formation, Alberta.

Other material examined.—UALVP 44127–30 (total:4), P4s; NMC 9103, p4; UALVP 44133, 44134, m1s. NMC 9103 from Calgary 2E/7E, Paskapoo Formation, Alberta.

Occurrence.—Latest Torrejonian of North America.

Discussion.—These specimens are best referred to *Baiotomeus*, following the criteria of Krause (1987), including: 1) p4 profile low and unvaulted posteriorly; 2) an incipient serration is present

on p4; 3) prominent and ventrally pointed exodaenodont lobe on p4; 4) P4 with poorly developed anterolabial lobe; 5) P4 with well-developed labial cusp row; 6) L p4: L m1 lower than in *Ptilodus* or *Prochetodon*. *Baiotomeus rhotionion* n. sp. differs from congeners as in the diagnosis.

The distinctive p4 profile and diminutive nature of the referred specimens clearly separate this taxon from other species of *Baiotomeus*. *Baiotomeus rhotionion* n. sp. is the earliest known occurrence of the genus in Canada, and possibly North America.

Family CIMOLODONTIDAE Marsh, 1889
 Genus ANCONODON Jepsen, 1940
 ANCONODON COCHRANENSIS (Russell, 1929)
 Figure 4.10–4.11

Material examined.—UALVP 44135 p4 (L = 4.7; H = 1.9; L1 = 1.3).

Occurrence.—Late Torrejonian to early Tiffanian of North America.

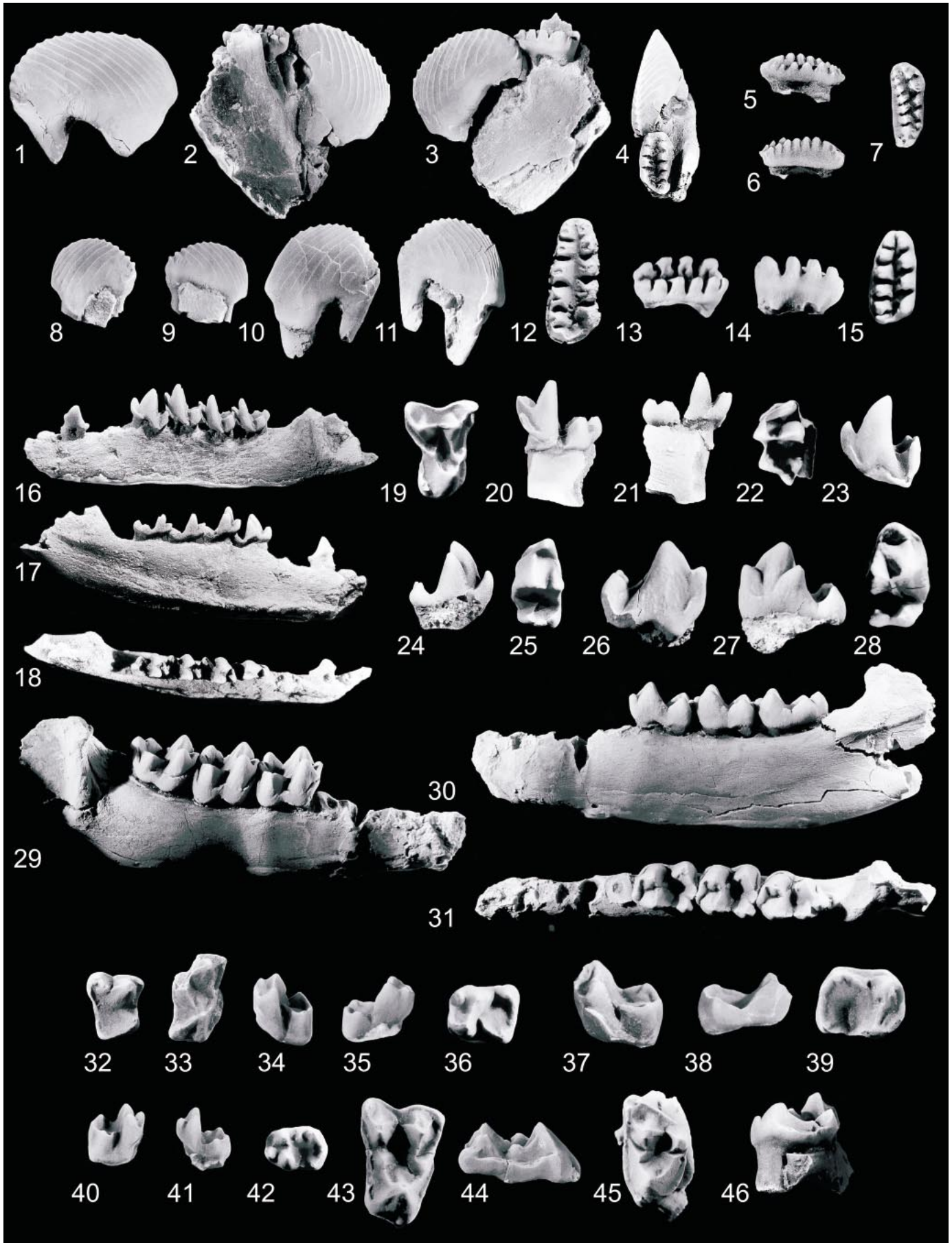
Discussion.—Satisfactory descriptions of p4 of *A. cochranensis* are in Russell (1929, 1932), Simpson (1937), Jepsen (1940), and Vianey-Liaud (1986). The Nose Creek p4 is referred to *Anconodon* by virtue of a highly arched profile and straight anterior margin (Krause and Gingerich, 1983). The specimen is best referred to *A. cochranensis*, being smaller and having a shorter, more nearly vertical anterior margin than p4 of the contemporaneous *A. gidleyi* (Simpson, 1935). UALVP 44135 is nearly identical to p4, *A. cochranensis*, from Cochrane 2, Alberta (Russell, 1929), and Douglass Quarry, Montana (Krause and Gingerich, 1983). *Anconodon cochranensis* is a widespread taxon in late Torrejonian faunas of the Western Interior of North America.

Superfamily “TAENIOLABIDOIDEA”
 (Granger and Simpson, 1929)
 Family EUCOSMODONTIDAE Jepsen, 1940
 Subfamily EUCOSMODONTINAE Jepsen, 1940
 Genus STYGIMYS Sloan and Van Valen, 1965
 cf. STYGIMYS sp.
 Figure 4.12

Description.—m1 cusp formula 6:5; crown subrectangular in occlusal view, with cusp rows diverging posteriorly; external cusps conical anteriorly, increasing in size and height, and becoming crescentic posteriorly; third and fourth external cusps massive; internal cusps subrescenscentic.

Material examined.—UALVP 44142, m1 (L = 4.2; W = 1.8).

Discussion.—UALVP 44142 resembles m1s of *Stygimys* in occlusal profile, posteriorly diverging cusp rows, and cusp shape. These features, however, are plesiomorphic, and shared by most eucosmodontids and primitive multituberculates (Weil, 1998). The referred m1 closely resembles those of *S. kuszmauli* Sloan and Van Valen, 1965, from the Bug Creek Anthills (Archibald, 1982), Montana, and *Stygimys* new species from the Lancian Long Fall locality of Saskatchewan (Fox, 1989), differing in having one fewer cusp in the external row, and in having external cusps that are crescentic [as opposed to conical to subquadrate (Archibald, 1982)]. The Torrejonian species of *Stygimys* are *S. jepseni* (including *Eucosmodon sparsus* Simpson, 1937, and *Parectypodus jepseni* Simpson, 1935) from Gidley Quarry, and *S. teilhardi* (including *Eucosmodon teilhardi* Granger and Simpson, 1929) from the Nacimiento Formation, New Mexico. The referred m1 differs from m1s of *S. jepseni* in being larger, with fewer cusps in the labial and lingual rows; it differs from m1s of *S. teilhardi* in being significantly smaller. Referral of UALVP 44142 to Lancian, Puercan, or Torrejonian species of *Stygimys* seems premature considering the scant evidence.



Subfamily MICROCOSMODONTINAE Holtzman and Wolberg, 1977
Genus ACHERONODON Archibald, 1982

ACHERONODON sp.
Figure 4.13–4.15

Description.—m1 cusp formula 6:4; crown subquadrate in occlusal aspect, cusp rows converging anteriorly; labial and lingual cusps leaning posteriorly and staggered posteriorly, rather than transversely opposed; labial cusps subquadrate anteriorly, increasing slightly in size and height, and becoming crescentic posteriorly; first labial cusp anteroposteriorly elongate; antepenultimate and penultimate labial cusps joined at their bases; ultimate labial cusp small, about half the size and height of antepenultimate and penultimate cusps; lingual cusps labiolingually compressed; first lingual cusp short, conical, with remaining cusps becoming pyramidal posteriorly; ultimate lingual cusp massive, nearly twice the anteroposterior length of penultimate or antepenultimate cusp; sigmoid notch well developed and angular (Krause, 1977; Weil, 1998).

Material examined.—UALVP 44144, m1 (L = 1.7; W = 0.8).

Discussion.—UALVP 44144 is morphologically closest to m1s of *Acheronodon*, a primitive member of the Microcosmodontinae (Archibald, 1982). m1s of this group are characterized generally by low cusp number, stout, robust cusps, anteriorly converging cusp rows, and the presence of a sigmoid notch (Krause, 1977; Weil, 1998). The Nose Creek specimen is similar to m1s from Cochrane 2, Alberta, referred to *Acheronodon* (Fox, personal commun., 2001), differing only in being slightly smaller; in this regard, UALVP 44144 more nearly approximates an m1 expected for *A. garbani* [sic] Archibald, 1982 from the Garbani Quarry, Tullock Formation, Montana. Referral of UALVP 44144 to *Acheronodon* sp. marks the first known Torrejonian occurrence of the genus.

Subclass THERIA Parker and Haswell, 1897

Infraclass EUTHERIA Gill, 1872

Order LIPOTYPHILA (Haeckel, 1866)

Suborder SORICOMORPHA Gregory, 1910

Family NYCTITHERIIDAE Simpson, 1928

Subfamily NYCTITHERIINAE Simpson, 1928

Genus LEPTACODON Matthew and Granger, 1921

“LEPTACODON” MUNUSCULUM Simpson, 1935

Figure 4.16–4.18, Table 8

Material examined.—UALVP 44227, incomplete dentary having p2, p4–m3, alveoli for p3; UALVP 44147, p4 fragment; UALVP 44148, 44149, m1s; UALVP 44151, m3.

Occurrence.—Late Torrejonian to middle Tiffanian of North America.

Discussion.—Satisfactory descriptions of the dentition of “*L.*” *munusculum* appear in Simpson (1935) and Krishtalka (1976b). The comparable parts of the dentition of “*L.*” *munusculum* from

TABLE 6—Measurements and descriptive statistics for the dentition of *Ptilodus montanus* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P1	L	4	2.4–2.6	2.55	0.10	0.039
	W	4	1.8–2.1	1.95	0.13	0.066
P2	L	5	2.1–2.6	2.32	0.19	0.083
	W	5	1.7–2.0	1.80	0.12	0.068
P3	L	1	2.1	2.10	—	—
	W	1	1.8	1.80	—	—
P4	L	1	5.0	5.00	—	—
	W	2	2.5–2.7	2.60	0.14	0.054
M2	L	1	2.2	2.20	—	—
	W	1	2.3	2.30	—	—
p4	L	6	7.7–8.2	8.00	0.22	0.027
	W	4	1.8–2.5	2.20	0.29	0.134
	H	6	2.4–2.6	2.50	0.09	0.036
	L1	6	1.2–1.7	1.53	0.19	0.121
m1	L	6	3.2–3.5	3.30	0.12	0.037
	W	5	1.6–1.8	1.70	0.08	0.049
m2	L	2	2.3–2.4	2.40	0.07	0.030
	W	2	1.9	1.90	0	0

Who Nose? are similar to those of “*L.*” *munusculum* from Gidley Quarry, Montana (Simpson, 1935) and Cochrane 2, Alberta (Youzwshyn, 1988), differing mainly in being smaller, in having more cuspidate lower molar paraconids, and in having a slightly larger m3. The Nose Creek specimens differ from teeth of pencontemporaneous *L. tener* Matthew and Granger, 1921 as described by Krishtalka (1976b); additionally, the referred p4s of “*L.*” *munusculum* differ from those of *L. tener* in having a larger, anteriorly directed, sectorial paraconid that is farther from the protoconid, a notched paracristid, and a tricuspid talonid that is less labially twisted.

Since Simpson’s diagnosis and description, the generic affinity of “*L.*” *munusculum* has been uncertain, being referred to *Leptacodon* (Simpson, 1935), “*Leptacodon*” (Krishtalka, 1976b; Gingerich et al., 1983; Youzwshyn, 1988), or *Pontifactor* West, 1974 (Krishtalka, 1976b; Bown and Schankler, 1982). Citing similarities in p4 structure, Krishtalka (1976b) suggested that “*L.*” *munusculum* be referred to *Pontifactor*. The p4 of “*L.*” *munusculum* is distinctly different from that of *L. tener*, but resembles p4s of other nyctitheriids such as *Nyctitherium* Marsh, 1872; “*L.*” *packi* Jepsen, 1930; *Amphidozitherium* Filhol, 1877; and *Pontifactor*. Bown and Schankler (1982, p. 58–59) noted these resemblances in their revision of the Nyctitheriidae, but cautioned, “. . . a complex of apparent crossing characters. . . masks the significance of the shared [diagnostic] attributes.” The teeth from Who Nose? seem best placed in “*Leptacodon*,” although I agree with Krishtalka (1976b) and Youzwshyn (1988) in the eventual removal of “*L.*” *munusculum* from *Leptacodon* (sensu stricto).

←

FIGURE 4—1–4, *Ptilodus montanus*, UALVP 44117, Rp4 in 1, labial view, ×4; UALVP 44113, incomplete right dentary having p4–m1 in 2, labial, 3, lingual, 4, occlusal view, ×3. 5–9, *Baiotomeus rhothonion* n. sp., UALVP 44127, LP4 in 5, labial, 6, lingual, 7, occlusal view, ×6; UALVP 44132, holotype, Lp4 in 8, labial, 9, lingual view, ×4. 10, 11, *Anconodon cochransensis*, UALVP 44135, Lp4 in 10, labial, 11, lingual view, ×5. 12, cf. *Stygimys* sp., UALVP 44142, Lm1 in occlusal view, ×6. 13–15, *Acheronodon* sp., UALVP 44144, Lm1 in 13, labial, 14, lingual, 15, occlusal view, ×11. 16–18, “*Leptacodon*” *munusculum*, UALVP 44227, incomplete left dentary having p2, p4–m3, and alveoli for p3, in 16, labial, 17, lingual, 18, occlusal view, ×7. 19–22, *Leptacodon tener*, UALVP 44154, RM2 in 19, occlusal view; UALVP 44158, Lm3 in 20, labial, 21, lingual, 22, occlusal view, both ×12. 23–25, Nyctitheriinae gen. and sp. indet., UALVP 44156, Lp4 in 23, labial, 24, lingual, 25, occlusal view, ×11. 26–31, *Elpidophorus* cf. *E. minor*, UALVP 44149, Rp4 in 26, labial, 27, lingual, 28, occlusal view, ×8; UALVP 44160, incomplete right dentary having m1–3 and alveoli for p3–4, in 29, labial, 30, lingual, 31, occlusal view, ×6. 32–36, *Ignacius* cf. *I. fremontensis*, UALVP 43287, RP4 in 32, occlusal view; UALVP 43289, RM1 in 33, occlusal view; UALVP 43291, Lm1 in 34, labial, 35, lingual, 36, occlusal view, all ×7. 37–39, Paromomyidae gen. and sp. indet., UALVP 43302, Lm2 in 37, labial, 38, lingual, 39, occlusal view, ×13. 40–42, *Palenochtha* cf. *P. minor*, UALVP 43301, Rm2 in 40, labial, 41, lingual, 42, occlusal view, ×10. 43–46, *Plesiolestes problematicus*, UALVP 43296, RM2 in 43, occlusal, 44, posterior view; UALVP 43297, LM3 in 45, occlusal, 46, posterior view, both ×7.

TABLE 7—Measurements and descriptive statistics for the dentition of *Baio-tomeus rhotonion* n. sp. from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P4	L	2	1.8	1.80	0	0
	W	2	0.7	0.70	0	0
p4	L	1	2.9	2.90	—	—
	W	1	1.0	1.00	—	—
	H	1	1.4	1.40	—	—
	L1	1	1.1	1.10	—	—
m1	L	2	1.7–1.8	1.80	0.07	0.039
	W	2	0.8–0.9	0.90	0.07	0.079

LEPTACODON TENER Matthew and Granger, 1921
Figure 4.19–4.22, Table 9

Material examined.—UALVP 44152, P4; UALVP 44154, 44155, M2s; UALVP 44150, m1; UALVP 44157, m1 or m2; UALVP 44158, m3.

Occurrence.—Late Torreyonian to latest Tiffanian of North America.

Discussion.—The dentition of *L. tener* has been thoroughly described and figured by McKenna (1968), Krishtalka (1976b) and Winterfeld (1982). The Nose Creek teeth are most similar to those of *L. tener* from Cochrane 2, Alberta (Youzwysyn, 1988), and Swain Quarry, Wyoming (Rigby, 1980), differing in being slightly larger and in having larger molar hypocones and hypoconids. The Nose Creek specimens further differ from the Cochrane 2 teeth in being more robust and higher crowned. The Who Nose? sample documents the earliest appearance of *L. tener* in western Canada.

NYCTITHERIINAE genus and species indeterminate
Figure 4.23–4.25

Description.—p4 molariform; paraconid low, conical, dorsally projecting, arising from base of protoconid; metaconid small, erect, posterolingual relative to protoconid; protoconid tall, subpyramidal, recurved posteriorly; trigonid notch deep; talonid tricuspid, transversely narrower than trigonid, with hypoconulid and hypoconid closely appressed; entocristid and cristid obliqua parallel; labial exodaenodonty prominent.

Material examined.—UALVP 44156, p4 (L = 1.5; TrW = 0.8; TaW = 0.7).

Discussion.—UALVP 44156 differs from p4 of *L. tener* in being larger and higher crowned, in having a taller metaconid that is transversely opposed to the protoconid, rather than being displaced posteriorly, and in having a larger, wider, and deeper talonid. UALVP 44156 differs from p4 of “*L.*” *munusculum* in being larger and higher crowned, in its less transverse trigonid, and smaller, more cuspidate paraconid that is less anteriorly directed.

TABLE 8—Measurements and descriptive statistics for the dentition of “*Leptacodon*” *munusculum* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
p2	L	1	0.7	0.70	—	—
	W	1	0.3	0.30	—	—
p4	L	1	1.1	1.10	—	—
	TrW	1	0.7	0.70	—	—
	TaW	1	0.6	0.60	—	—
	L	3	1.2–1.3	1.24	0.08	0.063
m1	TrW	3	0.7–0.9	0.77	0.12	0.151
	TaW	3	0.6–0.7	0.63	0.06	0.091
	L	1	1.2	1.20	—	—
m2	TrW	1	0.9	0.90	—	—
	TaW	1	0.8	0.80	—	—
	L	1	1.3	1.3	—	—
m3	TrW	2	0.6–0.8	0.69	0.13	0.185
	TaW	1	0.7	0.7	—	—

TABLE 9—Measurements and descriptive statistics for the dentition of *Leptacodon tener* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P4	L	1	1.5	1.50	—	—
	M2	L	2	1.3	1.30	0
m1	W	2	1.8–1.9	1.85	0.07	0.038
	L	1	1.2	1.20	—	—
	TrW	1	0.8	0.80	—	—
	TaW	1	0.7	0.70	—	—
m1 or m2	L	1	*1.3	1.30	—	—
	TrW	1	0.8	0.80	—	—
	TaW	1	0.9	0.90	—	—
m3	L	1	1.3	1.30	—	—
	TrW	1	0.8	0.80	—	—
	TaW	1	0.7	0.70	—	—

With respect to these differences, UALVP 44156 approximates descriptions of p4 of “*L.*” *packi* Jepsen, 1930 from Princeton Quarry, Wyoming (Jepsen, 1930; Krishtalka, 1976b), and Bangtail Quarry, Montana (Gingerich et al., 1983). Additionally, UALVP 44156 is nearly identical to p4s from Cochrane 2, Alberta, referred to *Leptacodon* species 2 (Youzwysyn, 1988); Youzwysyn considered these teeth to be of “*L.*” *packi*-type morphology. Although the generic affinities of “*L.*” *packi* have been questioned (for example, Krishtalka, 1976b; Bown and Schankler, 1982), the taxon has remained affiliated with *Leptacodon*, despite similarities to the dentition of *Nyctitherium* and other advanced nyctitheriines. UALVP 44156 is clearly distinct from similar teeth of both *L. tener* and “*L.*” *munusculum*; the paucity of specimens, however, precludes definitive referral, even to generic level. As such, UALVP 44156 is referred to the Nyctitheriinae with the anticipation that additional sampling will clarify the affinities of this specimen.

Order DERMOPTERA Illiger, 1811
Family PLAGIOMENIDAE Matthew and Granger, 1918
Genus ELPIDOPHORUS Simpson, 1927
ELPIDOPHORUS cf. *E. MINOR*
Figure 4.26–4.31, Table 10

Description.—p4 submolariform; trigonid cusps swollen; paraconid appressed to protoconid and anteriorly directed; paraconid and metaconid relatively low, conical, subequal in size and height, metaconid leaning posteriorly; talonid with turgid, subequal entoconid and hypoconid; postcristid between entoconid and hypoconid notched medially, entocristid low, cristid obliqua concave labially; m1–3 leaning anterolingually with wide talonids; paraconid anterolabial; metaconid and protoconid nearly equal in height; entoconid and hypoconid prominent, hypoconulid weakly developed on m1–2.

TABLE 10—Measurements and descriptive statistics for the dentition of *Elpidophorus* cf. *E. minor* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
p4	L	1	2.7	2.70	—	—
	TrW	1	1.8	1.80	—	—
	TaW	1	1.6	1.60	—	—
m1	L	4	2.5–2.6	2.55	0.06	0.023
	TrW	4	1.8–2.0	1.85	0.10	0.054
	TaW	4	2.1–2.2	2.15	0.06	0.027
	L	7	2.5–2.8	2.66	0.13	0.048
m2	TrW	7	2.0–2.5	2.23	0.21	0.092
	TaW	7	2.1–2.5	2.34	0.17	0.073
	L	3	2.8–*3.0	2.87	0.12	0.040
m3	TrW	3	*1.9–2.1	2.00	0.10	0.050
	TaW	3	1.6–1.8	1.70	0.10	0.059

TABLE 11—Measurements and descriptive statistics for the dentition of *Ignacius* cf. *I. fremontensis* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P4	L	1	1.6	1.60	—	—
	W	1	1.9	1.90	—	—
M1 or M2	L	1	*1.5	1.50	—	—
	W	1	*2.6	2.60	—	—
M3	L	2	1.2–1.3	1.24	0.07	0.056
	W	2	2.1	2.10	0	0
p4	L	1	1.3	1.30	—	—
	W	1	0.9	0.90	—	—
m1	L	1	1.5	1.50	—	—
	TrW	1	0.8	0.80	—	—
	TaW	1	1.2	1.20	—	—
m2	L	2	1.4–*1.5	1.45	0.07	0.049
	TrW	2	1.1–1.2	1.15	0.07	0.062
	TaW	2	1.2–1.3	1.25	0.07	0.057

Material examined.—UALVP 44199, p4; UALVP 44159, incomplete dentary with m1–2; UALVP 44160, incomplete dentary with m1–3; UALVP 44161, 44228, m1s; UALVP 44162–66 (total:5), m2s; UALVP 44167, 44229, m3s.

Occurrence.—Late Torrejonian of North America.

Discussion.—The Nose Creek specimens are similar to teeth referred to *E. minor* from Silberling Quarry, upper Lebo Formation, Montana (Simpson, 1937; Szalay, 1969), differing from similar teeth of *E. elegans* Simpson, 1927, from the Tiffanian of Alberta, in being decidedly smaller, having a more nearly premolariform p4, and in having lower molars with anterolabial paraconids. These specimens differ from the type material of *E. minor* from Silberling Quarry as follows: 1) p4 paraconid smaller, labial in position, and more appressed to the protoconid; 2) p4 talonid bicuspid; 3) molar paraconid small, and in a more anterolabial position; 4) molar metaconid subequal in height to the protoconid; 5) external cingulids weak; 6) molar talonid exodaenodonty less pronounced; 7) smaller size. The discovery of *E. cf. E. minor* at Who Nose? may represent its first known occurrence outside of the United States.

Order PRIMATES Linnaeus, 1758

Suborder PLESIAPIFORMES Simons and Tattersall in Simons, 1972

Family PAROMOMYIDAE (Simpson, 1940)

Subfamily PHENACOLEMURIDAE Simpson, 1955

Genus IGNACIUS Matthew and Granger, 1921

IGNACIUS cf. *I. fremontensis* (Gazin, 1971)

Figure 4.32–4.36, Table 11

Material examined.—UALVP 43287, P4; UALVP 43289, M1 or M2; UALVP 43286, 43293, M3s; UALVP 43288, p4; UALVP 43291, m1; UALVP 43290, 43292, m2s.

Occurrence.—Late Torrejonian to early Tiffanian of North America.

Discussion.—Satisfactory descriptions of nearly complete dentitions of *I. fremontensis* are in Gazin (1971), Krause (1978), Szalay and Delson (1979), and Robinson and Ivy (1994). The referred specimens are similar to comparable teeth of *I. fremontensis* from the Shotgun locality, Wyoming, and Cochrane 2, Alberta, but differ in several interesting features. The Who Nose? teeth have less inflated trigonid cusps, a more lingual paraconid, a greater separation of the paraconid and metaconid, a relatively broader talonid, and a prominent precingulid. Additionally, the referred upper molars have a better-developed parastylar region and metacone, a deeper ectoflexus, and a narrower hypoconal shelf. These features are primitive, occurring in homologous teeth of *Paromomys depressidens* Gidley, 1923, and may prove taxonomically

significant. The Who Nose? sample is the third and stratigraphically oldest known occurrence of *I. fremontensis* in western Canada (Fox, 1990).

PAROMOMYIDAE genus and species indeterminate

Figure 4.37–4.39

Description.—Crown subquadrate; trigonid anteroposteriorly compressed, talonid anteroposteriorly elongate; paraconid reduced, labial, and appressed to metaconid; protoconid subequal to metaconid; paracristid shelf-like and low on anterior trigonid face; protocristid high and notched medially; external cingulid strongly developed, forming prominent hypoflexid shelf; talonid shallow and open, with weak entoconid and hypoconid, and numerous accessory cuspules along postcristid; cristid obliqua low on postvallid; talonid notch shallow and not incised at base.

Material examined.—UALVP 43302, m2 (L = 2.3; TrW = 1.4; TaW = 1.6).

Discussion.—UALVP 43302 differs from lower molars of *Ignacius* in its larger size, more erect trigonid, and prominent precingulid and hypoflexid shelf. It further differs from m2s of *Ignacius* in having a low trigonid (Robinson and Ivy, 1994) and lacking an incised talonid notch. Hence, UALVP 43302 more closely approximates m2s of *Paromomys*, differing only in being smaller and more gracile, and having a relatively lower trigonid. Referral to *Paromomys* based on a single specimen is premature; as such, UALVP 43302 is referred only to the Paromomyidae.

Family PALAECHTHONIDAE Gunnell, 1989

Subfamily PALAECHTHONINAE Gunnell, 1989

Genus PALENOCHTHA Simpson, 1935

PALENOCHTHA cf. *P. minor* (Gidley, 1923)

Figure 4.40–4.42

Description.—Trigonid cusps bulbous and conical; paraconid labial, reduced; paracristid strongly flexed and shelf-like (Fox, 1984); metaconid slightly larger than protoconid; trigonid notch moderately developed and incised at base; precingulid weakly developed, not continuing past hypoflexid; talonid broad and shallow, bearing distinct, tall hypoconid, entoconid, hypoconulid; mesoconid weakly developed; cristid obliqua labial and low on postvallid; talonid notch moderately developed and not distinctly incised.

Material examined.—UALVP 43301, m2 (L = 1.3; TrW = 0.9; TaW = 1.0).

Occurrence.—Late Torrejonian of North America.

Discussion.—UALVP 43301 is best referred to *Palenochtha* cf. *P. minor*. In comparison with a cast of the type specimen from Gidley Quarry, Montana, UALVP 43301 differs in the cristid obliqua meeting the postvallid in a lower, more labial position, and in having a more distinct mesoconid swelling. In comparison with lower molars of *P. minor* from Swain Quarry, UALVP 43301 differs in lacking a medial crest descending from the metaconid to meet the cristid obliqua. UALVP 43301 also possesses a mesoconid swelling, a feature not noted on the material from Swain Quarry (Rigby, 1980; Gunnell, 1989); although Gunnell (1989) used the absence of a mesoconid on the lower molars of *Palenochtha* as a criterion for differentiating them from teeth of the closely related *Premnooides* Gunnell, 1989, the lower molars of *Palenochtha* more closely approximate the overall morphology of UALVP 43301. UALVP 43301 is the first record of *Palenochtha* in Canada, and a range extension for the taxon from the type locality in Montana.

Subfamily PLESIOLESTINAE Gunnell, 1989

Genus PLESIOLESTES Jepsen, 1930

PLESIOLESTES PROBLEMATICUS Jepsen, 1930

Figure 4.43–4.46

Material examined.—UALVP 43296, M2 (L = 2.3; W = 3.5); UALVP 43297, M3 (L = 2.1; W = 3.2).

Occurrence.—Late Torrejonian to early Tiffanian of North America.

Discussion.—Adequate descriptions of the dentition of *P. problematicus* appear in Jepsen (1930) and Gunnell (1989). Differing mainly in their slightly larger size, the Who Nose? specimens are virtually identical to comparable teeth from Swain Quarry, Wyoming (Rigby, 1980). When compared to homologous teeth from Rock Bench Quarry, Wyoming, the Who Nose? specimens are smaller and anteroposteriorly wider, with a deeper ectoflexus, have a weaker pre- and postmetacrista on M2, and have a better-developed parastylar area on M3. The Nose Creek sample is the first record of *Plesiolestes* in Canada.

Family PLESIADAPIDAE Trouessart, 1897
Genus PRONOTHODECTES Gidley, 1923
PRONOTHODECTES MATTHEWI Gidley, 1923
Figure 5.1–5.5, Table 12

Material examined.—UALVP 43284, I1; UALVP 43280, P4; UALVP 43278, i1; UALVP 43281, p3; UALVP 43282, p4; UALVP 43285, m1; UALVP 43279, 44231, 44232 (total:3), m2s; UALVP 43277, 43283, m3s; UALVP 43276, incomplete dentary with p4–m3; UALVP 43275, incomplete dentary with p4–m3.

Occurrence.—Late Torrejonian of North America.

Discussion.—Simpson (1937) and Gingerich (1976) provided thorough descriptions of nearly complete dentitions of *P. matthewi*. The referred specimens are within the recorded size and morphological range of the hypodigm of *P. matthewi* from Gidley Quarry, Montana (Gingerich, 1976), but differ in a number of subtle ways. The trigonids are anteroposteriorly and labiolingually shorter, and the talonid basins are deeper than those of the type material; additionally, the paraconids are more labial, mesoconids are absent, and the hypoconulid lobe of m3 is less elongate and furrowed, although this tooth is highly variable within the Nose Creek sample. The molar precingulids are particularly well developed in the Who Nose? specimens. These differences, although slight, are reminiscent of lower molars of earlier plesiadapiforms, including *Purgatorius* Sloan and Van Valen, 1965, and *Pandemonium* Van Valen, 1994. The Nose Creek sample of *P. matthewi* constitutes the first record of this important taxon in Canada.

Family PICRODONTIDAE Simpson, 1937
Genus PICRODUS Douglass, 1908
PICRODUS SILBERLINGI Douglass, 1908
Figure 5.6–5.8, Table 13

Material examined.—UALVP 43295, m1; UALVP 43294, incomplete left dentary with i1, p4–m2, alveoli for i2, c, p3, and m3.

Occurrence.—Late Torrejonian to middle Tiffanian of North America.

Discussion.—Descriptions of nearly complete dentitions of *P. silberlingi* can be found in Simpson (1937), Szalay (1968), and Gingerich et al. (1983). The referred specimens are nearly identical to Simpson's description of the type material (from Douglass, 1908), as well as to material from Gidley Quarry, Montana, Swain Quarry, Wyoming, and Cochrane 2, Alberta (Simpson, 1937; Rigby, 1980; Youzwshyn, 1988). The Nose Creek sample constitutes the earliest record of the taxon in Canada, and putatively, North America.

Order CONDYLARTHRA Cope, 1881b
Family ARCTOCYONIDAE (Giebel, 1855)
Subfamily OXYCLAENINAE (Scott, 1892)
Genus "CHRIACUS" Cope, 1883
"CHRIACUS"? sp.
Figure 5.9–5.11

Description.—Crown of p4 anteroposteriorly elongate, with swollen trigonid and talonid cusps; paraconid large, anteriorly directed, and sectorial; paracristid strongly developed and notched

ventrally; metaconid small, conical; protoconid massive; protoconid strongly developed, with medial carnassial notch; talonid shallow, with subequal, bulbous entoconid and hypoconid; entoconid high and sharp; talonid notch well developed; external cingulids strongly developed.

Material examined.—UALVP 44168, p4 (L = 4.8; TrW = 2.5; TaW = 2.5).

Discussion.—UALVP 44168 resembles p4s of arctocyonid condylarths, such as "*Chriacus*," *Thryptacodon* Matthew and Granger, 1915, and *Metachriacus* Simpson, 1935; UALVP 44168 differs from p4s of these taxa in smaller size, in having a more sectorial and anteriorly-projecting paraconid, in its larger, more distinct metaconid, and more prominent and posteriorly positioned hypoconid. The referred p4 particularly resembles that of *Spanoxyodon* Simpson, 1935. Simpson (1935) erected the taxon *S. latrunculus* for specimens from Gidley Quarry, Montana that he felt were distinct from teeth of "*Chriacus*" and *Metachriacus*. As Simpson (1937) noted, p4 of *S. latrunculus* possesses a metaconid that is larger and more distinct than on p4s of "*Chriacus*" and *Metachriacus*. Van Valen (1978) synonymized *S. latrunculus* with *C. baldwini* (Cope, 1882), along with *C. truncatus* Cope, 1884b; *C. schlosserianus* Cope, 1888; *M. provocator* Simpson, 1935; and *Tricentes crassicolliidens* Cope, 1884b, without significant discussion. Additionally, Van Valen synonymized *M. punitor* with "*C.*" *orthogonius* (Russell, 1929, but see Scott et al., 2002). These synonymies have been, for the most part, accepted (e.g., Cifelli, 1983; Williamson, 1996; McKenna and Bell, 1997). Youzwshyn (1988) and Williamson (1996) noted the problems associated with "*Chriacus*," and suggested a revision of the genus is in order. UALVP 44168 differs from p4s of *S. latrunculus* in being slightly smaller, in lacking a complete labial cingulid, and in having a more sectorial and anteriorly directed paraconid, a slightly deeper talonid, and a more acutely angled talonid notch.

UALVP 44168 most closely resembles p4s of *S. latrunculus* and *M. punitor*, more so to the former with respect to the well-developed paraconid and metaconid. The wide range of p4 morphologies of specimens referred to "*Chriacus*" is inconsistent with Van Valen's (1978) synonymies, suggesting the genus may in fact be a composite taxon, and that *Spanoxyodon* and *Metachriacus* may be valid.

Genus PROTHRYPTACODON Simpson, 1935
PROTHRYPTACODON ALBERTENSIS Fox, 1968
Figure 5.12–5.20

Material examined.—UALVP 44169, p3 (L = 2.8; W = 2.8); UALVP 44170, incomplete dentary with p4 and alveoli for p1–3 (L = 3.4; W = 1.8); UALVP 44171, m1 (L = 4.1; TrW = 2.5; TaW = 2.6); UALVP 44172, m2 (L = 4.0; TrW = 2.9; TaW = 2.8).

Occurrence.—Late Torrejonian of North America.

Discussion.—Fox (1968) and Johnston and Fox (1984) provided adequate descriptions for the dentition of *P. albertensis*, and reiteration is unnecessary. The Nose Creek specimens are virtually identical to teeth of *P. albertensis* known only from the type locality, a well core from near Balzac, Alberta, in the Paskapoo Formation; they differ from those of the holotype and only known specimen in: 1) p4 slightly smaller and shorter anteroposteriorly, with a poorly developed paraconid and talonid; 2) p4 possessing two distinct accessory cuspsules on the posterior face of the protoconid; 3) molar trigonids somewhat shorter anteroposteriorly; 4) paraconid of m1 slightly more external.

Van Valen (1978) considered *P. albertensis*, *Carcinodon aquilonius* Russell, 1974, and a larger, similar form from the Purgatory Hill locality, Montana, conspecific with *Oxyprimus albertensis* (Fox, 1968); but provided no justification. Citing differences in

p4 morphology, Johnston and Fox (1984) revalidated *P. albertensis*, reaffirming its distinctiveness from both *Oxyprimus* and *Carcinodon*. As Johnston and Fox indicated the p4 of *P. albertensis* is premolariform, whereas that of *Oxyprimus* is submolariform, possessing a distinct metaconid. Additionally, p4 of *C. aquilonius* has an enlarged, shearing talonid, quite unlike the simply constructed, unbasined p4 talonid of *Prothyrtacodon*.

The discovery of *P. albertensis* from the Who Nose? locality represents the first known occurrence of this taxon beyond the type locality. The co-occurrence of this taxon with mammals of Torrejonian aspect may support a Torrejonian age for that section of the Balzac core which originally contained UALVP 1338, agreeing with Fox's (1968) original conclusion.

Subfamily ARCTOCYONINAE Giebel, 1855

Genus COLPOCLAENUS Patterson and McGrew, 1962

COLPOCLAENUS cf. *C. PROCYONOIDES* (Matthew, 1937)

Figure 5.21–5.23

Description.—m3 low crowned, with highly rugose enamel; trigonid anteroposteriorly compressed, ovate, with low, poorly differentiated cusps; paraconid reduced, lingual, and appressed to metaconid; metaconid massive, transversely opposed to protoconid; talonid decidedly longer than trigonid, shallowly basined, with indistinct cusps; entoconid and hypoconid relatively indistinguishable; hypoconulid lobate and greatly expanded posteriorly; entocristid and postcristid papillate; labial cingulid strongly developed and continuous.

Material examined.—UALVP 44173, m3 (L = 8.5; TrW = 4.8; TaW = 4.5).

Occurrence.—Late Torrejonian to late Tiffanian of North America.

Discussion.—UALVP 44173 is nearly identical to m3s referred to *C. keeferi* Patterson and McGrew, 1962, from the DW-2 locality of Alberta (Fox, 1990), differing only in being somewhat less rugose, in having a proportionately longer talonid, and having a more distinct paraconid that is less appressed to the metaconid. In these respects, the referred tooth is similar to figured and described teeth pertaining to *Neoclaenodon procyonoides* Matthew, 1937, based on specimens from the Torrejon Arroyo, Nacimiento Formation, San Juan Basin, New Mexico. Simpson (1937) synonymized *N. procyonoides* with *Claenodon procyonoides*, and Van Valen (1978) synonymized Simpson's *Cl. procyonoides* and *Cl. silberlingi* with Patterson and McGrew's (1962) *Colpoclaenus*.

UALVP 44173 is best referred tentatively to *C. procyonoides* based on resemblance to m3s of *N. procyonoides* and *C. keeferi*, but is smaller overall. The Nose Creek specimen is within the recorded range for m3s of *C. cf. procyonoides* reported by Gazin (1956a) from the Saddle Locality, Bison Basin, southern Wyoming.

Family MIOCLAENIDAE Osborn and Earle, 1895

Subfamily MIOCLAENINAE Osborn and Earle, 1895

Genus PROMIOCLAENUS Trouessart, 1904

cf. *PROMIOCLAENUS ACOLYTUS* (Cope, 1882)

Figure 5.24–5.27, Table 14

Description.—M1 crown quadrate, with poorly-developed parastylar and metastylar regions; paracone and metacone subequal in size and height; preparacrista and postmetacrista well developed; paraconule and metaconule anterolingual to paracone and metacone, respectively, with internal and external wings poorly developed; protocone large, bulbous; trigon basin deep; hypocone short and appressed to protocone; precingulum prominent, cingulum incomplete lingually; lower premolars with large, inflated protoconid, metaconid absent, and unicusate talonid; p2–3 with

vestigial, anterior paraconid, talonid unbasined; p4 with prominent lingual paraconid, talonid shallow; lower molars subquadrate, with m3 reduced; trigonid cusps swollen; paraconid lingual, reduced, appressed to metaconid; protoconid and metaconid subequal and transversely opposed; entoconid and hypoconid largest talonid cusps; hypoconulid small, low, and close to entoconid; external cingulid incomplete labially.

Material examined.—UALVP 44175, M1; UALVP 44176, M1 or M2; UALVP 44177, incomplete dentary with p2–m3; UALVP 44178, incomplete dentary with m2–3; UALVP 44179, p2; UALVP 44180, 44270, p3s; UALVP 44181, p4; UALVP 44182, m2.

Discussion.—The above specimens most closely resemble homologous teeth of mioclaenid condylarths, especially those of *P. acolytus*, but with some differences: they are less inflated; the premolar paraconids are vestigial; the molar paraconids are distinct and internal; the m2 trigonid is wide; and the hypocone on M1 is small. In these features, the Nose Creek specimens resemble teeth of *Bubogonia* Johnston and Fox, 1984 and *Tiznatzinia* Simpson, 1935, both considered closely related to *Promioclænus* (Cifelli, 1983; Van Valen, 1988; Janis et al., 1998). The Nose Creek species differs however, in having p4s that lack a metaconid, low-crowned molars with a reduced and appressed paraconid, and in having a discontinuous ectocingulid, character states thought to be apomorphic among mioclaenines (Rigby, 1980; Johnston and Fox, 1984). Hence, the teeth of cf. *P. acolytus* from Who Nose? are derived relative to those of *Bubogonia* and, to a lesser degree, of *Tiznatzinia*, but more primitive than teeth of *P. acolytus* and *P. lemuroides* (Matthew, 1897). The p4s of the latter taxa have lost the paraconid and reduced or lost the metaconid; their lower molars are inflated, with a reduced paraconid that is appressed to the metaconid.

In his study of *P. acolytus* from Swain Quarry, Rigby (1980, p. 120–121) noted a high degree of variability in most dental elements compared to *P. acolytus* from Gidley Quarry and Kutz Canyon, including a molar hypocone that varied from “. . . a simple low cusp to a structure similar to the Hanopitex [sic] fold of some early primates,” a lower molar paraconid that ranged from “. . . [a] separate, high, distinct cusp to [a] slight inflation on the anterior surface of the metaconid,” and p4s with “. . . a well defined metaconid or [metaconid] totally absent.” Rigby refrained from naming a new taxon to accommodate the variants in the Swain Quarry sample, choosing instead to consider them as from a single population. The specimens from Who Nose? fall within the morphological range for *P. acolytus* from Swain Quarry, but differ in having a strong paraconid on p4, not noted in the Swain Quarry sample. Accordingly, the Nose Creek specimens are referred tentatively to *P. acolytus*, with the hope that further sampling will provide a better understanding of variation within this group.

Family HYOPSODONTIDAE Trouessart, 1879

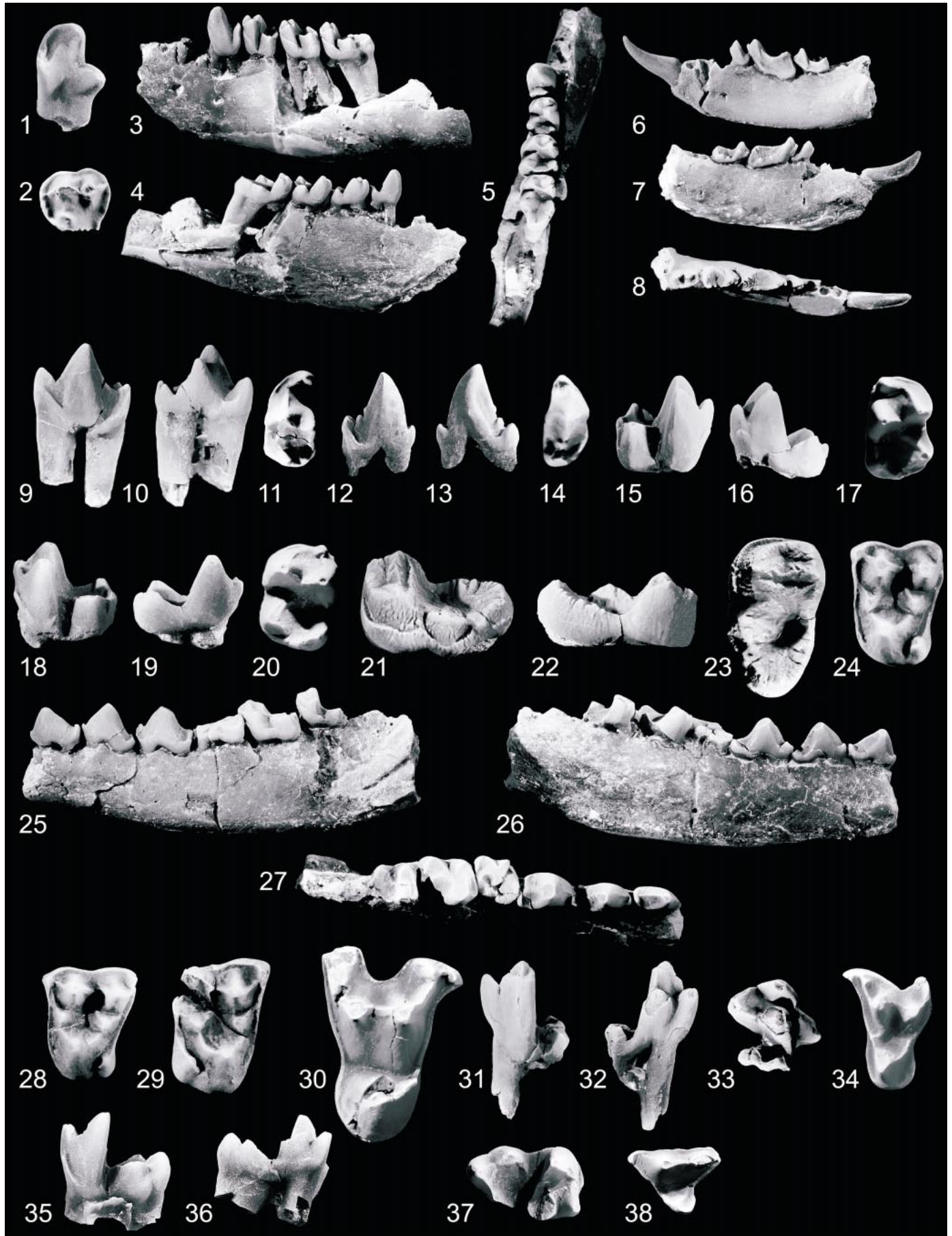
Subfamily TRICUSPIDONTINAE Simpson, 1929

Genus LITOMYLUS Simpson, 1935

LITOMYLUS sp.

Figure 5.28–5.29

Description.—M1 subquadrate; parastylar and metastylar regions reduced, preparacrista confluent with ectocingulum; paracone and metacone conical and subequal in size and height; conules and wings well developed; postmetaconule crista nearly continuous with postcingulum; protocone large, high; hypocone well developed and connected to postcingulum and base of protocone; precingulum well developed and confluent with ectocingulum at parastylar region; M2 crown as in M1, but more transverse labiolingually; paracone tall, parastylar lobe and preparacrista strongly developed; conules and external wings well developed; protocone



height equal to that of paracone; hypocone small, internal, and connected to protocone base by a strong crest; pre- and postcingula lingually discontinuous.

Material examined.—UALVP 44174, M1 (L = 2.7; W = 3.3); UALVP 44183, M2 (L = *2.8; W = 4.0).

Discussion.—Close morphological similarity between the molars from Nose Creek and similar teeth of *Litomylos* spp. from the Puercan and Tiffanian of Saskatchewan and Alberta identifies these specimens as pertaining to a species of *Litomylos*. The Who Nose? specimens are similar to M1s and M2s of *L. orthronepius* Johnston and Fox, 1984 from the Rav W-1 locality of Saskatchewan in being transversely wide, with expanded para- and metastylar areas, particularly on M2, and in having the hypocone connected to the base of the protocone by a short crest. The Nose Creek specimens differ, however, in being smaller overall, and in having a continuous paracingulum, a lingual metaconule, and a better-developed hypocone. These teeth differ significantly from teeth of Tiffanian species of *Litomylos*, including *L. dissantaneus* Simpson, 1935; *L. ishami* Gazin, 1956b; and *L. grandaletes* Scott, Fox, and Youzwyszyn, 2002 in being smaller, and in having subrectangular, rather than more nearly square, molars with less inflated cusps and better developed stylar regions.

The teeth from Who Nose? are most similar to upper molars of *L. orthronepius*, displaying few characters linking them to teeth of early Tiffanian species. The differences between the Nose Creek specimens and teeth of *L. orthronepius* are likely taxonomically significant, but formal naming and presentation of diagnosis must await the collection of a larger sample.

Order PANTODONTA Cope, 1873

Family CYRIACOTHERIIDAE Rose and Krause, 1982

Genus CYRIACOTHERIUM Rose and Krause, 1982

CYRIACOTHERIUM sp.

Figure 5.30, Table 15

Description.—P3 submolariform and weakly dilambdodont; parastylar and metastylar regions prominent, ectoflexus deep; paracone and metacone tall, subcrescentic; paracone and metacone bases wide labially; ectocingulum low and ridge-like; pre-paracrista long, high, and crestiform, with large, conical stylocone labial and slightly anterior to paracone; stylocrista high; postmetacrista elevated and crestiform; paracone and metacone conjoined for nearly half their heights; centrocrista acute, notched ventrally, and not deflected labially, reducing dilambdodonty; paraconule weak, metaconule and conule crests absent; protocone tall, with strongly developed crests; cingula discontinuous lingually.

Material examined.—UALVP 44184, 44185, P3s.

Discussion.—The submolariform state and weakly developed dilambdodonty of UALVP 44184 and 44185 clearly preclude their referral to the Pantolambdidae (Rose and Krause, 1982). The referred specimens seem closest in morphology to comparable teeth of members of the Cyriacotheriidae (Rose and Krause, 1982), but possess features that are considered primitive for the

TABLE 12—Measurements and descriptive statistics for the dentition of *Pronothodectes matthewi* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
I1	W	1	1.7	1.70	—	—
P4	L	1	1.7	1.70	—	—
i1	W	1	1.7	1.70	—	—
p3	L	1	1.7	1.70	—	—
	W	1	1.3	1.30	—	—
p4	L	3	1.8–2.0	1.90	0.10	0.053
	W	3	1.7	1.70	0	0
m1	L	3	2.1	2.10	0	0
	TrW	3	1.9–2.0	1.95	0.06	0.031
	TaW	3	1.9–2.1	2.00	0.10	0.050
m2	L	5	2.1–2.3	2.20	0.07	0.032
	TrW	5	1.9–2.2	2.12	0.13	0.061
	TaW	5	1.9–2.3	2.16	0.19	0.088
m3	L	4	2.7–3.3	3.10	0.25	0.083
	TrW	4	1.9–2.1	2.03	0.08	0.041
	TaW	4	1.9–2.0	1.95	0.05	0.030

family, including: 1) a deeper, horseshoe-shaped ectoflexus; 2) strongly developed parastylar and metastylar lobes; 3) distinct and prominent stylocone and parastyle; 4) paracone and metacone strongly appressed; 5) weak paraconule; 6) weak dilambdodonty. The Who Nose? specimens are similar to UALVP 10850, a P3 referred to *C. cf. C. argyreum* from the Roche Percée fauna of Saskatchewan (Rose and Krause, 1982). UALVP 44184 and 44185 differ from this tooth in being less robust; in having poorly developed cingula; in lacking accessory stylar cusps; in having a more prominently developed stylocone and parastyle; and in lacking well-developed conules.

The Nose Creek sample likely represents a new, primitive species of cyriacotheriid pantodont, considerably older than *C. argyreum*. Rose and Krause argued that *Cyriacotherium* evolved from a *Pantolambda*-like ancestor; the discovery of this primitive taxon from Who Nose? suggests this event may have occurred early in the Torrejonian.

Order CARNIVORA Bowdich, 1821

Family VIVERRAVIDAE Wortman and Matthew, 1899

Subfamily DIDYMICTINAE Flynn and Galiano, 1982

Genus PROTICTIS Matthew, 1937

PROTICTIS sp.

Figure 5.31–5.33

Description.—m1 trigonid tall, massive, and anteroposteriorly compressed; paraconid anterior, slightly appressed to metaconid; paracristid high, blade-like, with deeply incised carnassial notch; metaconid estimated to have been slightly lower than protoconid; protoconid tall, convex labially; protocristid with strong medial carnassial notch; talonid slightly narrower labiolingually than trigonid; hypoconid estimated to have been larger than either entoconid or hypoconulid; entoconid small, conical, and appressed

←

FIGURE 5—1–5, *Pronothodectes matthewi*, UALVP 43284, LI1 in 1, occlusal view; UALVP 43280, incomplete RP4 in 2, occlusal view, both $\times 8$; UALVP 43275, incomplete left dentary having p4–m3 and alveoli for p3 in 3, labial, 4, lingual, 5, occlusal view, $\times 4$. 6–8, *Picrodus silberlingi*, UALVP 43294, incomplete left dentary having i1, p4–m2 and alveoli for i2, c, p3, and m3, in 6, labial, 7, lingual, 8, occlusal view, $\times 4$. 9–11, “*Chriacus*”? sp., UALVP 44168, Lp4 in 9, labial, 10, lingual, 11, occlusal view, $\times 4$. 12–20, *Prothryptacodon albertensis*, UALVP 44170, Rp4 in 12, labial, 13, lingual, 14, occlusal view; UALVP 44171, Rm1 in 15, labial, 16, lingual, 17, occlusal view; UALVP 44172, Lm2 in 18, labial, 19, lingual, 20, occlusal view, all $\times 3$. 21–23, *Colpoclaenus* cf. *C. procyonoides*, UALVP 44173, Lm3 in 21, labial, 22, lingual, 23, occlusal view, $\times 4$. 24–27, cf. *Promioclaenus acolytus*, UALVP 44175, LM2 in 24, occlusal view, $\times 7$; UALVP 44177, incomplete left dentary having p2–m3 in 25, labial, 26, lingual, 27, occlusal view, $\times 3$. 28, 29, *Litomylos* sp., UALVP 44174, LM1 in 28, occlusal view; UALVP 44183, RM2 in 29, occlusal view, both $\times 7$. 30, *Cyriacotherium* sp., UALVP 44185, RP3 in occlusal view, $\times 4$. 31–33, *Protictis* sp., UALVP 44186, Lm1 in 31, labial, 32, lingual, 33, occlusal view, $\times 4$. 34–37, *Simpsonictis* cf. *S. jaynanneae*, UALVP 44187, LM1 in 34, occlusal view; UALVP 44188, Lm2 in 35, labial, 36, lingual, 37, occlusal view, both $\times 7$. 38, *Prodiacodon* cf. *P. furor*, UALVP 44145, LP3 in occlusal view, $\times 7$.

TABLE 13—Measurements and descriptive statistics for the dentition of *Picrodus silberlingi* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
i1	W	1	0.8	0.80	—	—
p4	L	1	0.8	0.80	—	—
	W	1	0.6	0.60	—	—
m1	L	2	2.5	2.50	0	0
	TrW	2	0.7–0.8	0.75	0.07	0.094
	TaW	2	1.1–1.2	1.15	0.07	0.061
m2	L	1	1.7	1.70	—	—
	TrW	1	0.8	0.80	—	—
	TaW	1	1.1	1.10	—	—

to postvallid; talonid notch narrow and emarginated ventrally; entocristid high and sectorial; talonid basin short and deep.

Material examined.—UALVP 44186, m1 (L = *4.7; TrW = 3.1; TaW = *2.8).

Discussion.—The high sectorial trigonid, blade-like paracristid, deeply incised carnassial notches in the paracristid and postcristid, and typical carnivoran shear patterns justify identification of UALVP 44186 as carnivoran (MacIntyre, 1966; Fox and Youzwyshyn, 1994). This tooth is closest in morphology to m1s of primitive viverravids, particularly those of Torrejonian *Protictis haydenianus* (Cope, 1882) and earliest Tiffanian *Pristinictis connata* Fox and Youzwyshyn, 1994, in having a much higher trigonid than talonid, an anteroposteriorly compressed trigonid, and an anteriorly positioned paraconid (Gingerich and Winkler, 1985; Fox and Youzwyshyn, 1994). UALVP 44186 differs from m1s of these taxa having a paracristid that is more lingually transverse and positioned higher on the protoconid. Insofar as these differences are concerned, UALVP 44186 resembles m1s of *Pro. paralus* Holtzman, 1978 and *Pro. agastor* Gingerich and Winkler, 1985, but differs in having the protoconid more closely appressed to the metaconid, a more acute talonid notch, and the entoconid nearer the posterior trigonid wall. These differences, along with the damaged condition of the specimen, permit referral only to *Protictis* sp.

Subfamily VIVERRAVINAE Wortman and Matthew, 1899

Genus SIMPSONICTIS MacIntyre, 1962

SIMPSONICTIS cf. *S. JAYNANNEAE* Rigby, 1980

Figure 5.34–5.37

Description.—M1 crown asymmetrically bilobate; parastylar region prominent and hook-like, with small, low, anterolabial stylocone, and minute, pyramidal parastyle; ectoflexus deep and acutely angled, ectocingulum low and narrow; paracone tall, conical, and joined basally with metacone; metacone short, leaning posterolingually; preparacrista high, blade-like, and continuous with stylocone; centrocrista asymmetrically v-shaped, wide, lacking basal carnassial notch; postmetacrista short and stout; metastyle absent; paraconule well developed and lingual relative to metaconule; trigon basin moderately deep; protocone anteroposteriorly compressed, leaning anteriorly; postcingulum wide posteriorly; cingula discontinuous lingually; m2 trigonid high, and labiolingually wide relative to talonid; paraconid low, cuspidate, and appressed to metaconid; metaconid estimated to have been subequal in height to protoconid; protocristid notched ventrally; talonid anteroposteriorly elongate; entoconid and hypoconid subequal and transversely opposed, hypoconulid long and finger-like; talonid notch acute.

Material examined.—UALVP 44187, M1 (L = 2.4; W = 3.2); UALVP 44188, m2 (L = 2.8; TrW = 1.8; TaW = 1.4).

Occurrence.—Late Torrejonian of North America.

Discussion.—The referred specimens bear closest resemblance to homologous teeth of *Simpsonictis* spp., particularly the tall,

TABLE 14—Measurements and descriptive statistics for the dentition of cf. *Promioclænus acolytus* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
M2	L	1	2.8	2.80	—	—
	W	1	3.6	3.60	—	—
p2	L	2	2.7–2.8	2.75	0.07	0.026
	W	2	1.3–1.4	1.35	0.07	0.052
p3	L	3	3.1–3.3	3.20	0.10	0.031
	W	3	1.6	1.60	0	0
p4	L	2	3.7	3.70	0	0
	W	2	2.2	2.20	0	0
m1	L	1	2.8	2.80	—	—
	TrW	1	*2.5	2.50	—	—
	TaW	1	*2.6	2.60	—	—
m2	L	3	3.1–3.4	3.23	0.15	0.047
	TrW	3	2.7–2.9	2.80	0.10	0.036
	TaW	3	2.6–3.1	2.87	0.25	0.088
m3	L	0	—	—	—	—
	TrW	2	2.5–2.6	2.55	0.07	0.028
	TaW	1	*2.2	2.20	—	—

needle-like cusps, lack of well-developed carnassial notches, a reduced paraconid lower in position with respect to the metaconid, and a trigonid that is reduced in height (MacIntyre, 1962; Gingerich and Winkler, 1985). The Nose Creek specimens are close in size and morphology to comparable teeth of both *S. tenuis* MacIntyre, 1962 from the Bighorn Basin, Wyoming, and *S. jaynanneae* Rigby, 1980 from the Washakie Basin, Wyoming. They are considerably smaller than homologous teeth referred to *S. pegus* Gingerich and Winkler, 1985 from the Bighorn Basin. Gingerich and Winkler (1985) considered *S. jaynanneae* better referred to *S. tenuis*, suggesting that the differences in measured values provided by Rigby (1980) were statistically insignificant; Gingerich and Winkler's critique did not, however, discuss the morphology of the M1 of *S. jaynanneae* as homologous teeth for *S. tenuis* were unknown at that time. Fox and Youzwyshyn (1994) referred an M1, CMNH 24936, from the early Tiffanian Saddle Locality of Wyoming to *S. tenuis* based on its occlusal relationship with lower teeth of that taxon. In their analysis of the relationship between *S. tenuis* and the early Tiffanian viverravid *Pristinictis connata* from Cochrane 2, Alberta, Fox and Youzwyshyn described topographical features of the M1 of *S. tenuis*, that appear to differ from those of the M1 of *S. jaynanneae*. These features include: 1) absence of a stylocone; 2) presence of well-developed para- and metaconules and their associated crests; 3) larger and taller paracone relative to the metacone; 4) preparacrista raised and blade-like as it crosses the stylar shelf. Hence, it appears that *S. jaynanneae* may be a valid taxon, exhibiting a more primitive M1 structure than that of *S. tenuis* (as Rigby had hypothesized) and more nearly approaching the primitive carnivoran condition observed in M1s of *Prist. connata* and, to an even greater degree, *Ravenictis krausei* Fox and Youzwyshyn, 1994 from the Ravenscrag Formation, Saskatchewan.

UALVP 44147 appears to share characters found in the M1s of both *S. tenuis* and *S. jaynanneae*. The larger parastylar lobe relative to the metastylar lobe, shorter metacone relative to the paracone, and poorly-developed conules and crests are synapomorphies between the Nose Creek specimen and M1 of *S. tenuis*.

TABLE 15—Measurements and descriptive statistics for the dentition of *Cyriacotherium* sp. from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P3	L	1	5.1	5.10	—	—
	W	2	7.5–7.8	7.60	0.21	0.028

By contrast, the presence of a stylocone and parastyle, lower pre-paracrista, well-developed para- and metacingula, and pre- and postcingula that are discontinuous with the para- and metacingula are symplesiomorphies between M1s of the Nose Creek specimen and those of *S. jaynanneae* and primitive carnivorans in general (Fox and Youzwyshyn, 1994). The referred m2, UALVP 44188, differs little from m2s referred to *S. tenuis* or from m2s referred to *S. jaynanneae*, but is closer to m2s of *S. jaynanneae* in overall size, in having a trigonid that is slightly more anteroposteriorly compressed, and in having a more ventrally positioned paracristid.

The Nose Creek specimens are best referred to *S. cf. S. jaynanneae* until a larger sample provides some idea of variation of the species to which they belong. It appears, at the very least, that these teeth represent a morphology intermediate between teeth of primitive carnivorans including *S. jaynanneae*, and those of *S. tenuis*. The presence of *Simpsonictis* at Who Nose? represents the earliest known occurrence of the taxon in Canada.

Infraclass EUTHERIA incertae sedis
Family LEPTICTIDAE Gill, 1872
Genus PRODIACODON Matthew, 1929
PRODIACODON cf. *P. furor* Novacek, 1977
Figure 5.38

Description.—P3 triangular; paracone tall and labiolingually compressed; parastyle weak, with small anterior cuspule; metacone labiolingually compressed, distinctly separate from paracone; centrocrista sharp, acute; protocone posterolingual to paracone, short, and subcrescentic; external cingulum well developed, but incomplete labially.

Material examined.—UALVP 44145, P3 (L = 2.3; W = 1.8).

Discussion.—UALVP 44145 is similar to P3s of primitive Late Cretaceous and early Tertiary leptictids, including those of *Gypsonictops* Simpson, 1927; *Myrmecoboides* Gidley, 1915; and particularly *Prodiacodon* Matthew, 1929. UALVP 44145 is most similar to P3 of *P. furor* from both Cochrane 2, Alberta, and Gidley Quarry, Montana, differing in being slightly smaller, having a greater separation of the paracone and metacone, and in having a larger, more posteriorly directed metacone. The referral of UALVP 44145 to *P. cf. P. furor* tentatively marks the earliest known occurrence of the taxon in Canada.

Family PALAEOERYCTIDAE (Winge, 1917)
PALAEOERYCTIDAE genus and species indeterminate
Figure 6.1–6.3

Description.—p4 premolariform; paraconid small, subconical, and anterolingual; protoconid tall, subconical; metaconid absent; protostylid crest strongly developed; talonid unicusate and unbasined; lower molar relatively low crowned; trigonid labiolingually transverse, with tall, spire-like cusps; paraconid labial; paracristid low, unnotched; metaconid and protoconid subequal; protoconid notched medially; precingulid prominent but short; talonid broadly basined and skewed labially; hypoconid and hypoconulid closely appressed relative to entoconid; entocristid high, talonid notch acute.

Material examined.—UALVP 44195, p4 (L = *1.3; W = 0.6); UALVP 44196, m1 or m2 (L = 1.6; TrW = 1.2; TaW = 0.9).

Discussion.—The curious suite of characters displayed by the Nose Creek specimens exemplifies the difficulties associated with referring isolated teeth to palaeoryctid taxa. Relative to the lower dentition of *Cimolestes* Marsh, 1889, here interpreted as representing the primitive palaeoryctid condition (but see Fox and Youzwyshyn, 1994, and references therein for discussion on the probable composite nature of *Cimolestes*), the Nose Creek specimens are derived, particularly in the more nearly equal height of the molar protoconid and metaconid, and the better-developed p4 paraconid. By contrast, the specimens are primitive relative to

homologous teeth of typical palaeoryctids in having a more lingual molar paraconid that is less appressed to the metaconid, and a shorter molar trigonid relative to the talonid. Additionally, UALVP 44196 differs from palaeoryctid molars in its low trigonid relative to the talonid, and broad, labiolingually expansive talonid; in these features, UALVP 44196 more closely approximates lower molars of *Pararyctes* Van Valen, 1966, and *Stilpnodon* Simpson, 1935.

Subfamily DIDELPHODONTINAE Matthew in Matthew and Granger, 1918
Genus PROCERBERUS Sloan and Van Valen, 1965
cf. PROCERBERUS sp.
Figure 6.4–6.6

Description.—m3 anteroposteriorly long, with trigonid and talonid subequal in length; trigonid low, with cusps forming an equilateral triangle; talonid with high cusps and crests; paraconid lingual, conical, distinctly separate from metaconid; paracristid high and crestiform, bearing single cuspule ventrally; metaconid and protoconid subequal and inclined posteriorly; trigonid notch deep; precingulid short and prominent; talonid cusps high, conical, and robust; entoconid positioned far posteriorly; hypoconulid small; entoconid and mesoconid moderately developed; entocristid and cristid obliqua anteroposteriorly elongate, forming a broad, shallow basin; talonid notch broadly U-shaped.

Material examined.—UALVP 44190, m3 (L = 3.0; TrW = 1.6; TaW = 1.5).

Discussion.—UALVP 44190 bears closest resemblance to teeth of *Procerberus*, differing from those of other didelphodontines in having a trigonid that is less anteroposteriorly compressed, and a paraconid that is conical and less anteriorly directed, appearing to be specialized for grinding and crushing, rather than piercing or shearing. UALVP 44190 is closest in overall structure to lower molars of early Paleocene *P. formicarum* Sloan and Van Valen, 1965, particularly in the near-equilateral triangular occlusal configuration of the trigonid cusps, conical paraconid, and stout, low-crowned trigonid cusps. UALVP 44190 differs from molars of *P. formicarum* in having an anteroposteriorly elongate talonid with a straight entocristid and cristid obliqua, an erect paraconid that is not deflected anteriorly, and more nearly conical talonid cusps; in these respects, UALVP 44190 may be closer to teeth expected for *P. plutonis* Van Valen, 1978, from Purgatory Hill, Montana. Van Valen described the upper dentition of *P. plutonis*, noting the anteroposteriorly elongate protocones on the molars; an elongate M3 protocone would certainly be accommodated by the anteroposteriorly elongate talonid of UALVP 44190.

Procerberus is known from Puercan localities in the Western Interior of North America, the youngest occurrences being at Rav W-1 and Simpson Quarry in Saskatchewan and Montana, respectively (Johnston and Fox, 1984; Fox, 1990; Buckley, 1994). Putative Torrejonian occurrences of the genus have been documented (Eberle, 1999 and references therein), but these specimens have yet to be described. Rather than definitively extending the temporal range of *Procerberus* by some two million years based on a meager sample, UALVP 44190 is best referred tentatively until a larger sample is acquired.

Genus GELASTOPS Simpson, 1935
GELASTOPS sp.
Figure 6.7–6.12, Table 16

Description.—P4 semimolariform and triangular in occlusal outline; ectocingulum low; parastylar and metastylar lobes well developed; parastyle anterolabial and small, metastyle compressed and blade-like; paracone large and pyramidal, metacone incipient; preparacrista strongly developed and unnotched; centrocrista and



postmetacrista notched medially; protocone short, nearly confluent with paracone; postprotocrista arcuate, bearing lingual accessory cusps; M2 transverse; parastylar and metastylar lobes strongly developed, ectoflexus shallow; parastylar lobe with small, conical parastyle and accessory stylar cusp; metastylar lobe with single labial cusp; paracone tall and conical; metacone estimated to have been conical and subequal to paracone; paraconule and metaconule conical, well developed, and anterior relative to bases of their respective trigon cusps; metaconule cristae indistinct; protocone large and compressed; pre- and postcingula are absent; m3 trigonid labiolingually transverse, with subequal protoconid and metaconid; paraconid labial, cuspidate, reduced, and appressed to metaconid; paracristid low and notched medially; trigonid notch acute; precingulid prominent and shelf-like; talonid broad and skewed labially; hypoconulid and entoconid closely appressed and shifted labially; talonid notch acute.

Material examined.—UALVP 44191, 44192, P4s; UALVP 44193, M2; UALVP 44194, m3.

Discussion.—The referred specimens were not found in association, and are referred to the same taxon on the basis of size and their being distinctly different from homologous teeth of *Procerberus* sp., the other didelphodontine taxon identified from Nose Creek. The referred teeth most closely approximate those of didelphodontines such as *Gelastops* and *Acmeodon* Matthew and Granger, 1921, particularly the semimolariform P4 and the development of the parastylar and metastylar lobes on M2. Furthermore, UALVP 44194 is virtually identical to m3s of *Gelastops* in having a low trigonid relative to the talonid, a lingually positioned paraconid, a metaconid that is larger than the paraconid, and a talonid that is broadly basined and labially skewed (Van Valen, 1966).

Family APATEMYIDAE Matthew, 1909
Subfamily APATEMYINAE Matthew, 1909
Genus JEPSANELLA Simpson, 1940
JEPSANELLA cf. *J. PRAEPROPERA* Simpson, 1940
Figure 6.13–6.14

Material examined.—UALVP 44198, I1 (L = 4.5; W = 1.5).

Occurrence.—Late Torrejonian to late Tiffanian of North America.

Discussion.—UALVP 44198 is virtually identical to comparable teeth referred to *J. cf. J. praepropera* from Cochrane 2 and Birchwood localities of Alberta (Youzwyshyn, 1988; Webb, 1996), differing only in being anteroposteriorly longer with a wider crown, in having a slightly more posterior placement of the posterocone, and in having a sharper, higher crest between the anterocone and posterocone. The presence of *J. cf. J. praepropera* at Who Nose? constitutes the earliest occurrence of this poorly known taxon in Western Canada.

TABLE 16—Measurements and descriptive statistics for the dentition of *Gelastops* sp. from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P4	L	2	*2.7–2.8	2.75	0.07	0.026
	W	2	*3.1–3.2	3.15	0.07	0.022
M2	L	1	2.1	2.10	—	—
	W	1	3.9	3.90	—	—
m3	L	1	2.6	2.60	—	—
	TrW	1	1.5	1.50	—	—
	TaW	1	1.0	1.00	—	—

Family PANTOLESTIDAE Simpson, 1937
Subfamily PANTOLESTINAE Simpson, 1937
Genus BESOECETOR Simpson, 1936
BESOECETOR SEPTENTRIONALIS (Russell, 1929)
Figure 6.15–6.23, Table 17

Material examined.—UALVP 44201, maxillary fragment with P4–M2; UALVP 44202, 44203, 44233 (total:3), P4s; UALVP 44204, 44205, M1s; UALVP 44206, M2; UALVP 44207, p2; UALVP 44208, p3; UALVP 44234, 44209, p4s; UALVP 44210, 44211, m1s; UALVP 44212–14 (total:3), m2s; UALVP 44215, mx.

Occurrence.—Late Torrejonian to middle Tiffanian of North America.

Discussion.—Descriptions of the dentition of *B. septentrionalis* occur in Simpson (1936, 1937 as “*Bessoecetor thomsoni*” and “*Bessoecetor diluculi*,” respectively). The Nose Creek specimens are virtually identical to teeth referred to *B. septentrionalis* from Cochrane 2 (Youzwyshyn, 1988; Scott et al., 2002), differing only in being slightly larger and higher crowned, P4 having a relatively smaller protocone, upper molars being more transverse, with better-developed para- and metastylar lobes and weaker hypocones, and lower molars with relatively wider talonids. The Who Nose? specimens are within size ranges for teeth referred to “*Propalaeosinopa diluculi*” (synonymized with *Bessoecetor septentrionalis* by Scott et al., 2002) from Swain Quarry, Wyoming (Rigby, 1980) and Douglass Quarry, Montana (Krause and Gingerich, 1983).

BESOECETOR sp. 1
Figure 6.24–6.26

Material examined.—UALVP 44216, m2 (L = 3.2; TrW = 2.0; TaW = 2.1).

Discussion.—The similarity of UALVP 44216 to teeth of *B. septentrionalis* identifies this specimen as pertaining to *Bessoecetor*. The tooth is similar in overall structure to m2s of *B. septentrionalis* from Who Nose? and Cochrane 2, but differs in being nearly 45 percent larger and proportionately higher crowned, particularly the talonid, whose cusps appear tall and spire-like, forming a deep basin. The entocristid and cristid obliqua are raised

←

FIGURE 6—1–3, Palaeoryctidae gen. and sp. indet., UALVP 44196, Rm1 or m2 in 1, labial, 2, lingual, 3, occlusal view, $\times 11$. 4–6, cf. *Procerberus* sp., UALVP 44190, Lm3 in 4, labial, 5, lingual, 6, occlusal view, $\times 8$. 7–12, *Gelastops* sp., UALVP 44191, LP4 in 7, occlusal view; UALVP 44192, LP4 in 8, occlusal view; UALVP 44193, LM2 in 9, occlusal view; UALVP 44194, Rm3 in 10, labial, 11, lingual, 12, occlusal view, all $\times 8$. 13, 14, *Jepsenella* cf. *J. praepropera*, UALVP 44200, LI1 in 13, labial, 14, lingual view, $\times 3$. 15–23, *Bessoecetor septentrionalis*, UALVP 44202, RP4 in 15, occlusal view; UALVP 44204, LM1 in 16, occlusal view; UALVP 44206, RM2 in 17, occlusal view; UALVP 44210, Lm1 in 18, labial, 19, lingual, 20, occlusal view; UALVP 44212, Lm2, in 21, labial, 22, lingual, 23, occlusal view, all $\times 8$. 24–26, *Bessoecetor* sp. 1, UALVP 44216, Lm2 in 24, labial, 25, lingual, 26, occlusal view, $\times 9$. 27–29, *Bessoecetor* sp. 2, UALVP 44218, Lm2? in 27, labial, 28, lingual, 29, occlusal view, $\times 9$. 30–42, *Paleotomus junior*, UALVP 44219, LDP4 in 30, occlusal view; UALVP 44223, Ldp4 in 31, labial, 32, lingual, 33, occlusal view; UALVP 44222, Lp4 in 34, labial, 35, lingual, 36, occlusal view; UALVP 44224, Lm1 in 37, labial, 38, lingual, 39, occlusal view; UALVP 44225, Lm2 in 40, labial, 41, lingual, 42, occlusal view, all $\times 9$.

TABLE 17—Measurements and descriptive statistics for the dentition of *Bessoecetor septentrionalis* from Who Nose?, Paskapoo Formation, Alberta.

Element	P	N	OR	M	SD	CV
P4	L	4	2.4–2.5	2.45	0.06	0.024
	W	4	1.9–2.5	2.15	0.26	0.123
M1	L	3	2.3–2.5	2.43	0.12	0.048
	W	3	2.9–3.1	3.03	0.12	0.038
M2	L	2	2.5–2.7	2.60	0.14	0.054
	W	2	3.7	3.70	0	0
p2	L	1	1.9	1.90	—	—
	W	1	0.7	0.70	—	—
p3	L	1	2.4	2.40	—	—
	W	1	0.9	0.90	—	—
p4	L	2	2.7–2.8	2.75	0.07	0.026
	W	2	1.1–1.2	1.15	0.07	0.062
m1	L	2	2.4–2.5	2.45	0.07	0.029
	TrW	2	1.6	1.60	0	0
	TaW	2	1.6	1.60	0	0
m2	L	1	2.5	2.50	—	—
	TrW	3	1.7–1.8	1.73	0.06	0.033
	TaW	1	1.7	1.70	—	—

and sectorial in construction, and a strongly developed entoconulid is present. UALVP 44216 differs further from lower molars of *B. septentrionalis* in possessing a stronger notch on the paracristid. At present, UALVP 44216 is referred to *Bessoecetor* until a larger sample can support a more definitive assignment.

BESSECECTOR sp. 2
Figure 6.27–6.29

Material examined.—UALVP 44218, ?m2 (L = 1.6; TrW = 1.0; TaW = 1.1).

Discussion.—UALVP 44218 is nearly identical to m2s of *B. septentrionalis*, differing in being nearly 35 percent smaller and proportionately more transverse. It further differs from molars of *B. septentrionalis* in having a more transverse paracristid, and a more anteroposteriorly compressed trigonid, and may represent a third species of *Bessoecetor* from Who Nose?.

Family Uncertain

Genus PALEOTOMUS Van Valen, 1967

PALEOTOMUS JUNIOR Scott, Fox, and Youzwyshyn, 2002

Figure 6.30–6.42

Description.—Scott et al. (2002) provided descriptions of the dentition of *P. junior*, with the exception of DP4 and p4, which are described here. DP4 paracone and metacone subequal; protocone short and inclined labially; parastylar and metastylar lobes weakly developed, stylar shelf labiolingually narrow; paracone and metacone crests well developed, with heavy wear, especially on centrocrista; conules and conule crests protuberant; protocone tall and subcrescentic; hypocone small and immediately posterior to protocone; cingula well developed; p4 submolariform; paraconid anteriorly projecting, large and conical; paracristid prominent and broadly notched; metaconid small, subconical, and posteriorly directed; protoconid large and trenchant; metastylid crest connecting apex of metacone to heel strongly developed and notched ventrally; hypoconid tall and trenchant, entoconid and hypoconulid low and poorly developed; talonid with lingual flange progressing to base of trigonid, forming a shallow basin.

Material examined.—UALVP 44219, DP4 (L = 2.8; W = 2.8); UALVP 44220, p2 (L = 2.1; W = 1.2); UALVP 44221, p3 (L = 3.2; W = 1.1); UALVP 44223, dp4 (L = 3.6; TrW = 1.3; TaW = 1.5); UALVP 44222, p4 (L = 3.9; W = 1.5); UALVP 44224, m1 (L = 3.0; TrW = 2.0; TaW = 1.7); UALVP 44225, m2 (L = 3.3; TrW = 2.2; TaW = 1.7).

Occurrence.—Late Torrejonian to earliest Tiffanian of North America.

Discussion.—The taxonomic affinities of *Paleotomus* have been discussed (Scott et al., 2002); the Nose Creek specimens offer little to resolve this dilemma, and are here placed in Order and Family uncertain. The referred specimens are virtually identical to comparable elements from Cochrane 2, Alberta, differing in dp4 having more pronounced exodaenodonty, and the lower molars being slightly more robust, and having a more external paraconid. The Nose Creek specimens appear to represent a continuation of the *Paleotomus* lineage back into the Torrejonian.

BIOSTRATIGRAPHIC CONCLUSIONS

Age of the Who Nose? local fauna.—Following the criteria of Archibald et al. (1987), the mammalian fauna from Who Nose? can be assigned to the Torrejonian North American Land Mammal Age (NALMA), because of the presence of *Palenochtha* and *Prothryptacodon*, taxa that are elsewhere restricted to the Torrejonian NALMA (Archibald et al., 1987). The presence of several additional genera, including *Anconodon*, *Baiotomeus*, *Leptacodon*, *Elpidophorus*, *Plesiolestes*, *Pronothodectes*, *Simpsonictis*, and *Bessoecetor*, all of which make their first appearance during the Torrejonian NALMA, lend additional support to a Torrejonian age. Although less important, the last known records of *Xyronomys* and *Stygimys* also occur during this interval. At the species level, taxa including *Ptilodus montanus*, *Plesiolestes problematicus*, and *Prothryptacodon albertensis* are restricted to the Torrejonian or older. Additionally, the Who Nose? local fauna contains ten genera considered by Archibald et al. (1987) to be characteristic of the Torrejonian NALMA.

Archibald et al. (1987) further subdivided the Torrejonian NALMA into three zones, each based on the successive first and last appearances of two unrelated taxa. These interval-zones, designated To1 through To3 are, from oldest to youngest, the *Periptychus/Tetraclaenodon* interval-zone (To1), the *Tetraclaenodon/Pantolambda* interval-zone (To2), and the *Pantolambda/Plesiadapis praecursor* interval-zone (To3). A To3 age for the Who Nose? local fauna is supported by taxa restricted to this zone. These index taxa are useful for constraining the age of local faunas, and in correlating isolated outcrops. Unequivocal To3 index taxa from the Who Nose? locality are *Pronothodectes matthewi* and *Prothryptacodon albertensis*, while tentatively identified To3 index taxa are *Elpidophorus* cf. *E. minor*, *Palenochtha* cf. *P. minor*, and *Simpsonictis* cf. *S. jayanneae*. Additionally, *Ptilodus montanus*, restricted to the latest Torrejonian by Gunnell (1994), and *Baiotomeus rhotonion* n. sp. may prove to be useful indices for the To3 interval-zone. Genera making their first appearances during the To3 interval-zone provide further, but less compelling evidence in support of a To3 age; these include *Mimetodon*, *Ignacius*, *Pronothodectes*, *Picrodus*, and *Paleotomus*. Additionally, the Who Nose? fauna shares at least 11 genera considered by Archibald et al. (1987) to be characteristic of the To3 interval-zone.

The Who Nose? local fauna is similar in general composition to faunas of latest Torrejonian age from localities in the Western Interior of the United States, and to those of earliest Tiffanian age from localities in the United States and Alberta (Table 18). Of these localities, the Who Nose? local fauna is closest in overall composition to the latest Torrejonian Gidley Quarry fauna of Montana and to the earliest Tiffanian Cochrane 2 fauna of Alberta. Of the 32 genera from the Who Nose? local fauna, 23 are shared with Gidley Quarry, and 22 are shared with Cochrane 2. Of special importance are the temporally restricted genera *Palenochtha* and *Prothryptacodon*, both of which occur at Who Nose? and Gidley Quarry but not in the Cochrane 2 fauna. The remaining genera shared between Who Nose? and Gidley Quarry, and between Who Nose? and Cochrane 2, are stratigraphically

TABLE 18—Taxonomic comparison of mammals from the Who Nose? locality, Alberta, with those of select late Torrejonian and early Tiffanian faunas from localities in the Western Interior of North America. "Genus" and "species" refer to similar occurrences in the comparable fauna at the generic and specific level, respectively; "—" indicates no match. Genus and/or species-level taxa unique to Who Nose? are excluded. Locality data from Rose (1981), Rigby (1980), and Youzwyshyn (1988).

WHO NOSE? TAXA	LOCALITIES			
	Rock Bench Quarry	Swain Quarry	Gidley Quarry	Cochrane 2
<i>Mesodma pygmaea</i>	species	—	species	species
<i>Xyronomys</i> sp.	—	genus	—	—
<i>Mimetodon silberlingi</i>	species	—	species	species
<i>Ectypodus</i> cf. <i>E. szalayi</i>	genus	species	species	species
<i>Parectypodus</i> cf. <i>P. sylviae</i>	—	species	genus	species
<i>Parectypodus corystes</i>	—	genus	genus	species
<i>Neoplagiaulax hunteri</i>	—	genus	genus	species
<i>Neoplagiaulax nelsoni</i>	—	species	genus	species
<i>Ptilodus gnomus</i>	genus	genus	genus	species
<i>Ptilodus montanus</i>	genus	genus	species	genus
<i>Baotomeus rathonion</i>	genus	genus	genus	genus
<i>Anconodon cochransensis</i>	species	—	species	species
cf. <i>Stygmimys</i> sp.	genus	—	genus	—
<i>Acheronodon</i> sp.	—	—	—	genus
"Leptacodon" <i>munusculum</i>	species	genus	species	species
<i>Leptacodon tener</i>	genus	species	genus	species
<i>Elpidophorus</i> cf. <i>E. minor</i>	—	—	—	genus
<i>Ignacius</i> cf. <i>I. fremontensis</i>	species	—	—	species
<i>Palenochtha</i> cf. <i>P. minor</i>	species	species	species	—
<i>Plesiolestes problematicus</i>	species	species	—	—
<i>Pronothodectes matthewi</i>	genus	—	species	genus
<i>Picrodus silberlingi</i>	species	species	species	species
? <i>Chriacus</i> sp.	genus	genus	genus	genus
<i>Prothryptacodon albertensis</i>	genus	genus	genus	—
<i>Colpoclaenus</i> cf. <i>C. procyonoides</i>	—	—	—	genus
cf. <i>Promioclauenus acolytus</i>	species	species	species	—
<i>Litomylus</i> sp.	genus	genus	genus	genus
<i>Protictis</i> sp.	genus	genus	genus	—
<i>Simpsonictis</i> cf. <i>S. jayanneae</i>	genus	species	genus	genus
<i>Prodiacodon</i> cf. <i>P. furor</i>	—	genus	species	species
<i>Gelastops</i> sp.	genus	genus	genus	—
<i>Jeppenella</i> cf. <i>J. praepropera</i>	species	species	species	species
<i>Bessoecetor septentrionalis</i>	—	species	species	species
<i>Paleotomus junior</i>	—	genus	—	species
Total Matches (genus)	21	21	23	22
Total Matches (species)	10	11	13	17

long-ranging and are of little value in constraining the age of the Who Nose? local fauna.

At the species level, the Who Nose? local fauna contains both Torrejonian and Tiffanian taxa, sharing 10, 11, and 13 species with Rock Bench Quarry, Swain Quarry, and Gidley Quarry [all latest Torrejonian in age (Rose, 1981; Rigby, 1980)], respectively, and 17 species with Cochrane 2 (earliest Tiffanian in age). A perfunctory examination of these similarities would suggest a younger, perhaps even Tiffanian age for the Who Nose? local fauna, despite the absence of the accepted Ti1 index taxon *Plesiadapis praecursor* Gingerich, 1975. Closer inspection, however, indicates that the similarities between the Who Nose? and Cochrane 2 faunas are owing largely to the presence of stratigraphically long-ranging species (e.g., *Mimetodon silberlingi*, *Neoplagiaulax hunteri*, *Bessoecetor septentrionalis*), none of which are previously known to be restricted to the Tiffanian. Further, I consider the presence of the plesiadapid primate *Pronothodectes matthewi* at Who Nose? to be of paramount importance: this taxon, an index for To3 (Gingerich, 1976), was restricted in both space and time, and its presence, in combination with the absence of taxa restricted to the Tiffanian, strongly suggests contemporaneity with latest Torrejonian faunas.

Youzwyshyn (1988) considered the Cochrane 2 fauna to be of an age intermediate between those of Shotgun, Wyoming (?To3) and Douglass Quarry, Montana (Ti1) based on overall taxonomic similarity; other authors (e.g., Secord, 1998) considered Cochrane 2 to be of uncertain age, or straddling the Torrejonian-Tiffanian boundary. Given a latest Torrejonian age for the Who Nose? local

fauna, the strong Tiffanian character combined with the presence of *Elpidophorus*, *Ignacius*, and *Plesiolestes*, all of which occur at Shotgun, may indicate an age slightly younger than the Gidley Quarry fauna.

ACKNOWLEDGMENTS

This paper is derived from part of the thesis research for my M.Sc. degree, successfully completed at the University of Alberta in January, 2001. I extend my gratitude to R. C. Fox for his guidance and support throughout the project, and for critical reviews of the manuscript. I thank my graduate committee members for helpful advice and reviews of the thesis. I am indebted to parties from the UALVP, particularly D. Spivak, for continued assistance in the field, and to A. Voss for sorting the concentrate. I extend my gratitude to D. Spivak and J. Gardner for critical reviews of the manuscript. G. F. Gunnell and an anonymous reviewer provided helpful comments on the manuscript. Funding for this research was provided me by a postgraduate scholarship from the Natural Sciences and Engineering Research Council (NSERC), Canada, and from graduate teaching assistantships from the University of Alberta, Canada.

REFERENCES

- AMEGHINO, F. 1890. Los plagiulacidos argentinos y sus relaciones zoológicas, geológicas, y geográficas. Boletín des Instituto geográfico argentino, 11:143–201.
- ARCHIBALD, J. D. 1982. A study of Mammalia and geology across the Cretaceous-Tertiary boundary in Garfield County, Montana. University of California Publications in Geological Science, 122:11–286.

- ARCHIBALD, J. D., P. D. GINGERICH, E. H. LINDSAY, W. A. CLEMENS, D. W. KRAUSE, AND K. D. ROSE. 1987. First North American land mammal ages of the Cenozoic Era, p. 24–76. *In* M. O. Woodburne (ed.), *Cenozoic Mammals of North America, Geochronology and Biostratigraphy*. University of California Press, Berkeley.
- BALLY, A. W., P. L. GORDY, AND G. A. STEWART. 1966. Structure, seismic data, and orogenic evolution of southern Canadian Rocky Mountains. *Bulletin of Canadian Petroleum Geology*, 14:337–381.
- BOWDICH, T. E. 1821. Analysis of the Natural Classifications of Mammalia for the use of Students and Travellers. J. Smith, Paris, 115 p.
- BOWN, T. M., AND D. M. SCHANKLER. 1982. A review of the Proteutheria and Insectivora of the Willwood Formation (lower Eocene), Bighorn Basin, Wyoming. *United States Geological Survey Bulletin*, 1523:1–79.
- BUCKLEY, G. A. 1994. Paleontology, geology and chronostratigraphy of Simpson Quarry (early Paleocene), Bear Formation, Crazy Mountains Basin, south-central Montana. Unpublished Ph.D. dissertation, Rutgers University, 429 p.
- CIFELLI, R. C. 1983. The origin and affinities of the South American Condylarthra and Early Tertiary Litopterna (Mammalia). *American Museum Novitates*, 2772:1–49.
- CLEMENS, W. A. 1966. Fossil mammals of the type Lance Formation, Wyoming, Pt. II, Marsupialia. *University of California Publications in Geological Science*, 62:1–122.
- COPE, E. D. 1873. Fourth notice of extinct Vertebrata from the Bridger and Green River Tertiaries. *Paleontological Bulletin*, 2:1–3.
- COPE, E. D. 1881a. Eocene Plagiaulacidae. *American Naturalist*, 15:921–922.
- COPE, E. D. 1881b. A new type of Perissodactyla. *American Naturalist*, 15:1017–1018.
- COPE, E. D. 1882. Synopsis of the Vertebrata of the Puerco Eocene epoch. *Proceedings of the American Philosophical Society*, 20:461–471.
- COPE, E. D. 1883. On the mutual relationships of the bunotherian Mammalia. *Proceedings of the National Academy of Sciences, Philadelphia* 35:77–83.
- COPE, E. D. 1884a. The Vertebrata of the Tertiary formations of the West. Book I. Report of the United States Geological and Geographical Survey Territories, Washington (F. V. Hayden), 3:1–1009.
- COPE, E. D. 1884b. Second addition to the knowledge of the Puerco epoch. *Proceedings of the American Philosophical Society*, 21:309–326.
- COPE, E. D. 1887. The marsupial genus *Chirox*. *American Naturalist*, 21:566–567.
- COPE, E. D. 1888. Synopsis of the vertebrate fauna of the Puerco series. *Transactions of the American Philosophical Society*, 16:298–361.
- DAWSON, F. M., C. G. EVANS, R. MARSH, AND R. RICHARDSON. 1994. Chapter 24. Uppermost Cretaceous and Tertiary Strata of the Western Canada Sedimentary Basin, p. 387–406. *In* G. D. Mossop and I. Shetsen (comps.), *Geological Atlas of the Western Canada Sedimentary Basin*. Canadian Society of Petroleum Geologists and Alberta Research Council, Calgary and Edmonton.
- DEMCHUK, T. D., AND L. V. HILLS. 1991. A re-examination of the Pasakoo Formation in the central Alberta Plains: the designation of three new members. *Bulletin of Canadian Petroleum Geology*, 39:270–282.
- DOUGLASS, E. 1908. Vertebrate fossils from the Fort Union beds. *Annals of the Carnegie Museum*, 5:11–26.
- EBERLE, J. J. 1999. Bridging the transition between didelphodonts and taeniodonts. *Journal of Paleontology*, 73:936–944.
- FILHOL, H. 1877. Considération sur la découverte de quelques mammifères fossiles appartenant à l'Eocène supérieur. *Société Philosophique de Paris Bulletin*, 1:51–54.
- FLYNN, J. M., AND H. GALIANO. 1982. Phylogeny of early Tertiary Carnivora, with a description of a new species of *Protictis* from the middle Eocene of northwestern Wyoming. *American Museum Novitates*, 2725:1–64.
- FOX, R. C. 1968. A new Paleocene mammal (Condylarthra: Arctocyonidae) from a well in Alberta, Canada. *Journal of Mammalogy*, 49:661–664.
- FOX, R. C. 1984. The dentition and relationships of the Paleocene primate *Micromomys* Szalay, with description of a new species. *Canadian Journal of Earth Sciences*, 21:1262–1267.
- FOX, R. C. 1989. The Wounded Knee local fauna and mammalian evolution near the Cretaceous-Tertiary boundary, Saskatchewan, Canada. *Palaeontographica (A)*, 208:11–59.
- FOX, R. C. 1990. The succession of Paleocene mammals in western Canada, p. 51–70. *In* T. M. Bown and K. D. Rose (eds.), *Dawn of the Age of Mammals in the Northern Part of the Rocky Mountain Interior, North America*. Geological Society of America Special Paper, 243.
- FOX, R. C., AND G. P. YOUZWYSHYN. 1994. New primitive carnivores (Mammalia) from the Paleocene of western Canada, and their bearing on relationships of the order. *Journal of Vertebrate Paleontology*, 14:382–404.
- GAMBARYAN, P. P., AND Z. KIELAN-JAWOROWSKA. 1995. Masticatory musculature of Asian taeniolabidoid multituberculate mammals. *Acta Palaeontologica Polonica*, 40:45–108.
- GAZIN, C. L. 1956a. Paleocene mammalian faunas of the Bison Basin in south-central Wyoming. *Smithsonian Miscellaneous Collections*, 131:1–57.
- GAZIN, C. L. 1956b. The occurrence of Paleocene mammal remains in the Fossil Basin of southwestern Wyoming. *Journal of Paleontology*, 30:707–711.
- GAZIN, C. L. 1971. Paleocene primates from the Shotgun member of the Fort Union Formation, in the Wind River Basin, Wyoming. *Proceedings of the Biological Society of Washington*, 84:13–38.
- GIDLEY, J. W. 1909. Notes on the fossil mammalian genus *Ptilodus*, with descriptions of new species. *Proceedings of the United States National Museum*, 36:611–626.
- GIDLEY, J. W. 1915. An extinct marsupial from the Fort Union with notes on the Myrmecobidae and other families of this group. *Proceedings of the United States National Museum*, 48:395–402.
- GIDLEY, J. W. 1923. Paleocene primates of the Fort Union, with discussion of relationships of Eocene primates. *Proceedings of the United States National Museum*, 63:1–38.
- GIEBEL, C. G. 1855. Die Säugetiere in zoologischer, anatomischer und palaeontologischer Beziehung umfassend dargestellt. Abel, Leipzig, 1108 p.
- GILL, T. N. 1872. Arrangement of the families of mammals and synoptical tables of characters of the subdivisions of mammals. *Smithsonian Miscellaneous Collections*, 230:1–98.
- GINGERICH, P. D. 1975. New North American Plesiadapidae (Mammalia, Primates) and a biostratigraphic zonation of the Middle and Upper Paleocene. *Contributions from the Museum of Paleontology, The University of Michigan*, 24:237–244.
- GINGERICH, P. D. 1976. Cranial anatomy and evolution of early Tertiary Plesiadapidae (Mammalia, Primates). *Papers on Paleontology, Museum of Paleontology, The University of Michigan*, 15:1–140.
- GINGERICH, P. D., P. HOUDE, AND D. W. KRAUSE. 1983. A new earliest Tiffanian (late Paleocene) mammalian fauna from Bangtail Plateau, western Crazy Mountain Basin, Montana. *Journal of Paleontology*, 75:957–970.
- GINGERICH, P. D., AND D. A. WINKLER. 1985. Systematics of Paleocene Viverravidae (Mammalia, Carnivora) in the Bighorn Basin and Clark's Fork Basin, Wyoming. *Contributions from the Museum of Paleontology, The University of Michigan*, 27:87–128.
- GRANGER, W., AND G. G. SIMPSON. 1929. A revision of the Tertiary Multituberculata. *Bulletin of the American Museum of Natural History*, 56:601–676.
- GREGORY, W. K. 1910. The orders of mammals. *Bulletin of the American Museum of Natural History*, 27:1–254.
- GUNNELL, G. F. 1989. Evolutionary history of Microsypoidea (Mammalia, ?Primates) and the relationship between Plesiadapiformes and Primates. *Papers on Paleontology, Museum of Paleontology, The University of Michigan*, 27:1–157.
- GUNNELL, G. F. 1994. Paleocene mammals and faunal analysis of the Chappo Type locality (Tiffanian), Green River Basin, Wyoming. *Journal of Vertebrate Paleontology*, 14:81–104.
- HAECKEL, E. 1866. Systematische Einleitung in die allgemeine Entwicklungsgeschichte. *Generelle Morphologie der Organismen, Berlin* 2: XVII–CLX.
- HOLTZMAN, R. C. 1978. Late Paleocene mammals of the Tongue River Formation, western North Dakota. Report of Investigation, North Dakota Geological Survey, 65:1–88.
- HOLTZMAN, R. C., AND D. L. WOLBERG. 1977. The Microcosmodontinae and *Microcosmodon woodi*, new multituberculate taxa (Mammalia)

- from the late Paleocene of North America. Scientific Publications of the Science Museum of Minnesota, New Series, 4:1–13.
- ILLIGER, C. 1811. Prodomus systematics mammalium et avium additis terminis zoographicis utriusque classis. Slafeld, Berlin, 301 p.
- JANIS, C. M., J. D. ARCHIBALD, R. L. CIFELLI, S. G. LUCAS, C. R. SCHAFF, R. M. SCHOCH, AND T. E. WILLIAMSON. 1998. Archaic ungulates and ungulatelike mammals, p. 247–259. In C. M. Janis, K. M. Scott, and L. L. Jacobs (eds.), *Evolution of Tertiary Mammals of North America*. Cambridge University Press, Cambridge and New York.
- JEPSEN, G. L. 1930. Stratigraphy and paleontology of northeastern Park County, Wyoming. *Proceedings of the American Philosophical Society*, 69:463–528.
- JEPSEN, G. L. 1940. Paleocene faunas of the Polecat Bench Formation, Wyoming. *Proceedings of the American Philosophical Society*, 83:217–340.
- JERZYKIEWICZ, T. 1997. Stratigraphic framework of the uppermost Cretaceous to Paleocene strata of the Alberta Basin. *Geological Survey of Canada Bulletin*, 510:1–20.
- JOHNSON, G. D., P. A. MURRY, AND J. E. STORER. 1994. Recovery of vertebrate microfossils. *Proceedings of the South Dakota Academy of Science*, 73:211–230.
- JOHNSTON, P. A., AND R. C. FOX. 1984. Paleocene and Late Cretaceous mammals from Saskatchewan, Canada. *Palaeontographica (A)*, 159:163–222.
- KRAUSE, D. W. 1977. Paleocene multituberculates (Mammalia) of the Roche Percée local fauna, Ravenscrag Formation, Saskatchewan, Canada. *Palaeontographica (A)*, 159:1–36.
- KRAUSE, D. W. 1978. Paleocene primates from western Canada. *Canadian Journal of Earth Sciences*, 15:1250–1271.
- KRAUSE, D. W. 1982. Evolutionary history and paleobiology of early Cenozoic Multituberculata (Mammalia), with emphasis on the family Ptilodontidae. Two volumes. Unpublished Ph.D. dissertation, The University of Michigan, Ann Arbor, 555 p.
- KRAUSE, D. W. 1987. *Baiotomus*, a new ptilodontid multituberculate (Mammalia) from the middle Paleocene of western North America. *Journal of Paleontology*, 61:595–603.
- KRAUSE, D. W., AND P. D. GINGERICH. 1983. Mammalian fauna from Douglass Quarry, earliest Tiffanian (late Paleocene) of the eastern Crazy Mountain Basin, Montana. *Contributions from the Museum of Paleontology, The University of Michigan*, 26:157–196.
- KRAUSE, D. W., AND M. C. MAAS. 1990. The biogeographic origins of late Paleocene-early Eocene mammalian immigrants to the Western Interior of North America, p. 71–105. In T. M. Bown and K. D. Rose (eds.), *Dawn of the Age of Mammals in the Northern Part of the Rocky Mountain Interior, North America*. Boulder, Geological Society of America Special Paper, 243.
- KRISHALKA, L. 1976a. Early Tertiary Adapisoricidae and Erinaceidae (Mammalia, Insectivora) of North America. *Bulletin of the Carnegie Museum of Natural History*, 1:1–40.
- KRISHALKA, L. 1976b. North American Nyctitheriidae (Mammalia, Insectivora). *Annals of the Carnegie Museum of Natural History*, 46:7–28.
- LEMOINE, V. 1882. Sur deux Plagioulaux Tertiaires, recuilles aux environs de Reims. *Comptes Rendus de l'Académie des Sciences*, 95:1009–1011.
- LERBEKMO, J. F., AND A. R. SWEET. 2000. Magnetobiostratigraphy of the continental Paleocene in the Calgary area, southwestern Alberta. *Bulletin of Canadian Petroleum Geology*, 48:285–306.
- LINNAEUS, C. 1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus, differentiis, synonymis, locis. Tomus I: Regnum animale. Editio decima, reformata. Laurentii Salvii, Stockholm* [Facsimile reprinted in 1956 by the British Museum of Natural History].
- MACINTYRE, G. T. 1962. *Simpsonictis*, a new genus of viverravine miacid (Mammalia, Carnivora). *American Museum Novitates*, 2118:1–7.
- MACINTYRE, G. T. 1966. The Miacidae (Mammalia, Carnivora), Pt. I, The systematics of *Ictidopappus* and *Protictis*. *Bulletin of the American Museum of Natural History*, 131:115–210.
- MARSH, O. C. 1872. Preliminary description of new Tertiary mammals. *American Journal of Science, Series 3*, 4:122–128.
- MARSH, O. C. 1880. Notice of Jurassic mammals representing two new orders. *American Journal of Science*, 11:425–428.
- MARSH, O. C. 1889. Discovery of Cretaceous Mammalia. *American Journal of Science*, 38:81–92.
- MATTHEW, W. D. 1897. A revision of the Puerco fauna. *Bulletin of the American Museum of Natural History*, 9:259–323.
- MATTHEW, W. D. 1909. The Carnivora and Insectivora of the Bridger Basin, middle Eocene. *Memoirs of the American Museum of Natural History*, 9:291–567.
- MATTHEW, W. D. 1929. Preoccupied names. *Journal of Mammalogy*, 10:171.
- MATTHEW, W. D. 1937. Paleocene faunas of the San Juan Basin, New Mexico. *Transactions of the American Philosophical Society*, 30:1–510.
- MATTHEW, W. D., AND W. GRANGER. 1915. A revision of the lower Eocene Wasatch and Wind River faunas, Pt. IV, Entelonychia, Primates, Insectivora (part). *Bulletin of the American Museum of Natural History*, 34:429–483.
- MATTHEW, W. D., AND W. GRANGER. 1918. A revision of the lower Eocene Wasatch and Wind River faunas, Pt. V, Insectivora (continued), Glires, Edentata. *Bulletin of the American Museum of Natural History*, 38:565–657.
- MATTHEW, W. D., AND W. GRANGER. 1921. New genera of Paleocene mammals. *American Museum Novitates*, 13:1–7.
- McKENNA, M. C. 1968. *Leptacodon*, an American Paleocene nyctitherid (Mammalia, Insectivora). *American Museum Novitates*, 2317:1–12.
- McKENNA, M. C. 1975. Toward a phylogenetic classification of the Mammalia, p. 21–46. In W. P. Luckett and F. S. Szalay (eds.), *Phylogeny of the Primates*. Plenum Press, New York.
- McKENNA, M. C., AND S. K. BELL. 1997. *Classification of Mammals Above the Species Level*. Columbia University Press, New York, 631 p.
- McLEAN, J. R. 1990. Paskapoo Formation, p. 480–481. In D. J. Glass (ed.), *Lexicon of Canadian Stratigraphy, Volume 4, Western Canada*. Canadian Society of Petroleum Geologists, Calgary.
- NOVACEK, M. J. 1977. A review of Paleocene and Eocene Leptictidae (Eutheria, Mammalia) from North America. *PaleoBios*, 24:1–42.
- OSBORN, H. F., AND C. EARLE. 1895. Fossil mammals of the Puerco beds. *Bulletin of the American Museum of Natural History*, 7:1–70.
- PARKER, T. J., AND W. A. HASWELL. 1897. *A Text-Book of Zoology. Volume 2*. Macmillan Press, London, 301 p.
- PATTERSON, B., AND P. O. MCGREW. 1962. A new arctocyonid from the Paleocene of Wyoming. *Breviora*, 174:1–10.
- RIGBY, J. K., JR. 1980. Swain Quarry of the Fort Union Formation, middle Paleocene (Torrejonian), Carbon County, Wyoming: geologic setting and mammalian fauna. *Evolutionary Monographs*, 3:1–179.
- ROBINSON, P., AND L. D. IVY. 1994. Paromomyidae (?Dermoptera) from the Powder River Basin, Wyoming and a discussion of microevolution in closely related species. *University of Wyoming Contributions in Geology*, 30:91–115.
- ROSE, K. D. 1981. The Clarkforkian Land Mammal Age and mammalian faunal composition across the Paleocene-Eocene boundary. *Papers on Paleontology, Museum of Paleontology, The University of Michigan*, 26:1–189.
- ROSE, K. D., AND D. W. KRAUSE. 1982. Cyriacotheriidae, a new family of early Tertiary pantodonts from western North America. *Proceedings of the American Philosophical Society*, 126:26–50.
- RUSSELL, L. S. 1926. A new species of the genus *Catopsalis* Cope from the Paskapoo Formation of Alberta. *American Journal of Science*, 12:230–234.
- RUSSELL, L. S. 1929. Paleocene vertebrates from Alberta. *American Journal of Science*, 17:162–178.
- RUSSELL, L. S. 1932. New data on the Paleocene mammals of Alberta, Canada. *Journal of Mammalogy*, 13:38–54.
- RUSSELL, L. S. 1948. A middle Paleocene mammal tooth from the Foothills of Alberta. *American Journal of Science*, 246:152–156.
- RUSSELL, L. S. 1958. Paleocene mammal teeth from Alberta. *Bulletin of the National Museum of Canada*, 147:96–103.
- RUSSELL, L. S. 1974. Fauna and correlation of the Ravenscrag Formation (Paleocene) of southwestern Saskatchewan. *Contributions from the Royal Ontario Museum Life Sciences*, 102:1–53.
- RUTHERFORD, R. L. 1927. Geology along the Bow River between Cochrane and Kananaskis, Alberta. *Scientific and Industrial Research Council of Alberta Report*, 17:1–29.
- SCHIEBOUT, J. A. 1974. Vertebrate paleontology and paleoecology of Paleocene Black Peaks Formation, Big Bend National Park, Texas. *Bulletin of the Texas Memorial Museum*, 24:1–88.

- SCOTT, C. S. 1997. A new Palaeocene mammal site from Calgary, Alberta. *Journal of Vertebrate Paleontology*, 17, supplement to no. 3:74A.
- SCOTT, C. S., R. C. FOX, AND G. P. YOUZWYSHYN. 2002. New earliest Tiffanian (late Paleocene) mammals from Cochrane 2, southwestern Alberta, Canada. *Acta Palaeontologica Polonica*, 47:691–704.
- SCOTT, W. B. 1892. A revision of the North American Creodonta, with notes on some genera which have been referred to that group. *Proceedings of the Academy of Natural Sciences, Philadelphia*, 44:291–323.
- SECORD, R. 1998. Paleocene mammalian biostratigraphy of the Carbon Basin, southeastern Wyoming, and age constraints on local phases of tectonism. *Rocky Mountain Geology*, 33:119–154.
- SIMONS, E. L. 1972. *Primate Evolution, An Introduction to Man's Place in Nature*. The Macmillan Company, New York, 322 p.
- SIMPSON, G. G. 1927. Mammalian fauna and correlation of the Paskapoo Formation of Alberta. *American Museum Novitates*, 268:2–10.
- SIMPSON, G. G. 1928. A new mammalian fauna from the Fort Union of southern Montana. *American Museum Novitates*, 297:1–15.
- SIMPSON, G. G. 1929. Paleocene and lower Eocene mammals of Europe. *American Museum Novitates*, 354:1–17.
- SIMPSON, G. G. 1935. New Paleocene mammals from the Fort Union of Montana. *Proceedings of the United States National Museum*, 83:221–244.
- SIMPSON, G. G. 1936. A new fauna from the Fort Union of Montana. *American Museum Novitates*, 873:1–27.
- SIMPSON, G. G. 1937. The Fort Union of the Crazy Mountain Field, Montana and its mammalian faunas. *Smithsonian Institution, United States National Museum Bulletin*, 169:1–287.
- SIMPSON, G. G. 1940. Studies on the earliest primates. *Bulletin of the American Museum of Natural History*, 77:185–212.
- SIMPSON, G. G. 1955. The Phenacolemuridae, new family of early primates. *Bulletin of the American Museum of Natural History*, 105:411–442.
- SLOAN, R. E. 1981. Systematics of Paleocene multituberculates from the San Juan Basin, New Mexico, p. 127–160. *In* S. G. Lucas, J. K. Rigby, Jr., and B. Kues (eds.), *Advances in San Juan Basin Paleontology*. University of New Mexico Press, Albuquerque.
- SLOAN, R. E. 1987. Paleocene and latest Cretaceous mammals, rates of sedimentation and evolution, p. 165–200. *In* J. E. Fassett and J. K. Rigby, Jr. (eds.), *The Cretaceous-Tertiary Boundary in the San Juan and Raton Basins, New Mexico and Colorado*. Geological Society of America Special Paper, 209.
- SLOAN, R. E., AND L. VAN VALEN. 1965. Cretaceous mammals from Montana. *Science*, 148:220–227.
- SZALAY, F. S. 1968. The Microdontidae, a family of early primates. *American Museum Novitates*, 2329:1–55.
- SZALAY, F. S. 1969. Mixodectidae, Microsopidae, and the insectivore-primate transition. *Bulletin of the American Museum of Natural History*, 140:193–330.
- SZALAY, F. S., AND E. DELSON. 1979. *Evolutionary History of the Primates*. Academic Press, New York, 580 p.
- TROUESSART, E. L. 1879. *Catalogue des mammifères vivants et fossiles*. *Revue et Magasin de Zoologie*, 7:219–285.
- TROUESSART, E. L. 1897. *Catalogus mammalium tam viventium quam fossilium*, Volume I. R. Friedlander und Sohn, Berlin, 1264 p.
- TROUESSART, E. L. 1904. *Catalogus mammalium tam viventium quam fossilium*. *Quinquennale supplementum*. Berolini, R. Friedlander und Sohn, Berlin, 929 p.
- VAN VALEN, L. 1966. Deltatheridia, a new order of mammals. *Bulletin of the American Museum of Natural History*, 132:1–126.
- VAN VALEN, L. 1967. New Paleocene insectivores and insectivore classification. *Bulletin of the American Museum of Natural History*, 135:221–284.
- VAN VALEN, L. 1978. The beginning of the Age of Mammals. *Evolutionary Theory*, 4:45–80.
- VAN VALEN, L. 1988. Paleocene dinosaurs or Cretaceous ungulates in South America? *Evolutionary Monographs*, 10:1–79.
- VAN VALEN, L. 1994. The origin of the plesiadapid primates and the nature of *Purgatorius*. *Evolutionary Monographs*, 15:1–79.
- VIANEY-LIAUD, M. 1986. Les Multituberculés Thanetiens de France, et leurs rapports avec les Multituberculés Nord-Américains. *Palaeontographica (A)*, 191:85–171.
- WEBB, M. W. 1996. Late Paleocene mammals from central Alberta. Unpublished M.Sc. thesis, University of Alberta, Edmonton, 257 p.
- WEIL, A. 1998. A new species of *Microcosmodon* (Mammalia: Multituberculata) from the Paleocene Tullock Formation of Montana, and an argument for the Microcosmodontinae. *PaleoBios*, 18:1–15.
- WEST, R. M. 1974. New North American middle Eocene nyctitheres (Mammalia, Insectivora). *Journal of Paleontology*, 48:983–987.
- WILLIAMSON, T. E. 1996. The beginning of the Age of Mammals in the San Juan Basin: biostratigraphy and evolution of Paleocene mammals of the Nacimiento Formation. *New Mexico Museum of Natural History Bulletin*, 8:1–141.
- WINGE, H. 1917. Udsigt over Insektaedernes indbyrdes Slaegtskab. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening*, 68:83–203.
- WINTERFELD, G. F. 1982. Mammalian paleontology of the Fort Union Formation (Paleocene), eastern Rock Springs Uplift, Sweetwater County, Wyoming. *Contributions to Geology, University of Wyoming*, 21:73–112.
- WORTMAN, J. L., AND W. D. MATTHEW. 1899. The ancestry of certain members of the Canidae, Viverridae, and Procyonidae. *Bulletin of the American Museum of Natural History*, 12:109–138.
- YOUZWYSHYN, G. P. 1988. Paleocene mammals from near Cochrane, Alberta. Unpublished M.Sc. thesis, University of Alberta, Edmonton, 484 p.