UNIVERSITY OF ALBERTA

MIDDLE PALEOCENE MAMMALS FROM CALGARY, ALBERTA, CANADA

by

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ABSTRACT

A new fossil mammal fauna from Canada is described. The locality, called Who Nose?, occurs in strata pertaining to the Paskapoo Formation, exposed on Nose Creek in northeast Calgary, Alberta. A sedimentological profile suggests deposition was fluviodeltaic in origin, and likely occurred in a channel-fill/oxbow complex. To date, some 400 dental specimens representing nine mammalian orders have been recovered, among them numerous well-preserved jaws. Biostratigraphic correlation suggests a latest Torrejonian age for the fauna based on the presence of the index taxon Pronothodectes matthewi. Faunal compositional analysis indicates a close similarity to the penecontemporaneous Gidley Quarry fauna of Montana. Recent magnetopalynostratigraphic analyses of strata containing the Who Nose? locality resulted in correlation with magnetic anomaly 28r, which correlates instead with early Torrejonian faunas in the Western Interior of the United States. The implied homotaxial diachroneity is here considered improbable, with local geological phenomena likely accounting for the discordant faunal correlation.

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INTRODUCTION

Fossil mammals from Alberta have been known since the early twentieth century and have figured prominently in the understanding of local and regional geology, stratigraphy, and mammalian evolution and paleofaunal composition (Fox, 1990a; Jerzykiewicz, 1997). The widespread distribution of mammalian localities across the province has permitted both intra- and extrabasinal correlations, resulting in reconstructions 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)

Biostratigraphic work in the Calgary and Foothills regions has received comparatively little attention, even though some of the earliest discovered fossil mammal sites in Canada are in this area. A debt is owed to the late Loris S. Russell, who, while working in the vicinity of Calgary and Cochrane in the early 1900's, discovered many of what were to become important fossil mammal sites (Russell, 1926, 1929, 1932a, 1948, 1958; Russell, in Rutherford, 1927; Fox, 1990a). Russell's pioneering fieldwork, descriptions, and subsequent attempts at biocorrelation using mammals were instrumental to the understanding of the local and regional geology, stratigraphy, and early Cenozoic mammal evolution.

This paper reports the results of my study of a new fossil mammal locality from the late Torrejonian of Calgary, Alberta. The site was discovered in 1989 by Dr. Don Brinkman of the Royal Tyrrell Museum of Palaeontology and subsequently brought to the attention of Dr. Richard C. Fox at the Laboratory for Vertebrate Paleontology, University of Alberta. The locality, christened Who Nose?, was first worked in the summer of 1989 by Dr. Fox and a field party from the University of Alberta. Subsequent trips in 1991 and 1996 through 1999 by field parties from the University of Alberta resulted in a large collection of mammal fossils. Since the commencement of excavations at the locality, approximately 400 specimens of have been recovered, among these, over 10 well preserved jaws. Additionally, the locality has yielded fragmentary remains of non-mammalian vertebrates including fish, crocodylians, and amphibians. The specimens from the Who Nose? locality constitute the largest collection of fossil mammals of this age from Canada, and offer a unique perspective on mammalian diversity from an otherwise poorly represented period of time in western Canada.

GEOLOGICAL ASPECTS

Location

The Who Nose? locality is located approximately three km east of Nose Hill in south central Alberta, Canada. The site is located at SW1/4 S23, T25, R1, W5, at approximately 51°08'N and 114°03'W, at approximately 1065m above sea level (Lerbekmo and Sweet, in press). The locality is exposed as a cutbank on the east side of West Nose Creek, some 300m north and upstream of the confluence of the west and north branches of Nose Creek (Figs. 1, 2).

Geological Setting

Regional Geology

Upper Mesozoic and lower Tertiary paralic and continental sediments of western Canada were deposited as a series of transgressive and regressive cycles associated with two depocentres: the Alberta Basin in the west and the Williston Basin in the east, with the two being 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). The 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).

Since Dawson's (1883, 1884) and Tyrrell's (1887) early stratigraphic classifications, an increasingly complex system of formational nomenclature has been used for non-marine strata in the Alberta Basin. Formational names differ throughout the basin and the application of local lithostratigraphic terms and changes in original meanings have hampered attempts at basinwide correlations (Jerzykiewicz, 1997). Tertiary strata of the central plains have been traditionally divided among three units: 1) the upper member of the Scollard Formation; 2) the Porcupine Hills Formation; 3) the Paskapoo Formation (Jerzykiewicz, 1997); fossil mammals are known from all three (Fox, 1990a). Jerzykiewicz (1997) has recently proposed a second order sequence, the Entrance-Paskapoo Sequence, encompassing the aforementioned formations.

Because end-member facies of both the Paskapoo and Porcupine Hills formations appear similar in lithic characteristics, consistent identification and application of nomenclature to these lithologies has always been problematic (Jerzykiewicz, 1997; Lerbekmo and Sweet, in press). As a result, referring the Who Nose? locality to the appropriate formation has proven difficult.

Geographical Distribution of the Paskapoo Formation

The name "Paskapoo Series" has been used for a series of discontinuous outcrops along the Blindman and Red Deer rivers (Paskapoo is the Cree term for "blind man") (Selwyn, 1874; Tyrrell, 1887; Carrigy, 1970). The type locality was not recorded; as such, the Paskapoo Formation is considered a composite (Carrigy, 1970). Strata of the Paskapoo Formation are extensive throughout the central Alberta Plains, comprising most of the surface bedrock (Demchuk and Hills, 1991). The Paskapoo strata are "...preserved in an asymmetrical syncline or homocline" (Carrigy, 1971:15), with steep dips to the west near the Foothills, and low, gradual dips eastwardly. The thickness varies from zero at the erosional edge of the plains, to 240m (787 ft) in the type area, to an excess of 1000m (3280 ft) westward (Carrigy, 1971; McLean, 1990a). Because the upper surface of the formation is the present erosional surface, thicknesses are of little interpretive value (McLean, 1990a). Tyrrell (1887) proposed the term "Paskapoo Series" for outcroppings in the central Alberta Plains region. He correlated this series with the "Porcupine Hills Series" of Dawson (1883), the "Willow Creek Series" and all but the lowest 200m of the "St. Mary's River Series", and proposed that the contact between the "Paskapoo Series" and the underlying "Edmonton Series" represented the Cretaceous-Tertiary boundary (Dawson et al., 1994). The concept of the "Paskapoo Series" was extended to the Foothills region by Russell (1932a), but he was unable to correlate the foothills outcrops directly with the type sections in the Red Deer River Valley. Indeed, Russell (1929, 1932a, 1932b, 1958) considered the outcrops in the foothills of southwestern Alberta a western extension of the "Paskapoo Series", an hypothesis apparently supported by Tozer's (1953, 1956) studies of uppermost Cretaceous and early Tertiary non-marine molluscan faunas. In fact, based on these molluscan assemblages, Tozer (1956) "...arbitrarily defined all Paleocene beds north of Township 13 in western Alberta as Paskapoo, thus obscuring the true relationship between the Porcupine Hills and Paskapoo formations" (Carrigy, 1971:12). Allan and Sanderson (1945) formally recognized the Edmonton and Paskapoo series as separate formations. In extensive studies of the lithostratigraphy and petrography of the uppermost Cretaceous (Lancian) and Paleocene strata of the Alberta Plains, Carrigy (1970, 1971) delimited the Paskapoo Formation from the Porcupine Hills Formation based on petrographic differences, but never established a true boundary, laterally or vertically, between the two (Demchuk and Hills, 1991). Most recently, Demchuk and Hills (1991) subdivided the Paskapoo Formation into three members, but did not elucidate lithostratigraphic differences between any of these units and the Porcupine Hills Formation. Indeed, in recent studies of the urban geology of Calgary, Osborn and Rajewicz (1998) upheld Carrigy's (1970) division of the Paskapoo and Porcupine Hills Formations within Calgary, stating that "...it is likely that both formations occur in Calgary" (Osborn and Rajewicz, 1998:94), but proffered no opinion as to the southern extent of the Paskapoo, the northern extent of the Porcupine Hills, or the overlap, if any, of the two.

Geographical Distribution of the Porcupine Hills Formation

The Porcupine Hills Formation is a relatively narrow strip of non-marine strata running southeast-northwest along the foothills of western Alberta, roughly paralleling the Rocky Mountains and the Alberta-British Columbia border (Youzwyshyn, 1988). The type section for the formation is in the Porcupine Hills, a prominent topographical feature in the southwest corner of the province. The depositional belt is narrow, and ranges in elevation from approximately 1006m (3300 ft.) to 1768m (5800 ft.) above sea level. The western extent of the Porcupine Hills Formation is truncated by a belt of thrust faults located west of the foreland basin (Carrigy, 1971). Northwardly, the unit grades into the Paskapoo Formation at some unknown distance within or north of the city of Calgary (Carrigy, 1971). The Porcupine Hills Formation is laterally equivalent to the east with the Ravenscrag Formation of southeastern Alberta and southern Saskatchewan

(McLean,1990b). The Porcupine Hills Formation forms "...an asymmetrical syncline with 25 degree dips to the east on the western limb, and low dips to the west on the eastern limb." (Carrigy, 1971:12), and reaches a maximum thickness of some 1220m (4000 ft.) in the type area (McLean, 1990b). Dawson (1883) assigned the name "Porcupine Hills Series" to the massive, cross-bedded sandstone and shaly layers cropping out in the Porcupine Hills, and named the underlying beds cropping out in the plains the "Willow Creek Series". Carrigy (1971:17) distinguished the Porcupine Hills Formation from the laterally equivalent Paskapoo Formation on the basis of detailed petrography, and extended the geographical range of the Porcupine Hills Formation from its type area in the southwest corner of the province to "...an unknown distance north of the city of Calgary". Carrigy (1971:17-19) included all vertebrate fossil localities in the Calgary area within the Porcupine Hills Formation, and stated that the "...Porcupine Hills Formation, which overlies the Willow Creek Formation in southwestern Alberta, also overlies the Paskapoo Formation on the Bow River", implying that strata in the Porcupine Hills Formation, at least in the Calgary area, were younger than strata in the Paskapoo Formation. Further, Carrigy (1971) emphasized that the exact geographical location of the lateral boundary between the Porcupine Hills and Paskapoo formations remains problematic. Investigations into vertebrate paleontology (Krause, 1978) and palynology (Jerzykiewicz and Sweet, 1986a, 1986b; Demchuk, 1987, 1990) have since refuted Carrigy's hypothesis regarding the overlap of strata of the Paskapoo Formation by those of the Porcupine Hills Formation, but contributed little to resolving the lateral Porcupine Hills Foramtion–Paskapoo boundary. Recent work in the Calgary area (Osborn and

Rajewicz, 1998) reconfirmed the presence of both Porcupine Hills and Paskapoo strata within the city.

Descriptive Lithology of the Paskapoo Formation

McLean (1990a:481) described strata of the Paskapoo Formation as displaying "...interbedded hard to soft mudstone, siltstone and sandstone, with subordinate limestone, coal, pebble conglomerate and bentonite." Additionally, thin coal beds are present (for example, the Obed-Marsh coal zone northeast of Hinton), and lenses of quartzite pebbles become common westwardly (Locker, 1973). Prominent massively-bedded or disturbed to cross-bedded, buff-weathering, medium to coarse grained sandstones characterize the majority of Paskapoo strata (McLean, 1990a; Demchuk and Hills, 1991), with subordinate chocolate brown to greenish-grey siltstone and mudstone, shale and coal. Conglomerates are a minor constituent (Demchuk and Hills, 1991). Primary sedimentary structures are absent, with the exception of minor trough cross-bedding and rare planar and ripple cross-lamination (Demchuk and Hills, 1991). Demchuk and Hills (1991) recently designated and diagnosed three members of the Paskapoo Formation on the basis of lithologic information retrieved from outcrops and core samples. These members (Haynes, Lacombe, and Dalehurst, in ascending superpositional order) are identifiable in outcrop and are useful in placing isolated outcrops in their proper stratigraphic context.

Descriptive Lithology of the Porcupine Hills Formation

McLean (1990b:503) described strata in the Porcupine Hills Formation as having characteristic "...olive brown shales interbedded with fine to coarse grained brownish grey, cross bedded limy sandstone and calcareous siltstone, in fairly well indurated beds. " Additionally, Carrigy (1971:19) characterized strata in the Porcupine Hills Formation as frequently being "...calcareous siltstones and hard, lenticular, crossbedded calcareous sandstones." Coal zones are absent. Jerzykiewicz and Sweet (1988:35) used the term "caliche" or "calcrete facies" to describe a persistent feature of both the Willow Creek and Porcupine Hills formations in the southeastern Alberta Foothills. Caliche, as described by Jerzykiewicz and Sweet (1988) informally refers to terrestrial calcium carbonate, usually in the form of caliche graebules (Brewer and Sleeman, 1964), rhizocretions (Kindle, 1923) and hardpan. Jerzykiewicz and Sweet (1988) characterized the Porcupine Hills Formation as containing weathering mudstone with small, scattered graebules, and sandstone layers with redeposited caliche debris as a constituent of channel lag deposits. Additionally, the strata may contain authigenic calcium carbonate in the form of pellets, ooids, and pisolites (Jerzykiewicz and Sweet, 1988, figs. 10C, D). Strata of the Porcupine Hills Formation are also characterized by so-called "red beds", pink to red coloured mudstone indicative of warm, semi-arid environments, within which the caliche facies is best developed, although lesser developed caliche features can also occur in grey-green silty to sandy mudstone (Jerzykiewicz and Sweet, 1988). Primary sedimentary structures are common in strata of the Porcupine Hills Formation, particularly trough-type cross stratification.

Formational Affinities of the Who Nose? Locality

The Who Nose? locality crops out on the east bank of West Nose Creek in the northeastern quadrant of Calgary (C. S. Scott, 1997; Lerbekmo and Sweet, in press).

Carrigy (1970, 1971), Osborn and Rajewicz (1998), and Lerbekmo and Sweet (in press) have demonstrated that strata of both the Paskapoo and Porcupine Hills formations crop out within the city; given the lithic similarities of both, the assigning of Paleocene vertebrate fossil localities to one formation or the other has been difficult and often arbitrary. By virtue of Carrigy's (1970, 1971) petrographic work, vertebrate fossil localities within and near the city of Calgary have been assigned to the Porcupine Hills Formation, including Dunbow Road (south of Calgary), Cochrane Sites 1 and 2 (west of Calgary), and R.C.A. Corehole 66-1 (north of Calgary) (Fox, 1990a). The absence of detailed petrographic analyses of these vertebrate-bearing outcrops, however, suggests that the formational assignments of these localities be tentative. I referred the Who Nose? locality to the Haynes member of the Paskapoo Formation of the Paskapoo-Porcupine Hills sequence (sensu Jerzykiewicz, 1997) based on the following criteria:

1) Gross lithologic characteristics of the strata containing the Who Nose? locality are consistent with those of the Paskapoo Formation. These include a richly organic, chocolate brown coloured fossiliferous siltstone/mudstone layer, and massively bedded, buff-weathering sandstone.
2) Lack of primary sedimentary structures.
3) Absence of caliche/calcrete and red-bed facies.
4) Although less compelling, a northerly location of the Who Nose? locality with respect to the type section of the Porcupine Hills Formation suggests a more confident referral to the Paskapoo Formation.

The above criteria can only serve to tentatively assign the Who Nose? locality to the Paskapoo Formation. A lack of sufficient outcrop in the Calgary and Foothills regions makes correlation difficult, if not impossible.

Lerbekmo and Sweet (in press:35), in their discussion of the problems associated with formational nomenclature in the Calgary area, place the Who Nose? locality within the Paleocene portion (upper member) of the Scollard Formation. The authors suggest that the usage of Paskapoo Formation be restricted to the "...youngest strata in the region, including those at Cochrane and northward where thin coals are present in 26r", but emphasize the arbitrary and transitional nature of the formational boundaries. For the present study I prefer to retain the Nose Creek locality within the Paskapoo Formation, in contradiction to the recent work of Lerbekmo and Sweet, on the basis of overall lithic similarity of the Who Nose? locality to sediments of known typical Paskapoo strata in the Red Deer area. Additionally, the use of age-specific criteria for characterizing formational boundaries by Lerbekmo and Sweet do not visually distinguish Scollard strata from Paskapoo strata. Formational units and their boundaries, in a lithostratigraphic sense, are defined by observable lithic criteria and stratigraphic position alone (NACSN, 1983). By using age-specific (biostratigraphic or magnetostratigraphic) criteria to identify formational boundaries, Lerbekmo and Sweet are, in essence, describing biostratigraphic and magnetostratigraphic units respectively. Until more precise lithic criteria are established for separating the Paskapoo, Porcupine Hills, and Scollard formations in the Calgary area, the Who Nose? locality is best referred to the Paskapoo Formation.

Sedimentology

The Who Nose? locality consists of a laterally variable, two meter thick section of siltstone and silty sandstone units with a thin interbedded shell coquina. Four distinct microstratigraphic units are recognized in cross section through the quarry (Fig. 3). Fossil vertebrate remains have been found exclusively in the middle two layers.

The basal unit (unit 1) consists of a coarse lag conglomerate, containing poorly sorted clay and pebble clasts bound by a soft, darkly coloured silty matrix. The lower extent of this basal layer is unknown, because it is poorly exposed throughout the area. The upper contact of this unit is gradational with unit 2.

The lowest fossiliferous unit (unit 2) above the basal lag is a coquina, comprised predominantly of crushed and disarticulated gastropod shells, bound by a soft, brown coloured matrix. The vertical thickness of this unit is variable: at its thickest, unit 2 comprises about 10cm (about 17 percent) of the productive horizon, and seems to thin distal from the main quarry. Vertebrate remains are present, although not as abundant as in the overlying unit. Unit 2 grades vertically into unit 3.

Unit 3 comprises the bulk and most productive portion of the fossiliferous horizons. The unit is composed of argillaceous siltstones, and very fine grained silty sandstones, chocolate brown in colour, weathering to light brown/buff. This horizon is variable in thickness, ranging from less than 10cm to greater than 70cm at its maximum (about 83 percent of the productive horizon). As with unit 2, this horizon tends to thin distally. Primary sedimentary structures are lacking. Vertebrate remains and root traces are abundant in this horizon, with evidence of differential settling (Buckley, 1994).

Unit 4 caps the Who Nose? locality. It consists of massively bedded, brown coloured, medium grained sandstone lacking organic remains. As with the underlying units, the thickness of this unit is laterally variable, ranging from less than 80cm to greater than two meters. Contact with the underlying unit 3 is sharp.

Depositional History

The nature of the Who Nose? deposit is one of fluvial hydraulic transport, as evidenced by the concentration of vertebrate remains, which include wholly aquatic (Amia, Lepisosteus, Esox) and semiaquatic (crocodylians, salamanders, ?albanerpetontids) organisms. The sequence of microstratigraphic units at the Who Nose? locality suggests a deposit of fluviodeltaic origins, with physical processes affecting accumulations, including hydraulic settling and/or winnowing, with slow or pulsed vertical aggredation (Behrensmeyer, 1991). The sedimentological evidence of the Who Nose? deposit indicates three possible depositional models: crevasse splay, floodplain deposit, or channel-fill/oxbow complex. Although all three models can be supported in part by the evidence, the channel-fill/oxbow complex is preferred, because it conforms to the greatest number of lines of evidence.

Crevasse splay deposits are generated when channel flow cuts through a localized breach in channel levees during flooding events, depositing the bedload in sequence along the floodplain, the coarser material being deposited proximal to the breach and finer material being deposited distal to the main channel (Buckley, 1994). It is unlikely that the Who Nose? deposit represents such an event, at least proximal to the splay, because size sorting is prominent (i.e., recovered specimens from the Who Nose? locality are sized-biased towards small-sized specimens). Additionally, sedimentary structures and well-preserved plant fossils, typical of splay deposits, are absent (Behrensmeyer, 1992).

Floodplain deposits are derived from a flooding event, be it a channel breach splay, overbank flooding, or other scenario where the autochthonous clastic component is deposited on areas distal to the main channel. As with the splay scenario, it is unlikely that the Who Nose? deposit represents such an event. Although floodplain deposits are typically lacking in obvious sedimentary structure, small-scale ripple marks are often present. Plant material, paleosol formation, and bioturbation resulting from prolonged aerial exposure are also common. The Who Nose? deposit may have been initially derived from a floodplain environment, with small, more easily transported specimens being washed into an abandoned channel or oxbow lake.

The channel-fill/oxbow complex is the favoured model, because it appears to conform most closely to the sedimentological evidence. A likely model could be:

1) Rapid channel abandonment, likely a neck cut-off, inducing a breach of a neck between two meanders, with the entrance to, and exit from, the meander loop quickly being plugged (Walker and Cant, 1984).
2) Subsequent filling of the resulting oxbow. Autochthonous sediments are deposited from the channel itself or, equally likely, allochthonous sediments from adjacent overbank environments.
3) Sporadic, yet frequent flooding from adjacent channels contributes to the vertical accretion. The resultant fill may be from simple overbank flooding, or distal crevasse splay/levee breach scenarios.

4) Flooding and subsequent filling of the channel is frequent enough to inhibit paleosol formation.

Hypotheses similar to this have been postulated for fossiliferous sites in the Eocene Willwood Formation of Wyoming (Bartels, 1990) and in the Permian Belle Plains and Arroyo formations of Texas (Behrensmeyer, 1988), although the Who Nose? locality does not show evidence of the paleosol formation seen of the latter two units. Although the channel-fill/oxbow complex conforms to the evidence observed at the locality, some important pieces of evidence for the model are lacking, most notably the absence of coarse-grained plugs at the distal ends of the quarry. It should be pointed out, however, that the Who Nose? locality represents only a two-dimensional depiction of a three-dimensional phenomenon, thus obscuring many aspects of the nature of the deposit.

Sedimentation Rates and Temporal Resolution

Estimated sedimentation rates for the middle Paleocene Paskapoo Formation are around 7.5cm/1000 years (Lerbekmo et al., 1992). This suggests that the fossil layer at Who Nose?, at a maximum thickness of 80cm, was deposited in a little under 11000 years, assuming a constant rate of sedimentation. Behrensmeyer (1992) has pointed out, however, that many depositional systems are of considerably longer or shorter durations, depending on sedimentation rate and fluvial processes. Additionally, temporal averaging of such deposits can be on the scale of 10^0–10^4 years. The sorting of specimens at the Who Nose? locality (i.e., the bias towards small-sized specimens) could indicate a greater interaction of fluvial processes and, as such, a greater degree of temporal averaging

(Behrensmeyer, 1992). Contrarily, the preservational state of the specimens and lack of transport abrasion might indicate a more rapid deposition and limited time in transit.

Temporal resolution at the Who Nose? locality is relatively high, because most taxa present are consistent with a late Torrejonian age. Taxa characteristic of this age include, at the generic level, Mesodma, Neoplagiaulax, Ectypodus, Parectypodus, Ptilodus, Anconodon, Leptacodon, Prodiacodon, Protictis, Chriacus and Litomylus (Archibald et al., 1987). Although these taxa are present in the Who Nose? deposit, they are, for the most part, long-ranging, and convey little information regarding fine-scale temporal resolution. More important taxa include Pronothodectes matthewi, Elpidophorus minor, Palenochtha minor, Prothryptacodon albertensis, and Simpsonictis jaynanneae. These taxa are restricted to the late Torrejonian, and as such, are indices for that time interval (Archibald et al., 1987). Many taxa at the Who Nose? locality represent first appearance datums (sensu Woodburne, 1987), indicating evolutionary first occurrences or immigration events. First appearance datums are a powerful tool for temporal resolution in biostratigraphy, particularly the use of concurrent and consecutive first appearance events. Additionally, stratigraphic range extensions at Who Nose? are at a minimum, providing more evidence for a late Torrejonian age and less evidence for significant temporal averaging. Of 55 described taxa, only two (Stygimys sp. 1 and Procerberus sp.) are known to occur exclusively in strata older than those of Who Nose?, and two (Navajovius sp. and Cyriacotherium sp.) occur exclusively in strata younger than those of Who Nose? As many of the taxa from Who Nose? are identified to the generic level only, additional sampling would likely increase temporal resolution.

TAXONOMIC ASPECTS

Techniques of Study

Methods

Fossils from the Who Nose? locality were collected by on-site hand quarrying. Rock matrix was split into dime-sized pieces in an attempt to preserve delicate and possibly articulated specimens. The residual matrix was then 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 rescreened in order to increase fossil yield. After drying, the concentrate was sorted and identifiable elements were removed for identification.

Specimens were photographed using a Zeiss Tessovar macrophotographic unit. The resulting negatives were digitized using a Polaroid Sprint Scanner 35 slide scanner and Adobe Photoshop 5.0 software. The images were printed using a Lexmark Optra L black and white laser printer at a resolution of 600 dpi. Images are as photographed and digital enhancement was restricted to homogenization of background tones.

The superimposition and orientation of tracings of multituberculate p4s follows Krause (1977). The drawings of multituberculate p4s were made by tracing digitized images of specimens using CorelDraw 8.0 software.

Higher level classification follows McKenna and Bell (1997). For completeness and historical interest, original diagnoses of taxa are included for specimens identified confidently or tentatively to species level. Where considered useful, appended diagnoses appear following the original diagnoses. Unpublished taxonomic names appear in quotation marks.

Abbreviations, Definitions, and Symbols

A. Institutions:

AMNH—American Museum of Natural History, New York.

CM—Carnegie Museum of Natural History, Pittsburgh.

KUVP—Museum of Natural History, University of Kansas, Lawrence.

NMMNH—New Mexico Museum of Natural History, Albuquerque.

PU—Museum of Natural History, Princeton University, Princeton. Specimens now housed in the Yale Peabody Museum, Yale University, New Haven.

TMM—Texas Memorial Museum, Austin.

UALVP—Laboratory for Vertebrate Paleontology, University of Alberta, Edmonton.

UMVP—Vertebrate Paleontology Collection, University of Minnesota, Minneapolis.

USNM—Smithsonian Institution, National Museum of Natural History, Washington.

UW—Geological Museum, University of Wyoming, Laramie.

B. Localities:

Rav W-1—Medicine Hat Brick and Tile Quarry, Ravenscrag West-1 horizon.

UADW-1—University of Alberta, Dennis Wighton Locality 1.

UADW-2—University of Alberta, Dennis Wighton Locality 2.

C. Dentitions:

I, i—Upper or lower incisor, respectively.

C, c—Upper or lower canine, respectively.

D, d—Upper or lower deciduous tooth, respectively.

P, p—Upper or lower premolar, respectively.

M, m—Upper or lower molar, respectively.

X, x—Tooth unidentifiable as to position.

L, R—Left or right, respectively.

D. Measurements:

H—Height of tooth, recorded as the "perpendicular distance between [the first true serration] and the baseline." (Krause, 1987:596). Pertaining to multituberculate p4s only.

Length 1—A measure of length along the baseline between perpendiculars drawn from the mesial crown margin and from the first true serration. Pertaining to multituberculate p4s only.

Lg—Maximum mesiodistal length of tooth.

Lg_{ave}—Mean mesiodistal length of tooth.

Lg_{mod}—Modal mesiodistal length of tooth.

TaWd—Maximum labiolingual width of talonid.

TrWd—Maximum labiolingual width of trigonid.

Wd—Maximum labiolingual width of tooth.

E. Statistics:

CV—Coefficient of variation.

M—Mean.

N—Sample size.

OR—Observed range.

P—Parameter.

SD—Standard deviation.

F. Symbols:

*—Indicates the value is an estimate.

G. Definitions:

cf.—Used to indicate tentative taxonomic referral of specimen.

?—When preceding a tooth position or taxonomic name, used to indicate a questionable identification of tooth locus or taxonomic referral of specimen, respectively.

Local fauna—Throughout this work, local fauna as defined by Tedford (1970) refers to mammals from the Who Nose? locality.

Dental Measurements and Terminology

All measurements were made by the author using a Wild M3 Zoom binocular microscope with 10X 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 measurement techniques follow Krause (1982, 1987). The blade-like lower teeth of multituberculates are considered p4s and not "m_bs" of Schiebout (1974) and Sloan (1981). Dental nomenclature and measurements of multituberculate dentitions other than p4 follow Krause (1977, 1982, 1987).

Therian dental nomenclature follows Van Valen (1966) as modified by Szalay (1969). Therian incisor nomenclature follows Gingerich (1976). Therian dental measurement techniques follow Clemens (1966) and Luo (1991). Carnivoran dental nomenclature follows MacIntyre (1966) and Fox and Youzwyshyn (1994). The terms premolariform, semimolariform, and submolariform are used as per Krishtalka (1976a). The terms mesial and distal are used as per Van Valen (1994a).

Systematic Paleontology

Class Mammalia Linnaeus, 1758

Subclass Theriiformes Rowe, 1988

Infraclass Allotheria Marsh, 1880

Order Multituberculata Cope, 1884a

Suborder Cimolodonta McKenna, 1975

Superfamily Ptilodontoidea Cope, 1887

Family Ptilodontidae Cope, 1887

Subfamily Neoplagiaulacinae Ameghino, 1890

Genus Mesodma Jepsen, 1940

Mesodma pygmaea Sloan, 1987

(Fig. 5, A-E; Table 1)

HOLOTYPE: AMNH 35298, incomplete left dentary with p4-m2.

TYPE LOCALITY: Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Montana (type locality [Sloan, 1987]); late Torrejonian of Wyoming (Cedar Mountain [locality UW V-81056], Polecat Bench Formation, southern Bighorn Basin, Hot Springs/Washakie Counties [Hartman, 1986]; Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose, 1981]; Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Rigby, 1980]); late Torrejonian of Texas (Eastern Tornillo Flat [T2; TMM 40147; Middle Peak; Alligator Alley], Black Peaks Formation, Brewster County [Schiebout, 1974]); latest Torrejonian (late middle Paleocene) of Montana (Medicine Rocks Site 1, Tongue River Formation, Ekalaka, Carter County [Gingerich, 1976; Krause, 1987]); latest Torrejonian of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Gunnell, 1989]); earliest Tiffanian (late Paleocene) of Alberta (Aaron's Locality, Paskapoo Formation, Alberta Syncline, Innisfail [pers. obs.]; Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); early Tiffanian (late Paleocene) of Montana (Scarritt Quarry [Simpson's Locality 56], Melville Formation, eastern Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]; early Tiffanian of Wyoming (Saddle Locality, Fort Union Formation, Bison Basin, Fremont County [Gazin, 1956a; Sloan in Holtzman, 1978; Sloan, 1987]); middle Tiffanian (late Paleocene) of Alberta (Joffre Bridge Roadcut Lower Level, Paskapoo Formation, Alberta Syncline, Red Deer [Fox 1990a]; UADW-2 locality, Paskapoo Formation, Alberta Syncline, Blackfalds [Fox, 1990a]); middle Tiffanian (late Paleocene) of North Dakota (Brisbane Locality, Slope Formation, Grant County [Holtzman, 1978]); middle Tiffanian of Wyoming (Hallelujah Hill [locality UW V-77005], Fort Union Formation, east flank Rock Springs Uplift, Sweetwater County [Winterfeld, 1982]); late Tiffanian (late Paleocene) of Alberta (Police Point locality , Ravenscrag Formation, Williston Basin, Elkwater [Krishtalka, 1973]; Swan Hills Site 1 , Paskapoo Formation, Alberta Syncline [Stonley, 1988]); late Tiffanian of Saskatchewan (Roche Percée local fauna , Ravenscrag Formation, Williston Basin [Krause, 1977]).

REFERRED SPECIMENS: UALVP 44051, P4; UALVP 44052, M2; UALVP 44049, 44050, p4s (total: 2); UALVP 44053, 44054, m1s (total: 2).

DIAGNOSIS: "The smallest species of Paleocene multituberculate in North America. Probably derived from Lancian Mesodma hensleighi from which it differs in uniformly smaller size and relatively larger blade" (Sloan, 1987:188).

DESCRIPTION: P4—Cusp formula is (0)2:6:0. In lateral aspect the crown resembles a scalene triangle with the cusps forming a smooth arc distally, creating a convex dorsal margin to the crown. The ultimate cusp is the highest above the base of the enamel. Two cusps are present on a well-defined mesiolabial lobe, and occur nearly opposite the first and second cusps of the medial row. Cusp size increases distally in both the medial and external rows, as do the intercusp ridges and grooves. The enamel overhangs both the mesial and distal roots, particularly the distolingual surface.

p4—p4 has nine (one specimen) or ten (one specimen) serrations; the tooth is low-crowned, being taller mesially than distally. The distal slope of the crown is virtually straight, descending distally from the third serration at a declination of approximately 30-35 degrees from the horizontal. The third serration is highest above the baseline. The exodaeneodont lobe is prominent and peaked ventrally. An incipient serration is present on both specimens; a single labial and lingual ridge descend mesioventrally from the first serration, and join with respective labial and lingual ridges from the second serration just distal to the incipient serration. All serrations, save the last three, possess well-defined ridges that descend mesioventrally along the labial and lingual sides of the crown. The distance between ridges becomes progressively greater distally. The distolabial shelf is formed by a ridge of enamel turning ventrally, and bulging labially, from the ultimate serration; the shelf is short, spanning the mesiodistal length of the ultimate and penultimate serrations only and bears no cusps or cuspules. The mesiobasal concavity is notched for reception of p3.

m1—Cusp formula is 6:4 (mode=6:4). The crowns are quadrate to subquadrate in occlusal aspect. The two rows of cusps faintly diverge distally, and all cusps lean distally. Cusp size increases distally, with the internal row being taller and more robust than the external row. The first cusp in the external row is circular in horizontal section, with the remaining cusps becoming more nearly crescentic distally. The cusps of the internal row are subcrescentic. A single specimen displays incipient conical cuspules at the mesial margin of the crown, mesial to the first cusps of the external and internal rows respectively. The labial surfaces of the internal cusps are worn nearly flat, and possess strong medial grooves that descend into the transverse valley.

COMPARISONS: The Nose Creek specimens compare most favourably with material described from the type locality (Sloan, 1987) and with specimens from the earliest Tiffanian Cochrane Site 2 of Alberta (Youzwyshyn, 1988). Specimens from the Who Nose? locality differ from similar teeth from both of these samples in being slightly smaller (for example, Lg_{ave} p4=2.35 mm, N=2, Who Nose?, as compared to Lg_{ave} p4=2.54 mm, N=9, Cochrane Site 2 [Youzwyshyn, 1988], and Lg_{mod} p4 =2.40 mm, Gidley Quarry [Sloan, 1987]); having fewer p4 serrations (p4 mean serration count=9.5, N=2, Who Nose?, as compared to p4 mean serration count=11, N=9, Cochrane Site 2 [Youzwyshyn, 1988], and p4 modal serration count=10, Gidley Quarry [Sloan, 1987]); and in being slightly more robust. Teeth referred to M. pygmaea from Who Nose? differ further from homologous teeth of the Cochrane Site 2 sample in having lower crowned P4s and p4s. The referred teeth differ from late Tiffanian specimens of M. pygmaea from the Police Point locality, Ravenscrag Formation, Alberta (Krishtalka, 1973) and Roche Percée locality, Ravenscrag Formation, Saskatchewan (Krause, 1977) in being significantly smaller (for example, Lg_{ave} p4=2.35 mm, N=2 from the Who Nose? Locality, as compared to Lg_{ave} p4=2.62 mm, N=11 from Roche Percée [Krause, 1977]); and in having fewer p4 serrations and P4 cusps.

DISCUSSION: Sloan's (1987) diagnosis of M. pygmaea continues the problems associated with Mesodma, namely that the genus cannot be diagnosed effectively by synapomorphies (Buckley, 1994). Rather, the genus is differentiated from other neoplagiaulacines on the basis of plesiomorphic dental characters (such as low p4 profile), and its member species are delimited by size criteria alone.

The teeth from Who Nose? are referred to M. pygmaea on the basis of features described in Sloan's diagnosis, and through comparisons with material from Cretaceous and Paleocene localities in Alberta and Saskatchewan. The specimens from the Who Nose? locality are smaller, more robust in overall proportions, and possess fewer cusps than their Tiffanian counterparts. They are most similar in both qualitative and quantitative characters to the type material from the Gidley Quarry and to specimens from the Cochrane Site 2 locality from Alberta. Additionally, the Nose Creek specimens are close in size and morphology to teeth referred to Lancian M. hensleighi Lillegraven, 1969 from the upper Edmonton Formation, Alberta, but are differentiated from these by possessing higher-crowned p4s with a higher positioned first serration, and in having a more poorly developed mesiolabial lobe with a greater cusp count on P4.

Sloan (1987) proposed an ancestor-descendant relationship between M. hensleighi and M. pygmaea. The similarity of morphologies of teeth from Who Nose? and those of M. hensleighi from Alberta appears to strengthen such an hypothesis. M. pygmaea is a long-ranging taxon, both stratigraphically (late Torrejonian to late Tiffanian) and geographically (Alberta to Texas). The Who Nose? sample represents the earliest occurrence of the taxon in western Canada.

Genus Xyronomys Rigby, 1980

Xyronomys sp.

(Fig. 5, F-K; Table 2)

REFERRED SPECIMENS: UALVP 44055, P4; UALVP 44056, 44057, 44058, p4 fragments.

DESCRIPTION: P4—The crown of UALVP 44085 is subquadrate in occlusal aspect, bearing four cusps on the mesiolabial lobe, and six discernable cusps on the medial row. The crown is exceedingly low in lateral aspect, with almost no drop along the distal margin. Post-mortem breakage and a large wear facet along the distal slope have obscured the original length and proportions of the crown, but the apogee appears to have been the ultimate or penultimate cusp, if an apogee existed at all. The enamel overhangs the mesial and distal roots lingually (moderate mesially, prominent distally).

p4—Two mesial halves and a single distal half constitute the sample of p4s referrable to this taxon. A total serration count is not possible; however, it is estimated that between ten and thirteen serrations were probably present. Serrations become stouter distally, and the antepenultimate and penultimate serrations do not appear to give rise to lingual ridges. The crown is low, with the apogee occurring at the fourth or fifth serration. The height of the first serration is nearly the same height as the remaining serrations. The exodaeneodont lobe is shallow and moderately peaked ventrally. The mesial margin of the crown does not protrude as a distinct "beak"; rather, it is smoothly arcuate, and it bears a single incipient serration. The ridges of the labial and lingual faces progress mesially at an acute angle from the horizontal, and are deflected ventrally as they approach the mesial margin of the crown. Labially, the ridges terminate at the baseline, except the first four, which terminate more dorsally towards the mesial margin of the crown. Distal curvature of the apical crest is slight, with the distal part of the tooth being low. The distolabial shelf is poorly developed and terminates ventral to the antepenultimate serration. The distal root is stout and oriented nearly vertically to the longitudinal axis of the crown and the region between the mesial and distal roots appears to have been horizontal. A notched mesiobasal concavity suggests the presence of a p3 on complete dentaries.

COMPARISONS: The Who Nose? specimens are referred to Xyronomys based on the low p4 profile and poorly developed exodaeneodont lobe, as per Rigby's (1980) diagnosis, and on the low-crowned nature of P4. The Nose Creek sample compares most favourably with descriptions of the type material from the Torrejonian Swain Quarry, Fort Union Formation, Wyoming and specimens from the Puercan Rav W-1 locality, Ravenscrag Formation, Saskatchewan (Johnston and Fox, 1984) in lacking a distinct mesial "beak", poorly developed distolabial shelf, and similar serration counts on p4. The Who Nose? specimens differ from both the Swain Quarry and Rav W-1 specimens, however, in having a better-developed, ventrally peaked exodaeneodont lobe, and a lower distal margin of p4. Additionally, the mesiobasal concavity is shallower on the Who Nose? specimens, and the labial ridges run at a more acute angle from the horizontal.

The single P4 is referred with question, as teeth from this locus are yet to be confidently referred to Xyronomys. Rigby (1980) and Johnston and Fox (1984) discussed the probability of confusing such elements with those of other small neoplagiaulacids, such as Mesodma. Youzwyshyn (1988:39) described an isolated P4, UALVP 24486, from the Cochrane Site 2 locality, and referred it to an unidentified neoplagiaulacid, stating that "...[the] low apical crest...might be predicted on the P4 of a neoplagiaulacid with a low-crowned p4", in reference to the hypothesized P4 morphology of Xyronomys. I concur with this hypothesis, and believe that the morphology of UALVP 44055 may be closer to what would be expected on the P4 of Xyronomys than that seen on UALVP 24486. UALVP 44055 differs from the Cochrane Site 2 specimen in having lower, more gently sloping mesial and distal margins.

DISCUSSION: Because of the paucity of specimens, the extent of variation in the Nose Creek sample cannot yet be ascertained. The aforementioned teeth are therefore referred to Xyronomys sp., rather than to X. swaini Rigby, 1980. The differences in p4 morphology between the Who Nose? specimens and those from Swain Quarry and Rav W-1 are slight, but may prove taxonomically significant upon additional sampling. The more ventrally peaked exodaeneodont lobe on p4 is primitive for the genus, based on Sloan's (1987) hypothesized ancestor-descendant relationship with Mesodma hensleighi.

Rigby originally referred Xyronomys to the Eucosmodontidae, based on a low p4 profile, similar to that observed in p4, Stygimys Sloan and Van Valen, 1965. Johnston and Fox (1984) questioned this referral, based on the absence of eucosmodontid P4s from Swain Quarry, and the possibility of confusing upper dental elements of Xyronomys with those of the diminutive neoplagiaulacid Mesodma. Although far from conclusive, referral of UALVP 44055 to Xyronomys suggests neoplagiaulacid, rather than eucosmodontid affinities, agreeing with Johnston and Fox. Pending further analysis of the Cochrane Site 2 material, the presence of *Xyronomys* sp. from the Who Nose? locality putatively represents the first known occurrence of the taxon in Alberta.

Genus Mimetodon Jepsen, 1940

Mimetodon silberlingi (Simpson, 1935a)

(Fig. 6, A-F; Table 3)

HOLOTYPE: USNM 9798, incomplete left dentary with I1, p4-m2.

TYPE LOCALITY: Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Montana (type locality [Rose, 1981]); late Torrejonian of Wyoming (Cedar Mountain [locality UW V-81056], Polecat Bench Formation, southern Bighorn Basin, Hot Springs/Washakie Counties [Hartman, 1986]); Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose, 1981]); late Torrejonian of Texas (Eastern Tornillo Flat [T2; TMM 40147; Middle Peak; Alligator Alley], Black Peaks Formation, Brewster County [Schiebout, 1974]); latest Torrejonian (late middle Paleocene) of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Gunnell, 1989]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); early Tiffanian (late Paleocene) of Alberta (Hand Hills West Lower Level, Paskapoo Formation, Alberta Syncline, NE of Drumheller [MacDonald, 1996]); middle Tiffanian (late Paleocene) of Alberta (Birchwood locality, Paskapoo Formation, Alberta Syncline, Drayton Valley [Webb, 1996]; Hand Hills West Upper Level, Paskapoo Formation, NE of Drumheller [MacDonald, 1996]; Joffre Bridge Roadcut Lower Level, Paskapoo Formation, Alberta Syncline, Red Deer [Fox, 1990a]; UADW-1 and UADW-2 localities, Paskapoo Formation, Alberta Syncline, Blackfalds [Fox, 1990a]); late Tiffanian (late Paleocene) of Alberta (Police Point locality , Ravenscrag Formation, Williston Basin, Elkwater [Krishtalka, 1973]; Swan Hills Site 1 , Paskapoo Formation, Alberta Syncline [Stonley, 1988]); late Tiffanian of Saskatchewan (Roche Percée local fauna , Ravenscrag Formation, Williston Basin [Krause, 1977]); late Tiffanian of North Dakota (Red Spring locality [L3236], Sentinel Butte Formation, near Riverdale, south of Garrison Dam, Mercer County [Kihm et al., 1993]); late Tiffanian of Texas (Joe's Bonebed [TMM 41366, 41365], Black Peaks Formation, western Tornillo Flat, Brewster County [Schiebout, 1974]); latest Tiffanian (late Paleocene) of Montana (Olive Locality, Tongue River Member, Fort Union Formation, Powder River Basin, Powder River County [Wolberg, 1979]).

REFERRED SPECIMENS: UALVP 44060, 44061, P4s (total: 2); UALVP 44062, 44063, 44064, M1s (total: 3); UALVP 44065, 44066, 44067, p4s (total: 3); UALVP 44069, 44070, 44071, m1s (total:3).

DIAGNOSIS: "Similar to Ectypodus musculus but smaller and more cusps on m1. Size close to ?Ptilodus sinclairi, but m1 significantly longer absolutely and relative to its width and with more cusps. Length p4 3.3 mm. Length m1 2.3 mm. Ratio length p4:length m1

1.4. Length m1:width m1 2.6. Serrations p4 12. Cusps m1 9:5 (or perhaps, counting rudiments, 10:6). Crest of p4 relatively low" (Simpson, 1935a:226).

DESCRIPTION: P4—Cusp formula is (0)2:7-8:0. In lateral profile, the distal slope is nearly straight while the mesial slope is slightly convex. The ultimate and penultimate cusps are subequal in height and are highest from the base of the enamel. In occlusal aspect, the medial row of cusps curves linguolabially. The mesiolabial lobe contains two cusps. Accessory cuspules are absent on both the mesiolabial lobe and the distal slope.

M1—Cusp formula is 7-9:10-12:5-6. The crown is concave ventrally. The internal cusps are subcrescentic to crescentic in horizontal section, and increase in size distally. The first internal cusp is small, barely more than a swelling. The first four cusps of the medial row are subpyramidal and four-sided, and are subequal in size and height. The external cusps are subcrescentic to crescentic in horizontal section, increase in size and height distally, and are rounded labially and flat lingually. The mesial root is similar to Krause's (1977) description, being mesiodistally elongate and transversely flat. The distal root is short and mesiodistally compressed.

p4—p4 has 10 or 11 serrations (mode=10). All specimens bear a single incipient serration. The crown is low in lateral profile with the apogee occurring at the third serration. The topographical features of the referred p4s are nearly identical to those described by Krause (1977) and need not be elaborated on further.

m1—Cusp formula is 7-8:5. The morphology of this tooth position has been adequately described by Krause (1977), and need not be elaborated further.

COMPARISONS: The Nose Creek sample compares most favourably with described teeth referred to M. silberlingi from the type locality (Simpson, 1935a, 1937), and specimens from the Cochrane Site 2 locality of Alberta (Youzwyshyn, 1988), particularly with respect to the low profile of p4, and the robust nature of P4. The sample from Who Nose? differs from those of later Tiffanian M. silberlingi, including the Roche Percée sample (Krause, 1977), in specimens being slightly smaller and in having lower-crowned p4s.

DISCUSSION: M. silberlingi was originally assigned to Ectypodus silberlingi by Simpson (1935a), reassigned to Mesodma silberlingi by Van Valen and Sloan (1966), then finally to M. silberlingi by Schiebout (1974) and Krause (1977). The teeth from the Who Nose? locality are most like those of M. silberlingi from Torrejonian, rather than Tiffanian, localities. The low-crowned lateral profile and less ventrally peaked exodaeneodont lobe on p4 suggest affinities with Lancian Mesodma thompsoni Clemens, 1964, a possible ancestor (Sloan, 1987). M. silberlingi is a long-ranging taxon, both stratigraphically (late Torrejonian to latest Tiffanian) and geographically (Alberta to Texas). The Nose Creek sample represents the earliest discovered occurrence of the taxon in western Canada.

Genus Ectypodus Matthew and Granger, 1921

Ectypodus sp., cf. E. szalayi Sloan, 1981

(Fig. 6, G-H; Table 4)

HOLOTYPE: AMNH 35536, left and right associated dentaries, each with I1-m2.

TYPE LOCALITY: Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Middle Torrejonian (middle Paleocene) of New Mexico (Big Pocket locality [Angels Peak; KUVP Loc. 13; Locality NM 13; NMMNH 2635; UALP 7435, 7436, 75144], Nacimiento Formation, Kutz Canyon, San Juan Basin, San Juan County [Taylor, 1981]); late Torrejonian (middle Paleocene) of Alberta (Cochrane Site 1, Porcupine Hills Formation, Alberta Syncline, Bow River [pers. obs.]); late Torrejonian of Montana (type locality [Rose, 1981]); late Torrejonian of Wyoming (Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Rigby, 1980]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); early Tiffanian (late Paleocene) of Alberta (Hand Hills West Lower Level, Paskapoo Formation, Alberta Syncline, NE of Drumheller [MacDonald, 1996]); middle Tiffanian (late Paleocene) of Alberta (Hand Hills West Upper Level, Paskapoo Formation, NE of Drumheller [MacDonald, 1996]).

REFERRED SPECIMENS: UALVP 44072, 44073, p4s (total: 2).

DIAGNOSIS: "p3 present; m_b [p4] length 2.69 mm, range 2.6-2.8 mm, 10-13 serrations (11 modal); m1 length 1.91 mm, range 1.8-2.0 mm, width 1.0 mm, range 0.9-1.1 mm, cusp formulae 8-9:4-6; m2 length 1.1 mm, range 1.0-1.1 mm, width 1.1 mm, range 1.0-1.1 mm, cusp formulae 4:2-3; m_b [p4]:m1 length ratio 1.33-1.51, modal ratio 1.40" (Sloan, 1981:145).

DESCRIPTION: p4—Serration count is 11 for both specimens. The crown is smoothly arcuate in lateral profile, forming a near symmetrical arc mesiodistally. The apogee of the crown is at the third or fourth serration. The first labial ridge descends mesioventrally and joins with the second labial ridge ventrally, and slightly mesial to, the first serration. Labial and lingual ridges extend mesioventrally in a straight line at a declination of about 45 degrees from the horizontal, and serrations and ridges become more prominent distally. The ultimate and penultimate serrations bear no prominent ridges labially or lingually; the antepenultimate serration bears a moderate ridge labially, but the lingual ridge is abruptly truncated. The exodaeneodont lobe is rounded ventrally, and is mesiodistally elongate. A prominent distolabial shelf is present, bearing no cusps or cuspules. The mesiobasal concavity is relatively deep and clearly notched for reception of p3.

COMPARISONS: The Who Nose? p4s are within measured ranges of the type material (Sloan, 1981, 1987), and appear to generally match the description and figure provided by Sloan (1981) and the figure in Gambaryan and Kielan-Jaworowska (1995). Additionally, the Nose Creek p4s are nearly identical to a single p4 from Cochrane Site 1 of Alberta, referred also to E. sp., cf. E. szalayi (pers. obs.). The p4s from both Who Nose? and Cochrane Site 1 differ from similar referred p4s from Cochrane Site 2 locality of Alberta (Youzwyshyn, 1988) in being slightly smaller and higher crowned; in having a higher first serration; in having a less distinct mesial "beak"; and in possessing a more nearly rounded, less ventrally peaked exodaeneodont lobe.

DISCUSSION: The morphology of the p4s referred to E. sp., cf. E. szalayi from the Who Nose? and Cochrane Site 1 localities is closer to that of the type material from Gidley Quarry than the p4s from Cochrane Site 2, particularly with respect to their smaller sizes and less ventrally peaked exodaeneodont lobes. The Cochrane Site 2 p4s are of a morphology intermediate between that of Torrejonian E. szalayi and late Tiffanian E. powelli Jepsen, 1940, its putative descendant (Sloan, 1987; Youzwyshyn, 1988).

The Who Nose? sample constitutes the earliest discovered occurrence in western Canada of this geographically extensive taxon.

?Ectypodus sp.

(Fig. 7, A-B; Table 5)

REFERRED SPECIMEN: UALVP 44074, p4.

DESCRIPTION: p4—UALVP 44074 (Lg=2.6 mm, Wd=1.7 mm) is small, low-crowned in lateral profile, and bears 10 serrations. In mesial or distal view, the tooth is strongly sinusoidal, with the crown leaning prominently labially. The mesial and distal slopes are smoothly arcuate, forming a subovate crown margin. The mesial crown margin forms a distinct "beak". The labial side of the crown is nearly flat, while the lingual side is moderately convex. The crown possesses ten true serrations and one incipient serration. The first true serration lacks a descending ridge labially, but a short lingual ridge descends mesioventrally, joining with the ridge from the third serration ventral to the incipient serration. The distance between the first and second true serrations is approximately 1.5 times the distance between other adjacent serrations. The labial and lingual ridges descend at a declination of about 40 degrees from the horizontal, and become further apart from one another distally. The penultimate and antepenultimate serrations bear no ridges, and the serrations become larger and more bulbous distally. A prominent distolabial shelf is present, containing a single, tiny cuspule. The enamel near the shelf is crenulated. The exodaeneodont lobe is large and mesiodistally expansive, and the mesiobasal concavity is shallow. The mesial root appears to have been robust, while the distal root is labiolingually flattened and leans mesially.

COMPARISONS: UALVP 44074 is reminiscent of p4s of other small neoplagiaulacids, including those of Mesodma, Mimetodon, and Ectypodus. The relatively high, arcuate profile precludes its referral to Xyronomys, and a relatively high first serration (height of first serration=0.6, 23 percent standard length of crown [Sloan, 1981]) seems to suggest affinities with Ectypodus, rather than Mesodma or Mimetodon. UALVP 44074 further differs from p4s of penecontemporaneous Mesodma pygmaea in being larger, having a less ventrally peaked exodaeneodont lobe, and having a more prominent distolabial shelf. UALVP 44074 is similar to p4s of Mimetodon silberlingi from the Who Nose? locality, but differs in having an exodaeneodont lobe that is mesiodistally long and ventrally rounded, and a more distinct mesial "beak". The Who Nose? p4 most closely approximates descriptions of p4s of Ectypodus szalayi from the Gidley Quarry (Sloan, 1981) and Ectypodus sp., cf. E. szalayi, from the Who Nose? locality. The similar crown profiles, distolabial shelf development, and exodaeneodont lobes suggest, at the very least, affinities to Ectypodus (Sloan, 1981). UALVP 44074 differs from p4, Ectypodus szalayi, primarily in being lower-crowned and having a less symmetrical crown profile.

DISCUSSION: Pending further sampling, UALVP 44074 is best referred to ?Ectypodus, because its morphology is closest to that of p4s referred to Ectypodus szalayi, particularly with respect to its arcuate profile, distolabial shelf development and high first serration. It is, however, relatively low-crowned, perhaps indicating a more primitive grade of development. Additional sampling is required to ascertain the taxonomic significance of UALVP 44074's morphology.

Genus Parectypodus Jepsen, 1930

Parectypodus sp., cf. P. sylviae (Rigby, 1980)

(Fig. 7, C-H; Table 6)

HOLOTYPE: AMNH 100939e, isolated p4.

TYPE LOCALITY: Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County, Wyoming.

KNOWN AGE AND DISTRIBUTION: Middle Torrejonian (middle Paleocene) of New Mexico (Big Pocket locality [Angels Peak; KUVP Loc. 13; Locality NM 13; NMMNH 2635; UALP 7435, 7436, 75144], Nacimiento Formation, Kutz Canyon, San Juan Basin, San Juan County [Taylor, 1981]); late Torrejonian (middle Paleocene) of Montana (Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County [Sloan, 1987]); late Torrejonian of Wyoming (type locality [Rigby, 1980]); latest Torrejonian (late middle Paleocene) of Montana (Medicine Rocks Site 1, Tongue River Formation, Ekalaka, Carter County [Gingerich, 1976; Krause, 1987]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Wyoming (Halfway Hill Locality, Hanna Formation, Carbon Basin, Carbon County [Secord, 1998]).

REFERRED SPECIMENS: UALVP 44235, 44075, P4s (total: 2); UALVP 44077, incomplete dentary with p4-m1; UALVP 44078, 44079, m1s (total: 2).

DIAGNOSIS: "M^b [P4] short, penultimate cusp highest; a steep straight posterior slope. There are 4 major cusps on the external row, with 1-2 small questionable posterior swellings. M_b [p4] is small with an extremely high even arcuate profile and a persistent posterior labial cuspular shelf. Cusp formulae follow: M^b [P4] 4-6:7-9, mode 4:8; M1, 0:11-12:9, mode 0:11:9; M2 1:4:2; M_b [p4] 10-12, mode 11; m1 8-10:5-6, mode 10:6; m2 4:2" (Rigby, 1980:40-41).

DESCRIPTION: P4—Cusp formula is (0)5-6:7:0. In lateral profile, the distal slope is nearly straight while the mesial slope is slightly convex.. The penultimate cusp in the medial row is highest above the base of the enamel. In occlusal aspect, the crown is oriented nearly straight mesiodistally, with little or no labiolingual flexion of the cusp rows. The mesiolabial lobe is faintly developed, and contains no cusps external to the labial row.

p4—In lateral view, the mesial slope resembles a smooth, sweeping arc, creating a near circular profile to the crown. The mesial slope breaks below the baseline of the tooth and descends distoventrally, forming a ventrally peaked, mesiodistally expansive exodaeneodont lobe. The apogee occurs at the third or fourth serration. The distolabial margin of the crown forms a nearly vertically oriented shelf, extending to the baseline of the crown; the shelf contains a large, prominent wear facet. The distances between ridges remain subequal throughout the mesiodistal extent of the crown.

m1—Cusp formula is 8-9:5 (mode=8:5). In occlusal aspect, the crown of m1 is subquadrate. The labial cusps are subcrescentic in cross section, wearing flat apically, and have flat labial and lingual sides. The lingual cusps are more massive than the labial cusps, are subpyramidal, and wear flat apically. The first two lingual cusps are fused at their bases, and wear to form a single, mesiodistally elongate cusp. The ultimate lingual cusp is mesiodistally long. Wear is prominent on the medial side of the lingual cusps, particularly the ultimate cusp.

COMPARISONS: The referred specimens from Who Nose? compare favourably with material described by Rigby (1980) from the Swain Quarry, differing only in the referred p4 having a smoother, more arcuate mesial profile. The referred P4s are more similar to those described and figured by Rigby (1980), and less like those from the Medicine Rocks I locality figured in Sloan (1987). The Swain Quarry and Who Nose? P4s differ from similar teeth from the Medicine Rocks Site I locality in having a steeper distal slope with the apogee of the crown occurring at the penultimate cusp. The referred P4s differ from teeth referred to P. sp., cf. P. sylviae from Cochrane Site 2 in being larger, lacking an external row of cusps; having a less arcuate mesial profile; and in having a steeper, more vertically oriented distal slope.

DISCUSSION: This taxon was originally referred to Ectypodus sylviae by Rigby (1980), and reassigned to P. sylviae by Sloan (1987). Secord (1998) has recently synonymized P. pattersoni Sloan, 1987 from the Shotgun fauna of Wyoming with P. sylviae. The Who Nose? specimens are most similar to the type material as described by Rigby (1980), more so I believe than the material from Cochrane Site 2 (Youzwyshyn, 1988) and from described and figured specimens from Medicine Rocks Site 1 (Sloan, 1987). The Nose Creek sample represents the earliest discovered occurrence of the taxon in western Canada.

Parectypodus "corystes", new species

(Fig. 8, A-F; Table 7)

ETYMOLOGY: corystes, Greek (korystos, adjective, masculine), meaning "helmeted, crested" in allusion to the distinctive lateral profile of p4.

HOLOTYPE: UALVP 40679, incomplete right dentary having p3-4, m1-2.

TYPE LOCALITY: Diss Locality, Coalspur Formation, Alberta Syncline, Alberta.

HYPODIGM: Type specimen and UALVP 44080, 43356, P4s (total: 2); UALVP 24377, 44081, 44082, 44083, p4s (total: 4); UALVP 24541, m1. Hypodigm specimens include those from the Who Nose?, Cochrane Site 2, and Diss localities.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Alberta (Who Nose? locality, Alberta Syncline, Calgary [Scott, 1997]); latest Torrejonian (middle Paleocene) of Alberta (type locality [Fox, 1990a]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]).

DIAGNOSIS: Medium-sized Parectypodus distinguished from all other species of the genus by its unique p4 profile; p4 comparable in size to those of P. vanvaleni Sloan, 1981 and P. sloani Schiebout, 1974, but much smaller than those of P. trovessartianus (Cope,

1882) and P. armstrongi Johnston and Fox, 1984. Differs from P. vanvaleni and P. sloani in p4 being larger, with steeper mesial and distal crown margins, and in having a greater serration count. Differs from p4, P. clemensi Sloan, 1981, P. sinclairi (Simpson, 1935a), P. laytoni (Jepsen, 1940), and P. sylviae in being larger and in having a greater serration count. Distinguished from Eocene species of Parectypodus in retaining p3.

DESCRIPTION: P4—Cusp formula is (0)4:7:0. The crown is subrectangular in occlusal aspect, with the mesial margin truncated labiolingually and nearly perpendicular to the longitudinal axis of the tooth. The mesiolabial lobe is angular labially, not smoothly arcuate, protruding as a triangular extension from the labial side of the medial cusp row. The mesial slope is smoothly convex and arcuate, while the distal slope is steep and slightly concave. The penultimate cusp is highest from the base of the enamel.

p3—The referred tooth is short and peg-like, and leans distally. The apex of the tooth inserts into the mesiobasal concavity of p4.

p4—p4 is high-crowned and arcuate in lateral aspect. The mesial slope forms a semi-circular arc, progressing distally to the fifth or sixth serration; the distal slope gently descends from the apogee at about a 45 degree declination from the horizontal. The mesial slope breaks at the level of the baseline and progresses distoventrally, forming a shallow, mesioventrally elongate exodaeneodont lobe and a moderate "beak" mesially. The crown bears 14 or 15 true serrations, with a single incipient serration; the second or third serration is often offset distally, creating a larger distance between it and the preceding serration. The incipient serration occurs mesial and slightly ventral to the first serration; a short ridge descends mesially from the incipient serration, forming a continuance with the mesial margin. The first serration bears a distinct ridge labially, which terminates just distal to the incipient serration; lingually, the ridge is more prominent and descends mesioventrally in a sinusoidal path until it terminates just mesial and ventral to the incipient serration. The second through twelfth labial ridges are prominent and progress more or less in a gentle mesioventral arc along the face of the crown. The second and third lingual ridges intersect ventral to the first serration; the remaining lingual ridges follow smoothly arcuate mesioventral paths along the face of the crown. The labial and lingual ridges become less prominent and more ventrally truncated distally, with the antepenultimate through ultimate cusps bearing no ridges. Serrations become larger and coarser distally. The distolabial shelf is mesiodistally short and crenulated below the penultimate and ultimate serrations. The mesiobasal concavity is moderately deep.

m1—Cusp formula is 10-11:5. The referred specimens are mesiodistally elongate and subquadrate in occlusal aspect. The cusps of the external row are subcrescentic in horizontal section and are subequal in height, save the last two or three, which are slightly lower. The last four internal cusps are subequal in size and height; the first internal cusp is short, nearly half the height of the remaining four cusps, but is appreciably longer mesiodistally. Grooves are present on the internal faces of both cusp rows.

COMPARISONS: Following Sloan's (1981) criteria, the p4s are assigned to <u>Parectypodus</u> based on:

1) High first serration.

2) The apogee of the apical crest occurring at the fifth serration.
3) The labial height of the enamel at the exodaeneodont lobe being greater than the standard length.
4) The distal angle between the plane of occlusion of m1 and the mesial face of p4 is nearly 90°.

The referred p4s deviate from Sloan's generic diagnosis in having a low p4:m1 ratio (1.38), considerably lower than the suggested 1.8-2.0 values. The referred P4s are questionably assigned to Parectypodus based on:

1) Lg P4 is 81 percent of Lg p4.
2) Mesial slope is short, slightly concave, and relatively steep.
3) Apical crest is slightly arcuate.

The morphology of the referred P4s differs from Sloan's generic diagnosis in having the penultimate cusp, rather than the antepenultimate cusp highest above the base. P. "corystes" is distinguished from congeners as per the diagnosis.

DISCUSSION: Youzwyshyn (1988) described teeth from the Cochrane Site 2 locality of Alberta and referred them to P., new species, but deferred naming and formal diagnosis until a larger sample was obtained. Similar teeth from the Diss locality of Alberta were referred to P., new species by Fox (1990a). Clearly, the specimens from these two localities and from Who Nose? are referable to the same taxon, being quite distinct from other species of Parectypodus.

Youzwyshyn (1988) noted the similarity of morphology between p4, P. "corystes" and that of an unnamed species of Parectypodus from the Puercan Rav W-1 locality of

Saskatchewan (Johnston and Fox, 1984). p4s of these taxa exhibit similarities in length, lateral profile, serration number, and the apogee of the apical crest occurring at the fourth serration. They differ, however, in the Puercan p4 having its greatest height located more mesially relative to the rest of the crown, being higher-crowned, having a higher first serration, and having a larger, more ventrally rounded exodaeneodont lobe (Fig. 4). I believe these differences likely to be taxonomically significant, and as such, do not consider the Puercan p4 as pertaining to P. "corystes".

The morphology of p4, P. "corystes", may be unique among species of Parectypodus in the Tertiary of North America and is not easily derivable from other known species of the genus. p4s of P. clemensi from the Swain Quarry of Wyoming and KU locality 13 of New Mexico generally approximate the condition observed in p4, P. "corystes"; as such, it is likely that P. "corystes" was derived from an ancestor possessing this generalized morphology.

Parectypodus sp., cf. P. new species

(Fig. 9, A-E; Table 8)

REFERRED SPECIMENS: UALVP 44084, P4; UALVP 44085, 44086, p4s (total: 2).

DESCRIPTION: P4—Cusp formula is (0)4:8:0. Laterally, P4 is high-crowned with the penultimate cusp highest from the base of the enamel. The mesial slope is gently concave, while the distal slope is moderately convex. The labial cusp row bears three distinct cusps and one tiny, mesially positioned cuspule. The ultimate labial cusp is transversely opposed to the antepenultimate lingual cusp. Labial cusps are strongly compressed labiolingually. The lingual basal enamel overhangs both labially canted roots.

p4—In lateral profile the crown resembles a high-crowned (H/Lg ratio=0.6) quarter circle with the mesial margin nearly vertically oriented. The apical crest is slightly convex dorsally, and the distal margin descends steeply. p4 has a serration count of 14 with a single incipient serration formed from the mesially directed labial ridge descending from the first true serration. Lingually, the first ridge is short, curves mesioventrally, and joins the third ridge distal to the incipient serration. The second serration bears well-developed labial and lingual ridges: labially, the ridge descends mesioventrally for a short distance and terminates before the first serration; lingually, the ridge descends mesioventrally and joins the third ridge distal to the first serration. Labially, the third ridge descends the crown face past the second ridge, and terminates distal to the first serration and adjacent to the incipient serration. Lingually, the third ridge joins the second and first ridges respectively, then bends abruptly ventrally at the mesial margin of the tooth, joining the fourth ridge well ventral to the first serration. The labial ridge of the fourth serration is abruptly truncated at the second serration. Serrations five through ten bear strong labial and lingual ridges. The valleys between ridges become wider distally. The distolabial shelf is not well developed, being no more than a bulge of the enamel, and the exodaeneodont lobe is dorsoventrally long and peaked ventrally. The mesiobasal concavity is notched for reception of p3.

COMPARISONS AND DISCUSSION: The arcuate profile of p4, as well as a high first serration suggests affinities with Parectypodus. The referred teeth from Who Nose? most likely represent a new species, based on the unique morphology of p4. The features observed in the Nose Creek p4s are, at best, only vaguely similar to those of P. sinclairi and P. laytoni with respect to the mesial profile of the crown. The mesial margin of the Nose Creek p4 is, however, much more vertically oriented than p4s of either of these taxa, and has a higher H/Lg ratio. The single P4 is questionably referred to this taxon based on criteria provided by Sloan (1981), including a short, relatively steep, concave distal slope, a cuspidate external row, and the antepenultimate cusp being highest above the base of the enamel. The generally high-crowned nature of the referred P4 would be predicted to occlude with a similarly high-crowned lower p4. Formal diagnosis is deferred until a larger sample is obtained and the extent of variability can be assessed.

Genus Neoplagiaulax Lemoine, 1882

Neoplagiaulax nelsoni Sloan, 1987

(Fig. 9, F-H; Table 9)

HOLOTYPE: UMVP 6030, left p4.

TYPE LOCALITY: Purgatory Hill, McCone County, Montana.

KNOWN AGE AND DISTRIBUTION: Late Puercan (early Paleocene) of Montana (type locality [Sloan, 1987]); late Torrejonian (middle Paleocene) of Alberta (Diss Locality, Coalspur Formation, Alberta Syncline, Robb [Fox, 1990a]); late Torrejonian of Wyoming (Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose 1981]; Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Rigby, 1980]); latest Torrejonian (late middle Paleocene) of Montana (Medicine Rocks Site 1, Tongue River Formation, near Ekalaka, Carter County [Gingerich, 1976; Krause, 1987]); latest Torrejonian of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Gunnell, 1989]); earliest Tiffanian (late Paleocene) of Alberta (Aaron's Locality, Paskapoo Formation, Alberta Syncline, Innisfail [pers. obs.]; Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); earliest Tiffanian of Wyoming (Halfway Hill Locality, Hanna Formation, Carbon Basin, Carbon County [Secord, 1998]).

REFERRED SPECIMEN: UALVP 44087, P4.

DIAGNOSIS: "This species differs from its larger descendant, N. hunteri in smaller sizes, fewer serrations, and lower cusp formulas. The very largest specimens of N. nelsoni overlap the very smallest specimens of N. hunteri in size and counts, but the mean values are significantly different as are the ages" (Sloan, 1987:188).

DESCRIPTION: P4—Cusp formula is (0)2:9:0. In lateral view, the mesial slope is slightly convex, while the distal slope is moderately concave. The penultimate and antepenultimate cusps are highest above the base of the enamel. The mesiolabial lobe is prominent and contains two cusps, transversely opposed to the second and fourth cusps of the medial row, respectively.

COMPARISONS: The P4 from Who Nose? is referred to Neoplagiaulax based on Sloan's (1981) criteria, including a distal slope that is less steep and a lower number of cusps in the external row relative to P4, Parectypodus. The Nose Creek specimen compares favourably with Sloan' (1987) description of P4s referred to N. nelsoni from the Purgatory Hill locality, with respect to both topographical and statistical criteria. Additionally, UALVP 44087 is similar to P4s referred to N. nelsoni from the Cochrane

Site 2 locality (Youzwyshyn, 1988), differing only in being slightly larger, hence closer to the mean values presented by Sloan (1987).

DISCUSSION: Sloan (1987) hypothesized an ancestor-descendant relationship between N. nelsoni and N. hunteri (Simpson, 1936), citing smaller sizes and lower cusp counts in the former, and noting that the difference in ages of the two taxa was significant. The putative sympatry of N. nelsoni and N. hunteri at Nose Creek, in addition to similar occurrences at the earliest Tiffanian Cochrane Site 2 of Alberta and Douglass Quarry of Montana, refutes the validity of age as a criterion for distinguishing these taxa. Although the sympatry of these taxa does not in itself rule out the ancestor-descendant relationship hypothesized by Sloan, it fails to demonstrate temporal isolation, indicating a divergence prior to the late Torrejonian, and most probably, a more complex evolutionary history.

Neoplagiaulax hunteri (Simpson, 1936)

(Fig. 10, A-F; Table 10)

HOLOTYPE: AMNH 33865, right dentary with i1-m2.

TYPE LOCALITY: Scarritt Quarry (Simpson's Locality 56), Melville Formation, eastern Crazy Mountain Basin, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); early Tiffanian (late Paleocene) of Montana (type locality [Krause and Maas, 1990]); early Tiffanian of North Dakota (X-X Locality [L28], lower Tongue River Formation, Golden Valley County [Hunter, 1999]); middle Tiffanian (late Paleocene) of Alberta (Joffre Bridge Roadcut Lower Level, Paskapoo Formation, Alberta Syncline, Red Deer [Fox 1990a]; UADW-2 locality, Paskapoo Formation, Alberta Syncline, Blackfalds [Fox, 1990a]); middle Tiffanian of North Dakota (Brisbane Locality, Slope Formation, Grant County [Holtzman, 1978]; Judson Locality [L6; L8] Tongue River Formation, Morton County [Holtzman 1978]; Wannagan Creek Quarry, Bullion Creek [Tongue River] Formation, Billings County [Erickson, 1991]); middle Tiffanian of Wyoming (Cedar Point Quarry, Polecat Bench Formation, Bighorn Basin, 9 miles south of Lovell, Big Horn County [Rose, 1981]; Chappo Type Locality [Type Chappo; Chappo Gulch;

Chappo-17], Chappo Member, Wasatch Formation, LaBarge Creek, LaBarge, Lincoln County [Gunnell, 1994]); late Tiffanian (late Paleocene) of Alberta (Police Point locality , Ravenscrag Formation, Williston Basin, Elkwater [Krishtalka, 1973]; Swan Hills Site 1 , Paskapoo Formation, Alberta Syncline [Stonley, 1988]); late Tiffanian of Saskatchewan (Roche Percée local fauna, Ravenscrag Formation, Williston Basin [Krause, 1977]); late Tiffanian of Montana (Circle Locality, Tongue River Formation, Glen Waller Ranch, McCone County [Wolberg, 1979]).

REFERRED SPECIMENS: UALVP 44088, P4; UALVP 44089, m1.

DIAGNOSIS: "Length p4, mean 4.55±0.05 mm, SD 0.2±0.04. Length m1, type, 2.6 mm. Length P4, mean (4 specimens) 3.0 mm. Ratio length p4:length m1, type, 1.8. Ratio length m1:width m1, type, 2.0, one paratype 2.5. Serrations p4 14-16, mode 15. Cusps, shearing edge P4 8-9. Cusps m1, one paratype 8:4" (Simpson, 1936:6).

DESCRIPTION: P4—Cusp formula is (0)1:9:0. In lateral aspect, UALVP 44088 is exceedingly high-crowned, with the antepenultimate cusp furthest from the base of the enamel. The mesial slope is highly convex, while the distal slope is more nearly straight. The mesiolabial lobe is prominent, traversing nearly half the length of the crown. Post-mortem damage has removed the cusp on the mesiolabial lobe; the dimensions of the base of the cusp, however, suggest that it was large, conical, and opposite the third and fourth cusps on the medial row.

m1—Cusp formula is 9:5. The morphology of UALVP 44089 is nearly identical to similar teeth from the Roche Percée locality of Saskatchewan (Krause, 1977), and, as such, offers nothing of significance to the description.

COMPARISONS: The specimens from Nose Creek compare most favourably with similar teeth from the Roche Percée locality of Saskatchewan (Krause, 1977), differing mainly in being slightly smaller (for example, Lg P4=3.1 mm, N=1, Who Nose?, versus Lg_{ave} P4=3.52 mm, N=6, Roche Percée) and in having a fewer cusps in the labial row on m1 (cusp formula=9:5, N=1, Who Nose? versus modal cusp formula=11:4, N=6, Roche Percée). The referred P4 differs further from P4s in the Roche Percée sample, as well as from similarly described teeth from Scarritt Quarry and Douglass Quarry in having the antepenultimate cusp highest from the base of the enamel, as opposed to the ultimate or penultimate cusps (Krause, 1977; Krause and Maas, 1990).

DISCUSSION: The strong similarities in morphology between the Who Nose? specimens and those from the Roche Percée locality likely indicate conspecificity, although the smaller sizes and lower m1 cusp count on the Who Nose? teeth seem to suggest a more primitive grade. *N. hunteri* was originally referred to *Ectypodus hunteri* by Simpson (1936a), then reassigned to its current position by Krause (1977). The Nose Creek sample putatively represents the earliest discovered occurrence of the taxon in western Canada.

cf. Neoplagiaulax sp.

(Fig. 10, G-I; Table 11)

REFERRED SPECIMEN: UALVP 44092, P4.

DESCRIPTION: P4—Cusp formula is (0)0:9:0. UALVP 44092 is high-crowned, with a mildly convex mesial slope and a distinctly concave distal margin. The ultimate cusp is highest from the base of the enamel. A mesiolabial lobe is absent and the medial cusp row is oriented mesiodistally; as such, the tooth has an elongate, labiolingually slender, trenchant appearance in occlusal view.

COMPARISONS AND DISCUSSION: UALVP 44092 is tentatively referred to Neoplagiaulax, based on the criteria of Sloan (1981) and on structural similarity to P4s of penecontemporaneous N. nelsoni from both the Who Nose? locality and the Cochrane Site 2 locality. The Nose Creek specimen, however, is distinctly different than P4s of this taxon, in being considerably more slender and gracile, in lacking an external cusp row, and in being more mesiodistally elongate. These differences most likely preclude conspecific referral, and may be significant at the generic level. Additional sampling is required to elucidate the affinities of this taxon. An identical uncatalogued P4 from the Diss locality of Alberta indicates a distribution for this taxon north of the Who Nose? locality (pers. obs.).

?Neoplagiaulax sp.

(Fig. 11, A-B; Table 12)

REFERRED SPECIMENS: UALVP 44090, 44091, p4s (total: 2).

DESCRIPTION: p4—Serration count is 13. In lateral view, the crown is relatively arcuate mesially, with the apogee of the apical crest occurring between the third and sixth serrations. The distal slope is nearly straight, descending from the sixth serration at a declination of about 35 degrees from the longitudinal axis of the tooth. The base and top of the crown are nearly parallel, creating a subtrapezoidal shape to the tooth. The labial ridges descend mesioventrally in a smoothly arcuate manner; the first serration lacks a labial ridge. The second through eleventh serrations bear ridges that are more or less equidistant from one another. Lingually, the first ridge joins the second ridge ventral and mesial to the first serration, while the second through ninth ridges descend mesioventrally at a relatively acute angle to the longitudinal axis of the tooth. Serrations become larger and more bulbous distally. The exodaeneodont lobe is mesiodistally compressed and distinctly v-shaped ventrally. The distolabial shelf is moderately developed, formed from a labial swelling of the enamel at the ultimate serration, and bears heavy apical wear. The mesiobasal concavity is moderately deep.

COMPARISONS AND DISCUSSION: UALVP 44090 and 44091 are referred with question to Neoplagiaulax based on the following criteria (Sloan, 1981):

1) H/Lg ratio of 0.36, within range of p4s, Neoplagiaulax and p4s, Ectypodus, but smaller than p4s, Parectypodus, and larger than p4s, Mesodma and Mimetodon.
2) Relative height of the first serration is greater than one-third the standard length of the tooth.
3) Labial height at the exodaeneodont lobe is less than the standard length of the tooth.
4) Weakly developed distolabial shelf.

The referred p4s are closest in morphology to p4s of Ectypodus powelli Jepsen, 1940 from the Roche Percée fauna of Saskatchewan, and to described and figured p4s of Neoplagiaulax macrotomeus Wilson, 1956 from the Little Pocket locality of the San Juan Basin, New Mexico (Sloan, 1987). p4s of both of these taxa are low-crowned, with a relatively straight distal margin. The Nose Creek p4s are closer to similar teeth of E. powelli in size, but are closer to those of N. macrotomeus in overall morphology. Krause (1977) pointed out the difficulties in distinguishing isolated p4s of Ectypodus and Neoplagiaulax, but stated that in p4, Neoplagiaulax, the apogee generally occurs at the fifth, sixth, or seventh serrations, as compared to the fourth serration in p4, Ectypodus. With this criterion and the aforementioned criteria of Sloan (1981), the Nose Creek specimens are referred with question to Neoplagiaulax with the recognition that additional sampling may result in an alternative referral.

Neoplagiaulacinae, genus and species unidentified

(Fig. 11, C-E)

REFERRED SPECIMENS: UALVP 44093, 44094, P4 fragments.

DESCRIPTION: P4—Both UALVP 44093 and 44094 preserve the distal portions of teeth from the P4 locus of a small neoplagiaulacid multituberculate. UALVP 44094, the better preserved of the two, preserves the final three cusps and the distal slope. The antepenultimate and penultimate cusps are conical and subequal in height; the ultimate cusp is conical and greatly hypertrophied, nearly twice the height and width of the preceding two cusps. The distal margin of the crown is smoothly concave, and flares lingually, producing a large enamelous expansion. This distolingual expansion is worn nearly flat in one specimen, and apical wear is noted on the lingual side and dorsal surface of the ultimate cusps in both specimens.

COMPARISONS AND DISCUSSION: Insofar as I am aware, the morphology of these teeth is unique among neoplagiaulacids, and likely represents a new taxon. The concave distal margin seems to preclude referral to Ectypodus, and the subequal, non-arcuate nature of the mesial slope seems to negate referral to Parectypodus or Neoplagiaulax (Sloan, 1981). The straight, low-crowned nature of these specimens probably occluded with a low-crowned p4, such as that seen in Xyronomys or Stygimys; the morphology of these specimens, however, is quite different than that seen in P4s referred to Xyronomys sp. from Who Nose?, and considerably different from P4s of typical eucosmodontids.

The paucity of specimens permits only subfamilial referral, with the anticipation that further collecting will allow a more precise estimate of taxonomic affinity.

Subfamily Ptilodontinae Cope, 1887

Genus Ptilodus Cope, 1881a

Ptilodus "gnomus" Youzwyshyn, 1988

(Fig. 11, F-G; Table 13)

HOLOTYPE: UALVP 18669, left P4.

TYPE LOCALITY: Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River, southwestern Alberta.

KNOWN AGE AND DISTRIBUTION: Earliest Tiffanian (late Paleocene) of Alberta (Aaron's Locality, Paskapoo Formation, Alberta Syncline, Innisfail [pers. obs.]; type locality [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); Scarritt Quarry [Simpson's Locality 56], Melville Formation, eastern Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); early Tiffanian of Wyoming (Saddle Locality, Fort Union Formation, Bison Basin, Fremont County [Gazin, 1956a; Sloan in Holtzman, 1978; Sloan, 1987]).

REFERRED SPECIMENS: UALVP 44262, P2; UALVP 44260, P3; UALVP 44261, M1; UALVP 44095, M2; UALVP 44096, p4; UALVP 44097, m1.

DIAGNOSIS: "P4 differs from P4 in all other species of Ptilodus in being substantially smaller (approximately 20 percent smaller than P4 of P. fractus Dorr, 1952, the smallest recognized species of the genus [Krause, 1982]). Further differs from P. fractus in possessing a teardrop-shaped P4; higher, more arcuate, crown on p4, with less obtuse and more evenly curved slope along the anterior margin; p4s with anterobasal concavity truncating to a peak dorsally; and consistently bears at least one fewer serration on p4 (11, five specimens; 10, one specimen) compared with P. fractus (12, two specimens)" (Youzwyshyn, 1988:47).

DESCRIPTION: P2, P3—Cusp number is four or five. The morphologies of these teeth are of typical ptilodontid condition, similar to those described by Youzwyshyn (1988). The Nose Creek specimens are of comparable size to the Cochrane Site 2 material.

M2—Cusp formula is 1:3:4. Notwithstanding the extra cusp in the lingual row, the referred specimen is identical in morphology to similar teeth from the Cochrane Site 2 locality. Nothing further need be added to Youzwyshyn's (1988) description.

p4—Serration count is estimated to be 11 with a single incipient serration. In lateral profile, the apical crest is nearly symmetrical and arcuate throughout its extent, ascending smoothly from the top of the mesiobasal concavity and reaching the apogee at the fourth or fifth serration. The distal margin descends from the apogee in roughly the same manner as the mesial slope, creating the strongly symmetrical appearance of the crown. The crown margin turns distoventrally from the mesiobasal concavity, forming a moderately wide exodaeneodont lobe; the distoventral enamel margin overhangs the distal root, creating the characteristic kidney-shaped crown profile typical of ptilodontid p4s. The mesial labial and lingual ridges are obscured by post-mortem abrasion, but appear to increase in distance from adjacent ridges distally. The ultimate and penultimate serrations bear no ridges, and serrations become larger and more bulbous distally. A small distolabial shelf is present, and the mesiobasal concavity is moderately peaked dorsally.

m1—Cusp formula is 6:4. In occlusal aspect, the referred m1 is rectangular in shape. The labial cusps are nearly pyramidal in longitudinal section, while the lingual cusps are subcrescentic. The labial faces of the lingual cusps are deeply grooved.

COMPARISONS: The referred specimens are nearly identical to similar teeth from Cochrane Site 2. The p4 from Nose Creek differs from p4s of the hypodigm in being slightly smaller (for example, Lg p4=5.3 mm, N=1, Who Nose? versus Lg_{ave} p4=5.46 mm, N=8, Cochrane Site 2), in having a mesiodistally narrower exodaeneodont lobe, and in having a more distinct mesial "beak".

DISCUSSION: The Who Nose? specimens are best referred to P. "gnomus", being nearly identical to similar teeth from the Cochrane Site 2 locality of Alberta. The slight differences in p4 morphology are accommodated by the variation in the hypodigm from Cochrane Site 2. The Who Nose? sample represents the earliest occurrence of the taxon, and indicates an origin earlier in the Torrejonian or Puercan.

Ptilodus montanus Douglass, 1908

(Fig. 12, A-F; Table 14)

HOLOTYPE: CM 1673, incomplete left dentary with p4-m1.

TYPE LOCALITY: Silberling Quarry (Simpson's Locality 1; Fish Creek; Bear Butte; Widdecombe Creek; Widdecombe Ranch), upper Lebo Formation, Crazy Mountain Basin, near Bear Butte, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Torrejonian (middle Paleocene) of Montana (School Well locality, Ludlow Member of the Fort Union Formation, Williston Basin, Glendive, Dawson County [Hunter et al., 1997]); late Torrejonian (middle Paleocene) of Montana (Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County [Sloan, 1987]; type locality [Simpson, 1937]; Upper Lebo Locality 50, upper Lebo Formation, Crazy Mountain Basin, Sweetgrass County [Simpson, 1937]; Upper Lebo Locality 51, upper Lebo Formation, Crazy Mountain Basin, Sweetgrass County [Simpson, 1937]); late Torrejonian of Wyoming (Little Muddy Creek Locality, Evanston Formation, Niobrara County [Gunnell, 1989]).

REFERRED SPECIMENS: UALVP 44098, 44099, 44100, 44101, P1s (total: 4); UALVP 44102, 44103, 44104, 44105, 44106, P2s (total: 5); UALVP 44107, P3; UALVP 44108, 44110, P4s (total: 2); UALVP 44111, M2; UALVP 44112, i1; UALVP 44113, 44114, incomplete dentaries with p4-m1 (total: 2); UALVP 44115, 44116, 44117, 44118, p4s (total: 4); UALVP 44119, 44120, 44121, 44122, m1s (total: 4); UALVP 44123, 44124, m2s (total: 2).

DIAGNOSIS: "Crown of p4 semi-elliptical in a lateral view; crown not high, and upper portion of cutting-edge not extremely convex; eleven distinct and two posterior indistinct ridges on the crown; m1 nearly one half the length of P4, with four external and six internal tubercles; anterior portion of the tooth narrower than posterior portion" (Douglass, 1908:14-15).

APPENDED DIAGNOSIS: "Medium sized species of Ptilodus, much smaller than P. titanus and much larger than P. tsosiensis, P. kummae, and P. fractus. Differs from P. mediaevus in having a relatively low-crowned p4 and relatively small anterior upper premolars (P1-3). Differs from P. wyomingensis in slightly larger size and in having a more evenly arched profile of p4. Differs from P. cedrus in consistently possessing fewer cusps in the lingual row of m1 and usually having fewer cusps at other tooth positions as well" (Krause, 1982:104).

DESCRIPTION AND COMPARISONS: P1, P2, P3—The referred mesial premolars are of typical ptilodontid morphology, and are most similar to those of P. montanus and P. mediaevus Cope, 1881a. Modal cusp values are as follows: P1 (2:1); P2 (2:2); P3 (3:3). The reduced nature of these premolars, relative to those of P. mediaevus, suggest affinities with P. montanus (Krause, 1982).

P4—Cusp formula is (2)*8:*9:0. The Nose Creek specimens are of typical ptilodontid morphology, being uniformly low-crowned and bearing large, coarse cusps. UALVP 44108, the most nearly complete specimen, bears a mesiolabial lobe supporting two prominent cusps labial to the external row. The referred specimens are similar to P4s of both P. mediaevus from the Swain Quarry of Wyoming (Rigby, 1980) and P. montanus; they are, however, smaller and display less robust proportions relative to homologous teeth of P. mediaevus, and as such are referred to P. montanus.

Lower dentition—The referred lower dentition is nearly identical to similar teeth from Gidley and Silberling Quarries of Montana assigned to P. montanus (Simpson, 1937; Krause, 1982). The referred p4s have a modal serration count of 15, are lower-crowned, and display a more nearly kidney-shaped lateral profile than homologous teeth of P. mediaevus. Of special note, one specimen possesses an incipient serration, a feature typical of p4s of Baiotomeus Krause, 1987. Insofar as I am aware, this is the first documented occurrence of an incipient serration on p4s referred to P. montanus.

DISCUSSION: The referred teeth from Who Nose? are nearly inseparable from similar dental elements from Silberling and Gidley Quarries of Montana. Statistically, the Who Nose? specimens are closer to the recorded sizes of the Silberling Quarry teeth, being smaller than those from Gidley Quarry.

P. montanus is represented in late Torrejonian and middle to late Tiffanian faunas in the United States. Gunnell (1994) has recently reassigned the Tiffanian occurrences of P. montanus to P. "cedrus" Krause, 1982, thus restricting the taxon to the late Torrejonian; as such, P. montanus may prove useful in biostratigraphic correlations.

The sample of P. montanus at the Who Nose? locality constitutes the first discovered occurrence of the taxon in Canada.

Ptilodus sp., cf. P. wyomingensis Jepsen, 1940

(Fig. 12, G-I; Table 15)

HOLOTYPE: PU 14219, incomplete right dentary with p3-m1 and alveolus for i1.

TYPE LOCALITY: Rock Bench Quarry, Fort Union Formation, Bighorn Basin, Fremont County, Wyoming.

KNOWN AGE AND DISTRIBUTION: late Torrejonian (middle Paleocene) of Wyoming (type locality [Rose 1981]); latest Torrejonian (late middle Paleocene) of Montana (Medicine Rocks Site 1, Tongue River Formation, Ekalaka, Carter County [Gingerich, 1976; Krause, 1987]); middle Tiffanian (late Paleocene) of North Dakota (Judson Locality [L6; L8] Tongue River Formation, Morton County [Holtzman 1978]; Wannagan Creek Quarry, Bullion Creek [Tongue River] Formation, Billings County [Erickson, 1991]).

REFERRED SPECIMENS: UALVP 44125 (fragment), 44126, P4s (total: 2).

DIAGNOSIS: "Very long i-p3 diastema. Incisor crown angulate along superior internal edge. Incisor crown ridged on superior labial edge. Root ends beneath p4. Crown of p3 has enamel only on supra-anterior face, and 1 ridgeform cusp, no anterior groove. 13-15 serrations on p4" (Jepsen, 1940:284).

APPENDED DIAGNOSIS: "Medium-sized species of Ptilodus, much smaller than P. titanus and much larger than P. tsosiensis, P. kummae, and P. fractus. Differs from P. mediaevus in having a relatively low-crowned p4 and relatively small upper premolars (P1-3). Differs from P. montanus in slightly smaller size and in having a more posteriorly canted profile of p4. Differs from P. cedrus in consistently possessing fewer cusps in lingual row of m1 and in usually having fewer cusps at other tooth positions as well" (Krause, 1982:118-119).

DESCRIPTION: P4—Cusp formula is (2)6:10:0. The crown is mesiodistally straight in occlusal aspect. The external row is smoothly and subtly convex labially, while the internal row is more nearly mesiodistally straight. A prominent, yet short mesiolabial lobe is present, terminating at the fourth cusp in the internal row, and between the second and third cusps of the external row. The mesiolabial lobe contains a small cuspule mesially, followed by a larger cusp distolabial in position with respect to the cuspule. The external cusp row traverses nearly the length of the crown, terminating at the eighth cusp of the internal row. The external row consists of six, relatively irregularly spaced cusps; the first two cusps are large and robust, the second being considerably larger than the first and remaining four, while the last four cusps are subequal in height. The internal row consisits of ten cusps, more or less subequal in height and equidistant from each other. All cusps are conical; those of the internal row and first three of the external row have mesiodistally directed crests traversing the intercusp valleys. The lingual face of the crown is relatively flat, and the basal margin enamel is smooth. The enamel of the apical part of the crown is somewhat crenulated. The mesial root is wide, while the distal root is mesiodistally stout and labiolingually compressed.

COMPARISONS: The referred specimens are morphologically similar to P4s of P. wyomingensis from the Rock Bench Quarry of Wyoming, and to P4s of P. kummae Krause, 1977 from the Roche Percée locality of Saskatchewan. UALVP 44126 differs from P4s assigned to P. kummae in having a more prominent mesiolabial lobe containing cusps. The Nose Creek specimens appear to approximate descriptions of the type material (Krause, 1982, 1987) and similar P4s from the Medicine Rocks localities of Montana (Krause, 1987) and Judson locality of North Dakota (Holtzman, 1978). The Nose Creek specimens differ plesiomorphically from P4s from these localities in retaining a more prominent mesiolabial lobe. Referral to P. wyomingensis is tentative, as the small sample size cannot effectively dismiss the similarity of morphology to P4s of other species of Ptilodus, particularly those of P. kummae.

DISCUSSION: The putative presence of this taxon at the Who Nose? locality may document the first sympatric occurrence of both P. wyomingensis and P. montanus. Krause's (1987) use of ptilodontid multituberculates as age estimators of late Torrejonian localities in Montana and Wyoming may be less valid in light of the evidence from Who Nose?.

Genus Baiotomeus Krause, 1987

Baiotomeus "rhothonion", new species

(Fig. 13, A-G; Table 16)

ETYMOLOGY: rhothonion, Greek (rhothonion, masculine), meaning small nose, in reference to the Nose Creek adjacent to the type locality and in allusion to the diminutive size of the species.

HOLOTYPE: UALVP 44132, left p4.

TYPE LOCALITY: Who Nose? Locality, Paskapoo Formation, Alberta Syncline, Calgary, Alberta.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Alberta (Calgary 2E/7E localities, Porcupine Hills Formation, Alberta Syncline, Elbow River [pers. obs.]; Cochrane Site 1, Porcupine Hills Formation, Alberta Syncline, Bow River [pers. obs.]; type locality [Scott, 1997]).

HYPODIGM: UALVP 44127, 44128, 44129, 44130, P4s (total: 4); UALVP 44131, M1; UALVP 44132, NMC 9103, p4s (total: 2); UALVP 44133, 44134, m1s (total: 2). Hypodigm includes specimens from the Who Nose? and Calgary 2E/7E localities.

DIAGNOSIS: Smallest species of the genus, p4 length approximately 57 percent smaller than that of B. douglassi (Simpson, 1935a), 51 percent smaller than that of B. lamberti Krause, 1987, and 20 percent smaller than that of B. "russelli" Youzwyshyn, 1988; Lg p4:Lg m1 =1.61, smallest ratio for the genus. Differs further from all other species of Baiotomeus in possessing a p4 with a more smoothly arcuate profile and lower serration count.

DESCRIPTION: P4—Cusp formula is (0-1):4-5:8-9:0 (mode=(0):5:8:0). In occlusal aspect, the crown is subquadrate; both the external and internal cusp rows are slightly convex labially, and appear to converge mesially. A weak mesiolabial lobe is present, housing a tiny, conical cusp on one specimen. The cusps of the external row are larger and more robust than those of the internal row, conical, and bear prominent mesiodistally directed ridges in the intercusp valleys. The second and third cusps of the external row are the largest, and cusps decrease in size and height distally. The cusps of the internal row are conical and increase in size and height distally. The crown is low throughout its mesiodistal extent. Wrinkling of the enamel is noted on the labial faces of the cusps and wear appears prominently in some specimens at the distal end of the crown, forming apical and interstitial facets, particularly at the distalmost margin.

M1—Cusp formula is 6:8:3. The referred specimen is of typical ptilodontid morphology, being teardrop-shaped in occlusal aspect, and somewhat concave dorsally. The external cusp row bears six cusps that are conical mesially, but become more nearly pyramidal distally. The antepenultimate cusp is the largest and highest cusp in this row. The cusps of the medial row are pyramidal to subquadrate mesially and become subcrescentic distally. The ultimate cusp in the medial row is the tallest on the crown. The internal cusp row bears three distinct cusps mesially and one cuspule distally. The cusps of this row increase in height mesiodistally and the mesial margin is somewhat papillate.

p4—Serration count is 11. In lateral profile, p4 is smoothly arcuate mesially, with the apical crest progressing to its full height at the fourth serration, whereupon it descends gently, in a relatively straight manner. The distal margin of the crown is not vaulted, as in p4, Ptilodus or Prochetodon (Krause, 1987). The apical crest contains 11 serrations and one incipient serration. Labially, the first ridge descends mesioventrally, forming the mesial margin of the crown, and terminates approximately halfway between the dorsal margin of the mesiobasal concavity and the first serration. The second ridge is short, descending somewhat obliquely mesioventrally, nearly forming the apical margin between the first and second serrations. The second ridge terminates ventral to the first serration. The third through ninth serrations bear strong labial ridges that progress mesioventrally at about a 45 degree declination from the longitudinal axis of the tooth; the ridges span nearly the entire length of the crown, terminating progressively lower towards the exodaeneodont lobe at the mesial margin of the tooth. Serrations 10 and 11 are more nearly conical, and bear no ridges labially or lingually. An aberrant ridge is present on the enamel between the mesial and distal roots, ventral to the ninth ridge. Lingually, the first and second ridges join one another mesioventral to the first serration. Ridges one through six terminate far mesially near the mesiobasal concavity. All serrations become larger and more bulbous distally. The distolabial shelf is poorly developed, formed at the distalmost margin of the crown and terminating ventral to the tenth serration. The enamel is moderately wrinkled at the level of the shelf. The exodaeneodont lobe is ventrally long and pointed, forming a distinct "V". The mesiobasal concavity is deep and short, and truncated dorsally with a prominent overhanging of enamel.

m1—Cusp formula is 6:4. The referred specimens are of typical ptilodontid morphology. The first two cusps of the external row are conical, while the remaining four are variably subcrescentic to crescentic in horizontal section. The internal cusps are nearly conical. The crown is somewhat dorsally flexed in lateral aspect.

COMPARISONS: The aforementioned specimens are best referred to Baiotomeus, following the criteria of Krause (1987), including:

1) p4 profile is low and unvaulted distally.
2) Presence of an incipient serration on p4 (but see p4, Ptilodus montanus, this paper).
3) Prominent and ventrally angular exodaeneodont lobe on p4.
4) P4 with poorly developed mesiolabial lobe.
5) P4 with well-developed labial cusp row (in terms of both size of cusps and completeness of the row).
6) Lg p4: Lg m1 lower than in Ptilodus or Prochetodon.

The Nose Creek specimens are referred to B. "rhothonion", new species, following the criteria of the diagnosis.

DISCUSSION: The distinctive p4 profile and diminutive nature of the referred specimens clearly separate this taxon from other species of Baiotomeus. Youzwyshyn (1988) referred material from the Cochrane Site 2 locality of Alberta to B. "russelli", new species, noting its diminutive size. The referred elements of B. "rhothonion", nearly 20 percent smaller than those of B. "russelli", may be of ideal ancestral morphology to the latter, requiring only increases in overall size, serration count and cusp count to achieve a B. "russelli"-like morphology.

B. "rhothonion" represents 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)

(Fig. 14, A-B; Table 17)

HOLOTYPE: UALVP 129, left p4.

TYPE LOCALITY: Cochrane Site 1, Porcupine Hills Formation, Cochrane, Bow River, Alberta.

KNOWN AGE AND DISTRIBUTION: late Torrejonian (middle Paleocene) of Alberta (Calgary 2E/7E localities, Porcupine Hills Formation, Alberta Syncline, Elbow River [Fox 1990a]); late Torrejonian of Montana (Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County [Sloan, 1987]; Silberling Quarry [Simpson's Locality 1; Fish Creek; Bear Butte; Widdecombe Creek; Widdecombe Ranch], upper Lebo Formation, Crazy Mountain Basin, near Bear Butte, Sweetgrass County [Simpson, 1937]); late Torrejonian of Wyoming (Cedar Mountain [localities UW V-82004, UW V-81054, UW V-82015], Polecat Bench Formation, southern Bighorn Basin, Hot Springs/Washakie Counties [Hartman, 1986]; Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose 1981]); earliest Tiffanian (late Paleocene) of Alberta (Aaron's Locality, Paskapoo Formation, Alberta Syncline, Innisfail [pers. obs.]; Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Douglass

Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); early Tiffanian (late Paleocene) of Wyoming (Saddle Locality, Fort Union Formation, Bison Basin, Fremont County [Gazin, 1956a; Holtzman, 1978; Sloan, 1987]).

REFERRED SPECIMENS: UALVP 44135, 44137, p4s (total: 2).

DIAGNOSIS: "p4 about 5 mm long; 14 marginal serrations; lateral ridges close together and nearly parallel to the long axis of the tooth; superior margin high and rounded; anterior excavation for p3 slight" (Russell, 1929:172).

DESCRIPTION AND COMPARISONS: p4—Adequate descriptions of the morphology of p4, A. cochranensis, occur in Russell (1929, 1932a), Simpson (1937), Jepsen (1940), and Vianey-Liaud (1986). The taxonomic history of the group is summarized in Youzwyshyn (1988). The Nose Creek specimens are referred to Anconodon by virtue of a highly arched p4 profile, and straight mesial margin (Krause and Gingerich, 1983). The specimens are best referred to A. cochranensis, being smaller in overall size, and in having a shorter, more nearly vertical mesial margin as compared to contemporaneous A. gidleyi (Simpson, 1935a). UALVP 44135, the only complete referred p4, is nearly identical to described and figured teeth from the Douglass Quarry, Montana, and the Cochrane Site 2 locality, Alberta (Krause and Gingerich, 1983; Youzwyshyn, 1988).

DISCUSSION: Originally referred to Ptilodus cochranensis (Russell, 1929), the taxon was reassigned to Ectypodus cochranensis by Simpson (1937), and subsequently referred to A. cochranensis by Van Valen and Sloan (1966). A. cochranensis is a ubiquitous taxon in late Torrejonian faunas of Canada and the Western Interior of the United States.

Superfamily Taeniolabidoidea (Granger and Simpson, 1929)

Family Eucosmodontidae (Jepsen, 1940)

Subfamily Eucosmodontinae Jepsen, 1940

Tribe Eucosmodontini Jepsen, 1940

Genus Stygimys Sloan and Van Valen, 1965

cf. Stygimys sp. 1

(Fig. 14, C-F; Table 18)

REFERRED SPECIMENS: UALVP 44140, ?P3; UALVP 44141, i1; UALVP 44142, m1.

DESCRIPTION: i1—The referred specimen is a distal fragment of about 7.3 mm in length, preserving a portion of the enamel band. The maximum diameter is 3.75 mm, while the minimum diameter is 1.6 mm, producing a maximum/minimum diameter ratio of 2.34. The crown is curved dorsoventrally and laterally compressed. The enamel is restricted to the mesioinferior surface of the crown, and progresses more dorsally on the labial side, to a height of approximately one third the dorsoventral height of the crown. In cross section, the crown is subovate, with the ventral surface turning slightly towards the midline.

m1—Cusp formula is 6:5. The referred m1 is moderately worn from post-mortem abrasion. The crown is subrectangular in occlusal view, with the two cusp rows diverging distally. The external cusps increase in size and height, although heavy wear has obscured the original dimensions of the crown. The cusps are conical mesially, but become more nearly crescentic distally. The third and fourth cusps are large and massive; the penultimate and antepenultimate cusps are confluent about their bases. The internal cusps are taller than the external cusps, and are subcrescentic throughout the row.

COMPARISONS: The two described specimens are referred to the same taxon based on size and a lack of compelling evidence from the Nose Creek sample that would support the presence of another, similarly sized eucosmodontine. Other penecontemporaneous eucosmodontines, including Eucosmodon americanus Matthew and Granger, 1921 and Neoliotomus ultimus (Granger and Simpson, 1929), are considerably larger with respect to similar dental elements.

Isolated eucosmodontine lower molars are frustratingly difficult to refer confidently to taxa. The Nose Creek specimen resembles m1s of Stygimys generally in occlusal profile, diverging cusp rows, and cusp shape. These features, however, are plesiomorphic, being shared by most eucosmodontids and primitive multituberculates in general (Weil, 1998). The referred m1 is similar to m1s of Stygimys kuszmauli Sloan and Van Valen, 1965 and Cimexomys gratus (Jepsen, 1930) from the Bug Creek Anthills (Archibald, 1982) and various Lancian and Puercan localities in the United States. UALVP 44142 is also similar to m1s of S. "cupressus" (S., new species, of Fox, 1990a), from the Lancian Long Fall locality of Saskatchewan. Lower molars of S. camptorhiza Johnston and Fox, 1984 from the Rav W-1 locality of Saskatchewan are unknown, but are undoubtedly of similar morphology. The Torrejonian species of Stygimys are restricted to S. jepseni (including Eucosmodon sparsus Simpson, 1937 and Parectypodus jepseni Simpson, 1935a) from the Gidley Quarry, and S. tielhardi (including Eucosmodon tielhardi Granger and Simpson, 1929) from the Nacimiento Formation of New Mexico. The referred m1 differs from m1s of the former taxon by being considerably larger and in having fewer cusps in the labial and lingual rows; the referred m1 differs from m1s of the latter taxon in being significantly smaller. The referred tooth, then, bears closest resemblance to the Cretaceous and Puercan species of Stygimys. UALVP 44142 differs from m1s referred to Stygimys kuszmauli in having one less cusp on the external row, and in having external cusps that are more nearly crescentic (as opposed to conical to subquadrate [Archibald, 1982]). In this regard, UALVP 44142 seems somewhat advanced.

Johnston and Fox (1984) consider a low maximum diameter: minimum diameter ratio a primitive character for i1s of Stygimys. The calculated ratio of 2.34 for the referred i1 suggests an intermediate phylogenetic position, being more derived than i1s of Lancian S. camptorhiza (max: min i1 diameter=2.12), and more primitive than those of Lancian Cimexomys gratus (max: min i1 diameter=2.49), Torrejonian S. tielhardi (max: min i1 diameter=3.25) and S. jepseni (max: min i1 diameter=2.86).

DISCUSSION: The obvious paucity of specimens, the worn nature of the m1, and the fragmentary state of i1 precludes definitive referral of these teeth, even to the generic level. Referral to the Lancian or Puercan species of Stygimys seems premature at this time considering the scant evidence. Based on limited morphological information, the specimens are best referred tentatively to S. sp. 1, with the understanding that the observed features suggest a closer relationship with earlier members of the genus. It is anticipated that future sampling will provide additional information on the affinities of these specimens.

cf. Stygimys sp. 2

(Fig. 14, G; Table 19)

REFERRED SPECIMEN: UALVP 44143, M1.

DESCRIPTION: M1—Cusp formula is 7:*9:3 . The crown is moderately convex dorsally. In occlusal aspect, the internal cusp row terminates at the fourth cusp of the medial row; the cusps are subcrescentic throughout their extent. The cusps of the medial row are obscured by wear at the mesial margin, but become strongly crescentic distally. The cusps of the external row are subconical. Ridges in the intercusp valleys are absent.

COMPARISONS: The referred M1 possesses a number of characters considered plesiomorphic for M1s of Cimolodonta generally, including a short, ridge-like lingual cusp row, parallel medial and labial cusps rows, and lacking ridges in the intercusp valleys (Weil, 1998; Montellano et al., 2000). As such, UALVP 44143 is similar to M1s of primitive cimolodontans such as Paracimexomys Archibald, 1982, Cimexomys Sloan and Van Valen, 1965, and primitive ptilodontoids. Barring size differences, the referred M1 is closest in morphology to similar teeth referred to Stygimys kuszmauli from the Cretaceous Bug Creek Anthills of Montana (Archibald, 1982). UALVP 44143 differs from M1s, S. kuszmauli, in being significantly smaller, more cuspidate, and in possessing crescentic, rather than subcrescentic, cusps in the medial row. In terms of size, only S. jepseni (Simpson, 1935a) of the Lebo Formation, Montana, is close. Simpson's descriptions of the specimens did not include M1s; the recorded ranges for p4 (Lg=4.3

mm) and m1 (Lg=3.1 mm), however, seem to be approximated by the dimensions of the Nose Creek M1.

DISCUSSION: UALVP 44143 seems best referred to cf. S. sp. 2, based on overall morphological similarity to M1, S. kuszmauli. The aforementioned differences, particularly a higher cusp count and crescentic medial cusps, may be indicative of an advanced morphotype. The putative sympatry of two distinct species of Stygimys in sediments of this age is, insofar as I am aware, novel.

Subfamily Microcosmodontinae Holtzman and Wolberg, 1977

Genus Acheronodon Archibald, 1982

Acheronodon sp.

(Fig. 15, A-C; Table 20)

REFERRED SPECIMEN: UALVP 44144, m1.

DESCRIPTION: m1—Cusp formula is 6:4. The crown is subquadrate in occlusal aspect, with the two cusp rows converging mesially, effectively "pinching off" the mesial margin. The labial and lingual cusps are staggered, rather than opposite to one another. The cusps of both rows lean slightly distally in lateral view, and the crown is linear dorsally, not convex. The external row has six cusps; the first cusp is mesiodistally elongate, and may be considered two distinct cusps, but wear has obscured their original relationship. The antepenultimate and penultimate cusps are confluent about their bases; the ultimate cusp is small, being about half the size and height of the antepenultimate and penultimate cusps. Cusps of the external row are subquadrate mesially, become more nearly crescentic distally, and increase slightly in size and height distally. The internal row contains four labiolingually-compressed cusps, all taller than the cusps of the external row. The first internal cusp is short (but not as short as the first external cusp), and conical. The remaining cusps are subequal in height and pyramidal in horizontal section; the ultimate internal cusp is massive, being nearly twice the mesiodistal length of the penultimate or antepenultimate cusp. Distal to the ultimate lingual cusp is the so-called sigmoid notch (Krause, 1977; Weil, 1998). The notch in UALVP 44144 is highly angular, forming an angle of approximately 135 degrees between the distal margin of the crown and the distal side of the ultimate cusp in the lingual row. The valley between the two cusp rows is narrow; grooving is present on the valley-facing sides of the internal cusps.

COMPARISONS: The morphology of UALVP 44144 seems closest to that of m1s of the Microcosmodontinae, an enigmatic group comprised of Acheronodon Archibald, 1982, "Allocosmodon" (=Microcosmodon woodi Holtzman and Wolberg, 1977; Fox, pers. comm.), Microcosmodon Jepsen, 1930 (sensu stricto), Pentacosmodon Jepsen, 1940 and Microcosmodon arcuatus Johnston and Fox, 1984. Lower m1s of this group are characterized generally by low cusp number; stout, robust cusps; cusp rows converging mesially; and presence of the sigmoid notch (Krause, 1977; Weil, 1998). Although the m1s of the included taxa are similar, some notable differences exist:

1) m1, "Allocosmodon", has external cusps that are quadrate to subquadrate throughout the extent of the row, in comparison with the subcrescentic external cusps of m1, Acheronodon spp., and the more nearly crescentic external cusps of m1, Microcosmodon.
2) m1, "Allocosmodon", possesses a poorly developed sigmoid notch; m1, Acheronodon, possesses a more distinct notch, particularly m1, Acheronodon "vossae", that possesses a highly angular notch; m1, Microcosmodon, possesses a sigmoid notch close to that observed in m1, Acheronodon.
3) The crown of m1, Microcosmodon, is highly convex dorsally; those of both Acheronodon and "Allocosmodon" are more nearly linear dorsally.

4) m1 cusp rows, Microcosmodon, converge strongly mesially; those of Acheronodon converge moderately; those of "Allocosmodon" converge slightly.

5) Cusps of m1, Microcosmodon, lean distally; cusps of m1, Acheronodon and "Allocosmodon", lean distally, but to a much lesser degree than those of Microcosmodon.

UALVP 44144 seems morphologically closest to lower m1s of Acheronodon with respect to the aforementioned criteria. The Nose Creek specimen is similar to m1s from the Cochrane Site 2 locality referred to A. "vossae" (Youzwyshyn, 1988), differing primarily in being slightly smaller. UALVP differs further from m1s of A. "vossae" and Microcosmodon in having a sigmoid notch that is arcuate, rather than angular, approaching the condition observed in m1s of "Allocosmodon" and Microcosmodon arcuatus. In this respect, UALVP 44144 may be considered primitive relative to m1s of A. "vossae" and Microcosmodon. With respect to size, the Nose Creek m1 more nearly approximates an m1 expected for A. garbani [sic] Archibald, 1982 from the Garbani Quarry (=Worm Coulee 1) of the Tullock Formation of Montana.

DISCUSSION: UALVP 44144 is best referred to Acheronodon sp., sharing features with lower molars of A. "vossae" and microcosmodontines in general. Archibald (1982) first described Acheronodon from an isolated p4 from the early Paleocene Garbani Quarry, Montana. To date, Acheronodon is known only from the type locality, and from the Cochrane Site 2 and Aaron's localities of Alberta. Fox (pers. comm.) hypothesizes Acheronodon to be in a position phylogenetically intermediate between that of "Allocosmodon" woodi and Microcosmodon conus Jepsen, 1930, based on, among other criteria, I2 morphology. The m1 morphologies of <u>Acheronodon</u> sp. from Nose Creek and <u>A</u>. "<u>vossae</u>" from Cochrane Site 2 seem to support such an hypothesis. Referral of UALVP 44144 to <u>Acheronodon</u> sp. marks the first known Torrejonian occurrence of the genus.

Infraclass Holotheria Wible, Rougier, Novacek, McKenna, and Dashzeveg, 1995

Supercohort Theria Parker and Haswell, 1897

Cohort Placentalia Owen, 1837

Magnorder Epitheria McKenna, 1975

Superorder Leptictida McKenna, 1975

Order Uncertain

Family Leptictidae Gill, 1872

Subfamily Leptictinae Gill, 1872

Genus Prodiacodon Matthew, 1929

Prodiacodon sp., cf. P. furor Novacek, 1977

(Fig. 15, D; Table 21)

HOLOTYPE: AMNH 35291, partial right dentary with p2-p4.

TYPE LOCALITY: Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: late Torrejonian (middle Paleocene) of Montana (type locality [Novacek, 1977]); latest Torrejonian of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Gunnell, 1989]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana

(Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); middle Tiffanian (late Paleocene) of Wyoming (Chappo Type Locality [Type Chappo; Chappo Gulch; Chappo-17], Chappo Member, Wasatch Formation, LaBarge Creek, LaBarge, Lincoln County [Gunnell, 1994]).

REFERRED SPECIMEN: UALVP 44145, P3.

DIAGNOSIS: "Similar to Prodiacodon concordiarcensis but 28 percent larger with p2 and p4 of simpler construction, consisting only of a high recurved cusp and a minute basal posterior heel. p2 subequal to p4 in height. p4 slightly lower than p5. Paraconid in p5 blade-like, directly anterior to the protoconid. Talonid of p5 and molars short anteroposteriorly as in P. concordiarcensis but not in P. puercensis or P. tauricinerei. p5 metaconid of much larger basal dimensions and situated more posteriorly than protoconid. Metaconid on lower molars much higher and more swollen than protoconid. Four cusps are present on molar talonids, as in P. puercensis and P. tauricinerei" (Novacek, 1977:27-28).

DESCRIPTION: P3—In occlusal aspect, the crown is triangular, with a mesiodistally elongate labial region and a mesiodistally compressed lingual region. A tall, labiolingually compressed paracone dominates the crown. The metacone has been broken away by post-mortem disturbance, but from the dimensions of its base, it appears to have been lower, more labiolingually compressed, and distinctly separate from the paracone. A small accessory cuspule is present mesial to the paracone on a weakly developed parastylar region. A sharp, acutely angled centrocrista is present between the paracone and metacone. Post-mortem damage has removed the metastylar area distal to the metacone; the presence or absence of a distally positioned accessory cuspule cannot be determined. The protocone is short, about half the height of the paracone and distinctly lower than the metacone, and is subcrescentic in horizontal section; it is positioned distolingual to the paracone. Heavy wear is noted on the distal face of the protocone, forming a broad, flat wear surface. The external cingulum is well developed, but is incomplete labially.

COMPARISONS: The referred tooth is similar to P3s of primitive Late Cretaceous and early Tertiary leptictids, including those of Gypsonictops Simpson, 1927a, Myrmecoboides Gidley, 1915, and particularly Prodiacodon Matthew, 1929. UALVP 44145 is most similar to P3, P. furor from the Cochrane Site 2 locality of Alberta, and the Gidley Quarry of Montana. The Nose Creek specimen differs from these teeth in being slightly smaller, having a greater separation of the paracone and metacone, and in having a larger, more distally pointing metacone.

DISCUSSION: The tentative referral of UALVP 44145 to P. furor marks the earliest known occurrence of the taxon in Canada.

cf. Prodiacodon sp.

(Fig. 15, E; Table 22)

REFERRED SPECIMEN: UALVP 44217, ?M2.

DESCRIPTION: ?M2—The crown of UALVP 44217 is labiolingually elongate and mesiodistally compressed. The parastylar region is prominent and mesially directed; a small cuspule (?stylocone) is noted at the confluence of the preparacrista and ectocingulum. The metastylar region is moderately developed, receiving a distolabially directed, high postmetacrista. The ectocingulum is high and ridge-like and the ectoflexus is shallow. The paracone and metacone are both subconical in cross section, with the paracone being taller, and more lingually expansive than the metacone at their bases. The conules are well developed, with the paraconule positioned well lingual relative to the metaconule. The protocone is well worn, but appears to have been tall and spire-like and nearly circular in horizontal section. The hypoconal salient is spur-like and prominent; the hypocone is worn, but appears to have been small and conical, and distinctly separate from the base of the protocone. The precingulum is weakly developed, barely spanning the mesial face of the protocone. The postcingulum is prominent but discontinuous with both the hypoconal salient and the lingual margin of the crown.

COMPARISONS: UALVP 44217 is similar to M2s, Prodiacodon concordiarcensis Simpson, 1935a from the Gidley Quarry of Montana and the Cochrane Site 2 locality of Alberta (Youzwyshyn, 1988). In addition to being nearly 50 percent smaller, the Nose

Creek specimen differs plesiomorphically from M2s of this taxon in having a more lingually positioned paraconule, in having a well-developed parastylar region and in having a more lingually expanded paracone base (Fox, 1984a). With respect to the position of the paraconule, UALVP 44217 resembles the condition observed in M2s of both Myrmecoboides montanensis Gidley, 1915 and Prodiacodon furor Novacek, 1977, but differs in being significantly smaller and having a shallower ectoflexus.

DISCUSSION: UALVP 44217 is best referred tentatively to Prodiacodon sp. until a larger sample is acquired. The more lingual placement of the paraconule is primitive for leptictids and placentals in general (Fox, 1984a), similarly occurring in upper molars of Prodiacodon puercensis, Prodiacodon furor, and Myrmecoboides montanensis. The Nose Creek specimen, however, seems advanced relative to the upper molars of these taxa in being lower-crowned and having a shallow ectoflexus.

Superorder Preptotheria McKenna, 1975

Grandorder Lipotyphla (Haeckel, 1866)

Order Erinaceomorpha Gregory, 1910

Erinaceomorpha insertae sedis

Genus McKennatherium Van Valen, 1965

cf. McKennatherium sp.

(Fig. 15, F-H; Table 23)

REFERRED SPECIMEN: UALVP 44146, m1 or m2 trigonid.

DESCRIPTION: m1 or m2—UALVP 44146 preserves the trigonid of a small molar tooth, presumed to be m1 or m2. The crown is triangular in occlusal aspect, labiolingually transverse and mesiodistally compressed. A protoconid and metaconid of subequal size and height dominate the trigonid. The paraconid is tiny and conical, positioned at the lingualmost extent of a high paracristid. The metaconid is subconical, large, and leans distally; the protoconid is large and pyramidal in horizontal section. The trigonid notch is moderately well developed. The trigonid basin is deep, with the inner walls of the paraconid and protoconid being flat, while that of the metaconid being convex internally. The paraconid is somewhat appressed to the metaconid. A well-developed external cingulid is present on the mesial face of the trigonid, ending at the base of the protoconid. The cristid obliqua apparently joined the postvallid at a position slightly labial to the midline.

COMPARISONS: UALVP 44146 bears closest resemblance to molar teeth of small, early Tertiary erinaceomorphs, including McKennatherium, Scenopagus McKenna and Simpson, 1959, and Diacocherus Gingerich, 1983. Additionally, the referred trigonid superficially resembles those of smaller hyopsodontid condylarths, such as Haplaletes Simpson, 1935a. The crestiform paracristid and the appression of the paraconid to the metaconid clearly differentiates this specimen from molar trigonids of nyctitheriids such as Leptacodon Matthew and Granger, 1921 and Nyctitherium Marsh, 1872. The large labiolingual dimension of the trigonid and relatively uninflated cusps differentiate UALVP 44146 from molar teeth of erinaceids such as Litolestes Jepsen, 1930, Leipsanolestes Simpson, 1928, and Cedrocherus Gingerich, 1983 and primitive hyopsodontids. The referred specimen differs plesiomorphically from lower molars of closely related Diacocherus and Adunator Russell, 1964 in being higher-crowned; in being labiolingually more transverse; in having less bulbous cusps; and in having a more lingually positioned paraconid (Krishtalka, 1976a; Fox, 1984a).

DISCUSSION: The Nose Creek specimen is referred to the Erinaceomorpha, following the criteria as outlined in Novacek, Bown, and Schankler (1985), including the compressed and crestiform nature of the paraconid and paracristid, and the more bunodont condition of the cusps as compared to molar teeth of palaeoryctids, leptictids, and primitive placentals in general. UALVP 44146 is tentatively referred to M. sp. based on the mesiodistal compression and lingual position of the paraconid, and the incomplete appression of the paraconid to the metaconid. The Nose Creek specimen is slightly smaller in trigonid dimensions as compared the Fort Union Formation specimens referred to M. ladae (Simpson, 1935a)(for example, TrWd=0.8 mm, N=1, Who Nose? versus TrWd=1.3 mm, N=6, Gidley Quarry). Rigby (1980) described two new species of McKennatherium, M. fredricki and M. martinezi, from the Swain Quarry of Wyoming. The trigonid dimensions of UALVP 44146 are closer to those recorded for the Swain Quarry sample (for example, TrWd =0.8 mm, N=1, Who Nose? versus TrWd =1.0 mm, N=1, M. fredricki, Swain Quarry). Additionally, the two Swain Quarry taxa display molar paraconids that are more distinct, conical, and mesially projecting, similar to that of UALVP 44146. Specific referral is deferred until a larger sample size is amassed, and direct observation of the Swain Quarry material can be made.

Order Soricomorpha Gregory, 1910

Superfamily Soricoidea Fischer de Waldheim, 1817

Family Nyctitheriidae Simpson, 1928

Subfamily Nyctitheriinae Simpson, 1928

Genus Leptacodon Matthew and Granger, 1921

Leptacodon munusculum Simpson, 1935a

(Fig. 16, A-C; Table 24)

HOLOTYPE: USNM 9819, left dentary with m1 and m3.

TYPE LOCALITY: Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Montana (type locality [Krishtalka, 1976b; Simpson, 1937]); late Torrejonian of Wyoming (Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose, 1981]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Bangtail locality, Fort Union Formation, Crazy Mountain Basin, Park County [Gingerich et al., 1983]; Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); middle Tiffanian (late Paleocene) of Alberta (Birchwood locality, Paskapoo Formation, Alberta Syncline, Drayton Valley [Webb, 1996]; UADW-2 locality, Paskapoo Formation, Alberta Syncline, Blackfalds[pers. obs.]); middle Tiffanian of Wyoming (Cedar Point Quarry, Polecat Bench Formation, Bighorn Basin, Lovell, Big Horn County [Rose, 1981]; Chappo Type Locality [Type Chappo; Chappo Gulch; Chappo-17], Chappo Member, Wasatch Formation, LaBarge Creek, LaBarge, Lincoln County [Gunnell, 1994]).

REFERRED SPECIMENS: UALVP 44227, incomplete dentary having p2, p4-m3, alveoli for p3; UALVP 44147, p4; UALVP 44148, 44149, m1s (total: 2); UALVP 44151, m3.

DIAGNOSIS: "Slightly smaller than Leptacodon tener, paraconids more reduced and more strictly internal, talonid of m3 relatively narrower. m1 length 1.2 mm. m3 length 1.1 mm" (Simpson, 1935a:11).

APPENDED DIAGNOSIS: "p4 is labiolingually compressed, and the talonid is narrow and defined by a straight and parallel entocristid and cristid obliqua. On m1-3 the paraconid is moderately compressed anteroposteriorly, and the talonid does not extend labially beyond the trigonid. The talonid of m3 is somewhat reduced" (Krishtalka, 1976b:11).

DESCRIPTION: p2—The tooth is simple in construction, being mesiodistally elongate and labiolingually compressed. The crown consisits of a tall, blade-like protoconid and a small, low, mesially positioned cuspule, here interpreted to be a rudimentary paraconid. The metaconid is lacking. The heel consists of a lone, median cuspule.

p4—The tooth is semimolariform, with the crown labiolingually compressed in occlusal view. A large, conical protoconid dominates the crown. The metaconid originates approximately halfway up the lingual face of the protoconid; it is slightly smaller in size and height than the protoconid, and is circular in horizontal section. The paraconid is massive and salient, arising mesial and slightly lingual to the protoconid base. The paraconid is strongly mesially directed, and is approximately half the height of the protoconid, and slightly shorter than the metaconid. The paracristid is notched and sectorial. A slight basining is noted between the bases of the paraconid and protoconid, and a short mesial cristid traverses the bases of the paraconid and protoconid. The talonid is prominent, being about half the length of, and of subequal width to, the trigonid, and bears three distinct cusps. The basin is moderately deep. The hypoconid is large, while the entoconid and hypoconulid are more nearly equal in size and height. The entoconid and hypoconulid are closely appressed, creating a "twinned" appearance. All talonid cusps are circular in horizontal section. The entocristid and cristid obliqua are nearly parallel to one another, and the cristid obliqua strikes the distal trigonid wall lingual to the midline of the crown. Labial exodaeneodonty is prominent, forming a deep hypoflexid.

Lower molars—The lower molars of L. munusculum have been adequately described by Simpson (1935a), Krishtalka (1976b) and Krause and Gingerich (1983). The Nose Creek specimens agree with these descriptions, differing only in being generally smaller and in having a slightly larger m3.

COMPARISONS: The Nose Creek specimens compare favourably with similar specimens referred to L. munusculum from the Gidley Quarry of Montana (Simpson, 1935a) and the Cochrane Site 2 locality of Alberta (Youzwyshyn, 1988). The Nose Creek specimens are differentiated from teeth of penecontemporaneous L. tener Matthew and Granger, 1921 as per the criteria presented in Krishtalka (1976b); additionally, p4, L. munusculum, Who Nose?, differs further from that of L. tener in:

1) Having a larger, mesially directed paraconid more nearly separate from the protoconid.
2) Having a more sectorial paraconid, with the paracristid forming a distinct notch with the protoconid.
3) Having a talonid which is less labially skewed and bearing three cusps.

DISCUSSION: The referred specimens are closer in morphology and size to lower dentitions of L. munusculum from the late Torrejonian than to those of the earliest Tiffanian, differing from the latter in being slightly smaller and in having more cuspidate paraconids on the lower molars.

Since Simpson's description and diagnosis, L. munusculum has been in taxonomic limbo, being variably referred to L. munusculum (Simpson, 1935a), "L." munusculum (Krishtalka, 1976b; Gingerich, et. al, 1983; Youzwyshyn, 1988), or affiliated with Pontifactor West, 1974 (Krishtalka, 1976b; Bown and Schankler, 1982). Krishtalka (1976b) indicated that the morphology of the lower dentition of "L." munusculum merited referral to the genus Pontifactor, citing similarities in p4 construction, and that further evidence from the upper dentition would support such action. The p4 of UALVP 44227 is distinctly different from that of L. tener Matthew and Granger, 1921, being labiolingually compressed; in having a large, mesially directed paraconid; and in having a tricuspid talonid. In these respects, the p4, L. munusculum, Nose Creek, bears resemblance to p4s of other nyctitheriids such as Nyctitherium Marsh, 1872, "L." packi Jepsen, 1930, Amphidozitherium Filhol, 1877 and Ponifactor. These resemblances were noted by Bown and Schankler (1982:58-59) in their revision of the group, but also that "...cross characters mask many of the diagnostic [characters]." In comparison with upper premolar and molar teeth from the Cochrane Site 2 locality referred to "L." munusculum (Youzwyshyn, 1988), it seems that no upper dental elements from the Nose Creek locality are referable to this taxon

The referred teeth from Who Nose? seem best placed in L. munusculum; although I agree with Krishtalka (1976b), Bown and Schankler (1982), and Youzwyshyn (1988) in the eventual removal of L. munusculum from Leptacodon (sensu stricto), the paucity of specimens from Nose Creek do not presently permit such action.

Leptacodon sp., cf. L. tener Matthew and Granger, 1921

(Fig. 17, A-F; Table 25)

HOLOTYPE: AMNH 17179, crushed rostrum with complete upper left dentition, fragmentary upper right anterior dentition, and fragmentary lower jaws with left m1-3, right p3-4, m1-2 and half of m3.

TYPE LOCALITY: Mason Pocket, Tiffany Beds, San José Formation, San Juan Basin, La Plata County, Colorado.

KNOWN AGE AND DISTRIBUTION: late Torrejonian of Wyoming (Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Rigby, 1980]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); early Tiffanian (late Paleocene) of Montana (Scarritt Quarry [Simpson's Locality 56], Melville Fm. eastern Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); middle Tiffanian (late Paleocene) of Alberta (Birchwood locality, Paskapoo Formation, Alberta Syncline, Drayton Valley [Webb, 1996]; UADW-2 locality, Paskapoo Formation, Alberta Syncline, Blackfalds [pers. obs.]); middle Tiffanian of Wyoming (Cedar Point Quarry, Polecat Bench Formation, Bighorn Basin, Lovell, Big Horn County [Rose, 1981]; Hallelujah Hill [locality UW V-77005], Fort Union Formation, east flank Rock Springs Uplift, Sweetwater County [Winterfeld, 1982]; Rainy-Day Resurrection [locality V-77059], Fort Union Formation, eastern Rock Springs Uplift, Sweetwater County

[Winterfeld, 1982]); middle Tiffanian of North Dakota (Brisbane Locality, Slope Formation, Grant County [Holtzman, 1978]; Judson Locality [L6; L8] Tongue River Formation, Morton County [Holtzman 1978]); late Tiffanian (late Paleocene) of Alberta (Police Point locality , Ravenscrag Formation, Williston Basin, Elkwater [Krishtalka, 1973]; Swan Hills Site 1 , Paskapoo Formation, Alberta Syncline [Stonley, 1988]); late Tiffanian of Saskatchewan (Roche Percée local fauna, Ravenscrag Formation, Williston Basin [Krause, 1977]); late Tiffanian of Montana (Circle Locality, Tongue River Formation, Glen Waller Ranch, McCone County [Wolberg, 1979]); late Tiffanian of Colorado (type locality [Simpson, 1935b]); latest Tiffanian (late Paleocene) of Montana (Olive Locality, Tongue River Member, Fort Union Formation, Powder River Basin, Powder River County [Wolberg, 1979]).

REFERRED SPECIMENS: UALVP 44152, P4; UALVP 44154, 44155, M2s (total: 2); UALVP 44150, m1; UALVP 44157, m1 or m2; UALVP 44158, m3.

DIAGNOSIS: "Length m1-3, 4.3 mm. Trigonid of p4 relatively low. Protoconid about equal to metaconid on m1, slightly lower on m2-3. Hypoconids all slightly larger than entoconids. Hypoconulids projecting, that of m3 prominently molar cusps slender" (Simpson, 1935b:14).

APPENDED DIAGNOSIS: "...the entoconids and hypoconulids of m1-3 are rather close together, and m3 has a strong separate hypoconulid" (McKenna, 1968:10).

DESCRIPTION AND COMPARISONS: Upper dentition—The upper dentition of L. tener has been described and figured by McKenna (1968), and the Nose Creek specimens do not differ substantially from the teeth described therein. Additionally, the referred specimens are similar to teeth from the Cochrane Site 2 locality referred to L. sp. 1 (Youzwyshyn, 1988), and to teeth referred to L. tener from the Police Point locality (Krishtalka, 1973). The Who Nose? sample differs from these in having slightly more robust proportions, in having the paracone and metacone less appressed to one another on P4 , and in having a more prominent metastylar area on P4.

Lower dentition—McKenna (1968), Krishtalka (1976b) and Winterfeld (1982) have adequately described the lower dentition of L. tener. The referred specimens from Who Nose? are virtually identical to McKenna's description of the type material, and to similar referred dentitions from the Police Point, DW-2 and Cochrane Site 2 localities of Alberta (Krishtalka, 1976b; Fox, 1990a; Youzwyshyn, 1988), Swain Quarry of Wyoming (Rigby, 1980) and the Judson and Brisbane localities of North Dakota (Holtzman, 1978). The Nose Creek teeth are most similar to those from the Cochrane Site 2 and Swain Quarry localities, differing only in being slightly smaller, in having larger molar hypoconids, and in having more nearly cuspidate molar paraconids.

DISCUSSION: The Nose Creek specimens seem closer in morphology to teeth of L. tener from the late Torrejonian and earliest Tiffanian than to those from the late Tiffanian, differing from the latter in being somewhat larger, more robust and higher-crowned. The occurrence of this taxon at Nose Creek represents its earliest known appearance in western Canada.

Nyctitheriinae, genus and species unidentified

(Fig. 17, G-I; Table 26)

REFERRED SPECIMEN: UALVP 44156, p4

DESCRIPTION: p4—The referred tooth is molariform, with a tall, subpyramidal protoconid, a lower metaconid, and a small conical paraconid. The protoconid is large and recurved distally, while the metaconid is smaller, more nearly erect, and occupies a distolingual position relative to the protoconid. The paraconid is lower than either the protoconid or metaconid, arising from the base of the former, and projects dorsally in a finger-like manner. A small precingulid is developed. The trigonid notch is deep, but not incised ventrally. The talonid is tricuspate and of slightly smaller labiolingual dimensions than the trigonid. The talonid cusps are subequal in size and height, and are circular in horizontal section. The hypoconulid and hypoconid are nearly connate, appearing twinned, and are slightly offset labially from the entoconid. The entocristid and cristid obliqua run parallel to one another, and form a moderately deep talonid basin. The cristid obliqua strikes the postvallid below the trigonid notch, but closer to the lingual side of the tooth relative to the longitudinal axis of the crown. The talonid notch is acute and moderately deep. Labial exodaeneodonty is prominent, particularly about the hypoflexid.

COMPARISONS: UALVP 44156 compares favourably with similar teeth of early Tertiary nyctitheriines. The referred specimen differs from p4s of <u>Leptacodon</u> <u>tener</u> in being larger and higher crowned; in having a taller metaconid that is more nearly transversely opposed to the protoconid, rather than being displaced distally; and in having a larger, wider, and deeper talonid. UALVP 44156 differs from similar teeth of Leptacodon munusculum in being larger and higher crowned; in having a trigonid that is less labiolingually compressed; and in having a smaller, cuspidate paraconid that is less mesially directed.

With respect to the aforementioned differences, UALVP 44156 seems to better approximate descriptions of p4, Leptacodon packi Jepsen, 1930 from the Princeton Quarry of Wyoming (Jepsen, 1930; Krishtalka, 1976b) and the Bangtail Quarry of Montana (Gingerich et al., 1983). Additionally, the referred specimen is nearly identical to homologous teeth from the Cochrane Site 2 locality of Alberta referred to Leptacodon, species 2 (Youzwyshyn, 1988). Youzwyshyn considered these teeth to be of L. packi-type morphology.

DISCUSSION: 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 perceived similarities to the dentitions of Nyctitherium and other advanced nyctitheriines. The referred specimen 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 expectation that additional sampling will elucidate the affinities of this specimen.

Grandorder Archonta Gregory, 1910

Order Primates Linnaeus, 1758

Suborder Dermoptera Illiger, 1811

Family Plagiomenidae Matthew and Granger, 1918

Genus Elpidophorus Simpson, 1927b

Elpidophorus sp., cf. E. minor Simpson, 1937

(Fig. 18, A-F; Table 27)

HOLOTYPE: PU 14201, left dentary with p3-m2.

TYPE LOCALITY: Silberling Quarry, Lebo Formation, eastern Crazy Mountain Basin, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Montana (type locality [Simpson, 1937]); latest Torrejonian (late middle Paleocene) of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Gunnell, 1989]).

REFERRED SPECIMENS: UALVP 44199, p4; UALVP 44159, incomplete dentary with m1-2; UALVP 44160, incomplete dentary with m1-3; UALVP 44161, 44228, m1s (total: 2); UALVP 44162, 44163, 44164, 44165, 44166, m2s (total: 5); UALVP 44167, 44229, m3s (total: 2).

DIAGNOSIS: "Smaller than Elpidophorus elegans or E. patratus. P3 slenderer than in E. patratus, paraconids p4-m2 more strictly internal, heel of p4 smaller and less strongly basined, elevation of inner cusps p4-m2 distinct but slightly less pronounced than in E. patratus" (Simpson, 1937:133).

DESCRIPTION: p4—UALVP 44199 is submolariform, bearing a labiolingually inflated trigonid and bicuspid talonid. The protoconid is the tallest trigonid cusp, and is subcircular in cross section. The metaconid and paraconid are subequal in size and height, conical, and are decidedly lower than the protoconid. The trigonid cusps have a swollen appearance. The metaconid originates on the lingual face of the protoconid, approximately halfway up from the base, and leans distally. The paraconid is distinct, originating mesiolingual to the protoconid, and is connate with the protoconid nearly its entire length. The mesially directed paraconid gives the trigonid an open appearance lingually. The paracristid is short, serving merely to join the apex of the paraconid to the protoconid, forming an angle of about 90 degrees. A faint paracingulid is present at the base of the paraconid. The trigonid notch is acute. The talonid basin is shallow; the entoconid and hypoconid are both swollen, and are subequal in height and size. The entoconid is positioned slightly more distal than the hypoconid. The postcristid between the entoconid and hypoconid is notched medially and does not possess cuspules, and the entocristid is low, such that the talonid is virtually open lingually. The cristid obliqua is concave labially, striking the postvallid at the midline. Two moderate and parallel protostylid crests run down the distal trigonid wall, the more labial joining the cristid obliqua at its union with the postvallid. The enamel of the labial face of the protoconid is somewhat crenulated.

Lower molars—The lower molars of E. minor have been described and figured by Szalay (1969) and Simpson (1937). The referred specimens from Nose Creek differ only in being smaller, and in having mesiolabially positioned paraconids.

COMPARISONS: The aforementioned specimens from Nose Creek are most similar in morphology to teeth referred to E. minor from the Silberling Quarry, upper Lebo Formation, Montana (Simpson, 1937; Szalay, 1969). The Nose Creek specimens differ from similar teeth of E. elegans Simpson, 1927b and E. "clivus" Stonley, 1988 from the Tiffanian of Alberta, in being decidedly smaller, having a more nearly premolariform p4, and in having lower molars with the paraconids in a mesiolabial position. The referred specimens differ from the type material, E. minor, in the following ways:

1) p4 paraconid smaller, labial in position, and more appressed to the protoconid.
2) p4 talonid bicuspid.
3) Molar paraconids small, and in a more mesiolabial position.
4) Molar metaconids subequal in height to the protoconids.
5) External cingulids weak.
6) Molar talonid exodaeneodonty less pronounced.
7) Generally smaller size.

DISCUSSION: The noted differences in lower premolar and molar morphologies prompt a tentative referral of the Nose Creek specimens to E. minor. The more nearly premolariform p4, including a bicuspid talonid, as well as the differences in molar characters may indicate a more primitive condition for the Who Nose? morph of Elpidophorus. UALVP 44199 seems closer in morphology to UALVP 25581, p4, E. sp., cf. E. elegans from the Cochrane Site 2 locality of Alberta (Youzwyshyn, 1988). As Youzwyshyn had indicated, the morphology of UALVP 25581 is more primitive than that seen on p4 of the temporally older E. minor, and that the propinquity of relationship between E. minor and E. elegans may be low, a view held by Simpson (1937), but not by Szalay (1969). The differences in morphology of UALVP 44199 and 25581 relative to that of p4, E. minor, are certainly striking and may prove taxonomically significant with further sampling from both localities. Simpson (1937:133) indicated that the generic affinity of E. minor may be suspect, but that "...the present data do not seem to warrant generic definition." It is with this view that I concur, as the only specimen definitively referred to this taxon is the type. As such, variation in the group is surely not understood.

The Who Nose? sample represents the first discovered occurrence of this poorly known taxon outside of the Western Interior of the United States.

Family Paromomyidae (Simpson, 1940)

Subfamily Phenacolemurinae Simpson, 1955

Tribe Phenacolemurini Simpson, 1955

Genus Ignacius Matthew and Granger, 1921

Ignacius fremontensis (Gazin, 1971)

(Fig. 19, A-H; Table 28)

HOLOTYPE: AMNH 88309, incomplete right dentary with p4-m2.

TYPE LOCALITY: Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County, Wyoming.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Wyoming (Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose, 1981]); latest Torrejonian (late middle Paleocene) of Wyoming (type locality [Gazin, 1971]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); early Tiffanian (late Paleocene) of Alberta (Aaron's Locality, Paskapoo Formation, Alberta Syncline, Innisfail [Fox, 1990a]).

REFERRED SPECIMENS: UALVP 43287, P4; UALVP 43289, M1 or M2; UALVP 43286, 43293, M3s (total: 2); UALVP 43288, p4; UALVP 43291, m1; UALVP 43290, 43292, m2s (total: 2).

DIAGNOSIS: "Size of p4 much smaller than in Phenacolemur [Ignacius] frugivorus. Lower molars a little smaller and relatively much narrower, with talonid basins relatively longer and narrower" (Gazin, 1971:32).

DESCRIPTION: P4—In occlusal view, UALVP 43287 is roughly trapezoidal in shape. A moderately developed parastyle and reduced metastylar region flank a weak stylar shelf and shallow ectoflexus. The crown is tricuspate and dominated by a conical paracone; the metacone is reduced and somewhat compressed transversely. The protocone is subequal in height to the metacone. The hypoconal shelf is expanded both distally and lingually, but does not extend distally past the metacone. The postparacrista is oblique to the premetacrista (sensu Krause, 1978), whereas the preprotocrista is confluent with the preparacrista.

M1 or M2—UALVP 43289 lacks the metacone due to post-mortem breakage. The tooth is quadrate to subquadrate in occlusal view, and is longer transversely than mesiodistally. The paracone and protocone are relatively low crowned and conical. The paraconule and metaconule are weakly developed. The hypoconal shelf is moderate, and a hypocone is lacking. All crests are low and a postcingulum is present. The postprotocone cingulum progresses to the paraconule and continues as the preparacrista to the parastyle (Doi, 1990; Robinson and Ivy 1994).

M3—UALVP 43286 and 43293 are subrhomboidal in occlusal view; the labial part is oblique, while the lingual part is rounded. The paracone and metacone are slightly labiolingually compressed, and the metacone is reduced. Both the paraconule and metaconule are weakly developed, the metaconule more so, and the protocone is inflated and bulbous. The hypoconal shelf is moderately well developed, but a hypocone is lacking. All crests are low. The postparacrista and premetacrista are nearly aligned along the mesiodistal axis of the tooth, and the preprotocrista joins the preparacrista at the paraconule. The mesial cingulum is well developed.

p4—In lateral profile, UALVP 43288 is smoothly convex mesially with a relatively steep profile. The tooth is dominated by a large, inflated protoconid mesially, and a broad talonid distally. A paraconid and metaconid are both lacking. The talonid is bicuspid, possessing a well-developed distinct entoconid and hypoconid, and a moderately deep basin. The entocristid descends steeply, striking the protoconid low; as such, the talonid is open lingually.

m1—In lateral profile, the trigonid of m1 leans strongly mesially. In occlusal view, the tooth is roughly rectangular and the trigonid and talonid are subequal in mesiodistal length. The paraconid is reduced and somewhat appressed to the larger metaconid, while the protoconid is subequal in size to the metaconid. The paracristid is distinct and high, effectively squaring off the trigonid crown. The protocristid is distinct and the trigonid notch shallow. A distinct entoconid and hypoconid are present on the shallowly basined talonid. A hypoconulid swelling is evident midway along the postcristid. The cristid obliqua strikes the postvallid labial to the midline. A prominent precingulid progresses labially, but does not continue as a postcingulid distal to the hypoflexid. The talonid notch is deep and not incised ventrally.

m2—In lateral profile, UALVP 43290 and 43292 lean mesially, at least as much as m1. In occlusal aspect, the teeth are subrectangular, and the talonid is longer mesiodistally than the trigonid, particularly when compared to m1. The paraconid is slightly reduced and somewhat appressed to the metaconid. The protoconid and metaconid are equal in height, and all trigonid cusps are bulbous. The paracristid and protocristid are similar to those on m1, but the trigonid notch is less distinct. The talonid is shallow, much more so than on m1, and possesses a distinct entoconid and hypoconid. The hypoconulid is not evident on either of the specimens. The cristid obliqua strikes the postvallid labial to the midline. A strong precingulid progresses labially as in m1. The hypoflexid is less acute than on m1, and the talonid notch is deep and not incised ventrally.

COMPARISONS: The specimens from the Who Nose? locality bear closest resemblance to descriptions of similar teeth of I. fremontensis from the type locality in the Fort Union Formation of Wyoming. In comparison, the Who Nose? specimens possess somewhat less inflated trigonid cusps, with the paraconid occupying a slightly more lingual position, a greater separation of the paraconid and metaconid, a relatively broader talonid, and a prominent precingulid. Relative to specimens from the Cochrane 2 locality of Alberta, the Who Nose? specimens are smaller in size with poorly swollen cusps. Additionally, the referred upper molars have a better developed parastylar region and metacone, a deeper ectoflexus, and a narrower hypoconal shelf, while the referred lower molars display a lower degree of paraconid–metaconid appression and a stronger precingulid. In comparison with specimens from Aaron's locality, Alberta (MacDonald, 1996), the Who Nose? specimens are slightly smaller in overall dimensions, with a better-developed metacone and a narrower hypoconal salient on the upper molars, and have a prominent precingulid on the more nearly erect lower molars.

DISCUSSION: The Who Nose? specimens are morphologically similar to teeth of the paromomyid I. fremontensis, but may represent a more primitive grade of phenacolemurine evolution. In particular, the presence of a better developed parastylar region, deeper ectoflexus and less distally expanded hypoconal shelf on the upper molars, combined with strong precingulids and an unreduced paraconid on the lower molars reflect plesiomorphies shared with Paromomys depressidens Gidley, 1923, a probable ancestor (Bown and Rose, 1976). The striking differences between the specimens from Who Nose? and those from both the Cochrane 2 and Aaron's localities indicate a possible rapid evolutionary event within this lineage from the latest Torrejonian (Who Nose? locality) to the earliest Tiffanian (Cochrane 2 and Aaron's localities).

Doi (1990) and Robinson and Ivy (1994) noted the preprotocrista on upper molars of I. fremontensis progresses to the paraconule and continues as the preparacrista to the parastyle. This condition is similar to that observed in upper molars of Paromomys (as opposed to the condition observed in upper molars of I. frugivorus Matthew and Granger, 1921, advanced phenacolemurines, and simpsonlemurines), and is considered plesiomorphic. Robinson and Ivy (1994) use this character to question the affinities of I. fremontensis, suggesting that it may not be referable to Ignacius. While a single specimen cannot support nor refute such a suggestion, UALVP 43289, in possessing this character, strengthens its referral to I. fremontensis, and in combination with the aforementioned plesiomorphic characters, affirms its hypothesized relationship to the structurally more primitive Paromomys.

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

cf. Ignacius sp.

(Fig. 20, A-C; Table 29)

REFERRED SPECIMENS: UALVP 43303, m1; UALVP 43304, m2.

DESCRIPTION: m1—In occlusal view, UALVP 43303 is subquadrate, with an compressed trigonid and broad, ovate talonid. The talonid is longer than the trigonid in both mesiodistal and transverse dimensions. The metaconid is the largest trigonid cusp, followed by a subequally high protoconid and a reduced paraconid. The paraconid is nearly confluent with the metaconid and lingually positioned, while the protoconid is slightly reduced, but distinct. The paracristid/paralophid complex is expanded mesially. The protocristid is distinct, and a faintly developed trigonid notch is discernible. The talonid is shallow and broadly ovate, expanded both labially and lingually past the trigonid. An entoconid and hypoconid are present, as well as a swelling in the position of the mesoconid. Numerous accessory cuspules occur along the postcristid. The cristid obliqua strikes the postvallid high and joins with a small crest descending from the metaconid at the midpoint between the metaconid and protoconid. The talonid notch is shallow and not incised at its base. A strong precingulid progresses labially and continues past the hypoflexid as the postcingulid. The labial cingulid proper forms a prominent shelf at the hypoflexid.

m2—The morphology of m2 is nearly identical to that of m1; however, the trigonid of UALVP 43304 is even more mesiodistally compressed, and the paracristid/paralophid complex is less mesially expanded. There are more accessory cuspules along the postcristid, and the hypoflexid shelf bears two distinct cuspules.

COMPARISONS: UALVP 43303 and 43304 most closely approximate the measurements of molar teeth of I. fremontensis, being smaller overall than molars of both I. frugivorus and I. graybullianus Bown and Rose, 1976. The Who Nose? specimens differ from molar teeth of I. fremontensis in having more nearly erect, mesiodistally compressed trigonids; paraconids that are more lingually positioned; open, shallow talonids; and prominent precingulids. Relative to similar teeth of I. frugivorus from the Roche Percée locality, Saskatchewan (Krause, 1977), the Who Nose? specimens are smaller in overall size, have mesiodistally-compressed trigonids that bear less turgid cusps, and have paraconids occupying more lingual positions. Additionally, the Nose Creek specimens have stronger precingulids, and larger, shallower, and more ovate talonids with cristids obliquae that are positioned higher on the postvallid. The extreme compression of the molar trigonids on the Who Nose? specimens is similarly observed in homologous teeth of I. graybullianus from the Wasatchian of Wyoming (Bown and Rose, 1976); however, the overall sizes of the Who Nose? specimens are considerably smaller, and the mesial expansion of the paracristid, characteristic of the lower molar dentition of I. graybullianus, is absent.

DISCUSSION: UALVP 43303 and 43304 display a curious mosaic of lower molar characters, some plesiomorphic (more nearly erect trigonids, poorly inflated cusps, lingual position of the paraconids, and strong precingulids), and others apomorphic (extreme compression of the trigonids, appression of the paraconids to the metaconids, and broad talonids). One could envision these specimens as a transition to a more advanced phenacolemurine dental condition, as seen in molar dentitions of Phenacolemur Matthew and Granger, 1915, Dillerlemur Robinson and Ivy, 1994, or Simpsonlemur Robinson and Ivy, 1994, particularly in the compression of the trigonids and the reduction of the paraconids. The Nose Creek specimens are, however, not as robust as homologous teeth of advanced phenacolemurines, nor do they display the more characteristic features seen in these taxa (for example, high trigonid relief, relatively deep trigonid notch, incised talonid notch [Robinson and Ivy, 1994]). The paucity of specimens prevents conclusive statements regarding the affinities of UALVP 43303 and 43304. It is apparent however, that these specimens could represent an advanced dental stage of Ignacius, more specialized than the dentitions of either I. fremontensis or I. frugivorus, and converging on the trigonid features of advanced phenacolemurines.

Paromomyidae, genus and species unidentified

(Fig. 20, D-F; Table 30)

REFERRED SPECIMEN: UALVP 43302, m2.

DESCRIPTION: m2—In occlusal view, UALVP 43302 is subquadrate. The trigonid and talonid are of equal transverse dimensions, but the talonid is longer mesiodistally. The trigonid is compressed mesiodistally. Post-mortem abrasion has removed the apical part of the paraconid; however, it appears to have been reduced, labial in position, and apparently appressed to the metaconid. The protoconid is subequal in height to the metaconid and distinct. The paracristid is shelf-like and moderately low on the mesial trigonid face; the protocristid is high, forming a distinct trigonid notch between the metaconid and protoconid. The talonid is shallow and open, with a weak entoconid and hypoconid. Numerous accessory cuspules are present along the postcristid. The cristid obliqua strikes the postvallid low and labial to the midline. The talonid notch is shallow and not incised at its base. A robust precingulid originating from the mesial face of the protoconid progresses distolabially, forming a prominent shelf about the hypoflexid, and continues as the postcingulid distal to the hypoflexid.

COMPARISONS: UALVP 43302 differs from lower molars of Ignacius in its robust and larger proportions, in having a more nearly erect trigonid, and in having a strong precingulid and hypoflexid shelf. With respect to these differences, UALVP 43302 appears to more closely approximate m2s of Paromomys. The referred specimen differs further from lower molars of Ignacius, and is more similar to homologous teeth of Paromomys, in displaying low trigonid relief and in lacking an incised talonid notch. UALVP 43302 is distinct from m2s of Paromomys in being less robust, and by its relatively lower trigonid relief. The Who Nose? specimen also resembles lower m2s of an undescribed species of Phenacolemur from the late Tiffanian Gao Mine locality (pers. obs.), Paskapoo Formation, Alberta: both are relatively square occlusally, have low trigonid relief, high paracristids, labially positioned cristids obliquae, shallow talonids, and thickened labial regions (as represented by the labial cingulid on UALVP 43302, and by a prominent hypoflexid shelf on the Gao Mine specimens).

DISCUSSION: This peculiar specimen displays characters that are both plesiomorphic (more nearly erect trigonid, precingulid, lacking an incised talonid notch) and apomorphic (compression of the trigonid, reduction of the paraconid). Quite clearly, if UALVP 43302 is referable to Phenacolemur, it differs from Gunnell's (1989) diagnosis of the genus in that it retains the paraconid on m2 (presumably a plesiomorphic character).

Robinson and Ivy (1994), in their comprehensive review of the Paromomyidae, restricted Phenacolemur to include the generotype P. praecox Matthew and Granger, 1915, P. simonsi Bown and Rose, 1976, P. fortior Robinson and Ivy, 1994, and two new species from the Wasatchian of North America. These taxa are united with respect to lower molar morphology by a constricted, deeply incised talonid notch and a mesiodistally elongate m3. In addition, the molar teeth of these taxa display high trigonid relief, a feature not pointed out by Robinson and Ivy. The single Nose Creek specimen does not closely approximate the m2s of any of the aforementioned taxa; rather, UALVP 43302 is closer to lower molars of Paromomys depressidens, Ignacius spp., and the undescribed material from Gao Mine. Both the Gao Mine material, as well as UALVP 43302, are similar to m2s of Dillerlemur (Robinson and Ivy, 1994) in possessing lower trigonid relief and a less constricted and unincised talonid notch. Although UALVP 43302 does not possess features characteristic to the lower dentitions of any one of these taxa to the exclusion of the others, its' suite of characters is most closely approximated by this grouping. Because of its peculiar nature, I refer UALVP 43302 only to the Paromomyidae.

Suborder Plesiadapiformes Simons and Tattersall in Simons, 1972

Family Palaechthonidae Gunnell, 1989

Subfamily Palaechthoninae Gunnell, 1989

Genus Palenochtha Simpson, 1935a

Palenochtha sp., cf. P. minor (Gidley, 1923)

(Fig. 20, G-I; Table 31)

HOLOTYPE: USNM 9639, right dentary with p4-m3 and alveoli for c, p2-p3.

TYPE LOCALITY: Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Montana (type locality [Simpson, 1935a]); late Torrejonian of Wyoming (Cedar Mountain [locality UW V-82004], Polecat Bench Formation, southern Bighorn Basin, Hot Springs/Washakie Counties [Hartman, 1986]; Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose, 1981]; Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Rigby, 1980]); latest Torrejonian (late middle Paleocene) of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Gunnell, 1989]).

REFERRED SPECIMEN: UALVP 43301, m2.

DIAGNOSIS: "p4 to m3=5.3 mm; m1 to m3=4.3 mm. About one-third smaller than Palaechthon alticuspis, with apparently a reduction of premolars to two instead of three, but with canine of moderate size and an enlarged incisor as in the species described above [P. alticuspis]" (Gidley, 1923:7).

APPENDED DIAGNOSIS: "Differs from Palaechthon and Premnoides by being significantly smaller, by having distinct and separate paraconids on lower molars, by having more open, less anteroposteriorly compressed molar trigonids, and by having a distinct buccal cingulid on lower molars" (Gunnell, 1989:19).

DESCRIPTION: m2—In lateral view, UALVP 43301 leans slightly mesially. In occlusal view, the talonid is slightly longer mesiodistally than the trigonid, while the trigonid and talonid are equal in transverse length. The trigonid cusps are bulbous and conical; the metaconid is slightly larger than the protoconid, and both cusps are considerably larger than the reduced paraconid. The paraconid is labial in position and the paracristid is strongly flexed and shelf-like (Fox, 1984b). The trigonid notch is moderate and incised at its base. A precingulid is present labially and does not continue as the postcingulid past the hypoflexid. The talonid is broad and shallow, with three distinct, subequally large and high cusps (hypoconid, entoconid, hypoconulid) and a swelling occupying the position of the mesoconid. The cristid obliqua strikes the postvallid labially, far more so than in homologous teeth of Micromomys Szalay, 1973, but in a relatively low position (but see Fox, 1984b). The talonid notch is moderate and not distinctly incised.

COMPARISONS: Lower molars of Palenochtha differ from those of Premnoides Gunnell, 1989 in having distinct, bulbous paraconids, separate from the other two trigonid cusps, less mesiodistal compression of the trigonids, deeper trigonid notches, and in possessing precingulids. They differ from lower molars of Palaechthon spp. in being generally smaller, having molar trigonids that are less mesiodistally compressed and possessing precingulids (Gunnell, 1989). Lower molars of P. minor differ from those of Palenochtha weissae Rigby, 1980 from the Swain Quarry of Wyoming in having paraconids that are more labial in position and a less open trigonids (Rigby, 1980).

DISCUSSION: UALVP 43301 is best referred to Palenochtha sp., cf. P. minor. In comparison with a cast of the type specimen, UALVP 43301 differs only in the cristid obliqua striking the postvallid in a lower and more labial position, and in having a more distinct mesoconid swelling. In comparison with described 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). The paucity of specimens precludes a decision as to whether or not this character is significant or merely individual variation. 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 Premnoides, the lower molars of Palenochtha more closely approximate the overall morphology of UALVP 43301.

UALVP 43301 represents the first record of Palenochtha in Canada, and a northerly geographic range extension for the taxon from the type locality in Montana.

Subfamily Plesiolestinae Gunnell, 1989

Genus Plesiolestes Jepsen, 1930

Plesiolestes problematicus Jepsen, 1930

(Fig. 21, A-F; Table 32)

HOLOTYPE: PU 13291, right dentary with p3, m1-3.

TYPE LOCALITY: Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County, Wyoming.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Wyoming (type locality [Jepsen, 1930; Rose, 1981]; Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Rigby, 1980]); latest Torrejonian (late middle Paleocene) of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Gunnell, 1989]); earliest Tiffanian (late Paleocene) of Montana (Bangtail locality, Fort Union Formation of Bangtail Plateau, western Crazy Mountain Basin, Park County [Gingerich et al., 1983]).

REFERRED SPECIMENS: UALVP 43296, 43298, M2s (total: 2); UALVP 43297, M3

NOTES ON DIAGNOSIS: As Jepsen's (1930) original treatment of the taxon included a complete characterization of the holotype rather than a brief diagnosis, Gunnell's more succinct appendant is used here.

APPENDED DIAGNOSIS: "P. problematicus differs from P. nacimienti by having a better developed talonid on both p3 and p4, by having a more distinct mesoconid on lower molars, by having m3 more expanded, less reduced, by having more distinct paraconids on lower molars, and by having weaker hypocones and precingula on upper molars" (Gunnell, 1989:23).

DESCRIPTION: M2—In occlusal aspect, the crown is subquadrate and longer transversely than mesiodistally. The parastylar and metastylar regions are poorly developed. The paracone and protocone lean mesially, the protocone more so, and the paracone and metacone are moderately flat labially. The paracone is slightly labial in position relative to the metacone. The pre- and postparacrista, pre- and postparaconule crista, and mesial cingulum are all strongly developed, emphasizing prevallum shear. The pre- and postmetacrista, pre- and postmetaconule crista, and postcingulum are less developed. The preparaconule crista is not continuous with the mesial cingulum, the pre- and postprotocrista are distinct and connect lingually to the para- and metaconule respectively (Gunnell, 1989). The paraconule is labial in position with respect to the metaconule and both are robust in construction. The protocone is tall and spire-like. The postprotocrista is straight, not sinusoidal (Youzwyshyn, 1988), and is moderately inclined, forming a broad trigon basin. The postprotocone cingulum is moderately developed and connects to the apex of the protocone, although a broad wear surface obscures its true point of attachment. The hypoconal salient is poorly developed, and a hypocone is lacking.

M3—In occlusal view, UALVP 43297 is labially oblique and lingually rounded. The parastylar area is strongly developed, with a faint cusp-like swelling mesial and labial to the paracone. The paracone and metacone are somewhat flattened labially, and the metacone is reduced in size. The preparacrista is robust, and runs labially to the parastylar area. The paraconule and metaconule are both well developed; as in M2, the paraconule crista is better developed than the metaconule crista. The preparaconule crista is separate and distinct from the precingulum. The protocone is large and somewhat inflated; the pre- and postprotocrista are low and distinct, forming a shallow trigon basin. The postprotocrista is relatively straight, not sinusoidal. A small, lingually positioned pericone occurs slightly mesial to the protocone, and its mesial margin is confluent with the precingulum. The postprotocone cingulum is faint and appears to reach the apex of the protocone. The hypoconal salient is weakly developed and a hypocone is lacking.

COMPARISONS: The Who Nose? specimens are best referred to P. problematicus. Molar teeth of Plesiolestes can be differentiated from those of palaechthonids by having a strong postprotocrista and preparaconule crista distinct from the precingulum (Gunnell, 1989). Molar teeth of Plesiolestes can further be differentiated from those of Torrejonia Gazin, 1968 by the postprotocone cingulum connecting near the apex of the distal protocone wall rather than closer to the base (Szalay, 1973). When compared to the Rock Bench material, the Who Nose? specimens are smaller in size; possess a deeper ectoflexus; have a weaker pre- and postmetacrista on M2; are wider mesiodistally; and possess a more developed parastylar area on M3. Relative to the Swain Quarry sample, the Who Nose? specimens are slightly larger in size, and share a pronounced parastylar area and well-developed conules on M3 (Rigby, 1980).

DISCUSSION: The Who Nose? specimens are closest in morphology to the Swain Quarry sample, particularly with respect to the pronounced parastylar area, and well developed conules on M3. A deeper ectoflexus on M2, combined with the characters of M3, may be suggestive of a more primitive grade than the material from the type locality. The Nose Creek sample represents the first discovered record of Plesiolestes in Canada.

Genus Torrejonia Gazin, 1968

?Torrejonia sirokyi (Szalay, 1973)

(Fig. 21, G; Table 33)

TYPE: AMNH 92135, right mandible with m2-3.

TYPE LOCALITY: Saddle Locality, Fort Union Formation, Bison Basin, Fremont County, Wyoming.

REFERRED SPECIMEN: UALVP 43305, M3.

DESCRIPTION: M3—In occlusal view, UALVP 43305 forms a scalene triangle with strongly oblique labial, and moderately rounded lingual side. The tooth is considerably wider transversely than mesiodistally. The parastylar area is well developed, while the metastylar area is strongly reduced. The paracone is larger than the metacone, and leans slightly mesially. The preparacrista and preparaconule crista are both well developed, and extend labially to the parastylar area. The postparacrista and premetacrista are oriented vertically with respect to each other, not offset labially or lingually as in some paromomyids (Gunnell, 1989). The paraconule and paraconule cristae are better developed relative to the metaconule and the metaconule cristae. The protocone is large and high, forming a deep trigon basin. The pre- and postcingulum are moderately developed, and the postprotocone cingulum is absent, although heavy wear and enamel loss have obscured the topography in this region. Heavy wear is noted on the centrocrista and prevallum, particularly the preparacrista and preparaconule crista.

COMPARISONS: UALVP 43305 is considerably larger than M3s referred to Plesiolestes, Palaechthon Gidley, 1923, and T. wilsoni Gazin, 1968 and is more bunodont relative to teeth of the former two. Referral of this specimen to ?T. sirokyi is based on overall size and the weaker developed pre- and postcingulum, as compared to homologous teeth of Plesiolestes problematicus. In comparison with similar, referred teeth from the Cochrane Site 2 locality, UALVP 43305 is somewhat less transverse and less mesiodistally extended; in comparison with similar referred teeth from the Birchwood locality of Alberta (Webb, 1996), the Who Nose? specimen is longer labiolingually. Szalay (1973) figured an upper third molar of T. sirokyi, UW 2253, similar in morphology to UALVP 43305. Statistically, the Nose Creek specimen is within the range provided by Szalay for length, but not for width.

DISCUSSION: Szalay (1973) and Szalay and Delson (1979) synonymized Torrejonia with Plesiolestes, citing a highly variable p4 in Plesiolestes (Gunnell, 1989). I concur with Gazin (1968), and Gunnell (1989) in the separation of Torrejonia and Plesiolestes, based on the morphology of the postprotocone cingulum. Szalay (1973:85) stated that "...in [T. sirokyi], the [postprotocone cingulum], which connects to the apex of the protocone in [lower molars of Plesiolestes problematicus], does not connect to the protocone as high as in the latter." This character, combined with size differences and less developed pre- and postcingula, seems worthy of generic distinction. Pre- and post-mortem abrasion has obscured the original proportions of the postprotocone cingulum on UALVP 43305, and as such, the development of this character is impossible to ascertain. The referral of this specimen to Torrejonia is thus questionable, with the anticipation that better-preserved specimens will provide more taxonomically useful information. UALVP 43305 potentially represents the third, and oldest discovered, occurrence of Torrejonia in Canada.

Family Microsyopidae Osborn and Wortman, 1892

Subfamily Uintasoricinae Szalay, 1969

Tribe Navajoviini Szalay and Delson, 1979

Genus Navajovius Matthew and Granger, 1921

cf. Navajovius sp.

(Fig. 21, H-J; Table 34)

REFERRED SPECIMEN: UALVP 43299, p4.

DESCRIPTION: p4—UALVP 43299 is double-rooted. The crown is dominated by a large, nearly vertically oriented protoconid. The talonid is basined, with a distinct entoconid and hypoconid, and lacking a hypoconulid. A protostylid crest originating from the lingualmost side of the distal protoconid face descends distally to the talonid notch; a second protostylid crest, labial in position and originating near the apex of the distal protoconid face, descends to within a short distance of the hypoflexid. Moderate wear surfaces are noted on the postcristid and distal protoconid crests, and a broad wear surface is observed at the hypoflexid. UALVP 43299 displays moderate labial exodaeneodonty.

COMPARISONS: UALVP 43299 bears closest resemblance to p4s referred to the late Paleocene genus Navajovius Matthew and Granger, 1921 from the middle Tiffanian and middle Clarkforkian of Colorado, Wyoming, Montana and Texas (Gunnell, 1989). The referred specimen is considerably smaller than p4s of palaechthonines and plesiolestines, and relatively unmodified, unlike the enlarged p4s of other diminutive microsyopids such as Tinimomys Szalay, 1974 and Micromomys Szalay, 1973 (Fox, 1984b). UALVP 43299 is similar to p4, Berruvius Russell, 1964, from the Thanetian of Berru and Cernay in France, but lacks a distinct paraconid (Gunnell, 1989).

DISCUSSION: Gunnell (1989:83) figured the lower dentition of Navajovius kohlhaasae Matthew and Granger, 1921, AMNH 17390. Morphologically, UALVP 43299 bears close resemblance to the p4 of this specimen. Gunnell considers the absence of both a paraconid and metaconid and a shallowly basined talonid on p4 to be plesiomorphic for navajoviines and microsyopids in general, and pointed out that a bicuspate talonid on p4 is suggestive of a derived state. The Nose Creek specimen, curiously, possesses all of these characters. If UALVP 43299 is indeed a navajoviine, then, it displays a mosaic of both plesiomorphic and apomorphic characters.

UALVP 43299 may well represent the oldest occurrence of Navajovius, suggesting that the evolutionary history of diminutive microsyopids is more ancient and complex than is currently understood. The putative sympatric occurrence of Palenochtha sp., cf. P. minor and cf. Navajovius sp. from Nose Creek casts some doubt on an ancestor-descendant relationship between the two, as suggested by Gunnell (1989), and may add support to the notion of a Purgatorius-like ancestor for both (Van Valen, 1994b).

Family Plesiadapidae Trouessart, 1897

Subfamily Plesiadapinae Trouessart, 1897

Genus Pronothodectes Gidley, 1923

Pronothodectes matthewi Gidley, 1923

(Fig. 22, A-E; Table 35)

TYPE: USNM 9547, right maxillary fragment with P4-M2.

TYPE LOCALITY: Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Montana (type locality [Gidley, 1923; Simpson, 1937]; latest Torrejonian (late middle Paleocene) of Montana (Medicine Rocks Site 1, Tongue River Formation, eastern Crazy Mountain Basin, Ekalaka, Carter County [Gingerich, 1976; Krause, 1987]; Mehling Site, Tongue River Formation, eastern Crazy Mountain Basin, Ekalaka, Carter County [Gingerich, 1976]).

REFERRED SPECIMENS: UALVP 43284, I1; UALVP 43280, P4; UALVP 43278, i1; UALVP 43281, p3; UALVP 43282, p4; UALVP 43285, m1; UALVP 43279, 44232, 44231, m2s (total: 3); UALVP 43277, 43283, m3s (total: 2); UALVP 43276, incomplete dentary with p4-m3; UALVP 43275, incomplete dentary with p4-m3.

DIAGNOSIS: "Size about one-fourth smaller than Nothodectes gidleyi. P4 to M2=5.9 mm; m1 to m3=7.3 mm. P4 relatively narrower and all molars, both upper and lower, relatively wider than in species of Nothodectes. P4 with paracone and metacone subequal but closely twinned; hypocone ridge only incipiently developed; no diastema in jaw; a very much reduced canine indicated; p1 slightly smaller than p2; both these teeth simple and single rooted. Trigonid of m1 with the three cusps about equal in size, their unworn summits forming a nearly equilateral triangle" (Gidley, 1923:12)

APPENDED DIAGNOSIS: "Similar to Pronothodectes jepi but significantly smaller—mean length and width of m1 are 2.13 mm and 2.03 mm, respectively, versus 2.35 mm and 2.22 mm in P. jepi" (Gingerich, 1976:18).

DESCRIPTION: Adequate descriptions of nearly complete dentitions of P. matthewi can be found in Simpson (1937) and Gingerich (1976). Upper first incisors are rare in most samples of Pronothodectes (for example, Gingerich's 1976 description included only two isolated I1s in his revision), and as such, are worthy of description.

I1—UALVP 43284 is a presumably procumbent, narrow-crowned tooth. The crown preserves three distinct, well-developed cusps: an anterocone, a laterocone and a mediocone. Post-mortem breakage has removed the posterocone, and a centroconule is absent. The mediocone and laterocone are equidistant behind the anterocone (Gingerich, 1976). The laterocone is robust, subconical, and forms a near 90° angle with the anterocone. The mediocone is small and moderately distinct. The anterocrista is strong, and a deep interstitial wear facet is formed along its margin. An apical wear facet is present on the anterocone.

COMPARISONS: The referred specimens fall within the recorded sizes and morphological ranges for the hypodigm of P. matthewi from the type locality (Gingerich, 1976). The trigonids are shorter, both mesiodistally and labiolingually, and the talonid basins are deeper than those of the type material. The paraconids are more labial in position, and the hypoconulid lobe of m3 is less elongate and distally furrowed, although this tooth locus is highly variable within the Nose Creek sample. The precingulids are particularly well developed in the Who Nose? specimens.

DISCUSSION: The specimens from Who Nose? are comparable to similar teeth in the hypodigm of the type material, but are on the lower end of the recorded size ranges, and possess features that are primitive, including lower molars which are less transverse (similar to those of Purgatorius Sloan and Van Valen, 1965); lack of a mesoconid on the cristid obliqua (similar to those of Purgatorius); a less elongate and furrowed hypoconulid lobe on m3 (similar to those of Pandemonium Van Valen, 1994b); and a labially positioned paraconid (similar to those of Purgatorius and Pandemonium). These characters, although subtle, may be suggestive of a more primitive grade of Pronothodectes. 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

(Fig. 23, A-C; Table 36)

HOLOTYPE: CM 1670, incomplete right dentary with p4-m1.

TYPE LOCALITY: Silberling Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Montana (Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County [Simpson, 1937]; type locality [Douglass, 1908]); late Torrejonian of Wyoming (Cedar Mountain [locality UW V-82004], Polecat Bench Formation, southern Bighorn Basin, Hot Springs/Washakie Counties [Hartman, 1986]; Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose, 1981]; Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Szalay, 1968; Rigby, 1980]); latest Torrejonian of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Gazin, 1971; Gunnell, 1989]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Bangtail locality, Fort Union Formation of Bangtail Plateau, western Crazy Mountain Basin, Park County

[Gingerich et al., 1983]; Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); earliest Tiffanian of Wyoming (Newell's Nook [USGSD-2003], Fort Union Formation, Powder River Basin, Big Horn County [Robinson and Honey, 1987]); early Tiffanian (late Paleocene) of Alberta (Hand Hills West Lower Level, Paskapoo Formation, Alberta Syncline, NE of Drumheller [MacDonald, 1996]); early Tiffanian of Wyoming (Saddle locality, Fort Union Formation, Bison Basin, Fremont County [McGrew and Patterson, 1962; Szalay, 1968]); middle Tiffanian (late Paleocene) of Alberta (UADW-2 locality, Paskapoo Formation, Alberta Syncline, Blackfalds [Fox, 1990a]); middle Tiffanian of Wyoming (Cedar Point Quarry, Polecat Bench Formation, Bighorn Basin, Lovell, Big Horn County [Rose, 1981]; Chappo Type Locality [Type Chappo; Chappo Gulch; Chappo-17], Chappo Member, Wasatch Formation, LaBarge Creek, LaBarge, Lincoln County [Gunnell, 1994]; Rainy-Day Resurrection [locality V-77059], Fort Union Formation, eastern Rock Springs Uplift, Sweetwater County [Winterfeld, 1982]).

REFERRED SPECIMENS: UALVP 43295, m1; UALVP 43294, incomplete left dentary with i1, p4-m2, alveoli for c, p3, m3.

NOTES ON DIAGNOSIS: Douglass (1908) originally assigned CM 1670 to P. silberlingi, referring the entire taxon questionably to the Epanorthidae (=Caenolestidae [Simpson, 1937]), and designated CM 1675 as the type of Megopterna minuta. Simpson (1937), in his analysis of the Silberling Quarry fauna synonymized M. minuta with P. silberlingi and provided a thorough diagnosis, which is used here.

APPENDED DIAGNOSIS: "Enlarged, procumbent anterior lower tooth, followed by three or four small teeth, the most posterior (?p4) 2-rooted but small and simple. m1 much enlarged, with a small, elevated, and procumbent trigonid with three poorly differentiated cusps, heel elongate and large, with a curving crest and two vague internal cuspules, basin not closed. m2 with lower, subquadrate but 3-cusped trigonid, large, oval, basined talonid with crest and two internal cusps. Enamel of both talonids papillated" (Simpson, 1937:135).

DESCRIPTION: Adequate descriptions for nearly complete dentitions of P. silberlingi can be found in Simpson (1937), Szalay (1968), and Gingerich et al. (1983).

COMPARISONS: The referred specimens are nearly identical to Simpson's description of the type material (from Douglass, 1908), as well as to material from Gidley and Swain Quarries (Simpson, 1937; Rigby, 1980). The referred teeth differ from similar referred teeth from the DW-2 locality (Fox, 1990a) in being smaller, higher-crowned, possessing a more mesially directed and distinct paraconid on m1 and m2, and a deeper talonid with a less appressed entoconid and mesoconid on m2.

DISCUSSION: The mesial position and distinct separation of the paraconid on the lower molars and a smaller overall size could be indicative of a more primitive grade of Picrodus. The Nose Creek specimens most closely approximate the condition observed in the dentitions of the type material, the Gidley and Swain Quarry samples, and the Cochrane 2 sample.

The Nose Creek sample constitutes the earliest discovered record of the taxon in Canada, and putatively, North America.

Grandorder Ungulata Linnaeus, 1766

Order Procreodi Matthew and Granger, 1915

Family Oxyclaenidae Scott, 1892

Genus Chriacus Cope, 1883

?Chriacus sp.

(Fig. 23, D-F; Table 37)

REFERRED SPECIMENS: UALVP 44168, p4.

DESCRIPTION: p4—The crown of UALVP 44168 is mesiodistally elongate and somewhat labiolingually compressed. The trigonid and talonid cusps are swollen. The trigonid is dominated by a massive, conical protoconid. A smaller, conical metaconid arises from a level approximately half way up the distolingual face of the protoconid, reaching a maximum height two thirds that of the protoconid. A large, mesially directed paraconid is located mesial and lingual to the protoconid. The paraconid is somewhat mesiolabially-distolingually compressed and sectorial. The strongly-developed paracristid is notched ventrally. A small, loph-like crest originating on the lingual face of the paraconid descends lingually, then distally, forming a shallow trigonid basin. A protostylid crest descends from the apex of the distal face of the protoconid to meet the cristid obliqua. The protocristid is compressed, forming a strongly-developed crest. The hypoflexid notch is shallow, and the trigonid notch is prominent, with a strongly-developed, keyhole-shaped carnassial notch at its base. The talonid is shallowly basined and contains a well-defined, subequal entoconid and hypoconid; both talonid cusps are bulbous and circular in horizontal section. A slight but distinct swelling located in a medial position between the entoconid and hypoconid is assumed to be the hypoconulid. The entocristid is sharply defined, crestiform, and joins with a distally-directed metastylid crest running from the apex of the metaconid. The union of these two crests forms a prominent v-shaped talonid notch. A single additional accessory crest is located on the distal trigonid wall, ventral to the trigonid notch. Strongly-developed mesial and distal external cingulids are present, ventral to the paraconid and protoconid, and labioventral to the hypoconid respectively. Large wear facets are noted on the postcristid, the protostylid crest, the mesial protoconid crest and the distal external cingulid, while the protoconid displays prominent apical wear.

COMPARISONS: UALVP 44168 bears superficial resemblance to p4s of didelphodontine cimolestids, such as Acmeodon Matthew and Granger, 1921 and Gelastops Simpson, 1935a; to deciduous p4s of viverravid carnivorans, such as Protictis Matthew, 1937; and to p4s and deciduous p4s of hypercarnivorous oxyclaenids, such as Chriacus and Thryptacodon Matthew and Granger, 1915. The Nose Creek specimen differs from similar teeth of didelphodontine cimolestids in having a much larger, sectorial paraconid that is mesially directed, as well as a more distinct metaconid. Additionally, UALVP 44168 possesses a shallow talonid basin with bulbous talonid cusps. The referred specimen differs from deciduous p4s of viverravid carnivorans in being generally less molariform, with much more robust, swollen trigonid and talonid cusps, and a more poorly-developed talonid. UALVP 44168 bears closest resemblance to p4s of oxyclaenid procreodians, particularly those of Spanoxyodon latrunculus Simpson, 1935a and Metachriacus punitor Simpson, 1935a. The Nose Creek specimen differs from p4s of these taxa in being slightly smaller; in lacking a complete labial cingulid; in having a more sectorial and mesially directed paraconid; and in having a more prominent and distally positioned hypoconid. UALVP 44168 differs further from p4, S. latrunculus, in having a slightly deeper talonid, with a more acutely angled talonid notch, more nearly approaching the condition observed in p4s, M. punitor.

DISCUSSION: Simpson (1935a) erected the taxon Spanoxyodon latrunculus to receive specimens from the Gidley Quarry that he presumably felt were distinct from similar teeth of closely related Chriacus and Metachriacus. As Simpson (1937) noted, p4 of S. latrunculus possesses a metaconid larger and more distinct than that observed on the p4s of Chriacus (sensu stricto) and Metachriacus, and considered p4, Spanoxyodon, to be submolariform. Van Valen (1978) synonymized S. latrunculus with Chriacus baldwini (Cope, 1882), along with Chriacus truncatus Cope, 1884b, Chriacus schlosserianus Cope, 1888, Metachriacus provocator Simpson, 1935a, and Tricentes crassicollidens Cope, 1884b, without significant discussion. Additionally, Van Valen synonymized Metachriacus punitor with Chriacus orthogonius (Russell, 1929). These synonymies have been, for the most part, accepted without much resistance (for example, Cifelli, 1983; Williamson, 1996; McKenna and Bell, 1997). Williamson (1996) and Youzwyshyn (1988) noted the problems associated with Chriacus (sensu lato), and suggested a future revision for the genus be in order.

The wide ranges of p4 morphologies of specimens referred to Chriacus (sensu lato) do not seem to support Van Valen's synonymies, suggesting the genus Chriacus may in fact be a composite. In Simpson's (1937:192) words, "...The size ranges of the [oxyclaenine] species do not differ greatly, and their morphology is markedly stereotyped in general pattern...yet are amazingly varied in minutiae and cannot be grouped into one or a few broad but natural genera." I concur with Simpson's (1937) and Williamson's (1996) opinions on the state of Chriacus. Although it is beyond the scope, and indeed the ability of the present work to revise the relationships within this taxon, I believe the original taxa Spanoxyodon and Metachriacus may be valid, at the very least on the basis of p4 morphology, as Simpson (1935a, 1937) had suggested.

Based on p4 morphology, UALVP 44168 bears closest resemblance to p4s of S. latrunculus and M. punitor, more so to the former with respect to the well-developed paraconid. As the single specimen cannot provide information regarding the possible variation in this taxon, and noting the complexity and possible composite nature of Chriacus, the Nose Creek specimen is referred to Chriacus sp. with question.

Genus Prothryptacodon Simpson, 1935a

Prothryptacodon albertensis Fox, 1968

(Fig. 24, A-I; Table 38)

HOLOTYPE: UALVP 1338, incomplete right mandibular ramus with alveoli for c, and p1, and with p2-4, m1-3 in place.

TYPE LOCALITY: ARC Core Hole 66-1 (depth 720ft, 6in), West Balzac, Paskapoo Formation, Alberta Syncline, south-central Alberta.

KNOWN AGE AND DISTRIBUTION: type locality only.

REFERRED SPECIMENS: UALVP 44169, p3; UALVP 44170, incomplete dentary with alveoli for p1-3, and with p4 in place; UALVP 44171, m1; UALVP 44172, m2.

DIAGNOSIS: "In distinction from Prothryptacodon furens (Simpson, 1935[a]; Simpson, 1937), P. albertensis is smaller, possesses slenderer and more elevated molar trigonids, less inflated and more nearly vertical external molar walls, and narrower molars" (Fox, 1968:661).

DESCRIPTION: p3—The trigonid of p3 contains a large, relatively high, sectorial protoconid. A small cuspule, mesial in position, arises from the base of the protoconid. A metaconid is absent. Mesial and distal protostylid crests bisect the protoconid mesiodistally. The mesial crest descends from the apex of the protoconid to its base, while the distal crest descends distally from the apex of the protoconid to the heel, and is moderately elevated dorsally. The talonid is small and simple in structure, consisting of a single, well-developed median cusp, interpreted to be the hypoconid. The talonid is unbasined.

p4—The crown of p4 is dominated by a large, slightly recurved sectorial protoconid. A small but well-developed mesially positioned paraconid arises from the base of the protoconid, and is approximately one eighth the height of the protoconid. A metaconid is absent. Strongly-developed mesial and distal protostylid crests bisect the protoconid mesiodistally, similar to those on p3. Two well-developed accessory cuspules occur on the distal protostylid crest approximately one quarter and one halfway up the distal face of the protoconid, the former being more pronounced than the latter. The heel has a single, medially positioned cusp, interpreted to be the hypoconid, and is unbasined. A well-developed precingulid is noted.

Lower molars—The crowns are subrectangular in occlusal aspect, with the talonids being transversely wider than the trigonids. The trigonids are slightly compressed mesiodistally, more so on m2, and are dominated by robust protoconids and metaconids; these cusps are subcircular in horizontal section and are subequal in size and height. The paraconids are slightly compressed mesiodistally, more so in m2, but retain a distinctly cuspidate appearance. The paraconids are relatively high on the crowns, and are lingually positioned. The protocristids are deeply incised, forming decidedly v-shaped trigonid notches. Massive and subequal hypoconids and entoconids dominate the talonids. The hypoconulids are considerably smaller than the other talonid cusps; on m1 it is slightly lingual to the midline, whereas on m2 it resides in a more nearly medial position. The cristids obliquae are convex labially and strike the postvallids well lingual and ventral to the trigonid notches. The entocristids form moderate talonid notches. The mesial and distal external cingulids are strongly developed, but are discontinuous with one another labially.

COMPARISONS: The Nose Creek specimens compare most favourably with similar teeth referred to P. albertensis Fox, 1968, known only from the type locality in the Paskapoo Formation of Alberta. The referred teeth differ from those of the type specimen in:

1) p4 is slightly smaller and narrower mesiodistally, and has a less well developed paraconid and talonid.
2) p4 possesses two distinct accessory cuspules on the distal face of the protoconid.
3) Molar trigonids are somewhat narrower mesiodistally.
4) The paraconid of m1 is slightly more external in position.

DISCUSSION: Notwithstanding these slight differences in dental morphology, the Who Nose? specimens are nearly identical to UA 1338, the type specimen, P. albertensis, as described by Fox (1968). Van Valen (1978) synonymized this taxon with Oxyprimus albertensis Fox, 1968, Carcinodon aquilonius Russell, 1974, and a larger, similar form from the Purgatory Hill locality in Montana, but providing no explanatory notes to justify the action. Johnston and Fox (1984) revalidated P. albertensis, reaffirming its distinctness from both Oxyprimus and Carcinodon, citing differences in p4 morphology.

Molar teeth of Oxyprimus, Carcinodon and Prothryptacodon are similar to one another, retaining plesiomorphic characters from a Protungulatum-like ancestor (Johnston and Fox, 1984). As Johnston and Fox indicated, p4s of P. albertensis are premolariform, whereas those of Oxyprimus are submolariform, possessing a distinct metaconid. Additionally, p4, P. albertensis, has a crested talonid and a small, mesially positioned paraconid, quite unlike the condition observed in p4, Oxyprimus. The referred specimens from the Who Nose? locality appear to substantiate the revalidation of P. albertensis.

The discovery of P. albertensis from the Who Nose? locality represents the first known occurrence of this taxon outside 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 UA 1338, agreeing with Fox's (1968) original hypothesis.

Family Arctocyonidae (Giebel, 1855)

Subfamily Arctocyoninae Giebel, 1855

Genus Colpoclaenus Patterson and McGrew, 1962

Colpoclaenus sp., cf. C. procyonoides (Matthew, 1937)

(Fig. 25, A-C; Table 39)

HOLOTYPE: AMNH 16554, upper and lower jaws.

TYPE LOCALITY: East Fork of Torrejon Arroyo, San Juan Basin, New Mexico.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of New Mexico (East Flank Torreon Wash [upper], Sinclair and Granger Locality 10,in part, Nacimiento Formation, Sandoval County [Williamson and Lucas, 1993]; Escavada Wash [upper], Sinclair and Granger Locality 14, in part, Nacimiento Formation, Sandoval County [Williamson and Lucas, 1993]); latest Torrejonian (late middle Paleocene) of New Mexico (West Flank Torreon Wash [Pantolambda Zone], Sinclair and Granger Locality 10, in part, Torreon Wash [Pantolambda Zone], in part, UCMP 87141, 87142; BUNM-77-184, BUNM-77-199a, Nacimiento Formation, Sandoval County [Williamson and Lucas, 1993]) early Tiffanian of Wyoming (Saddle locality, Fort Union Formation, Bison Basin, Fremont County [McGrew and Patterson, 1962; Szalay, 1968]); late Tiffanian (late Paleocene) of Montana (Circle Locality, Tongue River Formation, Glen Waller Ranch, McCone County [Wolberg, 1979]).

REFERRED SPECIMEN: UALVP 44173, m3.

DIAGNOSIS: "Hypocones of M1 and M2 and metacone of M3 well-developed; protoconids of m2 and m3 vestigial; premolars with prominent basal cusps and cingula. Closely comparable to the generic type, Neoclaenodon montanensis" (Matthew, 1937:37).

DESCRIPTION: m3—UALVP 44173 is low-crowned with highly rugose enamel. The talonid is decidedly longer mesiodistally than the trigonid, the latter being somewhat mesiodistally compressed, with low, poorly differentiated cusps. A massive metaconid dominates the trigonid, with a smaller, transversely opposed protoconid. The paraconid is strongly reduced, lingual in position, and appressed to the metaconid. The paracristid and protocristid are convex mesially and distally respectively, giving the trigonid a broad, oval shape in occlusal view. The talonid is long and shallowly basined with relatively indistinct cusps. The hypoconid is marked distolingually by a ventral emargination, while the hypoconulid is lobate and greatly expanded distally. The entocristid and postcristid are papillate, rendering the entoconid indistinguishable. The cristid obliqua strikes the distal trigonid wall well labial to the midline. The pre- and postcingulids are well developed and continuous labially. The enamel is wrinkled, particularly in the trigonid and talonid basins.

COMPARISONS: UALVP 44173 is nearly identical, save size, to m3s referred to Colpoclaenus keeferi from the DW-2 locality of Alberta. Morphologically, very little separates the Nose Creek specimen from similar teeth from DW-2. UALVP 44173 is somewhat less rugose, and has a proportionately longer talonid. Additionally, the paraconid of the Nose Creek specimen is less appressed to the metaconid, remaining relatively distinct. In these respects, the referred tooth is similar to figured and described teeth pertaining to Neoclaenodon procyonoides from the Nacimiento Formation, New Mexico (Matthew, 1937).

DISCUSSION: UALVP 44173 seems best referred tentatively to C. procyonoides based on structural similarity to m3s of N. procyonoides and C. keeferi, but being distinctly smaller overall. The Nose Creek specimen is within recorded ranges for m3s of C. sp. cf. C. procyonoides reported by Gazin (1956a) from the Saddle Locality, Bison Basin, in southern Wyoming.

Matthew (1937) erected the taxon N. procyonoides to receive small specimens of Neoclaenodon from the Torrejon Arroyo of the San Juan Basin, New Mexico. Simpson (1937) reassigned N. procyonoides to Claenodon procyonoides, based on what he perceived as compelling resemblances to Claenodon [=Arctocyon] ferox. Van Valen (1978) synonymized Simpson's Claenodon procyonoides and Claenodon silberlingi with Patterson and McGrew's (1962) Colpoclaenus, with no discussion given.

It seems likely that C. procyonoides is a composite taxon; few authors have referred specimens with confidence, likely due to a lack of published measured data or detailed descriptions. C. procyonoides, then, may be a wastebasket taxon, receiving specimens that fall outside the published ranges of teeth referable to C. keeferi, the generic type. Confident specific assignment is deferred until a larger sample is acquired, and the type material can be examined.

Order Condylarthra Cope, 1881b

Family Mioclaenidae Osborn and Earle, 1895

Subfamily Mioclaeninae Osborn and Earle, 1895

Genus Promioclaenus Trouessart, 1904

cf. Promioclaenus acolytus (Cope, 1882)

(Fig. 25, D-I; Fig. 26, A-C; Table 40)

REFERRED SPECIMENS: 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 (total: 2); UALVP 44181, p4; UALVP 44182, m2.

DESCRIPTION: M1—The crown of UALVP 44175 is quadrate in occlusal outline, with moderately developed parastylar and metastylar regions. The paracone and metacone are subequal in size and height and are circular in horizontal section. The preparacrista and postmetacrista are well developed, progressing labially to the parastylar and metastylar regions respectively. The postmetacrista joins the ectocingulum distolabial to the metacone. The conules are distinct, the metaconule being slightly larger than the paraconule, and both situated somewhat mesial and lingual to the bases of their respective trigon cusps. The internal and external conule wings are poorly developed and interrupt neither the pre- nor postcingulum. The protocone is large, bulbous and subcrescentic in horizontal section; the preprotocrista and postprotocrista are high, forming a deep trigon basin. The hypocone is conical, closely appressed to the protocone, and approximately half the dorsoventral height of the protocone. The precingulum is prominent, terminating at the base of the protocone. The postcingulum joins the hypocone labially and progresses uninterrupted to a point just below the metastylar region. The cingula are incomplete lingually.

Lower premolars—The crowns of the referred premolars are dominated by a large and inflated protoconid, while the metaconid is absent. p2-3 retain a vestigial, mesially positioned paraconid, while p4 possesses a low and prominent, lingually positioned paraconid that displays heavy wear. A moderately developed crest runs mesially and distally from the apex of the protoconid. The talonid is unbasined on p2-3 and shallowly basined on p4, and is unicuspate on all premolars.

Lower molars—The referred molars are all heavily worn, particularly UALVP 44177, and topographical features are difficult to distinguish. The molars are observed, however, to be subquadrate in occlusal aspect, with m3 reduced relative to m1-2. The trigonid cusps are swollen; the paraconids are decidedly reduced and slightly appressed to, but not confluent with, the metaconids. The paraconids are in an internal position, nearly directly mesial to the metaconids. The protoconids and metaconids are subequal in height and size and nearly transversely opposed. The entoconids and hypoconids appear to have been the dominant talonid cusps, with the hypoconulids smaller, lower and close to the entoconids. The talonid notches are mesiodistally wide, and the cristids obliquae are high, striking the distal trigonid walls just below the trigonid notches. The external cingulids are incomplete labially, being interrupted at the bases of the protoconids and hypoconids.

COMPARISONS: The inflated appearance of p4, the swollen nature of the cusps, the reduction and appression of the molar paraconid to the metaconid and the mesiodistally wide talonid notch suggest an affinity with mioclaenid condylarths (Rigby, 1980; Johnston and Fox, 1984). The Nose Creek sample bears resemblance to the dentitions of primitive members of the Mioclaeninae, such as those of Bubogonia Johnston and Fox, 1984 from the Puercan of New Mexico and Saskatchewan, Tiznatzinia Simpson, 1936 from the Puercan of New Mexico, and Promioclaenus from the Torrejonian of the United States. The referred lower molars seem most similar to those of P. acolytus in having a distinct paraconid and a reduced m3, but differ in being generally less inflated and having a more mesiodistally elongate trigonid. Curiously, the referred p4s are more similar to those of Tiznatzinia and to a lesser degree, Bubogonia, in having a strong, mesiolingually positioned paraconid.

DISCUSSION: The Nose Creek sample seems to bear closest resemblance to similar dentitions referred to P. acolytus from various localities in the United States, but appear to retain a suite of plesiomorphic characters, particularly in the antemolar dentition. Plesiomorphic characters retained from a presumed Protungulatum-like ancestor (Rigby, 1980; Van Valen, 1988) include:

1) The presence of a strongly developed p4 paraconid and vestigial paraconids on p2-3.
2) The less inflated nature of p4 as compared to p4s of P. spp.
3) The separation of the molar paraconid and metaconid, and the internal position of the paraconid.
4) m2 trigonid wider than talonid.

5) Hypocone small on M1.

Insofar as these features are concerned, the Nose Creek specimens resemble teeth of Bubogonia and Tiznatzinia, both considered to be closely related to Promioclaenus (Cifelli, 1983; Van Valen, 1988; Janis et al., 1998). The sample from Nose Creek differs from similar teeth referred to these taxa, however, in having p4s that lack the metaconid, in having lower-crowned molars that possess a reduced paraconid that is slightly appressed to the metaconid, and in having a discontinuous ectocingulid, character states hypothesized to be apomorphic among mioclaenines (Rigby, 1980; Johnston and Fox, 1984). In this respect, the teeth of cf. P. acolytus from Who Nose? are derived compared to similar teeth of Bubogonia and, to a lesser degree, those of Tiznatzinia, but primitive with respect to the dentitions of P. acolytus and Promioclaenus lemuroides (Matthew, 1897). These latter two taxa possess p4s that have lost the paraconid and have a reduced to absent metaconid, and lower molars that are swollen in appearance, and have a reduced paraconid that is appressed to the metaconid.

In analyzing the sample of P. acolytus from Swain Quarry, Rigby (1980:120-121) noted a high and unusual degree of variability in most dental elements as compared to penecontemporaneous samples from the Gidley Quarry and Kutz Canyon localities. These observations of variation included a molar hypocone that varied in structure from being "...a simple low cusp to a structure similar to the "Hanopithex [sic] fold" of some early primates", a lower molar paraconid that ranges 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 erecting a new taxon to accommodate the distinctly different elements in the Swain Quarry sample, choosing instead to view the sample as a highly variable population. The referred specimens from Who Nose? appear to fall within the recorded morphological ranges for P. acolytus from Swain Quarry, but differ in the presence of a strong paraconid on p4, a feature not noted in the Swain Quarry sample. Although the Nose Creek sample contains only two p4s, both possess this character, and by virtue of the large wear facets on the mesial and mesiolabial surfaces, the paraconid was evidently an important topographical feature of the tooth during the masticatory cycle. As such, 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, and with the anticipation that the sample may be better referred to an alternative, more primitive mioclaenine taxon.

Family Hyopsodontidae Trouessart, 1879

Subfamily Tricuspiodontinae Simpson, 1929

Genus Litomylus Simpson, 1935a

Litomylus sp.

(Fig. 26, D-E; Table 41)

REFERRED SPECIMENS: UALVP 44174, M1; UALVP 44183, M2.

DESCRIPTION: M1—UALVP 44174 is subquadrate in occlusal outline, with large trigon cusps. The parastylar and metastylar regions are reduced and the preparacrista is confluent with the ectocingulum. The paracone and metacone are nearly conical and are subequal in size and height. The conules and conule wings are well-developed, residing nearly directly lingual to their respective trigon cusps. The postmetaconule crista terminates far lingual to the postmetacrista, and is nearly continuous with the postcingulum. The protocone is large and high, subcrescentic in horizontal section, and leans distally. Strong protoconal cristae progress labially from the apex of the protocone and terminate lingual to the conules. The hypoconal salient is prominent; the hypocone is tall and spire-like, and confluent with a strong postcingulum. A mesial hypoconal crest connects the hypocone to the base of the distal wall of the protocone. The precingulum is well developed, terminating at the base of the protocone and confluent with the ectocingulum about the parastylar region.

M2—The crown of UALVP 44183 is similar to that of UALVP 44174, but is decidedly more transverse labiolingually. The metacone and metastylar region are broken off; the paracone is tall and circular in cross section, and connected to a prominent, mesially directed parastylar lobe by a robust preparacrista. Both conules are strongly developed, as are their external wings. The internal conule wings are much less evident, particularly the postparaconule crista. The protocone is high, approximately equal to the paracone, and is nearly crescentic in cross section. The hypocone is a small cusp, subequal in size and height to the conules, and located slightly internal to the protocone on a well-developed, distally expansive salient. As in UALVP 44174, the hypocone is connected to the protocone distally by a crest; this crest is much more prominent in UALVP 44183 than in the former. Pre- and postcingula are strong and discontinuous about the lingual margin of the crown; the precingulum is continuous about the mesial margin of the tooth, progressing labially to the parastylar lobe.

COMPARISONS: Close morphological similarity between the referred molars from Nose Creek and similar teeth of Litomylus spp. from the Puercan and Tiffanian of Alberta identifies these specimens as pertaining to a species of Litomylus. The Who Nose? specimens are similar to M1s and M2s of Litomylus orthronepius Johnston and Fox, 1984 from the Rav W-1 locality of Saskatchewan in being transversely elongate; in possessing expanded para- and metastylar areas, particularly on M2; in having the hypocones connected to the bases of the protocones by short crests; and in possessing well-developed ectocingula. The Nose Creek specimens differ, however, in being smaller overall; in having continuous paracingula; having postmetaconule cristae that terminate more labially with respect to the postmetacristae, much closer to the postcingula; in having more lingually positioned metaconules; and in having somewhat better developed hypoconal salients. The referred teeth differ significantly from similar teeth of Tiffanian species of Litomylus, including Litomylus dissentaneus Simpson, 1935a, Litomylus ishami Gazin, 1956b, and Litomylus "grandaletes" Youzwyshyn, 1988 in being smaller, having subrectangular rather than more nearly square occlusal outlines, having less inflated cusps and in possessing better developed stylar regions. The Nose Creek specimens differ further from teeth of these taxa in possessing smaller hypocones that are more closely appressed to the protocones and in having weakly developed crests connecting the hypocones to the protocones.

DISCUSSION: The referred specimens from Nose Creek are plesiomorphically similar to upper molars of L. orthronepius from the Rav W-1 locality of Saskatchewan, displaying few apomorphic characters linking them with teeth of early Tiffanian species. The aforementioned differences between the Nose Creek specimens and teeth of L. orthronepius may prove to be taxonomically significant, however, in light of a larger sample. As such, the Nose Creek specimens are referred to L. sp., with the similarity of molar morphology closer to that of the more primitive L. orthronepius than to stratigraphically younger members of the group.

Grandorder Ferae Linnaeus, 1758

Order Carnivora Bowdich, 1821

Suborder Feliformia Kretzoi, 1945

Family Viverravidae Wortman and Matthew, 1899

Subfamily Didymictinae Flynn and Galiano, 1982

Genus Protictis Matthew, 1937

Protictis sp.

(Fig. 27, A-C; Table 42)

REFERRED SPECIMENS: UALVP 44186, m1.

DESCRIPTION: m1—UALVP 44186 is of typical carnivoran morphology, with a tall, massive trigonid and a much lower talonid. The talonid is slightly shorter labiolingually than the trigonid in occlusal aspect. The trigonid is somewhat mesiodistally compressed, with the paraconid being slightly appressed to the metaconid. The trigonid cusps are massive and form an isosceles triangle in occlusal outline, with the protoconid at the apex of the more acute angle. The protoconid is large, convex labially, and is considerably taller than the paraconid. Damage and wear have obscured the original dimensions of the metaconid, but it is estimated that it was slightly lower than the protoconid. The paraconid is mesial to the metaconid and compressed mesiodistally, forming a relatively high shearing paracristid. The paraconid appears to have been lower than the metaconid originally, and does not project mesially to the same extent as in other viverravids. Deeply incised carnassial notches are present at the labial margin of the paracristid and at the midpoint of the protocristid. The talonid is heavily damaged distally, but it is estimated that the hypoconid was larger than either the entoconid or hypoconulid, and the basin was short and deep. The entoconid was apparently small, conical, and rather appressed to the postvallid, forming a narrow, nearly vertically oriented talonid notch. The talonid notch is ventrally emarginated and the entocristid is high and sectorial. The cristid obliqua strikes the postvallid slightly lingual to the carnassial notch. A small precingulid is present on the mesial face of the protoconid. Vertical shear facets corresponding to postvallum-prevallid shear with P4 and M1 are noted on the mesiolingual, distolingual, and distolabial faces of the trigonid.

COMPARISONS: The high sectorial trigonid, blade-like paracristid, the presence of distinct, deeply incised carnassial notches in the paracristid and postcristid and typical carnivoran shear facets justify the ordinal level referral of UALVP 44186 (MacIntyre, 1966; Fox and Youzwyshyn, 1994). The referred specimen seems closest in morphology to m1, Protictis spp., in having a much higher trigonid than talonid, a sectorial, somewhat mesially positioned paraconid/paracristid, and a high paracristid in relation to the metaconid and protoconid (Gingerich and Winkler, 1985). UALVP 44186 differs from m1s of penecontemporaneous Pristinictis connata Fox and Youzwyshyn, 1994 from the Cochrane Site 2 locality of Alberta in having a less mesiodistally compressed trigonid and a more lingually extensive and higher positioned paraconid/paracristid. The Nose Creek specimen differs further from m1, Prist. connata, in having the paraconid in a more mesial position, and the protoconid and metaconid being more nearly equal in height.

The referred molar approaches the morphology of m1s of Torrejonian Protictis haydenianus (Cope, 1882) and middle Tiffanian Protictis paralus Holtzman, 1978. UALVP 44186 is similar to m1s, P. haydenianus, in having the protoconid and metaconid subequal in height and size; it differs from m1s of this taxon in having a paracristid that is more lingually transverse and relatively higher on the protoconid. The referred molar is similar to m1s of P. paralus in overall size, but differs in having the paraconid more nearly appressed to the metaconid, a more acute talonid notch, and an entoconid which is more appressed to the distal trigonid wall.

DISCUSSION: UALVP 44186 displays a curious suite of primitive and derived viverravid characters. The mesiodistal compression of the trigonid, coupled with the slight difference in protoconid and metaconid heights suggests affinities with primitive viverravids, as observed in lower molars of Prist. connata and P. haydenianus. Contrarily, the lingually transverse and relatively high position of the paraconid/paracristid suggests affinities with more derived members of the group, as represented in lower molars of P. paralus and Protictis agastor Gingerich and Winkler, 1985. The morphology of the talonid may be unique among primitive didymictines: the appression of the entoconid to the distal trigonid wall, the high sectorial entocristid, and the deeply incised talonid notch suggest a possible enhancement of distolingual shear, quite unlike the condition observed in m1s of Protictis spp., but similar to that observed in the m1s of viverravines such as Simpsonictis MacIntyre, 1962 (pers. obs.).

The paucity of specimens and the unusual combination of plesiomorphic and apomorphic characters prevent specific referral of UALVP 44186 until a larger sample is acquired. This m1 is best referred to P. sp., representing a primitive form that is uniquely specialized for distolingual shear.

Subfamily Viverravinae Wortman and Matthew, 1899

Genus Simpsonictis MacIntyre, 1962

Simpsonictis sp., cf. S. jaynanneae Rigby, 1980

(Fig. 27, D-H; Fig. 28, A-C; Table 43)

HOLOTYPE: AMNH 87932b, isolated P4.

TYPE LOCALITY: Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County, Wyoming.

KNOWN AGE AND DISTRIBUTION: Late Torrejonian (middle Paleocene) of Alberta (Diss Locality, Coalspur Formation, Alberta Syncline [Fox, 1990]); late Torrejonian of Wyoming (type locality [Rigby, 1980]).

REFERRED SPECIMENS: UALVP 44187, M1; UALVP 44188, m2.

DIAGNOSIS: "P4 slightly larger than S. tenuis. Metastylar blade is bilobate with 2 elongate separate portions. Crests from the apex of the paracone are weak, inflated and poorly developed. Lower molar protolophid crests are much larger and blade-like than S. tenuis with distance from the posterior carnassial notch to the metaconid and protoconid apices reduced" (Rigby, 1980:82).

DESCRIPTION: M1—The crown of UALVP 44187 is roughly triangular in outline, and is asymmetrically bilobate about the stylar shelf, with a prominent, hook-like parastylar region and a rounded metastylar region. The parastylar lobe is greatly enlarged and extends slightly further labial than the metastylar lobe. The asymmetrical proportions of the stylar area form a relatively deep and acutely angled ectoflexus. A small, low stylocone arises mesial and labial to the paracone at the junction of the preparacrista and the ectocingulum. The stylocone is slightly compressed mesiodistally, but retains a decidedly cusp-like appearance. A small, well-worn parastyle arises directly mesial to the stylocone, and connects to the latter by a short stylocristid. The parastyle is pyramidal in horizontal section and approximately half the height of the stylocone. The ectocingulum is relatively low and narrow, but is wider about the parastylar and metastylar regions. The paracone is tall, conical, and partially confluent at its base with a low, conical metacone. The paracone is nearly twice as tall as the metacone, and extends further lingually at its base. The metacone leans distally and slightly lingually. The preparacrista is high and blade-like, progressing labially towards the stylar shelf; the preparacrista joins the stylocone lingually, then continues from the labial side of this cusp towards the parastyle. The centrocrista is asymmetrically v-shaped in labial aspect; the shear pattern of the centrocrista is typically carnivoran, with a strong vertical facet descending mesiolingually from the mesial face of the metacone into the trigon basin from contact with the hypoconid of m1 (Fox and Youzwyshyn, 1994). A carnassial notch is absent at the base of the centrocrista; rather, the valley between the paracone and metacone is ventrally arcuate. The postmetacrista is short and stout, forming a high crest, and runs distolabially to the corner of the metastylar region. A metastyle is absent. The paraconule is large and well developed, and is higher and in a more lingual position with respect to the metaconule. The original dimensions of the metaconule are somewhat obscured by post-mortem abrasion, but it appears to have been weakly developed in comparison with the paraconule. The pre- and postparaconule cristae are prominent, whereas those of the metaconule are poorly developed. The paracingulum is continuous from the paraconule to the parastyle; the extent of the metacingulum cannot be accurately ascertained, but it appears to progress to a point distal and ventral to the metacone. The trigon basin is moderately deep, owing to the slight confluence of the paracone and metacone bases and relatively high pre- and postprotocristae. The protocone is compressed mesiodistally and is subcrescentic in horizontal section; it leans slightly mesially and is rounded lingually. The preprotocone crista is high, whereas the postprotocone crista is lower and sinusoidal in distal view. Carnassial notches at the unions of the preprotocone crista and paraconule, and postprotocone crista and metaconule, are absent. The precingulum is wide and joins the preparaconule crista at base of the paracone; this crest then continues as the paracingulum to the parastyle. The postcingulum flares distally at its lingualmost extent; its labial proportions are somewhat obscured from abrasion, but it appears to terminate below the metaconule. The pre- and postcingula are discontinuous lingually about the protocone.

m2—The trigonid of UALVP 44188 is moderately high, decidedly more so than the talonid. In occlusal outline the trigonid forms an isosceles triangle, with the protoconid at the apex of the more acute angle. The trigonid is slightly wider labiolingually than the talonid. A large protoconid dominates the trigonid; post-mortem abrasion has removed the metaconid, but from the dimensions of its base it is estimated that the cusp was at least as large and as tall as the protoconid. The paraconid is closely appressed to the metaconid and is low in position, approximately half way up the protoconid and metaconid. The paraconid/paracristid is compressed mesiodistally, but retains a distinctly cuspidate appearance. Heavy wear is evident on the mesial face of the protoconid along the prominent precingulid, as well as apically on the paraconid and labiolingually across the paracristid. The strong wear along the paracristid has obscured the ventral aspect of this structure; as such, the presence or absence of a carnassial notch at its union with the protoconid cannot be ascertained. A small carnassial notch is noted on the protocristid. The talonid is mesiodistally elongate, more so than the trigonid, and contains three well-developed cusps: a large, mesiodistally long finger-like hypoconulid, and subequal and transversely opposed entoconid and hypoconid. The talonid is moderately basined; the entocristid descends sharply mesioventrally, forming an acute talonid notch. The cristid obliqua is convex labially and strikes the distal trigonid face just lingual to the midline.

COMPARISONS: The referred specimens bear closest resemblance to homologous teeth of Simpsonictis spp., particularly with respect to the tall, 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 similar teeth of both Simpsonictis tenuis MacIntyre, 1962 from the Bighorn Basin and Simpsonictis jaynanneae Rigby, 1980 from the Washakie Basin. The referred specimens are considerably smaller than homologous teeth referred to Simpsonictis pegus Gingerich and Winkler, 1985 from the Bighorn Basin.

DISCUSSION: Gingerich and Winkler (1985) consider S. jaynanneae from the Swain Quarry of Wyoming better referred to S. tenuis, suggesting that the measured values provided by Rigby (1980) were statistically insignificant. Gingerich and Winkler's critique did not, however, discuss the morphology of M1, 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 ascribed to that taxon. In their analysis of the relationship between S. tenuis and the early Tiffanian viverravid Pristinictis connata from the Cochrane Site 2 locality, Fox and Youzwyshyn described topographical features of M1, S. tenuis, that appear to differ from those of M1, S. jaynanneae. These features include:

1) The absence of a stylocone.
2) The presence of well-developed para- and metaconules and their associated crests.
3) A larger and taller paracone as compared to the metacone.
4) The preparacrista forms a raised, blade-like structure as it crosses the stylar shelf.

Insofar as these features are concerned, it appears that S. jaynanneae may in fact be a valid taxon, exhibiting a decidedly more primitive M1 structure than that of S. tenuis (as Rigby had hypothesized) and more nearly approaching the plesiomorphic carnivoran condition observed in M1s of Prist. connata (Fox and Youzwyshyn, 1994) and to a greater degree, Ravenictis krausei Fox and Youzwyshyn, 1994 from the Ravenscrag Formation of 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, S. tenuis. Contrarily, the presence of a stylocone and parastyle, lower preparacrista, 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 from Gidley and Rock Bench quarries (Gingerich and Winkler, 1985) or from m2s referred to S. jaynanneae from the Swain Quarry (Rigby, 1980). UALVP 44188 is closer to m2s of S. jaynanneae in overall size, in having a trigonid that is slightly more mesiodistally compressed, and in having a more ventrally positioned paracristid.

The Nose Creek specimens are best referred to S. sp., cf. S. jaynanneae until a larger sample provides some idea of variation. It appears, at the very least, that these teeth represent a morphology somewhat intermediate between that observed in similar teeth of primitive carnivorans including S. jaynanneae, and that of S. tenuis.

The presence of Simpsonictis at Who Nose? represents the earliest known occurrence of the taxon in Canada.

Carnivora, genus and species unidentified

(Fig. 28, D-F; Table 44)

REFERRED SPECIMEN: UALVP 44189, incomplete dentary with m2.

DESCRIPTION: UALVP 44189 preserves the distal portion of the dentary of a diminutive carnivoran, with a small tooth interpreted to be in the m2 locus. The crown is tall with a needle-like protoconid; post-mortem damage has removed the paraconid and metaconid. From the dimensions of the base, the paraconid appears to have been compressed mesiodistally and blade-like, and somewhat appressed to the metaconid; the metaconid appears to have been at least as tall as the protoconid. The talonid is typically carnivoran in morphology, with a well-developed, finger-like hypoconulid that projects distally, a prominent hypoconid, and a slightly smaller entoconid. The cristid obliqua and entocristid are raised and sharp, and aligned nearly parallel to one another. The cristid obliqua is straight labially, not convex. The precingulid is well developed.

COMPARISONS AND DISCUSSION: UALVP 44189 appears closest in morphology to m2s of Simpsonictis tenuis from the Gidley and Rock Bench Quarries (Gingerich and Winkler, 1985), but is considerably smaller in size (for example, length m2, Who Nose?=1.4 mm versus mean length m2, S. tenuis, Rock Bench Quarry=2.6 mm), in possessing a paraconid that is more closely appressed to the metaconid, in having a more broadly basined talonid, and in having a more reduced entoconid. The paucity of specimens precludes confident referral, even at the generic level; as such, UALVP 44189 is referred to Carnivora, genus and species unidentified.

Order Cimolesta McKenna, 1975

Family Palaeoryctidae (Winge, 1917)

Palaeoryctidae, genus and species unidentified 1

(Fig. 29, A-F; Table 45)

REFERRED SPECIMENS: UALVP 44195, p4; UALVP 44196, m1 or m2.

DESCRIPTION: p4—UAVLP 44195 is premolariform in structure, with a tall, subconical protoconid dominating the crown. The metaconid is absent. A small but distinct paraconid originates at the mesiolingual base of the protoconid and projects mesiolingually. A strongly developed protostylid crest runs down the distal wall of the protoconid to the talonid. The talonid is broken distally, but it appears to have been unicuspate and unbasined.

m1 or m2—In occlusal aspect, the trigonid of UALVP 44196 is labiolingually transverse and somewhat mesiodistally compressed, forming an isosceles triangle. The trigonid cusps are spire-like and tall relative to the talonid, but the tooth is low-crowned relative to those of other palaeoryctids. The protoconid is large and subcrescentic in horizontal section, whereas the metaconid is shorter and more nearly conical. The paraconid is faintly mesiodistally compressed and subellpitical, distinctly separate from the metaconid, and occupies a position slightly labial to the metaconid. The paracristid is low and not notched medially; the protocristid forms an acute angle between the protoconid and metaconid, and is notched medially. The precingulid is prominent but short, terminating prior to the labial base of the protoconid. The talonid is characteristically skewed labially, placing the entoconid close to the longitudinal axis of the crown. The talonid possesses three distinct cusps of subequal size and height. The hypoconid and hypoconulid are closely approximated in position relative to the entoconid. The cristid obliqua is straight labially, and strikes the postvallid in a medial position. The entocristid is high, forming a deep talonid basin and an acutely angled talonid notch.

COMPARISONS: The referred p4 differs from p4s of primitive cimolestans, such as Cimolestes Marsh, 1889 in possessing a relatively better developed paraconid. UALVP 44196 differs from molars of Cimolestes in having the protoconid and metaconid subequal in height, and a broader, more labially skewed talonid (Middleton, 1983; Buckley, 1994). The Nose Creek sample appears to differ from teeth of contemporaneous palaeoryctids, such as Palaeoryctes Matthew, 1913, in having a premolariform p4 and a lower molar with a subconical, internally positioned paraconid. Additionally, UALVP 44196 appears to differ with respect to most palaeoryctids in having a low trigonid relative to the talonid, and a broad, labiolingually expansive talonid. In these features, UALVP 44196 more closely approximates the condition of the lower molars of Pararyctes Van Valen, 1966. The Who Nose? specimens appear closest in size to similar teeth of Stilpnodon simplicidens Simpson, 1935a from the Gidley Quarry of Montana, differing primarily in being somewhat larger, with the trigonid of UALVP 44196 being more transverse and having a labiolingually more narrow talonid.

DISCUSSION: The uncertainties regarding the phylogenetic positions of members of the Palaeoryctidae as well as the polarity of characters within the group have been well documented (for example, Clemens, 1973; Archibald, 1982; Middleton, 1983; Buckley, 1994). Although certain features of the dentition are shared between palaeoryctid taxa, it is uncertain as to whether or not these shared features are uniquely derived from some ancestral type or are themselves the primitive states (Buckley, 1994). Many of the diagnostic characters used to define the Palaeoryctidae are also found in other placental groups; thus, the polarities of these characters are uncertain and cannot be resolved easily through outgroup analysis (Clemens and Lilligraven, 1986; Luo, 1991) As such, generalizations of "primitive" or "derived" must be used with caution, and most certainly as explicitly relative terms.

The curious mosaic of character states displayed by the Nose Creek specimens reinforce the difficulties of accurately referring isolated teeth to palaeoryctid taxa. Relative to the lower dentition of Cimolestes, here interpreted as representing the primitive cimolestan condition (but see Fox and Youzwyshyn, 1994, and references therein for a discussion of the composite nature of Cimolestes), the Nose Creek specimens appear derived, particularly with respect to the p4 paraconid and the more nearly equal height of the molar protoconid and metaconid. Contrarily, the referred specimens appear primitive relative to homologous teeth of typical palaeoryctids in having a more lingually positioned molar paraconid that is less appressed to the metaconid and a shorter molar trigonid relative to the talonid. The Nose Creek specimens approach the condition of similar teeth of S. simplicidens, known only from the type material from the Gidley Quarry of Montana (Simpson, 1935a). Rose (1981) made reference to undescribed palaeoryctids from the Gidley, Rock Bench and Scarritt quarries that closely approximate the sizes of the Nose Creek specimens. A more confident and precise referral is deferred until a larger sample is amassed, and the specimens from the Gidley, Rock Bench and Scarritt quarries can be examined.

Palaeoryctidae, genus and species unidentified 2

(Fig. 29, G-H; Table 46)

REFERRED SPECIMENS: UALVP 44197, ?M2.

DESCRIPTION: ?M2—The crown of UALVP 44197 is tricuspate, with tall, needle-like cusps. The parastylar region is slightly damaged from post-mortem abrasion, but it appears to have been labially expansive, but not hook-like. A stylocone appears to have been absent, but a small parastyle is present in the mesiolabial corner of the parastylar region. The metastylar region is expanded labially, slightly more so than that of the parastylar area, and is distinctly lobate in occlusal outline. The ectocingulum is prominent. The paracone is conical and lingually expanded at its base, while the metacone is labiolingually compressed and leans both lingually and distally. The preparacrista and postmetacrista are well developed and exhibit strong vertical wear surfaces. A well-developed paraconule is positioned lingually with respect to the weaklier developed metaconule. The conule cristae are poorly developed, particularly the internal cristae. The preparaconule crista was evidently continuous with the paracingulum, while the postmetaconule crista terminates abruptly at the lingual base of the metacone. Strong wear surfaces are noted on the preparaconule crista and paracingulum, suggesting an emphasis on prevallum shear. The protocone is tall, mesiodistally compressed and needle-like, and subequal in height to the paracone. The preprotocrista and postprotocrista are high and crestiform, forming a relatively deep trigon basin. The trigon basin deepens distally in keeping with the distolingual twisting of the lingual part of the tooth. Faint pre- and postcingula are present.

COMPARISONS: UALVP 44197 is symplesiomorphous with upper molars of Cimolestes in possessing a distally directed metacone; a paracingulum being continuous to the parastyle; and poorly developed conule wings (Fox, 1984a; Buckley, 1994). UALVP 44197 is synapomorphous with upper molars of typical palaeoryctids, in being less labiolingually transverse; having a reduced stylar shelf; the absence of a stylocone; in having a reduced preparacrista; and having faint pre- and postcingula. The Nose Creek specimen differs from upper molars of Palaeoryctes in being less labiolingually transverse; in having a more separate paracone and metacone; in having a reduced parastylar region; and in displaying faintly developed pre- and postcingula. With respect to these differences, UALVP 44197 is similar to upper molars of Procerberus Sloan and Van Valen, 1965. The diminutive size of the Who Nose? specimen approaches that expected for an upper molar of Stilpnodon simplicidens.

DISCUSSION: The affinities of UALVP 44197 are unclear. The suite of plesiomorphic and apomorphic characters and paucity of specimens make specific referral impossible, although the specimen approaches the predicted size of upper molars of S. simplicidens. A more specific referral awaits further sampling.

Suborder Didelphodonta McKenna, 1975

Family Cimolestidae Marsh, 1889

Genus Paleotomus Van Valen, 1967

Paleotomus "junior" Youzwyshyn, 1988

(Fig. 30, A-J; Fig. 31, A-F; Table 47)

HOLOTYPE: UALVP 25605, left m3.

TYPE LOCALITY: Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River, Alberta.

KNOWN AGE AND DISTRIBUTION: Latest Torrejonian (late middle Paleocene) of Wyoming (Shotgun [UW V-60014, V-60016; Keefer Hill; Twin Buttes; Jenkins Mountain; New Anthill], Shotgun Member, Fort Union Formation, Fremont County [Youzwyshyn, 1988; Gunnell, 1989]); earliest Tiffanian (late Paleocene) of Alberta (type locality [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Youzwyshyn, 1988; Krause and Maas, 1990]).

REFERRED SPECIMENS: UALVP 44219, DP4; UALVP 44220, p2; UALVP 44221, p3; UALVP 44222, p4; UALVP 44223, dp4; UALVP 44224, m1; UALVP 44225, 44226, m2s (total: 2).

DIAGNOSIS: "Differs from Paleotomus senior (Simpson, 1937) and P. milleri Rigby, 1980 in being smaller (approximately 40 percent smaller than P. senior and 20 percent smaller than P. milleri). Differs from an undescribed species of P. from the early late Tiffanian of Saskatchewan in being approximately 45 percent smaller" (Youzwyshyn, 1988:264).

DESCRIPTION: DP4—The tooth is triangular in occlusal aspect, with a mesiodistally elongate stylar region and a mesiodistally compressed lingual part. The crown displays a prominent and subequal paracone and metacone, and a shorter, labially inclined protocone. The parastylar and metastylar lobes are weakly developed and the stylar shelf is labiolingually narrow. The paracone is circular in cross section and is nearly vertically erect, whereas the metacone is labiolingually compressed and leans slightly lingually. The pre- and postparacristae and pre- and postmetacristae are well developed and display heavy wear, with strong vertical striations, particularly on the centrocrista. The conules and their associated crests are protuberant and closely appressed to their respective trigon cusps. The paraconule is slightly mesial to the paracone, and more lingual relative to the metaconule. The protocone is high and subcrescentic in horizontal section. The preprotocrista is heavily worn, obscuring its originally prominent character. The hypocone is small and immediately distal to the protocone. The pre- and postcingula are well developed.

p3—A large protoconid and a small, unicuspate heel characterize the crown. The paraconid is small and conical, and projects mesially from the mesiolingual base of the protoconid. The metaconid is absent. Prominent mesially and distally directed protostylid crests run from the apex of the protoconid; the former runs down the mesial face of the protoconid, forming a raised edge; the latter bisects the distal face of the protoconid and runs distally to meet the heel. A short crest originating at the apex of the talonid cusp runs mesiolingually, joins the distobasal part of the protoconid and forms a shallow talonid basin.

p4—The tooth is submolariform in structure with the trigonid displaying three distinct cusps. The protoconid is large and trenchant; a smaller subconical metaconid is situated approximately half way up the distolingual face of the protoconid and is directed distally. A strongly developed metastylid crest progresses distally from the apex of the metacone to the heel. The paraconid is large and conical, and projects mesially from base of the protoconid. A prominent and broadly notched lingual paracristid runs along the lingual margin of the crown to the base of the protoconid. The talonid is unicuspate; a crest originating at the apex of the talonid cusp runs mesially towards the postvallid, and forms a strong, ventrally incised notch at its union with the metastylid crest. A broad, lingually expansive flange protrudes from the talonid cusp to the base of the trigonid, forming a shallow talonid basin.

dp4—UALVP 44223 is molariform in construction. A tall, subconical protoconid and a slightly shorter metaconid dominate the crown. The metaconid is positioned distolingual to the protoconid, and the two are conjoined for almost half their dorsoventral extents. The paraconid is located mesial to the protoconid and is nearly vertically erect, not projecting mesially. A large accessory cusp is positioned mesiolingual to the paraconid along a prominent lingual accessory paracristid. The size and position of this cusp creates the appearance of a "twinned" paraconid. The lingual accessory paracristid is low and progresses distally, joins the trigonid at the base of the protoconid/metaconid complex and forms a mesiolingually positioned trigonid basin. The paracristid proper joins a mesially descending protostylid crest, forming a prominent notch at their union. The protocristid is notched medially. The talonid is large and robust, wider than the trigonid, with three distinct, well-separated cusps. The hypoconid is the largest talonid cusp, followed by a smaller, subequal entoconid and hypoconulid. The hypoconid and hypoconulid are subcrescentic in horizontal section, whereas the entoconid is more nearly circular. A tiny entoconulid is present on a low entocristid, and a swelling interpreted as a mesoconid occurs on the cristid obliqua. The talonid notch is broad and open lingually. The cristid obliqua is high at the hypoconid, but descends mesially and strikes the postvallid low and slightly external to the trigonid notch. Labial exodaeneodonty is noted over the mesial and distal roots.

m1—The trigonid is notably taller and labiolingually wider than the talonid. The protoconid is the largest and highest trigonid cusp; the lingual face is decidedly concave. The metaconid is tall, slightly shorter than the protoconid, and convex along its internal face. The paraconid is slightly reduced and external in position relative to the metaconid; the position of the paraconid forms along with the other trigonid cusps an acute, nearly equilateral triangle in occlusal aspect. The paracristid is high and notched. The protocristid is broadly V-shaped, and the trigonid notch is deeply incised and high in position, well above the level of the talonid. The precingulid is prominent and shelf-like. A minor swelling is present at the base of the paraconid. The talonid is robust in construction and open lingually. Three distinct, equally spaced talonid cusps are present; wear has reduced the original sizes of the cusps, but all appear to have been nearly equal in height, although from the dimensions of its base, the hypoconid was apparently more massive than either the entoconid or hypoconulid. The hypoconid is subcrescentic in cross section, whereas the entoconid and hypoconulid are more nearly circular. Both an entoconulid and mesoconid are absent. The talonid crests are all high and sectorial; the cristid obliqua strikes the postvallid at a low position, ventral to the trigonid notch.

m2—Relative to m1, m2 is larger, with a decidedly higher and labiolingually more transverse trigonid. The paracristid is higher and extends further lingually; the trigonid, in turn, is in the form of an isosceles triangle in occlusal aspect, compared the more nearly equilateral condition observed in m1. The precingulid is more prominent on m2, and progresses further both labially and lingually.

COMPARISONS: The referred specimens from Nose Creek are virtually identical to homologous teeth of P. "junior" Youzwyshyn, 1988 from the Cochrane Site 2 locality of Alberta. The referred teeth differ from those of Paleotomus senior (Simpson, 1937) and Paleotomus milleri Rigby, 1980 as per the diagnosis. Additionally, the Nose Creek specimens differ from similar teeth of Paleotomus carbonensis Secord, 1998 from the Hanna Basin of Wyoming in being some 35 percent smaller, and from similar teeth of Paleotomus radagasti Van Valen, 1978 in being some 53 percent smaller. The referred teeth differ from undescribed teeth of Paleotomus from the Roche Percée locality of Saskatchewan in being smaller, higher crowned with tall acute cusps, and in having proportionately higher molar trigonids relative to the talonids (pers. obs.).

DISCUSSION: Paleotomus was erected in 1967 by Van Valen to receive an m3, AMNH 33990, originally ascribed to Palaeosinopa senior by Simpson (1937), from the Scarritt Quarry. Van Valen considered the specimen to be of didelphodontan stock, and referred it as such to the Deltatheridia. Two upper molars, AMNH 33991 and 33828, were retained within Palaeosinopa as per Simpson's original allocations, but referred to a new species, Palaeosinopa simpsoni. Gingerich (1980) recognized Paleotomus as being distinct from Palaeosinopa, and synonymized Van Valen's Palaeos. simpsoni with P. senior, citing more constricted lingual parts of the upper molars and weakly developed hypocones as defining characteristics; Gingerich then referred Paleotomus to the Pantolestidae. Krause and Gingerich (1983) accepted this referral based on new specimens of P. senior from the Douglass Quarry of Montana. Youzwyshyn (1988) described material from the Cochrane Site 2 locality of Alberta, which he referred to P. "junior", new species, a taxon he referred to the Pantolestidae, in agreement with Gingerich (1980) and Krause and Gingerich (1983). In describing material from the Hanna Basin of Wyoming, Secord (1998) considered Paleotomus to be a pantolestid, but did not comment further on its taxonomic position. McKenna and Bell (1997) considered Paleotomus to be of didelphodontan cimolestid affinity, agreeing with Van Valen's original hypothesis.

It is clear from the repeated taxonomic shuffling that the affinities of Paleotomus are not clearly understood, due largely to meagre samples. Van Valen (1967:250) acknowledged the fact that the trigonid of AMNH 33990, a lower third molar, was "...unusually tall and the tooth is unusually large for a didelphodontine", a statement emphasized by Gingerich and Krause (1983) in their referral of Paleotomus to the

Pantolestidae. The newly described cimolestid Alveugena carbonensis Eberle, 1999 from the Ferris Formation in the Hanna Basin of Wyoming suggests, at the very least, the presence of an early Paleocene didelphodontan cimolestid considerably larger in size than P. radagasti, the largest species of the genus. Additionally, the lower m3 of Paleotomus more nearly approaches the morphology of homologous teeth of both Cimolestes magnus Clemens and Russell, 1965 and Procerberus formicarum Sloan and Van Valen, 1965. m3, Paleotomus, is plesiomorphically similar to m3s of these primitive didelphodontan cimolestids in retaining a high trigonid relative to the trigonids of m1 and m2, and in having a reduced talonid width relative to those of m1 and m2.

Paleotomus then, is diagnosed by characters considered plesiomorphic for the Didelphodonta, including moderately high and sectorial molar paraconids; high trigonids; protoconids larger and higher than the metaconids; reduced m3 talonids; centrally positioned hypoconulids; lingually constricted upper molars; and weakly developed hypocones (Van Valen, 1966; Gingerich, 1980). The species therein have been diagnosed for the most part on the basis of size, with little accompanying morphological criteria. Insofar as the plesiomorphic characters are concerned, the dentition of Paleotomus most closely resembles the condition observed in similar teeth of the Late Cretaceous taxon C. magnus. A cast of PU 14616, P. senior, from the Douglass Quarry of Montana reveals few differences in lower dental morphology between it and lower dentitions of C. magnus from Alberta. It is beyond the scope or ability of the present study to rediagnose Paleotomus, or to re-evaluate the taxon Pantolestinae; as Paleotomus appears to lack apomorphic characters relating it to typical and contemporaneous pantolestids such as Propalaeosinopa; however, I provisionally concur with Van Valen's original hypothesis of didelphodontan affinities for the taxon, agreeing with McKenna and Bell's (1997) most recent classification.

The Nose Creek specimens appear to represent a continuation of the Paleotomus lineage back into the Torrejonian. Further comment on the affinities of this taxon must await a larger sample from both the Who Nose? and Cochrane Site 2 localities.

Genus Procerberus Sloan and Van Valen, 1965

cf. Procerberus sp.

(Fig. 31, G-I; Table 48)

REFERRED SPECIMENS: UALVP 44190, m3.

DESCRIPTION: m3—The crown of UALVP 44190 is mesiodistally long, with the trigonid and talonid subequal in length. The trigonid appears low relative to the talonid owing to the high talonid cusps and crests. A metaconid and protoconid that are subequal in size and height dominate the trigonid. The paraconid is reduced, conical, and positioned nearly directly mesial to the metaconid; the paraconid is distinctly separate from the metaconid and nearly vertically erect, giving the trigonid the appearance of an equilateral triangle in occlusal outline. The metaconid is large and subtriangular in horizontal section, and leans distally. The protoconid is tall and acute, subtriangular in horizontal section, and is inclined distally. The internal face of the protoconid is flat, whereas the labial margin is more nearly convex. The paracristid is well worn, but appears to have been moderately high and crestiform. A small cuspule is present between the paraconid and protoconid on the paracristid. The protocristid displays evidence of wear, both on the lingual side of the protoconid and on the labial side of the metaconid. The trigonid notch is deep and notches are absent on the paracristid and protocristid. The precingulid is prominent, originating on the prevallid at the mesiolabial face of the paraconid, progressing a short distance lingually, and terminating at the mesiolingual face of the protoconid. The talonid cusps are high and robust, and circular in horizontal section. The entoconid and hypoconid are subequal in size and height, whereas the hypoconulid is decidedly smaller. The entoconid is positioned far distally, almost at the level of the hypoconulid. The basin-facing margin of the hypoconid is flat, while that of the entoconid and of the hypoconulid are more nearly convex. A small, medially positioned entoconulid is developed along the entocristid, and a mesoconid is developed medially along the cristid obliqua. The entocristid and cristid obliqua are mesiodistally elongate, extending the length of the talonid, and form a broad, shallow basin. The talonid notch is slight, resembling a broad U shape in lingual aspect; as a result, the talonid is virtually open lingually. The cristid obliqua is straight labially and strikes the postvallid at a position slightly lingual to the midline.

COMPARISONS: The Nose Creek specimen bears closest resemblance to m3s of early Paleocene didelphodontan cimolestids (sensu Van Valen, 1966). The referred molar is most similar to homologous teeth of Procerberus, differing from lower molars of other penecontemporaneous didelphodontans, including those of Gelastops Simpson, 1935a and Acmeodon Matthew and Granger, 1921, in having a trigonid that is less mesiodistally compressed, and a paraconid that is more nearly erect, conical, and less mesially directed, appearing to be specialized for grinding and crushing, rather than piercing or shearing.

The Who Nose? specimen appears closest in morphology to lower molars of the Late Cretaceous and early Paleocene didelphodontan Procerberus formicarum Sloan and Van Valen, 1965. UALVP 44190 resembles molar teeth of P. formicarum in trigonid morphology, including having a conical paraconid, a nearly equilaterally triangular occlusal configuration of the cusps, and somewhat stout, low-crowned cusps relative to the talonid. Additionally, the Who Nose? specimen is similar to the molar talonids of P. formicarum in having high cusps and crests, and the presence of both an entoconulid and mesoconid. The referred specimen differs from molar teeth of P. formicarum in having a more nearly erect paraconid that is not deflected mesially, a mesiodistally longer talonid with a straight entocristid and cristid obliqua, a much broader talonid notch and talonid basin, and comparatively more nearly conical talonid cusps.

With respect to the mesiodistally elongate talonid, the referred specimen may be closer to lower molar teeth predicted for Procerberus plutonis Van Valen, 1978 from the Purgatory Hill locality of Montana. Van Valen described the upper dentition of P. plutonis, noting the presence of mesiodistally elongate protocones on the molars; such an elongate protocone on M3 would certainly be accommodated by the mesiodistally elongate talonid of UALVP 44190.

DISCUSSION: The Nose Creek specimen seems closest in morphology to similar teeth of Procerberus spp., appearing specialized for crushing and grinding, rather than for piercing or shearing, as observed in the molar teeth of palaeoryctid cimolestans. Procerberus is known predominantly from Puercan localities in Canada and the United States, the youngest occurrences being at the Rav W-1 and Simpson localities in Saskatchewan and Montana respectively (Johnston and Fox, 1984; Fox, 1990a; 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 extending the temporal range of Procerberus by some two million years based on a meagre sample, UALVP 44190 is tentatively referred to this taxon until a larger sample is acquired.

Cimolestidae, genus and species unidentified

(Fig. 32, A-H; Table 49)

REFERRED SPECIMENS: UALVP 44191, 44192, P4s (total: 2); UALVP 44193, M2; UALVP 44194, ?m3.

DESCRIPTION: P4—The crown is triangular in occlusal outline and semimolariform in construction. The stylar shelf is well-developed, supporting strongly developed parastylar and metastylar lobes. The ectocingulum is prominent and low relative to the paracone. A small conical parastyle is present at the mesiolabial corner of the crown, and is distinctly separate from the paracone. The metastylar lobe is large, more so than the parastylar lobe, and supports a large, labiolingually compressed metastyle distolabial to the metacone. A strong preparacrista connects the apex of the paracone to the distolingual part of the parastyle; the preparacrista is not notched. The paracone is large and pyramidal, central in position, and is conjoined with a conical, incipient metacone. A strong notch is present between the paracone and metacone. The postmetacrista is prominent and notched at its union with the metastyle. The protocone is short, approximately equal in height to the metacone, and is nearly confluent with the paracone at its mesiolingual face. The pre- and postcingula are confluent with the preprotocrista and postprotocrista respectively. The postprotocrista is sweeping and arcuate, convex lingually, and bears accessory cuspules along the lingualmost margin. The trigon basin is shallow and defined distally by the postprotocrista.

M2—UALVP 44193 is labiolingually transverse and mesiodistally short, forming an acute triangle in occlusal outline. The parastylar and metastylar lobes are strongly developed and labially transverse, forming a deep ectoflexus. The parastylar area is lobate in occlusal aspect. A small, conical parastyle is located at the mesiolabial corner of the crown; a second stylar cusp, smaller than the parastyle, is noted immediately distal to the parastyle. This cusp, here interpreted as an accessory stylar cusp, is not connected to either the parastyle or paracone by the preparacrista. The metastylar region is lobate in occlusal aspect, but more mesiodistally compressed and less labially expansive relative to the parastylar lobe. A tiny metastylar cusp is present at the extreme labial margin of the metastylar lobe. The ectocingulum is reduced. The paracone is tall and nearly circular in cross section. The metacone is broken away; from the dimensions and structure of the base, it appears to have been conical and subequal in size and height to the paracone. The metacone likely leaned distally and lingually relative to the positions of the paracone and protocone. The preparacrista and postmetacrista are both strongly developed but highly worn; the centrocrista is moderately worn and forms an acute angle in labial aspect. The paraconule and metaconule are both conical and distinct. The paraconule leans mesially and is more lingually positioned relative to the metaconule; both are slightly mesially shifted relative to the bases of their respective trigon cusps. The paraconule cristae are well developed, whereas those of the metaconule are indistinct (postmetaconule crista) or absent (premetaconule crista). The protocone is large, nearly as tall as the paracone, and subcrescentic in horizontal section, owing to slight mesiodistal compression. The protocone cristae are prominent, forming the mesial and distal margins of a deep, pocket-like trigon basin. Pre- and postcingula are absent.

?m3—The trigonid of UALVP 44194 is decidedly taller than the talonid and labiolingually transverse, forming an acute angled triangle in occlusal aspect. The trigonid possesses a subequal protoconid and metaconid, and a reduced paraconid. The protoconid is subtriangular in cross section, whereas the metaconid is more nearly circular. The paraconid is somewhat appressed to the metaconid and labial in position, and remains separate and distinctly cuspidate. The paracristid is low and notched medially, and displays heavy wear. The protocristid is moderately worn, and forms an acutely angled trigonid notch. The arrangement of trigonid cusps and crests forms a deep, mesiodistally constricted trigonid basin. The precingulid is prominent and shelf-like. The talonid is broadly basined and skewed labially. The three talonid cusps are distinct; the hypoconid is worn flat, but appears to have been more massive, but lower in height than the entoconid or hypoconulid. The hypoconulid and entoconid are in close proximity and shifted slightly labially; as a result, the longitudinal axis of the tooth passes through the postcristid between the entoconid and the hypoconulid. The entocristid is slightly damaged and heavily worn, obscuring its original proportions; the resultant talonid notch is mesiodistally widened, but forms an acute angle nonetheless. The cristid obliqua contacts the postvallid medially, and is straight labially.

COMPARISONS: The referred specimens were not found in association, and the occlusal fit of UALVP 44193 and 44194 is poor; they are referred to the same taxon on the basis of size and their being distinctly different from homologous teeth of either Procerberus sp. and Paleotomus "junior", the two other didelphodontan taxa identified from Nose Creek.

The morphologies of the referred specimens from Who Nose? seem derived relative to teeth of primitive didelphodontans, such as Cimolestes, in having a more nearly molariform P4 with a more labially positioned protocone (not as molarized, however, as that of Procerberus), in having a subequal protoconid and metaconid, and having a lower trigonid relative to the talonid on m2. Contrarily, the referred teeth retain plesiomorphic traits seen in similar teeth of Cimolestes, including a labiolingually transverse M2, a conical paracone and metacone, lack of pre- or postcingula, and a labiolingually transverse trigonid on m2. The referred teeth most closely approximate similar teeth of contemporaneous didelphodontans such as Gelastops and Acmeodon, particularly with respect to the semimolariform condition of P4 and the development of the parastylar and metastylar lobes on M2. Furthermore, the Nose Creek lower molar resembles those of Gelastops and Acmedon 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).

DISCUSSION: The referred specimens from Nose Creek are of didelphodontan cimolestid stock, most closely approximating the morphology of teeth referred to Gelastops (Simpson, 1935a; Van Valen, 1966) but apparently retaining plesiomorphic characters observed in the dentition of Cimolestes. Any meaningful consideration of the referred specimens must await further sampling.

Suborder Apatotheria Scott and Jepsen, 1936

Family Apatemyidae Matthew, 1909

Subfamily Apatemyinae Matthew, 1909

Genus Jepsenella Simpson, 1940

Jepsenella sp., cf. J. praepropera Simpson, 1940

(Fig. 33, A-B; Table 50)

HOLOTYPE: AMNH 35292, right dentary with m1-3.

TYPE LOCALITY: Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County, Montana.

KNOWN AGE AND DISTRIBUTION: late Torrejonian (middle Paleocene) of Montana (type locality [McKenna, 1963; Simpson, 1940]); late Torrejonian of Wyoming (Cedar Mountain [locality UW V-81056], Polecat Bench Formation, southern Bighorn Basin, Hot Springs/Washakie Counties [Hartman, 1986]); Rock Bench Quarry [Locality No. 6], Fort Union Formation, Bighorn Basin, Park County [Rose, 1981]; Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Rigby, 1980]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); late Tiffanian of Texas (Joe's Bonebed [TMM 41366, 41365], Black Peaks Formation, western Tornillo Flat, Brewster County [Schiebout, 1974]).

REFERRED SPECIMEN: UALVP 44198, I1.

DIAGNOSIS: "An apatemyid with lower molar trigonids elevated far above the talonids, protoconids and metaconids high and subequal, paraconids lower but strong and distinct, that of m3 smallest and median in position, squaring of anteroexternal trigonid rim less pronounced than in later forms, hardly noticeable on m3, talonid of m3 short" (Simpson, 1940:186).

DESCRIPTION: I1—UALVP 44198 possesses a simple, elongate crown, with a large, mesial anterocone and a small, distal posterocone.

COMPARISONS: UALVP 44198 differs from I1s of the late Tiffanian Apatemys Marsh, 1872 (=Labidolemur Matthew and Granger, 1921) in being mesiodistally longer, with a more nearly straight anterocone (Gingerich and Rose, 1982). The Nose Creek specimen differs from similar teeth from the Cochrane Site 2 locality in being mesiodistally longer with a wider crown, in having a more distal placement of the posterocone, and in having a sharper, higher crest between the anterocone and posterocone. UALVP 44198 differs from I1s from the Birchwood Locality in being smaller.

DISCUSSION: The Who Nose? specimen is virtually identical to teeth referred to J. sp., cf. J. praepropera from the Cochrane Site 2 and Birchwood localities of Alberta (Youzwyshyn, 1988; Webb, 1996). The presence of J. sp., cf. J. praepropera at Who Nose? putatively marks the earliest occurrence of this poorly known taxon.

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Suborder Pantodonta Cope, 1873

Superfamily Pantolambdoidea Cope, 1883

Family Cyriacotheriidae Rose and Krause, 1982

Genus Cyriacotherium Rose and Krause, 1982

cf. Cyriacotherium sp.

(Fig. 33, C; Table 51)

REFERRED SPECIMENS: UALVP 44184, 44185, P3s (total: 2).

DESCRIPTION: P3—The referred teeth are large and robust, and submolariform in structure. The crown is weakly dilambdodont, transversely wide and mesiodistally compressed, and dominated by a subequally tall, subcrescentic paracone and metacone. The parastylar and metastylar regions are prominent and highly lobate in construction, forming a deep, horseshoe-shaped ectoflexus. The stylar shelf is concave vertically, the paracone and metacone widening considerably at the labial side of their bases. The ectocingulum is low relative to the heights of the paracone and metacone, but is robust and ridge-like. The preparacrista is long, high and crestiform, and bears a large, conical stylocone labial and slightly mesial to the paracone. From the apex of the stylocone, a strong stylocrista descends mesially to join a lower, subconical parastyle, directly mesial in position to the stylocone. The metastylar lobe is squared off labially and extends labially as far as the parastylar region. Post-mortem abrasion has obscured the topography of this region; as such, the presence or absence of a metastylar cusp cannot be ascertained. The postmetacrista, as with the preparacrista, is elevated and crestiform.

The paracone and metacone are closely appressed, being conjoined for almost half their heights, forming a highly acute centrocrista. The centrocrista is notched ventrally and is not deflected labially, reducing the dilambdodont appearance of the crown. The paracone and metacone are concave labially and somewhat convex lingually, particularly at their conjoined bases. A paraconule swelling occurs at the labialmost extent of the postprotocrista. The metaconule and conule crests are absent. The protocone is tall, subequal in height to the paracone and metacone, and is nearly circular in horizontal section. The preprotocrista is well developed and continuous with the precingulum; the postprotocrista is more poorly developed relative to the preprotocrista, and is not confluent with the postcingulum. The mesial and distal cingula are discontinuous about the lingual face of the protocone.

COMPARISONS: The Nose Creek specimens resemble upper premolar dentitions of primitive pantodonts. 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 homologous teeth of members of the Cyriacotheriidae (Rose and Krause, 1982), but possess features that are considered primitive for the family. The referred teeth differ from P3, Cyriacotherium argyreum Rose and Krause, 1982, the basal member of the family, in:

1) Having a deeper, horseshoe-shaped ectoflexus.
2) Having strongly developed parastylar and metastylar lobes.
3) Having a distinct and prominent stylocone and parastyle.
4) Having the paracone and metacone strongly appressed to one another.

5) Absence of conules and their associated crests.

6) Having an open trigon basin.

7) Having weak dilambdodonty.

The Who Nose? specimens are similar to UALVP 10850, a questionable P3 pertaining to C. sp., cf. C. argyreum (Rose and Krause, 1982), and an uncatalogued P3 tentatively assigned to C. argyreum (pers. obs.), both from the Roche Percée fauna of Saskatchewan. UALVP 44184 and 44185 differ from these teeth in having less robust proportions; open trigon basins; more poorly developed mesial and distal cingula; lack of accessory stylar cuspules; more prominently developed stylocone and parastyle; and lacking conules.

DISCUSSION: The Nose Creek sample may represent a new, more primitive species of cyriacotheriid pantodont, considerably older than C. argyreum. Rose and Krause hypothesized 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.

Suborder Pantolesta McKenna, 1975

Family Pantolestidae Cope, 1884a

Subfamily Pentacodontinae Simpson, 1937

Genus Aphronorus Simpson, 1935a

?Aphronorus sp.

(Fig. 33, D-F; Table 52)

REFERRED SPECIMENS: UALVP 44271, ?m1 trigonid.

DESCRIPTION: ?m1—UALVP 44200 preserves the trigonid of a molar tooth interpreted to be of the m1 locus. The trigonid is tricuspate with a large, conical metaconid and a distinctly lower, subpyramidal protoconid. The paraconid is reduced to a tiny cuspule and is situated mesial and somewhat labial to the metaconid. The protoconid is mesiodistally elongate, and is connected to the paraconid by a mesially prominent and arcuate paracristid; this configuration of cusps and crests gives the trigonid a subtrapezoidal appearance in occlusal aspect. The protoconid is convex internally, whereas the paraconid and metaconid are virtually flat. The cusps are well spaced, forming a broad, open trigonid basin. The trigonid notch is shallow. The ectocingulid is strongly developed. The cristid obliqua apparently struck the postvallid labial to the trigonid notch, possibly indicating a broad, open talonid.

COMPARISONS AND DISCUSSION: UALVP 44200 appears closest in morphology to m1 trigonids of the pentacodontine mammal Aphronorus. The referred specimen is close in both size and morphology to similar trigonids of both Aphronorus simpsoni Gazin, 1939 and Aphronorus fraudator Simpson, 1935a; it differs, however, in having a more lingually positioned paraconid and in being more mesiodistally compressed. The referred specimen differs from molars referred to cf. Aphronorus sp. from the Douglass Quarry of Montana (Krause and Gingerich, 1983) and the Cochrane Site 2 locality of Alberta (Youzwyshyn, 1988) in being less mesiodistally compressed, lower crowned, and smaller. The single referable element suggests that this taxon is rare at Who Nose?, and is thus only questionably referred to Aphronorus.

Subfamily Pantolestinae Simpson, 1937

Genus Propalaeosinopa Simpson, 1927b

Propalaeosinopa "septentrionalis" (Russell, 1929)

(Fig. 34, A-I; Fig. 35, A-C; Table 53)

HOLOTYPE: UALVP 126, incomplete left dentary with m3.

TYPE LOCALITY: Cochrane Site 1, Porcupine Hills Formation, Alberta Syncline, southwestern Alberta.

KNOWN AGE AND DISTRIBUTION: late Torrejonian (middle Paleocene) of Alberta (type locality [Fox, 1990a]); late Torrejonian of Montana (Gidley Quarry, upper Lebo Formation, Crazy Mountain Field, Sweetgrass County [Simpson, 1937]; Silberling Quarry [Simpson's Locality 1; Fish Creek; Bear Butte; Widdecombe Creek; Widdecombe Ranch], upper Lebo Formation, Crazy Mountain Basin, near Bear Butte, Sweetgrass County [Simpson, 1937]); late Torrejonian of Wyoming (Cedar Mountain [localities UW V-82004, 82006, 82015, 82040], Polecat Bench Formation, southern Bighorn Basin, Hot Springs/Washakie Counties [Hartman, 1986]; Swain Quarry, Fort Union Formation, Washakie Basin, Carbon County [Szalay, 1968; Rigby, 1980]); earliest Tiffanian (late Paleocene) of Alberta (Cochrane Site 2, Porcupine Hills Formation, Alberta Syncline, Cochrane, Bow River [Youzwyshyn, 1988; Fox, 1990a]); earliest Tiffanian of Montana (Douglass Quarry [Simpson's Locality 63], Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); early Tiffanian (late Paleocene) of Montana (Scarritt Quarry

[Simpson's Locality 56], Melville Formation, eastern Crazy Mountain Basin, Sweetgrass County [Krause and Maas, 1990]); middle Tiffanian (late Paleocene) of Alberta (Burbank locality, Paskapoo Formation, Alberta Syncline, at the confluence of Blindman and Red Deer Rivers [Fox 1990a]; Hand Hills West Upper Level, Paskapoo Formation, NE of Drumheller [MacDonald, 1996]; Joffre Bridge Roadcut Lower Level, Paskapoo Formation, Alberta Syncline, Red Deer [Fox 1990a]; UADW-2 locality, Paskapoo Formation, Alberta Syncline, Blackfalds [Fox, 1990a]); middle Tiffanian of Wyoming (Cedar Point Quarry, Polecat Bench Formation, Bighorn Basin, Lovell, Big Horn County [Rose, 1981]; Chappo Type Locality [Type Chappo; Chappo Gulch; Chappo-17], Chappo Member, Wasatch Formation, LaBarge Creek LaBarge, Lincoln County [Gunnell, 1994]; Hallelujah Hill [locality UW V-77005], Fort Union Formation, east flank Rock Springs Uplift, Sweetwater County [Winterfeld, 1982]; Rock Springs Uplift (UW V-78052), Fort Union Formation, east flank Rock Springs Uplift, Sweetwater County [Winterfeld, 1982]); middle Tiffanian of North Dakota (Brisbane Locality, Slope Formation, Grant County [Holtzman, 1978]; Judson Locality [L6; L8] Tongue River Formation, Morton County [Holtzman 1978]).

REFERRED SPECIMENS: UALVP 44201, maxillary fragment with P4-M2; UALVP 44202, 44203, 44233, P4s (total: 3); UALVP 44204, 44205, M1s (total: 2); UALVP 44206, M2; UALVP 44207, p2; UALVP 44208, p3; UALVP 44234, 44209, p4s (total: 2); UALVP 44210, 44211, m1s (total: 2); UALVP 44212, 44213, 44214, m2s (total: 3); UALVP 44215, mx.

DIAGNOSIS: "Lower molars small, each less than 3 mm long; paraconid small but distinct; talonid with three distinct tubercles" (Russell, 1929:173 [Diacodon septentrionalis]).

APPENDED DIAGNOSIS: "Much smaller than any known species of Palaeosinopa. p4 strongly trenchant, with large anterior basal cuspate and incipient basining of talonid. Molar cusps high and slender. M1-2 with smaller hypocones than in most advanced species. Metacone of M3 distinct. Length M1-2 6.1 mm" (Simpson, 1935a:230 [Palaeosinopa diluculi]).

DESCRIPTION AND COMPARISONS: Dental descriptions of P. "septentrionalis" occur in Simpson (1936, 1937 as "Bessoecetor thomsoni" and "Bessoecetor diluculi", respectively) and Stonley (1988). The Nose Creek specimens are most similar to teeth referred to P. "septentrionalis" from the Cochrane Site 2 locality of Alberta (Youzwyshyn, 1988), but differ in the following ways:

1) Better developed parastylar and metastylar lobes, particularly on M2.
2) Upper molars more transverse and less mesiodistally compressed.
3) Weaker hypocone and hypoconal salient.
4) Molar trigonids less mesiodistally compressed.
5) Generally higher crowned.
6) Slightly larger lower molar dimensions.

The referred specimens are within recorded ranges for teeth similar referred to P. diluculi from the Swain Quarry of Wyoming (Rigby, 1980) and the Douglass Quarry of Montana (Krause and Gingerich, 1983).

DISCUSSION: Simpson erected Propalaeosinopa in 1927 to receive specimens from the middle Tiffanian Erickson's Landing locality of Alberta. Youzwyshyn (1988) synonymized Russell's "Diacodon" septentrionalis with P. diluculi, and noted the distinct nature of Propalaeosinopa albertensis Simpson, 1927b. The Nose Creek specimens compare favourably with similar teeth of P. "septentrionalis" from Cochrane Site 2 and late Torrejonian and early Tiffanian sites from Canada and the United States; the aforementioned differences may, however, prove taxonomically significant in light of a larger sample.

Propalaeosinopa sp.1

(Fig. 35, D-F; Table 54)

REFERRED SPECIMEN: UALVP 44216, m2.

DESCRIPTION AND COMPARISONS: The referred molar is similar in overall structure to homologous teeth of Propalaeosinopa "septentrionalis" from the Who Nose? and Cochrane Site 2 localities, but differs in being nearly 45 percent larger and proportionately higher crowned, particularly the talonid. The talonid cusps appear tall and spire-like, forming a deep talonid basin. The entocristid and cristid obliqua are raised and sectorial in construction, and a strong entoconulid is present. The referred molar differs further from molars of P. "septentrionalis" in possessing a stronger carnassial notch on the paracristid. UALVP 44216 is similar to lower molars referred to Propalaeosinopa albertensis from the Swan Hills and DW-2 localities of Alberta (Stonley, 1988; Fox, 1990a), differing primarily in being larger and higher crowned, in having a more lingually positioned paraconid, and in having a stronger carnassial notch. Additionally, UALVP 44216 resembles lower molars of undescribed pantolestids from the Roche Percée locality of Saskatchewan, differing primarily in being smaller and less bunodont.

DISCUSSION: The similarity of morphology of UALVP 44216 to homologous teeth of P. "septentrionalis" identifies these specimens as pertaining to members of Propalaeosinopa. The larger size of the referred molar relative to those of P.

"septentrionalis", and its similarity to the Swan Hills and DW-2 specimens may support referral to P. albertensis. The hypsodont condition of UALVP 44216 relative to that observed in similar teeth of P. "septentrionalis" and P. albertensis, the sectorial nature of the entocristid and cristid obliqua, and the strong carnassial notch indicate an emphasis on shear, a condition quite unlike the crushing or piercing dentitions of contemporaneous pantolestines. At present, UALVP 44216 is referred only to Propalaeosinopa until a larger sample can support a more definitive assignment.

Propalaeosinopa sp. 2

(Fig. 35, G-I; Table 55)

REFERRED SPECIMENS: UALVP 44218, ?m2.

DESCRIPTION AND COMPARISONS: The referred molar is nearly identical to homologous teeth of Propalaeosinopa "septentrionalis", differing in being nearly 35 percent smaller and proportionately more labiolingually transverse. UALVP 44218 further differs from molars of P. "septentrionalis" in having a lophate paracristid/paraconid that is more labially extensive, and a more mesiodistally compressed trigonid. A meagre number of specimens from the Tiffanian Roche Percée fauna of Saskatchewan may be referable to this taxon.

DISCUSSION: At present, the single specimen can be assigned only to Propalaeosinopa based on similarities to homologous teeth of P. "septentrionalis". P. sp. 2 represents the third distinct species of Propalaeosinopa from Who Nose?.

CHRONOLOGICAL ASPECTS

Biostratigraphy

Age of the Who Nose? Local Fauna

Fossil mammalian taxa areone line of evidence for correlating Cenozoic continental sediments in North America. The information gleaned from this biochronology can be extrapolated to, and compared with, similar schemes throughout the world. The Wood Committee (1941), whose work presented the first formal biozonation of the Tertiary continental sediments using fossil mammals, followed in the footsteps of H. F. Osborn and W. D. Matthew's (1929) first attempts at formulating chronostratigraphic zonations ("life-zones" of Osborn and Matthew) (Osborn, 1929). A recent revision of the Wood Committee's formal report forms the basis for the current biozonation of the Cenozoic of North America (Archibald et al., 1987), and is followed here. Williamson (1996) provided a more recent attempt at redefining the biozonations of Archibald et al. (1987), based on new material from the San Juan Basin of New Mexico. Despite its intentions, this redefinition is unproven outside the San Juan Basin, and, to my knowledge, has been accepted by only one author (Secord, 1998). Williamson's (1996) biozonation is useful for intrabasinal correlations within the San Juan Basin and the immediate area, but is of limited use for far-ranging extrabasinal correlations because most of the taxa used to characterize or define boundaries are endemic to the San Juan Basin or southern faunal province (Sloan, 1987).

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). That the local fauna can be assigned to the Torrejonian, rather than to the preceding Puercan or subsequent Tiffanian NALMA, is indicated at the generic level by the presence of Palenochtha and Prothryptacodon, taxa that are restricted elsewhere to the Torrejonian NALMA (Archibald, et al., 1987). The presence of supraspecific taxa, including Anconodon, Baiotomeus, Leptacodon, Elpidophorus, Plesiolestes, Pronothodectes, Simpsonictis, and Propalaeosinopa, which make their first appearances during the Torrejonian NALMA, lend support for a Torrejonian age. Although less important, the last known records of Xyronomys and Stygimys also occur during this age. At the specific level, taxa including Ptilodus montanus, Plesiolestes problematicus, and Prothryptacodon albertensis are restricted to the Torrejonian or older. Additionally, the Who Nose? local fauna shares ten of the 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 more refined, To3, age for the Who Nose? local fauna is supported by taxa restricted to this zone. These so-called index taxa are useful for constraining the age of local faunas, and in correlating isolated outcrops. Unequivocally identified To3 index taxa from the Who Nose? locality are Pronothodectes matthewi and Prothryptacodon albertensis, while tentatively identified To3 index taxa are Elpidophorus sp., cf. E. minor, Palenochtha sp., cf. P. minor, and Simpsonictis sp., cf. S. jaynanneae. Additionally, Ptilodus montanus, restricted to the latest Torrejonian by Gunnell (1994), and Baiotomeus "rhothonion" may prove to be useful indices for the To3 interval-zone. Supraspecific taxa making their first appearances during the To3 interval-zone provide further, but less compelling evidence supporting a To3 age. Such first appearance taxa include Mimetodon, Ignacius, Pronothodectes, Picrodus, and Paleotomus. Additionally, the Who Nose? fauna shares at least 11 genera considered by Archibald et al. (1987) characteristic of the To3 interval-zone.

Faunal Comparisons

The Who Nose? local fauna is similar in general composition to faunas of latest Torrejonian age from localities in the United States, and to those of earliest Tiffanian age from localities in the United States and Alberta (Table 56). Of these localities, the Who Nose? local fauna appears closest in overall composition to the latest Torrejonian Gidley Quarry fauna of Montana and to the earliest Tiffanian Cochrane Site 2 fauna of Alberta. Of the 35 described genera from the Who Nose? local fauna, 24 are shared with Gidley Quarry, and 24 are shared with Cochrane Site 2. Of special importance are the genera Palenochtha and Prothryptacodon, both of which occur in the Who Nose? and Gidley Quarry faunas to the exclusion of the Cochrane Site 2 fauna. The remaining genera shared between Who Nose? and Gidley Quarry, and those shared between Who Nose? and Cochrane Site 2, are stratigraphically long-ranging; as such, they are of little value in constraining the age of the Who Nose? local fauna or in demonstrating contemporaneity of strata.

At the specific level, the Who Nose? local fauna appears to contain both Torrejonian and Tiffanian taxa. The Who Nose? fauna shares 11, 12, and 13 species matches with Rock Bench Quarry, Swain Quarry, and Gidley Quarry, respectively, and 18 species matches with Cochrane Site 2. Despite the strong taxonomic similarity between the Who Nose? locality and the Cochrane Site 2 locality, I consider the presence of the rare plesiadapid Pronothodectes matthewi at Who Nose? to be of paramount importance; this taxon was restricted in both space and time, and its presence in both the Who Nose? and Gidley Quarry faunas strongly suggests contemporaneity. Additionally, the majority of species shared between Who Nose? and Cochrane Site 2 are stratigraphically long-ranging, with only one, Parectypodus "corystes", shared uniquely between them. Youzwyshyn (1988) considered the Cochrane Site 2 fauna to be of an age intermediate between those of Shotgun (?To3) and Douglass Quarry (Ti1) based on overall taxonomic similarity; other authors (e.g., Secord, 1998; Alroy, 2000) have considered this locality to be of uncertain age, or straddling the Torrejonian-Tiffanian boundary. The strong Tiffanian character of the Who Nose? fauna, 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.

The strong bias towards small-sized specimens at the Who Nose? locality may be a factor of some importance in faunal comparisons. The absence of larger-bodied organisms at Who Nose? may be real, or contrarily may be a result of depositional and/or taphonomic biases. Such possibilities must be taken into account when addressing species diversity, paleocommunity associations, and even extinction and immigration events (Bown and Beard, 1990). Additionally, biases against a particular size class may effectively eliminate specimens pertaining to taxa which may be potentially important biocorrelators. The discovery of larger-bodied organisms at Who Nose? would not only allow more accurate assessments of overall diversity, but may be useful in testing hypotheses of faunal contemporaneity.

Magnetobiostratigraphy

Based on the work of Butler and Lindsay (1985) at the Kutz Canyon locality in the San Juan Basin of New Mexico, Archibald et al. (1987) considered faunas of Torrejonian age to appear first in sediments of normal polarity, interpreted as pertaining to chron 28n, and to extend into sediments of normal polarity, interpreted as pertaining to chron 27n. Archibald et al. (1987) suggested the separation of sediments of typical Puercan-age from those of typical Torrejonian-age occurs at chron 28r and portions of the subjacent and superjacent chrons of normal polarity. Mammalian biostratigraphical evidence indicates a latest Torrejonian age for the Who Nose? local fauna, supported by index taxa, characteristic taxa, and similarity to faunas from well-sampled Torrejonian localities from the Western Interior of the United States, including Gidley Quarry, Rock Bench Quarry, and Swain Quarry. These localities have recently been interpreted as pertaining to chron 27r (Flynn et al., 1984; Butler et al., 1987; Alroy, 2000).

In a recent study of the continental Paleocene in the Calgary area, Lerbekmo and Sweet (in press) examined strata of the Foothills and Central Plains regions in an attempt to place the fossil mammal localities occurring there in a polarity time scale framework. Magnetostratigraphic analysis of a 30m composite stratigraphic section from the Who Nose? locality resulted in an interpretation of all but the lowest few meters of the section pertaining to reversed polarity. Using palynological evidence and regional structural trends as time control, Lerbekmo and Sweet correlated the Who Nose? locality with a

200m stratigraphic section from the Cochrane Site 2 locality and a 310m section from the Balzac 66-1 Corehole to chron 28r. Additionally, a second locality of presumed Torrejonian age, Calgary 2E/7E, was correlated to chron 29n. These interpretations suggest that the strata containing the Who Nose? and Calgary 2E/7E localities and their associated faunas are correlative with localities of early Torrejonian age in the United States, hypotheses that appear incongruent with the mammalian biostratigraphic evidence presented above. That an incongruity exists between these two lines of evidence suggests methodological problems with either the biostratigraphic or magnetostratigraphic interpretations or, contrarily, a correct interpretation of both, necessarily implying faunal diachroneity.

Methodological Problems in Biostratigraphic Correlation

Mammalian fossils are the primary chronological reference in Tertiary terrestrial deposits (Lindsay et al., 1987). Recognizing changes in component fossils (evolution), resolution becomes greater, and time and stratigraphy can be more nearly correlated. The irreversibility of these evolutionary processes (i.e., evolutionary novelties appear only once) and their unique temporal and stratigraphic duration provide a sound means for correlation (Woodburne, 1987). Inherent problems within this biochronologic time frame, however, may limit the ability for time and stratigraphy to be correlated.

Objections to the zonations of Archibald et al. (1987) have been made, particularly with respect to the use of single taxon characterizations versus faunal characterizations to define boundaries (Prothero, 1995; Woodburne and Swisher, 1995; Williamson, 1996). Single taxon characterizations, while assumed to be synchronous throughout their ranges, are likely to be diachronous, or time-transgressive, to some degree, owing to differing rates of dispersal or preservational biases (Flynn et al., 1984; Alroy, 1998). Multiple taxon characterizations, although less diachronous, may suffer equally from stratigraphic and temporal overlap of defining taxa, consequently lowering their age-resolving power. Additionally, the use of plesiadapid primates and the stratophenetic scheme of Gingerich (1976) to define zone boundaries of the latest Torrejonian and all of the Tiffanian NALMA has come under criticism (e.g., Watters and Krause, 1986; Fox, 1990b; Secord, 1998; Alroy, in press). Specifically, the restricted geographical ranges of Pronothodectes and Plesiadapis, coupled with the need for large samples and/or complete specimens for confident identifications greatly reduces their effectiveness in correlation.

The robustness of biostratigraphic correlation is also reduced by poorly sampled localities and taxa. Datum planes using organisms as markers are hypothesized correlations of biological events to stratigraphic horizons (Walsh in Alroy, in press); as such, they are subject to age-range changes with increased empirical observations (Alroy, 1998).

Lerbekmo and Sweet (in press), in placing the mammal-bearing localities in the Calgary area into a magnetic polarity framework, suggest that the Calgary 2E/7E (Russell, 1929; Fox, 1990a) and Who Nose? localities pertain to chrons 29n and 28r respectively. If correct, the faunas associated with these localities would thus be correlative with earliest Torrejonian faunas of the Western Interior of the United States (Flynn et al., 1984; Archibald et al., 1987). To1 and To2 faunas are otherwise unknown in Canada and poorly represented north of Utah (e.g., the Mosquito Gulch and Horsethief

Canyon faunas of eastern Montana, considered To1 by Archibald [1982] and Archibald et al. [1987] are represented by meagre collections). Well-sampled earliest Torrejonian faunas from the Dragon Canyon locality in Utah (Tomida and Butler, 1980; Tomida, 1981), and the lower and west Kutz Canyon localities in New Mexico (Archibald et al., 1987 and references therein) are dominated by arctocyonid procreodians and pleuraspidotheriine, mioclaenine, and periptychine condylarths. As neither the Who Nose? nor the Calgary 2E/7E faunas share index or characteristic taxa with these early Torrejonian faunas of the United States, non-contemporaneity is implied. It should be noted, however, that latitudinal provincialization between typical northern and southern faunas may exist (Sloan, 1987; Buckley, 1994), and that distinctly different, endemic faunas between both regions may not necessarily denote significant differences in time.

Methodological Problems in Magnetostratigraphic Correlation

Magnetostratigraphy is a powerful tool for correlating rock units. Because reversals in the Earth's magnetic field are globally synchronous and geologically instantaneous, the application of magnetostratigraphic evidence to local and regional sections provides a high degree of resolution to constraints on age. As powerful a tool as magnetostratigraphy is, however, it suffers from a number of physical limitations and biases that compromise its age-constraining abilities.

Insufficient amount of outcrop or a lack of sediments that can be reliably analyzed can lead to "spot-sampling" or the necessity for composite sections rather than continuous sampling through one complete section (Buckley, 1994). Unidentified unconformities representing extensive periods of time and unequal sedimentation rates may confuse local magnetostratigraphy (Lindsay et al., 1987), while weathered outcrop and various forms of remnant magnetization in samples make obtaining and assessing the subsequent data difficult. Additionally, the establishment of the stratigraphic levels of local sections relative to the zero datum is paramount to placing these sections into their proper stratigraphic context.

The geomagnetic polarity time scale (GMPTS), used as the standard for correlating local sequences and patterns of magnetic polarity reversals, is calibrated directly using K-Ar dating for younger sediments. For older sediments, however, the GMPTS is calibrated by assumptions as to seafloor spreading rates and through extrapolated radiochronometric methods (Flynn et al., 1984; Woodburne, 1987). As Woodburne (1987:4) has indicated, "...[because of] systematic errors inherent in the K-Ar system...determination of the ages of [magnetic] reversals is systematically inaccurate to the same degree as is any other aspect of the geologic time scale when measured by such chronometric systems."

Of particular importance is the frequent inability to correlate local magnetostratigraphic data to the geomagnetic polarity time-scale directly. A lack of syndepositional strata that can be dated radioisotopically necessitates a priori assumptions as to the age of the strata in question (Buckley, 1994). These assumptions are often made on the basis of biochronologic information; in many instances, polemic logic is invoked—an estimate of age by biostratigraphic evidence is confirmed through magnetostratigraphic data, thus supporting the original hypothesis of age. Such circular logic warrants an accompanying caveat to the idea that magnetostratigraphic information can be used "independently" of other data—it cannot, and its usefulness and reliability as a tool for estimating age is governed by the inherent degrees of error that accompany the calibrating mechanisms.

The study section from Nose Creek is a composite of three short subsections, all of which are weathered, resulting in localized diagenesis producing chemical remnant magnetization overprinting (Lerbekmo and Sweet, in press). Additionally, the presence of an extensive disconformity identified at the base of the Paskapoo Formation (Lerbekmo et al., 1990; Lerbekmo et al., 1992), and subsequently inferred to the Porcupine Hills Formation in the Olympic Ski Jump section (Lerbekmo and Sweet, in press), could conceivably pose difficulties not only in inferring resultant magnetostratigraphic data, but in placing the Who Nose? locality into its proper stratigraphic position relative to the zero datum. That the correlations of both the Who Nose? and Calgary 2E/7E localities, both of which are placed stratigraphically below the disconformity, appear incongruent with known earliest Torrejonian faunas; and that the Cochrane Site 2 (earliest Tiffanian) and Olympic Ski Jump (late Torrejonian) localities, both of which are placed stratigraphically above the disconformity, are congruent with known earliest Tiffanian and late Torrejonian faunas, logically suggests the possibility of incorrect stratigraphic positions of the Who Nose? and Calgary 2E/7E localities, or equally likely, that the sub-Paskapoo disconformity represents a shorter duration of time in the Calgary area than previously thought.

Faunal Diachroneity

If the interpretations of both the biostratigraphic and magnetostratigraphic evidence are correct, faunal diachroneity on the magnitude of 1.5 million years would necessarily be implied (Archibald et al., 1987; Butler et al., 1987), with characteristic late Torrejonian aspect faunas at Who Nose? and Calgary 2E/7E appearing earlier than faunas of similar composition farther to the south and in the Western Interior of the United States. Diachronous taxa and faunal assemblages are of little value in constraining the age of associated strata, because their time-transgressive appearances do not represent unequivocal synchronous datum planes. Faunas of this type, termed homotaxial by Huxley (1862, 1870), result in assemblages characteristic of different ages being coeval in different regions.

Lerbekmo and Sweet, in an attempt to account for this diachroneity, hypothesized earlier appearances of Torrejonian elements in the north, followed by delayed dispersal to the southern latitudes. These hypotheses are not unlike those presented by Butler and Lindsay (in Butler et al., 1981) in their work in the San Juan Basin, New Mexico. Butler and Lindsay's resolutions to the perceived diachroneity of faunas under their study were "...discordant faunal correlations and/or barriers to faunal interchange that retarded dispersal between the northern and southern Rocky Mountains" (this situation has since been resolved [Butler and Lindsay, 1983], and To3 localities in the San Juan Basin are currently correlated with chron 27r and the lower part of chron 27n). Although intuitive, hypotheses of this nature are difficult to support without rigourous geochronological testing and geographical sampling of all strata involved (Flynn et al., 1984).

Flynn et al. (1984) rigourously demonstrated the robustness of current biostratigraphic correlation techniques and suggested that diachroneity of faunal assemblages assigned to presumably non-overlapping NALMAs is unlikely. Additionally, nearly a century's worth of empirical evidence and multidisciplinary geochronological studies support the synchrony of individual NALMAs and the temporally discrete nature of successive NALMAs, and that the inherent diachroneity of individual taxa are much shorter, temporally, than the duration of any NALMA.

Chronocorrelation, Biostratigraphy, and Magnetostratigraphy

Lerbekmo and Sweet's interpretations of the paleomagnetic data and resultant correlations of the Who Nose? and Calgary 2E/7E localities question the validity of chronocorrelation based on biostratigraphic evidence in Cenozoic rocks using fossil mammals. Given the methodological problems with biostratigraphic and magnetostratigraphic correlation techniques, the possibility of discovering diachronous taxa, given a more complete fossil record, seems likely. Despite the inherent problems associated with biostratigraphic correlation, it has since William Smith's (1815) Principle of Palaeontological Correlation, remained one of the most effective and objective means of recognizing temporal intervals in stratigraphic sections, and offers the highest degree of resolution in constraining age and correlating local sections from one area to another (Woodburne, 1987). As such, significant diachroneity of faunal assemblages is unlikely; rather, the similarities between the Who Nose? fauna and typical Torrejonian aspect faunas from the United States are real, and likely represent contemporaneity.

A more parsimonious alternative to the above scenario requires that, at least locally, phenomena of geology, facies, biogeography, or all three, are causing confusion with respect to the interpretation of the data. In particular, the nature and extent of the sub-Paskapoo disconformity may be of some importance. Authors have argued that the lower contact of the Paskapoo Formation with the underlying Scollard Formation as regionally disconformable (Allan and Sanderson, 1945), intrabasinally and variably disconformable (Lerbekmo et al., 1992), or vague and impossible to define consistently across the basin (Dawson, 1990). Assumptions as to the magnitude of the hiatus may bias the interpretations of paleomagnetic data, or equally, create a degree of error in the stratigraphic placement of the Who Nose? and Calgary 2E/7E localities. If the mammalian biostratigraphic evidence is correct, and correlative localities within the Western Interior of the United States are penecontemporaneous, then the usefulness and ability of magnetostratigraphy and paleopalynology as chronocorrelative tools must be reconsidered.

Summary

Mammalian biostratigraphic correlation indicates a latest Torrejonian (To3) age for the Who Nose? fauna. Magnetostratigraphic evidence incongruous with the mammalian evidence suggests the possibility of faunal diachroneity between the Who Nose? local fauna and typical latest Torrejonian aspect faunas in the Western Interior of the United States. Homotaxial diachroneity could have serious implications for the use of fossil mammals as chronologic estimators. Faunal diachroneity is here considered unlikely, although the methodological problems associated with current biochronological techniques and the lack of well-sampled early Torrejonian localities cannot effectively dismiss this possibility. An alternative, more parsimonious scenario suggests local geologic phenomena may play a significant role in obtaining and interpreting the paleomagnetic data. That magnetostratigraphic and/or palynologic correlation could be affected by such phenomena warrants caution in the interpretation of such data.

IMPLICATIONS FOR FUTURE RESEARCH

The Who Nose? locality offers a unique opportunity to document and study fossil mammals from a poorly represented period of time in the Alberta Basin. As collecting from this locality has been limited at best, the potential for making significant discoveries is great. Additional sampling from this locality and others of similar age in the area will surely improve the understanding of regional middle Paleocene vertebrate communities, mammalian evolution, and local and regional geology. Of particular interest is the recognition of the contentious Torrejonian/Tiffanian boundary, a subject of current research in the Hanna Basin of Wyoming (Secord, 1998; Higgins, 1999) and the Fort Union Formation of Montana (Krause and Maas, 1987). Information provided by latest Torrejonian faunas such as Who Nose? may prove valuable in constraining this boundary.

The questions generated from this study are of great interest to biostratigraphy and geochronology in general. In particular, if the putative homotaxial diachroneity as documented at Who Nose? is real, could this be indicative of a more widespread phenomenon, both geographically and temporally? If so, can fossil mammals continue to be used as effective biocorrelators? Contrarily, if diachronous assemblages are merely artifacts of methodological problems, of what value are these techniques to estimating geochronology? Do the caveats that accompany biostratigraphic and magnetostratigraphic data outweigh their usefulness for constraining age? These questions merit continued study of strata in the Calgary area, including a concerted effort to discover more mammal-bearing sequences with which to test hypotheses of diachroneity.

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TABLES

Table 1. Measurements and descriptive statistics for the dentition of Mesodma pygmaea from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	1.9	1.90	-	-
	Width	1	0.7	0.70	-	-
M2	Length	1	1.1	1.10	-	-
	Width	1	*1.2	1.20	-	-
p4	Length	2	2.3-2.4	2.35	0.07	3.01
	Width	2	0.8-0.9	0.85	0.07	8.32
	Height	1	0.7	0.70	-	-
	Length 1	1	0.4	0.40	-	-
m1	Length	2	1.6	1.60	0	0.00
	Width	2	0.7-0.8	0.75	0.07	9.43

Table 2. Measurements and descriptive statistics for the dentition of Xyronomys sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	1.6	1.60	-	-
	Width	1	0.7	0.70	-	-
p4	Width	2	0.7-0.9	0.80	0.14	17.68
	Length 1	1	*1.4	1.40	-	-

Table 3. Measurements and descriptive statistics for the dentition of Mimetodon silberlingi from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	2	2.3-2.4	2.35	0.07	3.01
	Width	2	0.8	0.80	0.00	0.00
M1	Length	3	2.5-2.8	2.63	0.15	5.80
	Width	3	1.1-1.5	1.27	0.21	16.43
p4	Length	3	2.6-2.7	2.67	0.06	2.17
	Width	2	0.7-0.9	0.80	0.14	17.68
	Height	3	1.0-1.1	1.03	0.06	5.61
	Length 1	3	0.9-1.2	1.03	0.15	14.78
m1	Length	3	2.0-2.4	2.33	0.21	8.93
	Width	3	0.9-1.0	0.93	0.06	6.21

Table 4. Measurements and descriptive statistics for the dentition of Ectypodus sp., cf. E. szalayi from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	2	2.6	2.60	0	0
	Width	2	0.8	0.80	0	0
	Height	2	1.1	1.10	0	0
	Length 1	2	1.2-1.3	1.25	0.07	5.66

Table 5. Measurements and descriptive statistics for the dentition of ?Ectypodus sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	1	2.6	2.60	-	-
	Width	1	1.7	1.70	-	-
	Height	1	0.9	0.90	-	-
	Length 1	1	1.0	1.00	-	-

Table 6. Measurements and descriptive statistics for the dentition of Parectypodus sp., cf. P. sylviae from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	2	2.0	2.00	0.00	0.00
	Width	2	0.7	0.70	0.00	0.00
p4	Length	1	2.8	2.80	-	-
	Width	1	1.0	1.00	-	-
	Height	1	1.4	1.40	-	-
	Length 1	1	1.0	1.00	-	-
m1	Length	3	1.7-1.9	1.83	0.12	6.30
	Width	3	0.8	0.80	0.00	0.00

Table 7. Measurements and descriptive statistics for the dentition of Parectypodus "corystes", new species, from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	2	2.9	2.90	0.00	0.00
	Width	2	1.1-1.4	1.18	0.15	12.77
p4	Length	5	3.5-3.8	3.61	0.10	2.77
	Width	4	0.9-1.2	1.05	0.13	12.30
	Height	5	1.4-1.5	1.50	0.05	3.65
	Length 1	5	0.4-0.6	0.50	0.07	14.14
m1	Length	2	2.6-2.8	2.70	0.14	5.24
	Width	2	1.0-1.1	1.10	0.07	6.43

Table 8. Measurements and descriptive statistics for the dentition of Parectypodus sp., cf. P. new species, from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	2.1	2.10	-	-
	Width	1	0.8	0.80	-	-
p4	Length	1	2.5	2.50	-	-
	Width	1	0.6	0.60	-	-
	Height	1	1.7	1.70	-	-
	Length 1	1	0.2	0.20	-	-

Table 9. Measurements and descriptive statistics for the dentition of Neoplagiaulax nelsoni from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	3.4	3.40	-	-
	Width	1	1.3	1.30	-	-

Table 10. Measurements and descriptive statistics for the dentition of Neoplagiaulax hunteri from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	3.1	3.10	-	-
	Width	1	1.3	1.30	-	-
m1	Length	1	2.6	2.60	-	-
	Width	1	1.1	1.10	-	-

Table 11. Measurements and descriptive statistics for the dentition of cf. Neoplagiaulax sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	2.9	2.9	-	-
	Width	1	0.7	0.7	-	-

Table 12. Measurements and descriptive statistics for the dentition of ?Neoplagiaulax sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	1	3.3	3.30	-	-
	Width	1	0.8	0.80	-	-
	Height	1	1.6	1.60	-	-
	Length 1	1	0.5	0.50	-	-

Table 13. Measurements and descriptive statistics for the dentition of Ptilodus "gnomus" from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P2	Length	1	1.6	1.60	-	-
	Width	1	1.4	1.40	-	-
P3	Length	1	1.7	1.70	-	-
	Width	1	1.2	1.20	-	-
M2	Length	1	1.8	1.80	-	-
	Width	1	1.8	1.80	-	-
p4	Length	1	5.3	5.30	-	-
	Width	1	2.1	2.10	-	-
	Height	1	1.2	1.20	-	-
	Length 1	1	1.0	1.00	-	-
m1	Length	1	2.7	2.70	-	-
	Width	1	1.4	1.40	-	-

Table 14. Measurements and descriptive statistics for the dentition of Ptilodus montanus from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P1	Length	4	2.4-2.6	2.55	0.10	3.92
	Width	4	1.8-2.1	1.95	0.13	6.62
P2	Length	5	2.1-2.6	2.32	0.19	8.29
	Width	5	1.7-2.0	1.80	0.12	6.80
P3	Length	1	2.1	2.10	-	-
	Width	1	1.8	1.80	-	-
P4	Length	1	5.0	5.00	-	-
	Width	2	2.5-2.7	2.60	0.14	5.44
M2	Length	1	2.2	2.20	-	-
	Width	1	2.3	2.30	-	-
p4	Length	6	7.7-8.2	8.00	0.22	2.71
	Width	4	1.8-2.5	2.20	0.29	13.38
	Height	6	2.4-2.6	2.50	0.09	3.58
	Length 1	6	1.2-1.7	1.53	0.19	12.14
m1	Length	6	3.2-3.5	3.30	0.12	3.67
	Width	5	1.6-1.8	1.70	0.08	4.92
m2	Length	2	2.3-2.4	2.40	0.07	2.95
	Width	2	1.9	1.90	0.00	0.00

Table 15. Measurements and descriptive statistics for the dentition of Ptilodus sp., cf. P. wyomingensis from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	5.3	5.30	-	-
	Width	1	2.3	2.30	-	-

Table 16. Measurements and descriptive statistics for the dentition of Baiotomeus "rhothonion", new species, from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	2	1.8	1.80	0.00	0.00
	Width	2	0.7	0.70	0.00	0.00
M1	Length	1	2.0	2.00	-	-
	Width	1	1.0	1.00	-	-
p4	Length	1	2.9	2.90	-	-
	Width	1	1.0	1.00	-	-
	Height	1	1.4	1.40	-	-
	Length 1	1	1.1	1.10	-	-
m1	Length	2	1.7-1.8	1.80	0.07	3.93
	Width	2	0.8-0.9	0.90	0.07	7.86

Table 17. Measurements and descriptive statistics for the dentition of Anconodon cochranensis from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	1	4.7	4.70	-	-
	Width	1	1.7	1.70	-	-
	Height	2	1.9-*2.0	2.00	0.07	3.54
	Length 1	2	1.3-*1.4	1.40	0.07	5.05

Table 18. Measurements and descriptive statistics for the dentition of cf. Stygimys sp. 1 from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
i1	Max. Dia.	1	3.8	3.80	-	-
	Min. Dia.	1	1.6	1.60	-	-
m1	Length	1	4.2	4.20	-	-
	Width	1	1.8	1.80	-	-

Table 19. Measurements and descriptive statistics for the dentition of cf. Stygimys sp. 2 from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
M1	Length	1	2.1	2.10	-	-
	Width	1	1.1	1.10	-	-

Table 20. Measurements and descriptive statistics for the dentition of Acheronodon sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m1	Length	1	1.7	1.70	-	-
	Width	1	0.8	0.80	-	-

Table 21. Measurements and descriptive statistics for the dentition of Prodiacodon sp., cf. P. furor from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P3	Length	1	2.3	2.30	-	-
	Width	1	1.8	1.80	-	-

Table 22. Measurements and descriptive statistics for the dentition of cf. Prodiacodon sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
?M2	Length	1	1.3	1.30	-	-
	Width	1	2.1	2.10	-	-

Table 23. Measurements and descriptive statistics for the dentition of cf. McKennatherium sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m1 or m2	Trigonid length	1	1.3	1.30	-	-
	Trigonid width	1	2.1	2.10	-	-

Table 24. Measurements and descriptive statistics for the dentition of Leptacodon munusculum from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p2	Length	1	0.7	0.72	-	-
	Width	1	0.3	0.34	-	-
p4	Length	1	1.1	1.10	-	-
	Trigonid width	1	0.7	0.70	-	-
	Talonid width	1	0.6	0.60	-	-
m1	Length	3	1.2-1.3	1.24	0.08	6.30
	Trigonid width	3	0.7-0.9	0.77	0.12	15.06
	Talonid width	3	0.6-0.7	0.63	0.06	9.12
m2	Length	1	1.2	1.20	-	-
	Trigonid width	1	0.9	0.93	-	-
	Talonid width	1	0.8	0.84	-	-
m3	Length	1	1.3	1.26	-	-
	Trigonid width	2	0.6-0.8	0.69	0.13	18.45
	Talonid width	1	0.7	0.66	-	-

Table 25. Measurements and descriptive statistics for the dentition of Leptacodon sp., cf. L. tener from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	1.5	1.53	-	-
M2	Length	2	1.3	1.30	0.00	0.00
	Width	2	1.8-1.9	1.85	0.07	3.82
m1	Length	1	1.2	1.20	-	-
	Trigonid width	1	0.8	0.80	-	-
	Talonid width	1	0.7	0.70	-	-
m1 or m2	Length	1	*1.3	1.30	-	-
	Trigonid width	1	0.8	0.80	-	-
	Talonid width	1	0.9	0.90	-	-
m3	Length	1	1.3	1.30	-	-
	Trigonid width	1	0.8	0.80	-	-
	Talonid width	1	0.7	0.70	-	-

Table 26. Measurements and descriptive statistics for the dentition of Nyctitheriinae, genus and species unidentified from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	1	1.5	1.50	-	-
	Trigonid width	1	0.8	0.80	-	-
	Talonid width	1	0.7	0.70	-	-

Table 27. Measurements and descriptive statistics for the dentition of Elpidophorus sp., cf. E. minor from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	1	2.7	2.70	-	-
	Trigonid width	1	1.8	1.80	-	-
	Talonid width	1	1.6	1.60	-	-
m1	Length	4	2.5-2.6	2.55	0.06	2.26
	Trigonid width	4	1.8-2.0	1.85	0.10	5.41
	Talonid width	4	2.1-2.2	2.15	0.06	2.69
m2	Length	7	2.5-2.8	2.66	0.13	4.79
	Trigonid width	7	2.0-2.5	2.23	0.21	9.24
	Talonid width	7	2.1-2.5	2.34	0.17	7.33
m3	Length	3	2.8-*3.0	2.87	0.12	4.03
	Trigonid width	3	*1.9-2.1	2.00	0.10	5.00
	Talonid width	3	1.6-1.8	1.70	0.10	5.88

Table 28. Measurements and descriptive statistics for the dentition of Ignacius fremontensis from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	1	1.6	1.60	-	-
	Width	1	1.9	1.90	-	-
M1 or M2	Length	1	*1.5	*1.50	-	-
	Width	1	*2.6	*2.60	-	-
M3	Length	2	1.2-1.3	1.24	0.01	1.14
	Width	2	2.1	2.09	0.05	2.37
p4	Length	1	1.3	2.70	-	-
	Width	1	0.9	1.60	-	-
m1	Length	1	1.5	1.53	-	-
	Trigonid width	1	0.8	0.80	-	-
	Talonid width	1	1.2	1.20	-	-
m2	Length	2	1.4-*1.5	1.45	0.07	4.88
	Trigonid width	2	1.1-1.2	1.15	0.07	6.15
	Talonid width	2	1.2-1.3	1.25	0.07	5.66

Table 29. Measurements and descriptive statistics for the dentition of cf. Ignacius sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m2	Length	1	1.7	1.70	-	-
	Trigonid width	1	1.3	1.30	-	-
	Talonid width	1	1.4	1.40	-	-

Table 30. Measurements and descriptive statistics for the dentition of Paromomyidae, genus and species unidentified from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m2	Length	1	2.3	2.30	-	-
	Trigonid width	1	1.4	1.40	-	-
	Talonid width	1	1.6	1.60	-	-

Table 31. Measurements and descriptive statistics for the dentition of Palenochtha sp., cf. P. minor from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m2	Length	1	1.3	1.30	-	-
	Trigonid width	1	0.9	0.90	-	-
	Talonid width	1	1.0	1.00	-	-

Table 32. Measurements and descriptive statistics for the dentition of Plesiolestes problematicus from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
M2	Length	2	2.1-2.3	2.20	0.14	6.43
	Width	1	3.5	3.50	-	-
M3	Length	1	2.1	2.10	-	-
	Width	1	3.2	3.20	-	-

Table 33. Measurements and descriptive statistics for the dentition of ?Torrejonia sirokyi from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
M3	Length	1	2.8	2.80	-	-
	Width	1	4.9	4.90	-	-

Table 34. Measurements and descriptive statistics for the dentition of cf. Navajovius sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	1	1.0	1.00	-	-
	Width	1	0.7	0.70	-	-

Table 35. Measurements and descriptive statistics for the dentition of Pronothodectes matthewi from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
I1	Width	1	1.7	1.70	-	-
	Depth	1	1.9	1.90	-	-
P4	Length	1	1.7	1.70	-	-
i1	Width	1	1.7	1.70	-	-
	Depth	1	2.4	2.40	-	-
p3	Length	1	1.7	1.70	-	-
	Width	1	1.3	1.30	-	-
p4	Length	3	1.8-2.0	1.90	0.10	5.26
	Width	3	1.7	1.70	0.00	0.00
m1	Length	3	2.1	2.10	0.00	0.00
	Trigonid width	3	1.9-2.0	1.95	0.06	3.07
	Talonid width	3	1.9-2.1	2.00	0.10	5.00
m2	Length	5	2.1-2.3	2.20	0.07	3.18
	Trigonid width	5	1.9-2.2	2.12	0.13	6.13
	Talonid width	5	1.9-2.3	2.16	0.19	8.79
m3	Length	4	2.7-3.1	2.95	1.53	51.94
	Trigonid width	4	1.9-2.1	2.03	1.14	55.94
	Talonid width	4	1.9-2.0	1.81	0.98	54.10

Table 36. Measurements and descriptive statistics for the dentition of Picrodus silberlingi from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
i1	Width	1	0.8	0.80	-	-
p4	Length	1	0.8	0.80	-	-
	Width	1	0.6	0.60	-	-
m1	Length	2	2.5	2.50	0.00	0.00
	Trigonid width	2	0.7-0.8	0.75	0.07	9.43
	Talonid width	2	1.1-1.2	1.15	0.07	6.09
m2	Length	1	1.7	1.70	-	-
	Trigonid width	1	0.8	0.80	-	-
	Talonid width	1	1.1	1.10	-	-

Table 37. Measurements and descriptive statistics for the dentition of ?Chriacus sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	1	4.8	4.80	-	-
	Trigonid width	1	2.5	2.50	-	-
	Talonid width	1	2.5	2.5	-	-

Table 38. Measurements and descriptive statistics for the dentition of Prothryptacodon albertensis from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p3	Length	1	2.8	2.8	-	-
	Width	1	1.3	1.30	-	-
p4	Length	1	3.4	3.40	-	-
	Width	1	1.8	1.80	-	-
m1	Length	1	4.1	4.10	-	-
	Trigonid width	1	2.5	2.50	-	-
	Talonid width	1	2.6	2.60	-	-
m2	Length	1	4.0	4.00	-	-
	Trigonid width	1	2.9	2.90	-	-
	Talonid width	1	2.8	2.80	-	-

Table 39. Measurements and descriptive statistics for the dentition of Colpoclaenus sp., cf. C. procyonoides from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m3	Length	1	8.5	8.50	-	-
	Trigonid width	1	4.8	4.80	-	-
	Talonid width	1	4.5	4.50	-	-

Table 40. Measurements and descriptive statistics for the dentition of cf. Promioclaenus acolytus from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
M2	Length	1	2.8	2.80	-	-
	Width	1	3.6	3.60	-	-
p2	Length	2	2.7-2.8	2.75	0.07	2.57
	Width	2	1.3-1.4	1.35	0.07	5.24
p3	Length	3	3.1-3.3	3.20	0.10	3.12
	Width	3	1.6	1.60	0.00	0.00
p4	Length	2	3.7	3.70	0.00	0.00
	Width	2	2.2	2.20	0.00	0.00
m1	Length	1	2.8	2.80	-	-
	Trigonid width	1	*2.5	2.50	-	-
	Talonid width	1	*2.6	2.60	-	-
m2	Length	3	3.1-3.4	3.23	0.15	4.72
	Trigonid width	3	2.7-2.9	2.80	0.10	3.57
	Talonid width	3	2.6-3.1	2.87	0.25	8.78
m3	Length	0	-	-	-	-
	Trigonid width	2	2.5-2.6	2.55	0.07	2.77
	Talonid width	1	*2.2	2.20	-	-

Table 41. Measurements and descriptive statistics for the dentition of Litomylus sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
M1	Length	1	2.7	2.70	-	-
	Width	1	3.3	3.30	-	-
M2	Length	1	*2.8	2.80	-	-
	Width	1	4.0	4.00	-	-

Table 42. Measurements and descriptive statistics for the dentition of Protictis sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m1	Length	1	*4.7	4.70	-	-
	Trigonid width	1	3.1	3.10	-	-
	Talonid width	1	*2.8	2.80	-	-

Table 43. Measurements and descriptive statistics for the dentition of Simpsonictis sp., cf. S. jaynanneae from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
M1	Length	1	2.4	2.40	-	-
	Width	1	3.2	3.20	-	-
m2	Length	1	2.8	2.80	-	-
	Trigonid width	1	1.8	1.80	-	-
	Talonid width	1	1.4	1.40	-	-

Table 44. Measurements and descriptive statistics for the dentition of Carnivora, genus and species unidentified, from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m2	Length	1	1.4	1.40	-	-
	Trigonid width	1	0.9	0.90	-	-
	Talonid width	1	0.7	0.70	-	-

Table 45. Measurements and descriptive statistics for the dentition of Palaeoryctidae, genus and species unidentified 1, from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
p4	Length	1	*1.3	1.30	-	-
	Width	1	0.6	0.60	-	-
m1 or m2	Length	1	1.6	1.60	-	-
	Trigonid width	1	1.2	1.20	-	-
	Talonid width	1	0.9	0.90	-	-

Table 46. Measurements and descriptive statistics for the dentition of Palaeoryctidae, genus and species unidentified 2, from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
?M2	Length	1	1.3	1.30	-	-
	Width	1	2.0	2.00	-	-

Table 47. Measurements and descriptive statistics for the dentition of Paleotomus "junior" from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
DP4	Length	1	2.8	2.80	-	-
	Width	1	2.8	2.80	-	-
p2	Length	1	2.1	2.10	-	-
	Width	1	1.2	1.20	-	-
p3	Length	1	3.2	3.20	-	-
	Width	1	1.1	1.10	-	-
dp4	Length	1	3.6	3.60	-	-
	Trigonid width	1	1.3	1.30	-	-
	Talonid width	1	1.5	1.50	-	-
p4	Length	1	3.9	3.90	-	-
	Width	1	1.5	1.50	-	-
m1	Length	1	3.0	3.00	-	-
	Trigonid width	1	2.0	2.00	-	-
	Talonid width	1	1.7	1.70	-	-
m2	Length	2	3.3	3.30	0.00	0.00
	Trigonid width	2	2.2	2.20	0.00	0.00
	Talonid width	2	1.7-1.9	1.80	0.14	7.86

Table 48. Measurements and descriptive statistics for the dentition of cf. Procerberus sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m3	Length	1	3.0	3.00	-	-
	Trigonid width	1	1.6	1.60	-	-
	Talonid width	1	1.5	1.50	-	-

Table 49. Measurements and descriptive statistics for the dentition of Cimolestidae, genus and species unidentified from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	2	*2.7-2.8	2.75	0.07	2.57
	Width	2	*3.1-3.2	3.15	0.07	2.24
M2	Length	1	2.1	2.10	-	-
	Width	1	3.9	3.90	-	-
?m3	Length	1	2.6	2.60	-	-
	Trigonid width	1	1.5	1.5	-	-
	Talonid width	1	1.0	1.0	-	-

Table 50. Measurements and descriptive statistics for the dentition of Jepsenella sp., cf. J. praepropera from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
I1	Length	1	4.5	4.50	-	-
	Width	1	1.5	1.50	-	-
	Height	1	2.9	2.90	-	-

Table 51. Measurements and descriptive statistics for the dentition of cf. Cyriacotherium sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
?P4	Length	1	5.1	5.10	-	-
	Width	2	7.5-7.8	7.60	0.21	2.79

Table 52. Measurements and descriptive statistics for the dentition of ?Aphronorus sp. from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
?m1	Trigonid width	1	1.7	1.70	-	-

Table 53. Measurements and descriptive statistics for the dentition of Propalaeosinopa "septentrionalis" from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
P4	Length	4	2.4-2.5	2.45	0.06	2.36
	Width	4	1.9-2.5	2.15	0.26	12.31
M1	Length	3	2.3-2.5	2.43	0.12	4.75
	Width	3	2.9-3.1	3.03	0.12	3.81
M2	Length	2	2.5-2.7	2.60	0.14	5.44
	Width	2	3.7	3.70	0.00	0.00
p2	Length	1	1.9	1.90	-	-
	Width	1	0.7	0.70	-	-
p3	Length	1	2.4	2.40	-	-
	Width	1	0.9	0.90	-	-
p4	Length	2	2.7-2.8	2.75	0.07	2.57
	Width	2	1.1-1.2	1.15	0.07	6.15
m1	Length	2	2.4-2.5	2.45	0.07	2.89
	Trigonid width	2	1.6	1.60	0.00	0.00
	Talonid width	2	1.6	1.60	0.00	0.00
m2	Length	1	2.5	4.00	-	-
	Trigonid width	3	1.7-1.8	1.73	0.06	3.33
	Talonid width	1	1.7	1.70	-	-

Table 54. Measurements and descriptive statistics for the dentition of Propalaeosinopa sp.1, from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
m2	Length	1	3.2	3.20	-	-
	Trigonid width	1	2.0	2.00	-	-
	Talonid width	1	2.1	2.10	-	-

Table 55. Measurements and descriptive statistics for the dentition of Propalaeosinopa sp. 2, from the Who Nose? locality.

Element	P	N	OR	M	SD	CV
?m1	Length	1	1.6	1.60	-	-
	Trigonid width	1	1.0	1.00	-	-
	Talonid width	1	1.1	1.10	-	-

Table 56. Biostratigraphic comparison of selected mammals from the Who Nose? locality, Alberta, with occurrences of comparable late Torrejonian (middle Paleocene) and early Tiffanian (late Paleocene) faunas.

	Localities									
	dc	wf	bp	rb	sq	sg	gq	sl	dq	c2
	Magnetic Anomaly*									
	28n	27r	27r	27r	27r	27r	27r	27r	26r	26r
Who Nose? Taxa										
Mesodma pygmaea	○	○	○	●	●	●	●	○	●	●
Xyronomys sp.	○	○	○	○	◉	○	○	○	○	○
Mimetodon silberlingi	○	○	○	●	○	●	●	○	◉	●
Ectypodus sp., cf. E. szalayi	○	◉	●	◉	●	◉	●	○	○	●
Parectypodus sp., cf. P. sylviae	◉	○	◉	○	●	●	◉	◉	○	●
Parectypodus "corystes"	◉	○	◉	○	◉	◉	◉	◉	○	●
Neoplagiaulax nelsoni	◉	○	○	○	●	●	◉	○	●	●
Neoplagiaulax hunteri	◉	○	○	○	◉	◉	◉	○	●	●
Ptilodus "gnomus"	◉	◉	○	◉	◉	◉	◉	◉	●	●
Ptilodus montanus	◉	◉	○	◉	◉	◉	●	●	○	◉
Ptilodus sp., cf. P. wyomingensis	◉	◉	○	●	◉	◉	◉	◉	○	◉
Baiotomeus rhinus	○	○	○	◉	◉	○	◉	◉	○	◉
Anconodon cochranensis	○	○	◉	●	○	◉	●	●	●	●
cf. Stygimys sp. 1	○	○	○	◉	○	○	◉	◉	○	○
cf. Stygimys sp. 2	○	○	○	◉	○	○	◉	◉	○	○
Acheronodon sp.	○	○	○	○	○	○	○	○	○	◉
Prodiacodon sp., cf. P. furor	○	◉	◉	○	◉	○	●	○	●	●
cf. McKennatherium sp.	○	◉	○	◉	◉	○	◉	○	○	○
Leptacodon munusculum	○	○	○	●	◉	○	●	○	●	●
Leptacodon tener	○	○	○	○	●	○	◉	○	◉	●
Elpidophorus sp., cf. E. minor	○	○	○	○	○	●	○	●	◉	◉

Table 56. (continued)

	Localities									
	dc	wf	bp	rb	sq	sg	gq	sl	dq	c2
	Magnetic Anomaly*									
	28n	27r	27r	27r	27r	27r	27r	27r	26r	26r
Ignacius fremontensis	○	○	○	●	○	●	○	○	◉	●
Palenochtha sp., cf. *P. minor*	○	○	○	●	●	●	●	○	○	○
Plesiolestes problematicus	◉	○	◉	●	●	●	○	○	○	○
cf. *Torrejonia sirokyi*	○	◉	○	○	○	●	○	○	○	●
cf. *Navajovius* sp.	○	○	○	○	○	○	○	○	○	○
Pronothodectes matthewi	○	○	○	◉	○	○	●	○	○	◉
Picrodus silberlingi	○	○	○	●	●	●	●	●	●	●
?*Chriacus* sp.	◉	◉	◉	◉	◉	◉	◉	◉	◉	◉
Prothryptacodon albertensis	○	◉	○	◉	◉	○	◉	◉	○	○
Colpoclaenus cf. *C. procyonoides*	○	●	●	○	○	◉	○	○	◉	◉
cf. *Promioclaenus acolytus*	◉	●	●	●	●	◉	●	●	○	○
Litomylus sp.	○	◉	○	◉	◉	◉	◉	○	◉	◉
Protictis sp.	◉	◉	◉	◉	◉	○	◉	◉	○	○
Simpsonictis sp., cf. *S. jaynanneae*	○	○	○	◉	●	○	◉	○	◉	◉
Paleotomus "*junior*"	○	○	○	○	○	●	○	○	●	●
cf. *Procerberus* sp.	○	○	○	○	○	○	○	○	○	○
Jepsenella sp., cf. *J. praepropera*	○	○	○	●	●	○	●	○	○	●
cf. *Cyriacotherium* sp.	○	○	○	○	○	○	○	○	○	○
?*Aphronorus* sp.	◉	○	○	◉	○	◉	◉	◉	○	◉
Propalaeosinopa "*septentrionalis*"	○	○	○	○	●	○	●	●	●	●
Total Matches (genus ◉)	8	11	9	22	21	18	24	13	15	24
Total Matches (species ●)	0	2	3	11	12	10	13	6	8	18

Table 56. (continued)

Localities:

wf West Flank Torreon Wash (Pantolambda Zone), To3, San Juan Basin, New Mexico
bp Big Pocket, To2, San Juan Basin, New Mexico
dc Dragon Canyon, To1, Wasatch Plateau, Utah
rb Rock Bench Quarry, To3, Bighorn Basin, Wyoming
sq Swain Quarry, To3, Washakie Basin, Wyoming
sg Shotgun (Keefer Hill), ?To3-Ti1, Wind River Basin, Wyoming
gq Gidley Quarry, Crazy Mountain Field, Montana
dq Douglass Quarry, Crazy Mountain Field, Montana
sl Silberling Quarry, Crazy Mountain Field, Montana
c2 Cochrane Site 2, Alberta Syncline, Alberta

Symbols:

● Species occurs in comparative fauna.
◉ Genus occurs in comparative fauna.
○ No match at the generic or specific level.

* Magnetic anomaly data from Archibald et al. (1987), Butler et al. (1987), Alroy (2000), and Lerbekmo and Sweet (in press).

FIGURES

Figure 1.

Geographic location of the Who Nose? locality in south-central Alberta.

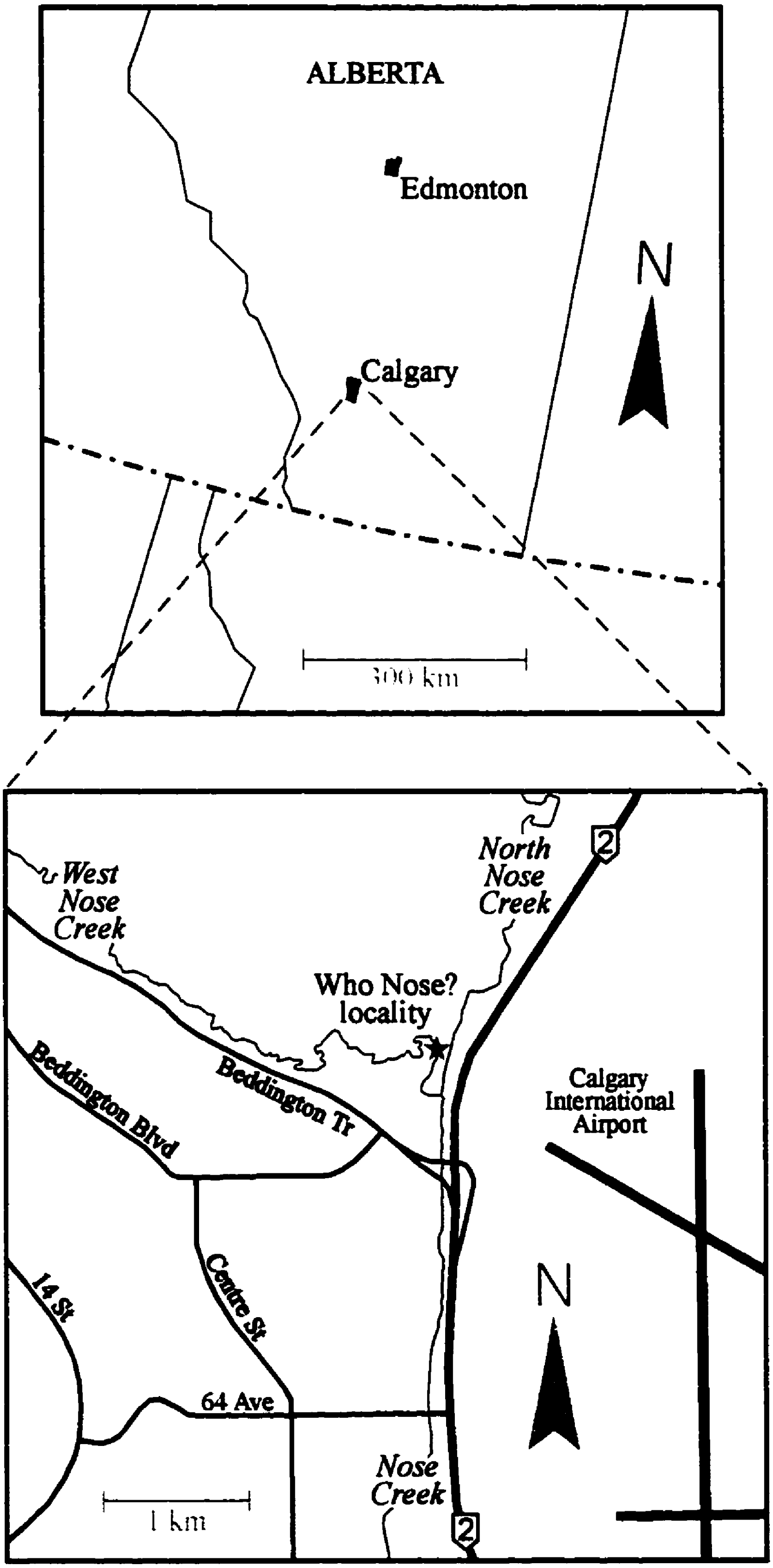
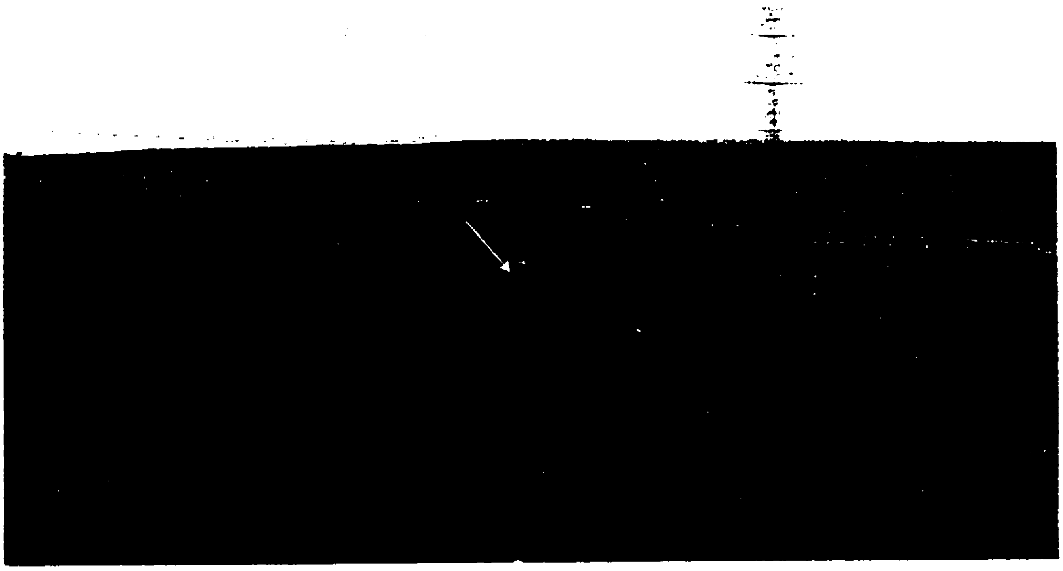

ALBERTA
Edmonton
Calgary
N
300 km
West Nose Creek
North Nose Creek
Who Nose? locality
Beddington Tr
Beddington Blvd
Calgary International Airport
Centre St
14 St
64 Ave
N
Nose Creek
1 km
2
2

Figure 2.

Who Nose? locality, Paskapoo Formation, Alberta.

A. Cutbank on West Nose Creek, northeast Calgary. Arrow points to fossil layer.

B. Exposed strata containing the Who Nose? locality. Arrow points to fossil layer.



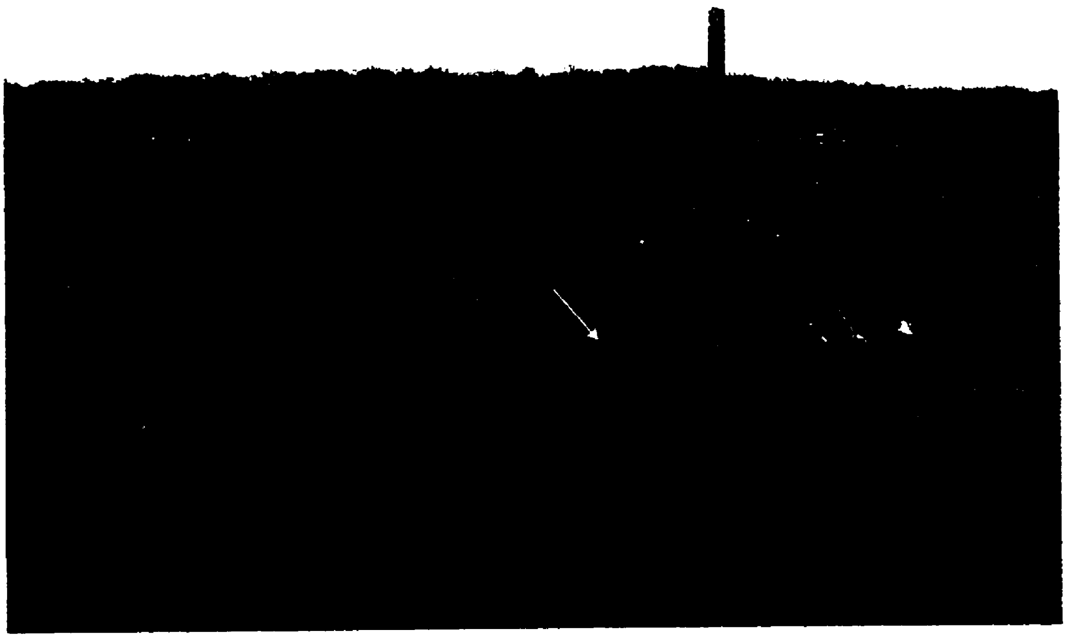


Figure 3.

Microstratigraphic cross section of the Who Nose? locality.

For explanation of numbers in figure refer to sedimentology chapter (pp.12-13).

Figure 4.

Superimposed outlines of labial surfaces of p4's referred to Parectypodus "corystes", new species, from Who Nose?, Diss, and Cochrane Site2 localities, Alberta (black lines) and Parectypodus sp. from the Rav W-1 locality, Saskatchewan (grey line).

Outlines oriented as per Krause (1977)

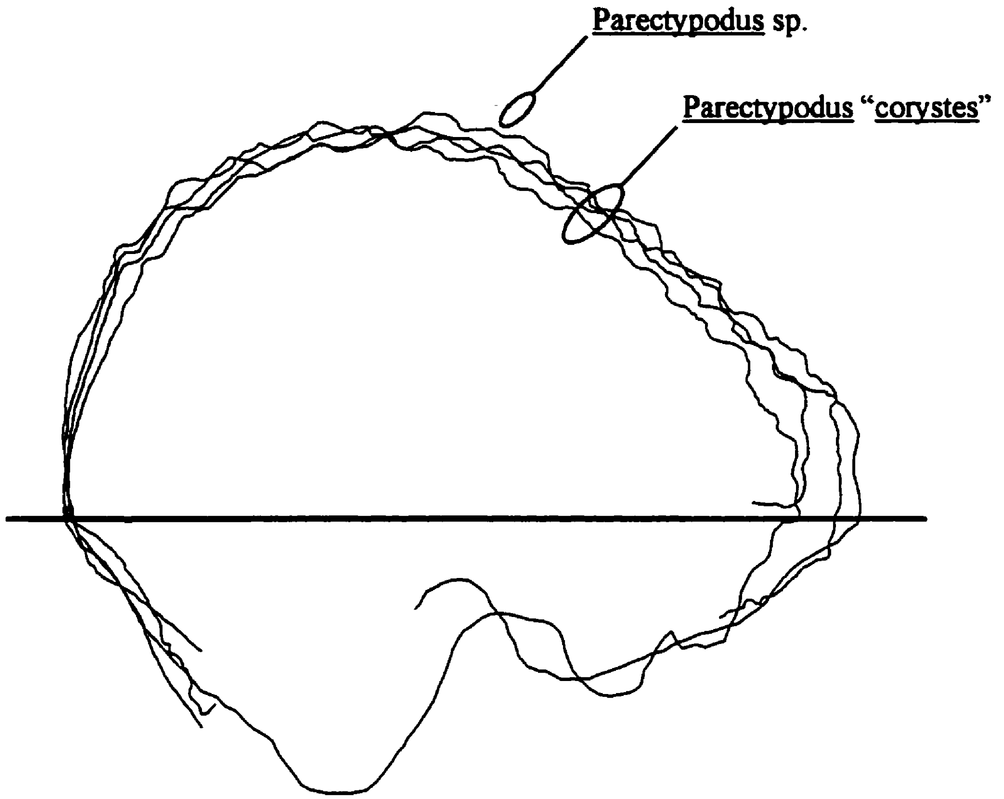

Parectypodus sp.
Parectypodus "corystes"

Figure 5.

Mesodma pygmaea

A. Labial view, UALVP 44051, RP4, scale bar=0.5 mm.

B. Lingual view, UALVP 44051, RP4, scale bar=0.5 mm.

C. Occlusal view, UALVP 44051, RP4, scale bar=0.5 mm.

D. Labial view, UALVP 44049, Rp4, scale bar=0.5 mm.

E. Lingual view, UALVP 44049, Rp4, scale bar=0.5 mm.

Xyronomys sp.

E. Labial view, UALVP 44055, RP4, scale bar=0.5 mm.

F. Lingual view, UALVP 44055, RP4, scale bar=0.5 mm.

G. Occlusal view, UALVP 44055, RP4, scale bar=0.5 mm.

H. Labial view, UALVP 44056, incomplete Rp4, scale bar=0.5 mm.

I. Labial view, UALVP 44056, incomplete Rp4, scale bar=0.5 mm.

J. Lingual view, UALVP 44058, incomplete Rp4, scale bar=0.5 mm.

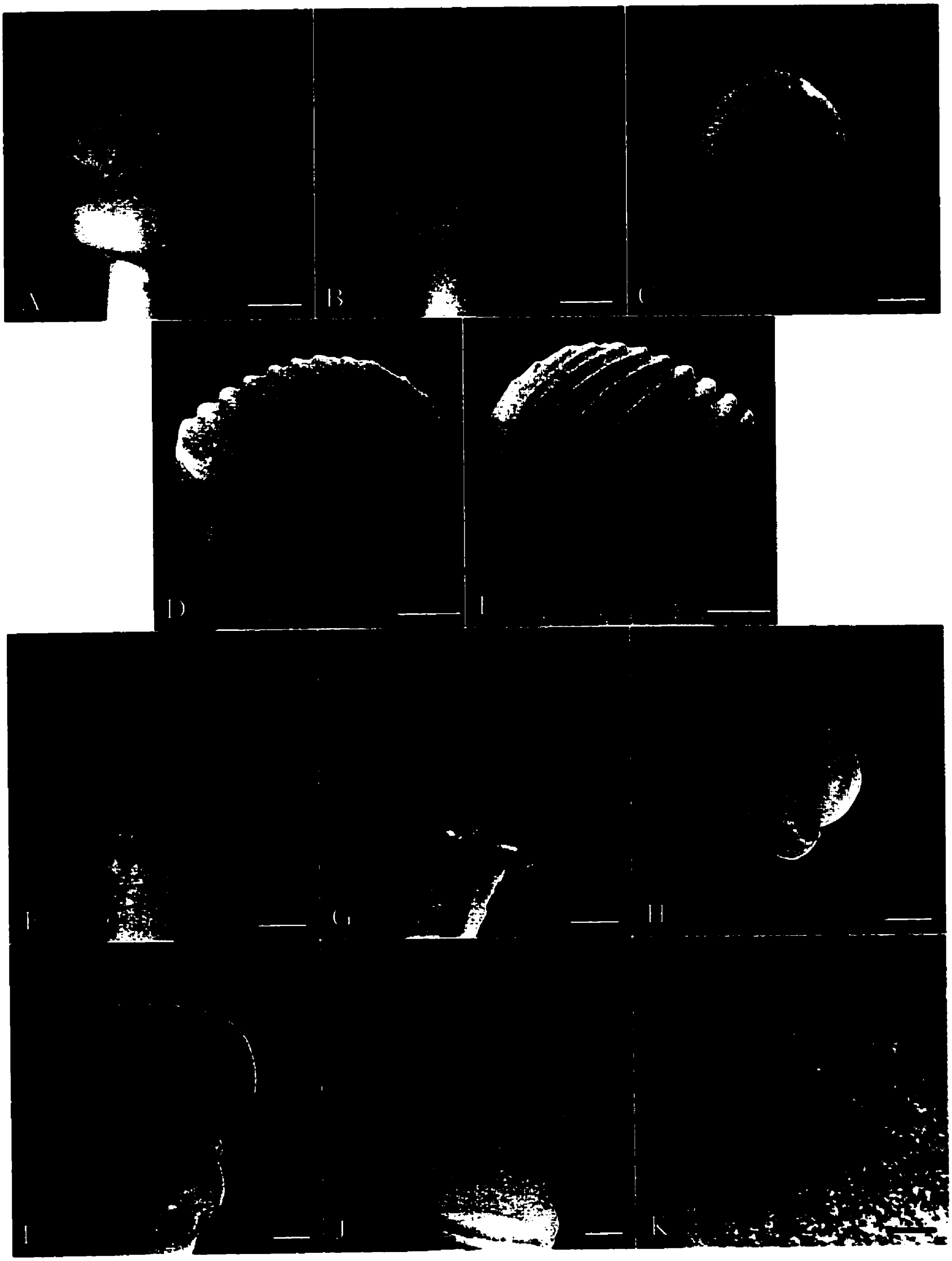

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Figure 6.

Mimetodon silberlingi

A. Labial view, UALVP 44061, RP4, scale bar=0.5 mm.

B. Lingual view, UALVP 44061, RP4, scale bar=0.5 mm.

C. Occlusal view, UALVP 44061, RP4, scale bar=0.5 mm.

D. Occlusal view, UALVP 44064, LM1, scale bar=0.5 mm.

E. Labial view, UALVP 44066, Lp4, scale bar=0.5 mm.

F. Lingual view, UALVP 44066, Lp4, scale bar=0.5 mm.

Ectypodus sp., cf. E. szalayi

G. Labial view, UALVP 44073, Rp4, scale bar=0.5 mm.

H. Lingual view, UALVP 44073, Rp4, scale bar=0.5 mm.

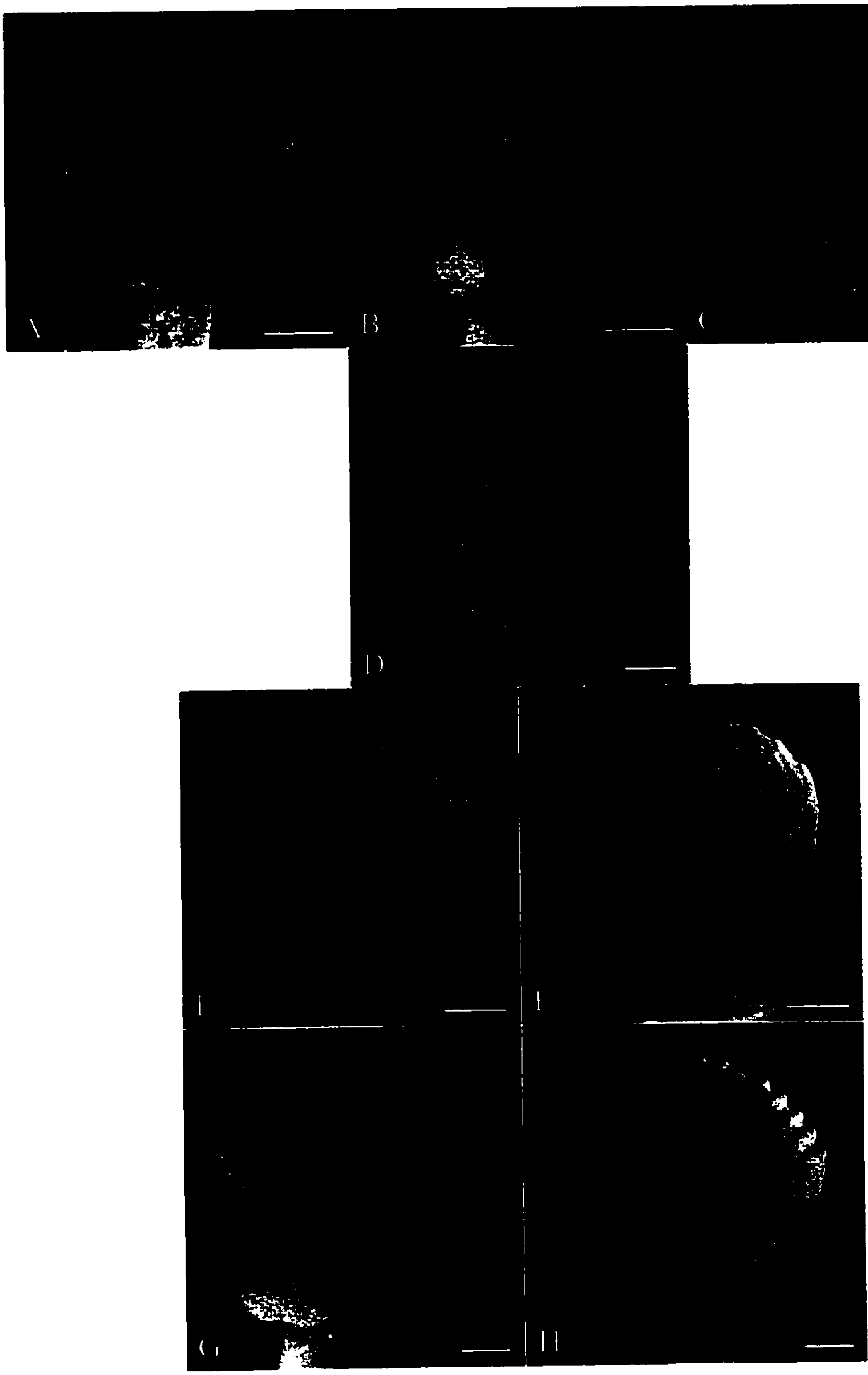
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Figure 7.

?<u>Ectypodus</u> sp.

A. Labial view, UALVP 44074, Lp4, scale bar=0.5 mm.

B. Lingual view, UALVP 44074, Lp4, scale bar=0.5 mm.

<u>Parectypodus</u> sp., cf. <u>P</u>. <u>sylviae</u>

C. Labial view, UALVP 44235, LP4, scale bar=0.5 mm.

D. Lingual view, UALVP 44235, LP4, scale bar=0.5 mm.

E. Occlusal view, UALVP 44235, LP4, scale bar=0.5 mm.

F. Labial view, UALVP 44077, incomplete left dentary having p4-m1, scale bar=0.5 mm.

G. Lingual view, UALVP 44077, incomplete left dentary having p4-m1, scale bar=0.5 mm.

H. Occlusal view, UALVP 44077, incomplete left dentary having p4-m1, scale bar=0.5 mm.

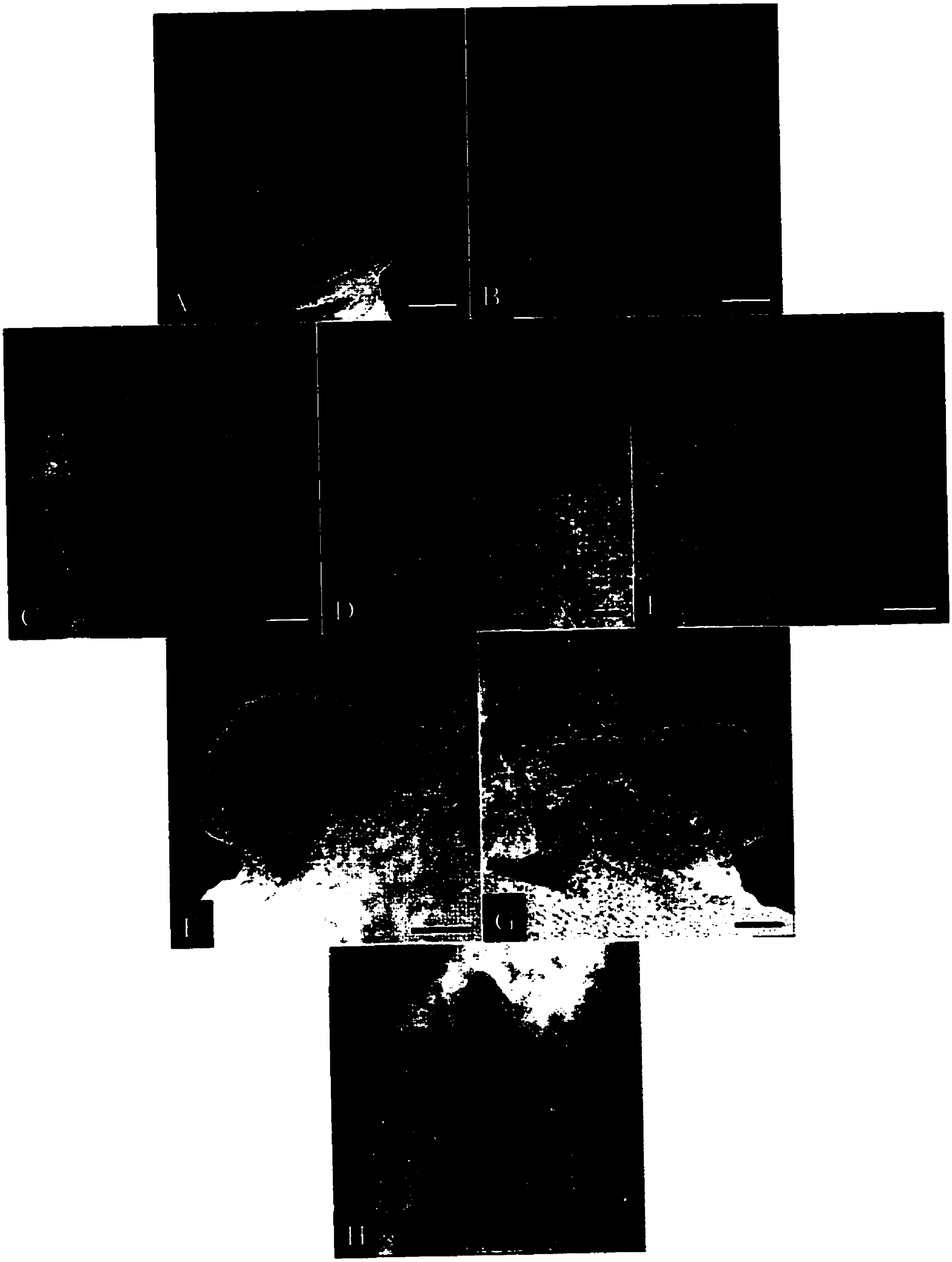

Figure 8.

Parectypodus "corystes", new species

A. Labial view, UALVP 44080, RP4, scale bar=1.0 mm.

B. Lingual view, UALVP 44080, RP4, scale bar=1.0 mm.

C. Occlusal view, UALVP 44080, RP4, scale bar=1.0 mm.

D. Labial view, UALVP 44081, Lp4, scale bar=1.0 mm.

E. Lingual view, UALVP 44081, Lp4, scale bar=1.0 mm.

F. Labial view, UALVP 40679, incomplete right dentary having p3-m2, scale bar=1.0 mm.

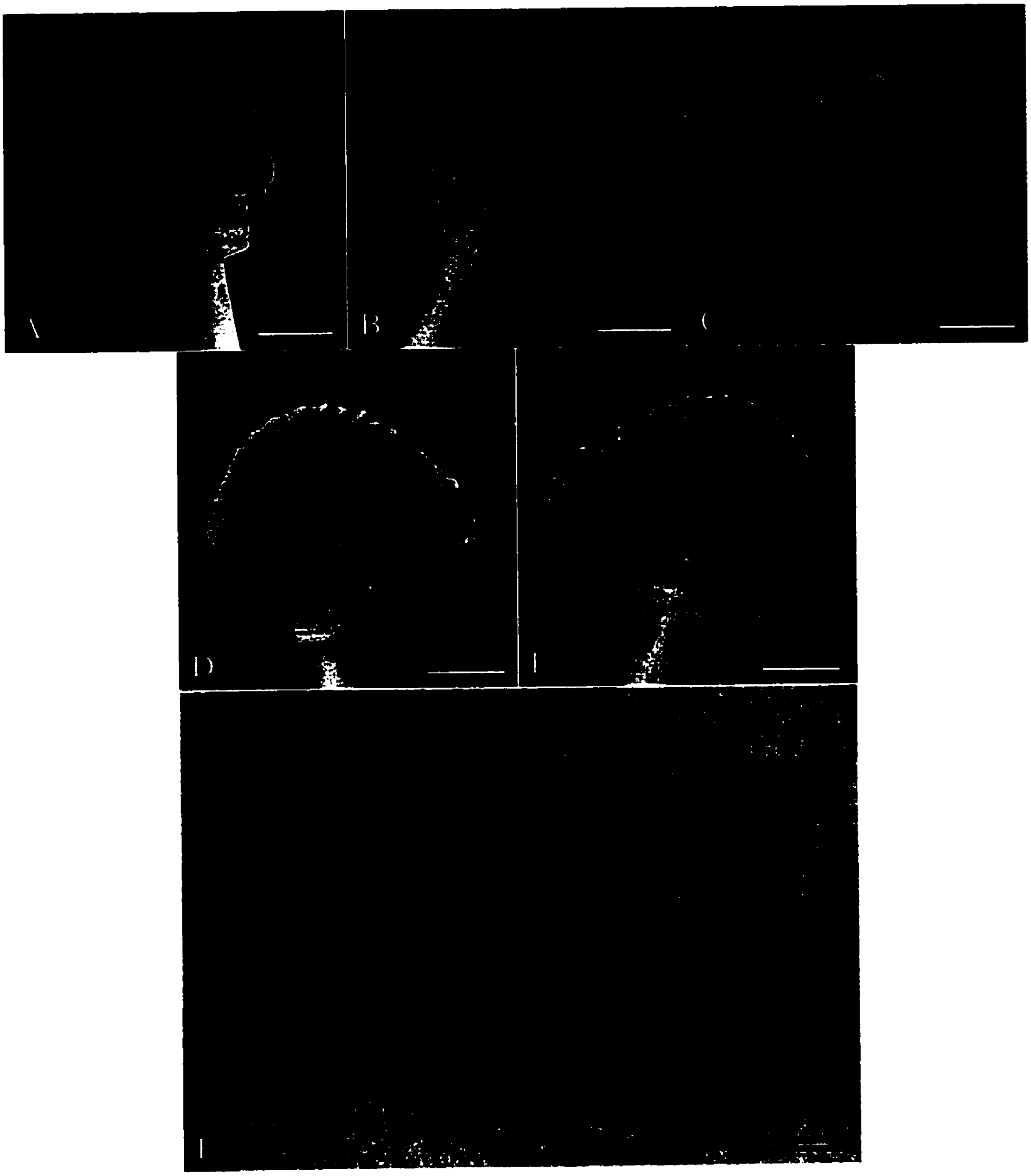

Figure 9.

Parectypodus sp., cf. P. new species

A. Labial view, UALVP 44084, LP4, scale bar=0.5 mm.

B. Lingual view, UALVP 44084, LP4, scale bar=0.5 mm.

C. Occlusal view, UALVP 44084, LP4, scale bar=0.5 mm.

D. Labial view, UALVP 44085, Rp4, scale bar=1.0 mm.

E. Lingual view, UALVP 44085, Rp4, scale bar=1.0 mm.

Neoplagiaulax nelsoni

F. Labial view, UALVP 44087, RP4, scale bar=1.0 mm.

G. Lingual view, UALVP 44087, RP4, scale bar=1.0 mm.

H. Occlusal view, UALVP 44087, RP4, scale bar=1.0 mm.

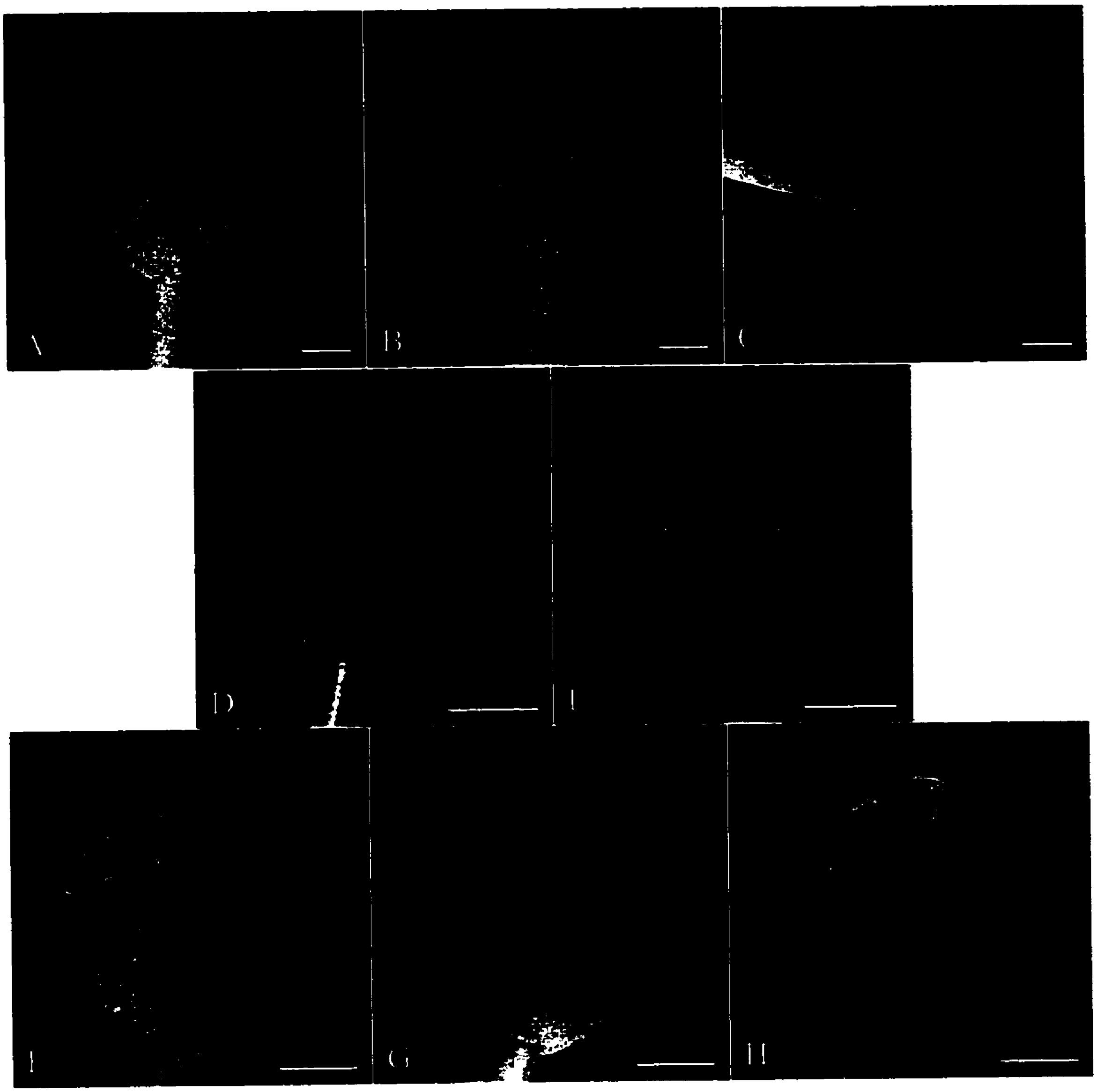
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Figure 10.

Neoplagiaulax hunteri

A. Labial view, UALVP 44088, RP4, scale bar=1.0 mm.

B. Lingual view, UALVP 44088, RP4, scale bar=1.0 mm.

C. Occlusal view, UALVP 44088, RP4, scale bar=1.0 mm.

D. Labial view, UALVP 44089, Rm1, scale bar=1.0 mm.

E. Lingual view, UALVP 44089, Rm1, scale bar=1.0 mm.

F. Occlusal view, UALVP 44089, Rm1, scale bar=1.0 mm.

cf. Neoplagiaulax sp.

G. Labial view, UALVP 44092, RP4, scale bar=1.0 mm.

H. Lingual view, UALVP 44092, RP4, scale bar=1.0 mm.

I. Occlusal view, UALVP 44092, RP4, scale bar=1.0 mm.

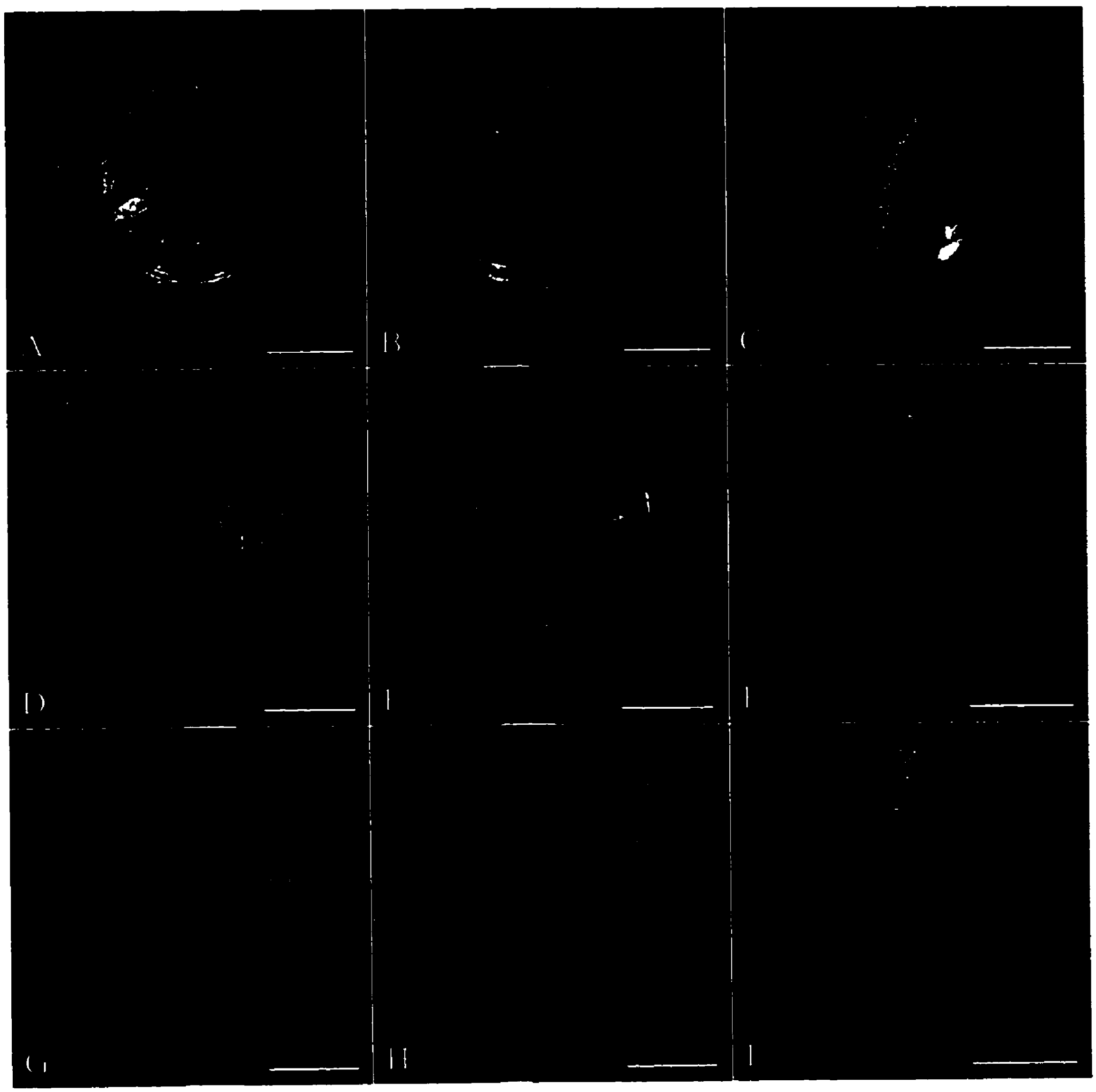

Figure 11.

?Neoplagiaulax sp.

A. Labial view, UALVP 44091, Rp4, scale bar=1.0 mm.

B. Lingual view, UALVP 44091, Rp4, scale bar=1.0 mm.

Neoplagiaulacinae, genus and species unidentified

C. Labial view, UALVP 44094, incomplete P4, scale bar=0.5 mm.

D. Lingual view, UALVP 44094, incomplete P4, scale bar=0.5 mm.

E. Occlusal view, UALVP 44094, incomplete P4, scale bar=0.5 mm.

Ptilodus "gnomus"

F. Labial view, UALVP 44096, Rp4, scale bar=1.0 mm.

G. Lingual view, UALVP 44096, Rp4, scale bar=1.0 mm.

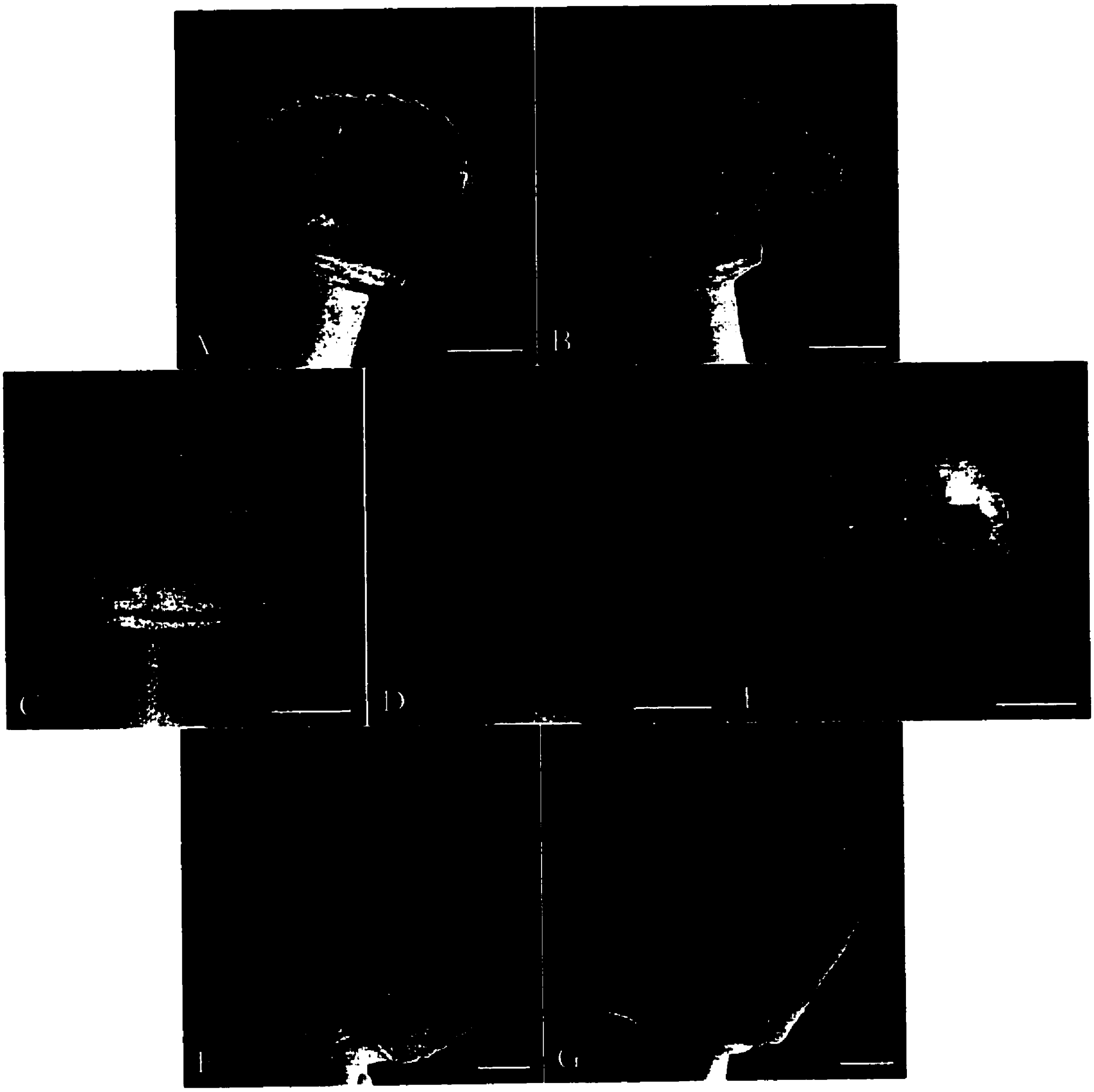

Figure 12.

Ptilodus montanus

A. Occlusal view, UALVP 44108, LP4, scale bar=1.0 mm.

B. Labial view, UALVP 44117, Rp4, scale bar=2.0 mm.

C. Labial view, UALVP 44113, incomplete right dentary having p4-m1, scale bar=2.0 mm.

D. Lingual view, UALVP 44113, incomplete right dentary having p4-m1, scale bar=2.0 mm.

E. Occlusal view, UALVP 44113, incomplete right dentary having p4-m1, scale bar=2.0 mm.

F. Occlusal view, UALVP 44124, Rm2, scale bar=1.0 mm.

Ptilodus sp., cf. P. wyomingensis

G. Labial view, UALVP 44121, LP4, scale bar=1.0 mm.

H. Lingual view, UALVP 44121, LP4, scale bar=1.0 mm.

I. Occlusal view, UALVP 44121, LP4, scale bar=1.0 mm.

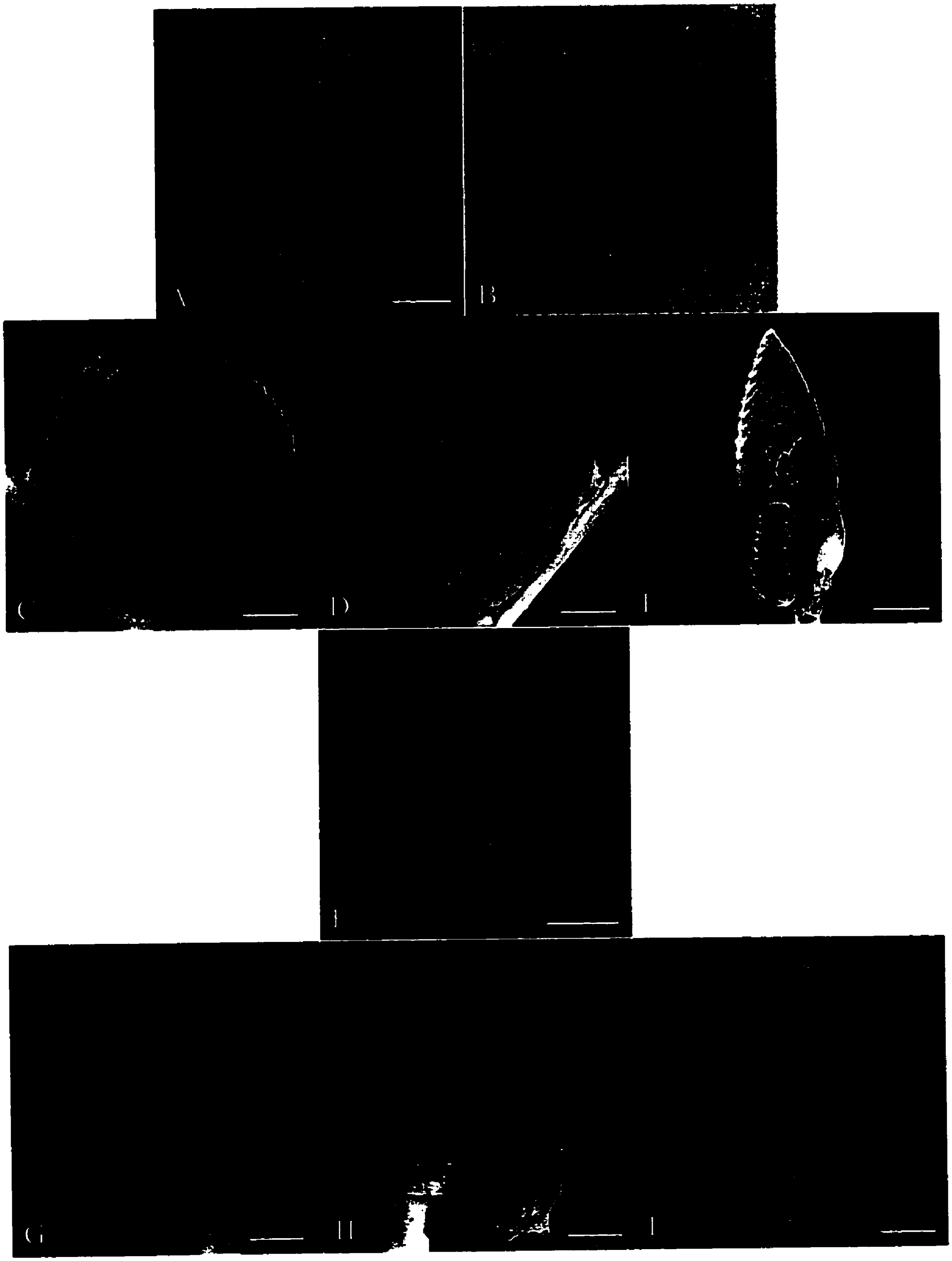
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Figure 13.

Baiotomeus "rhothonion", new species

A. Labial view, UALVP 44127, LP4, scale bar=0.5 mm.

B. Lingual view, UALVP 44127, LP4, scale bar=0.5 mm.

C. Occlusal view, UALVP 44127, LP4, scale bar=0.5 mm.

D. Occlusal view, UALVP 44131, RM1, scale bar=0.5 mm.

E. Labial view, UALVP 44132, Lp4, scale bar=1.0 mm.

F. Lingual view, UALVP 44132, Lp4, scale bar=1.0 mm.

G. Occlusal view, UALVP 44133, Lm1, scale bar=1.0 mm.

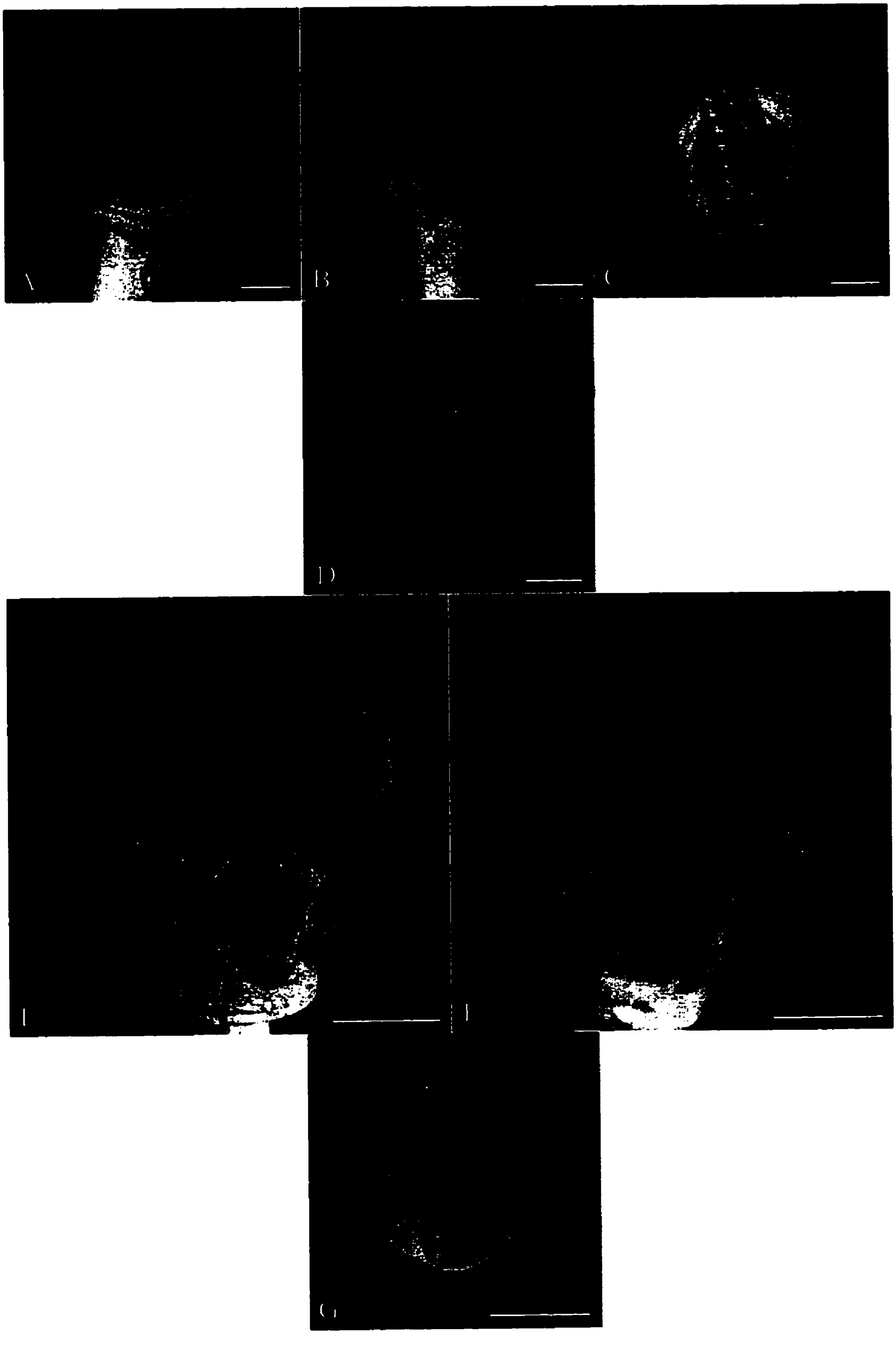

Figure 14.

Anconodon cochranensis

A. Labial view, UALVP 44135, Lp4, scale bar=1.0 mm.

B. Lingual view, UALVP 44135, Lp4, scale bar=1.0 mm.

cf. Stygimys sp. 1

C. Labial view, UALVP 44141, incomplete Ri1, scale bar=2.0 mm.

D. Medial view, UALVP 44141, incomplete Ri1, scale bar=2.0 mm.

E. Occlusal view cross section, UALVP 44141, incomplete Ri1, scale bar=2.0 mm.

F. Occlusal view, UALVP 44142, Lm1, scale bar=1.0 mm.

cf. Stygimys sp. 2

G. Occlusal view, UALVP 44143, LM1, scale bar=1.0 mm.

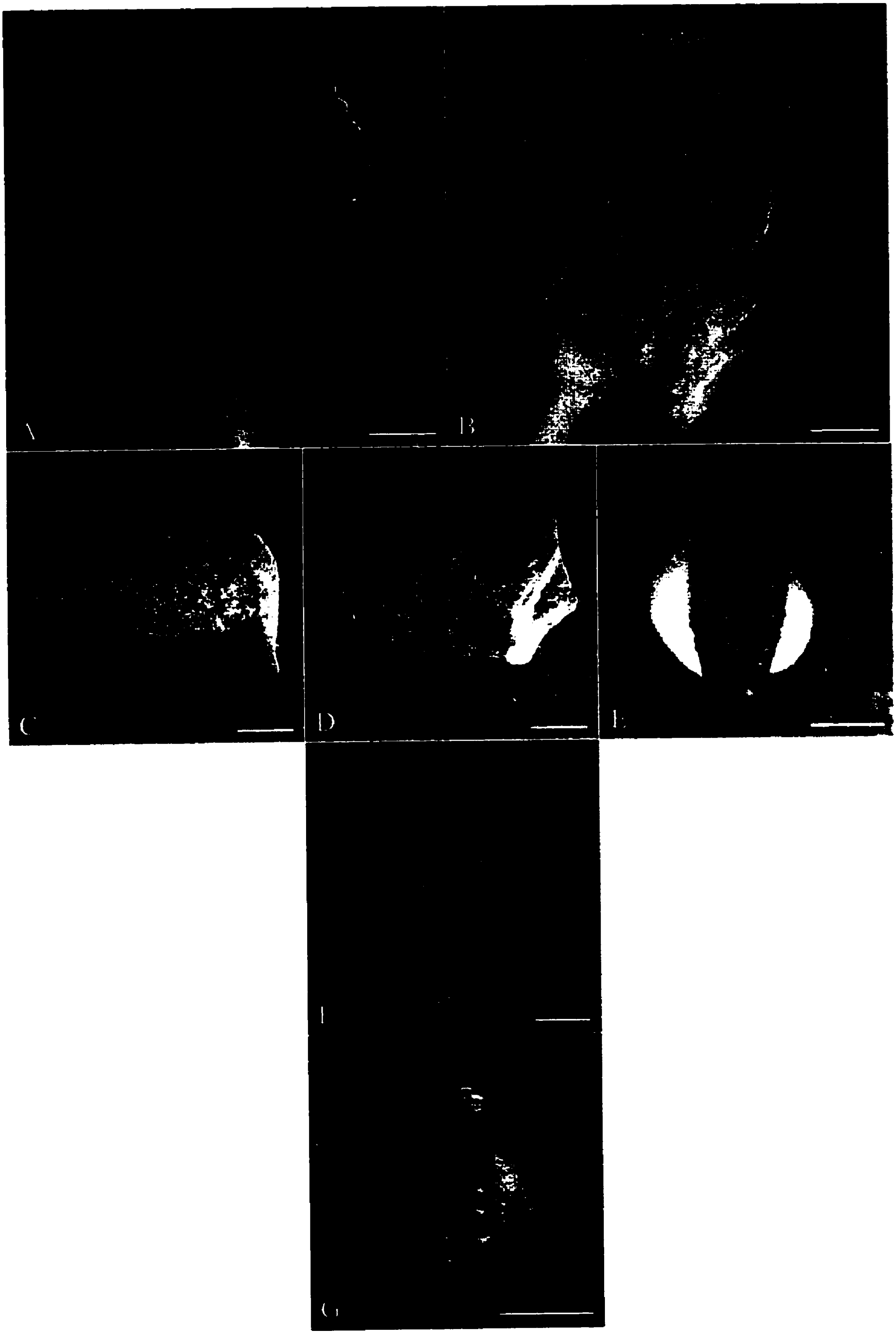

Figure 15.

Acheronodon sp.

A. Labial view, UALVP 44144, Lm1, scale bar=0.5 mm.

B. Lingual view, UALVP 44144, Lm1, scale bar=0.5 mm.

C. Occlusal view, UALVP 44144, Lm1, scale bar=0.5 mm.

Prodiacodon sp., cf. P. furor

D. Occlusal view, UALVP 44145, LP3, scale bar=0.5 mm.

cf. Prodiacodon sp.

E. Occlusal view, UALVP 44217, RM1, scale bar=0.5 mm.

cf. McKennatherium sp.

F. Labial view, UALVP 44146, incomplete ?Lm1, scale bar=0.5 mm.

G. Lingual view, UALVP 44146, incomplete ?Lm1, scale bar=0.5 mm.

H. Occlusal view, UALVP 44146, incomplete ?Lm1, scale bar=0.5 mm.

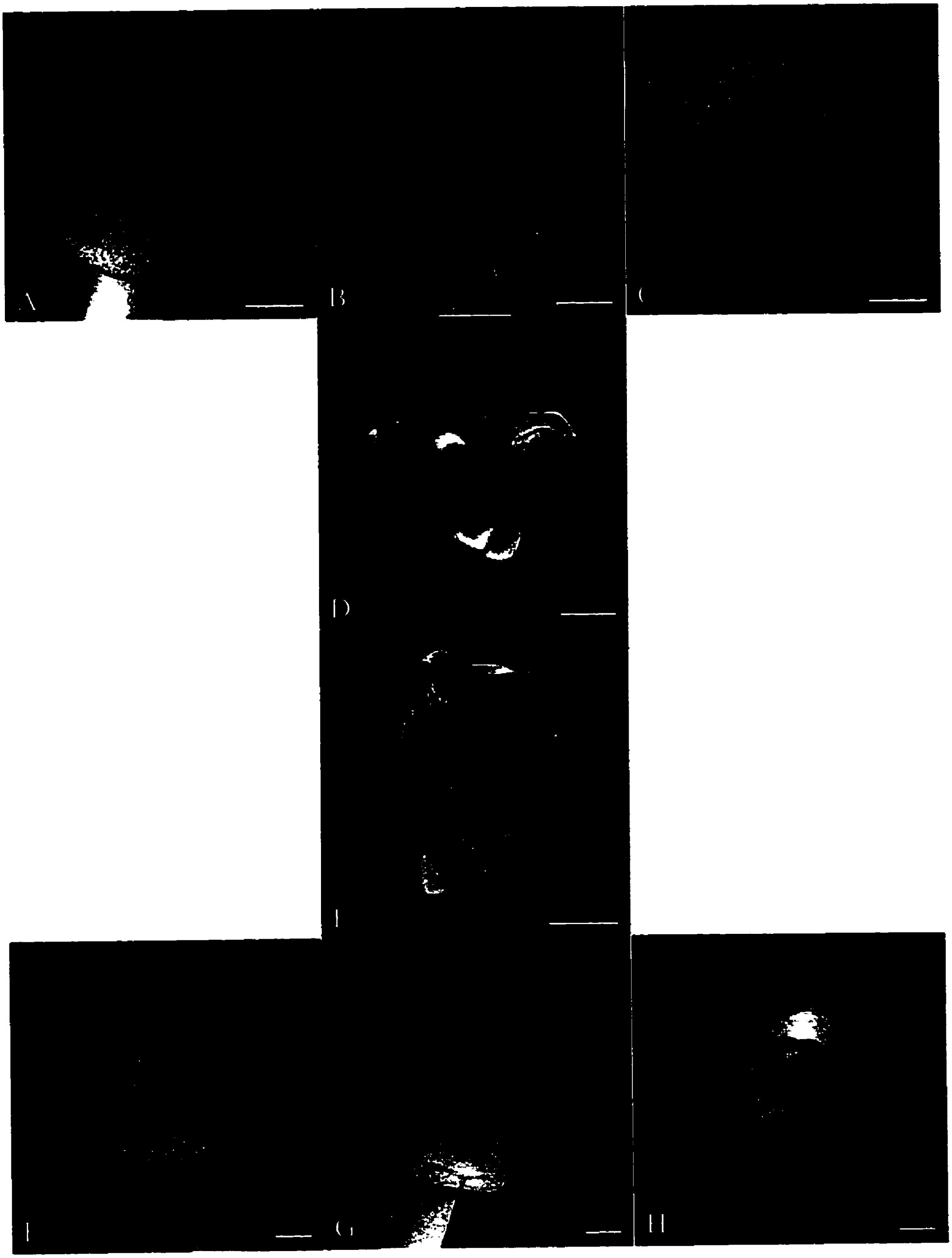
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Figure 16.

Leptacodon munusculum

A. Labial view, UALVP 44227, incomplete left dentary having p2, p4-m3, and alveoli for p3, scale bar=2.0 mm.

B. Lingual view, UALVP 44227, incomplete left dentary having p2, p4-m3, and alveoli for p3, scale bar=2.0 mm.

C. Occlusal view, UALVP 44227, incomplete left dentary having p2, p4-m3. and alveoli for p3, scale bar=2.0 mm.

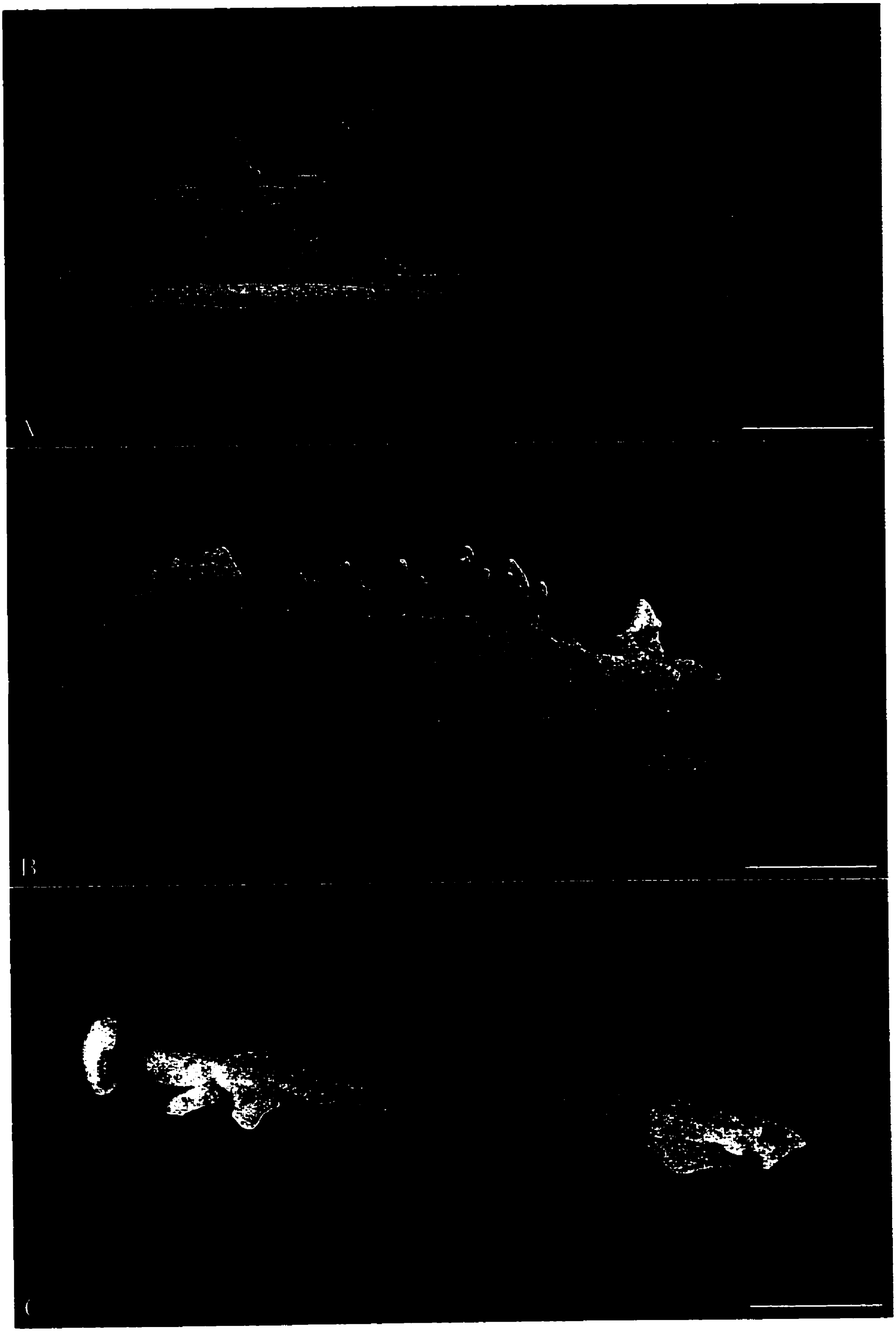

Figure 17.

Leptacodon sp., cf. L. tener

A. Labial view, UALVP 44152, LP4, scale bar=1.0 mm.

B. Occlusal view, UALVP 44152, LP4, scale bar=1.0 mm.

C. Occlusal view, UALVP 44154, RM2, scale bar=0.5 mm.

D. Labial view, UALVP 44158, Lm3, scale bar=0.5 mm.

E. Lingual view, UALVP 44158, Lm3, scale bar=0.5 mm.

F. Occlusal view, UALVP 44158, Lm3, scale bar=0.5 mm.

Nyctitheriinae, genus and species unidentified

G. Labial view, UALVP 44156, Lp4, scale bar=0.5 mm.

H. Lingual view, UALVP 44156, Lp4, scale bar=0.5 mm.

I. Occlusal view, UALVP 44156, Lp4, scale bar=0.5 mm.

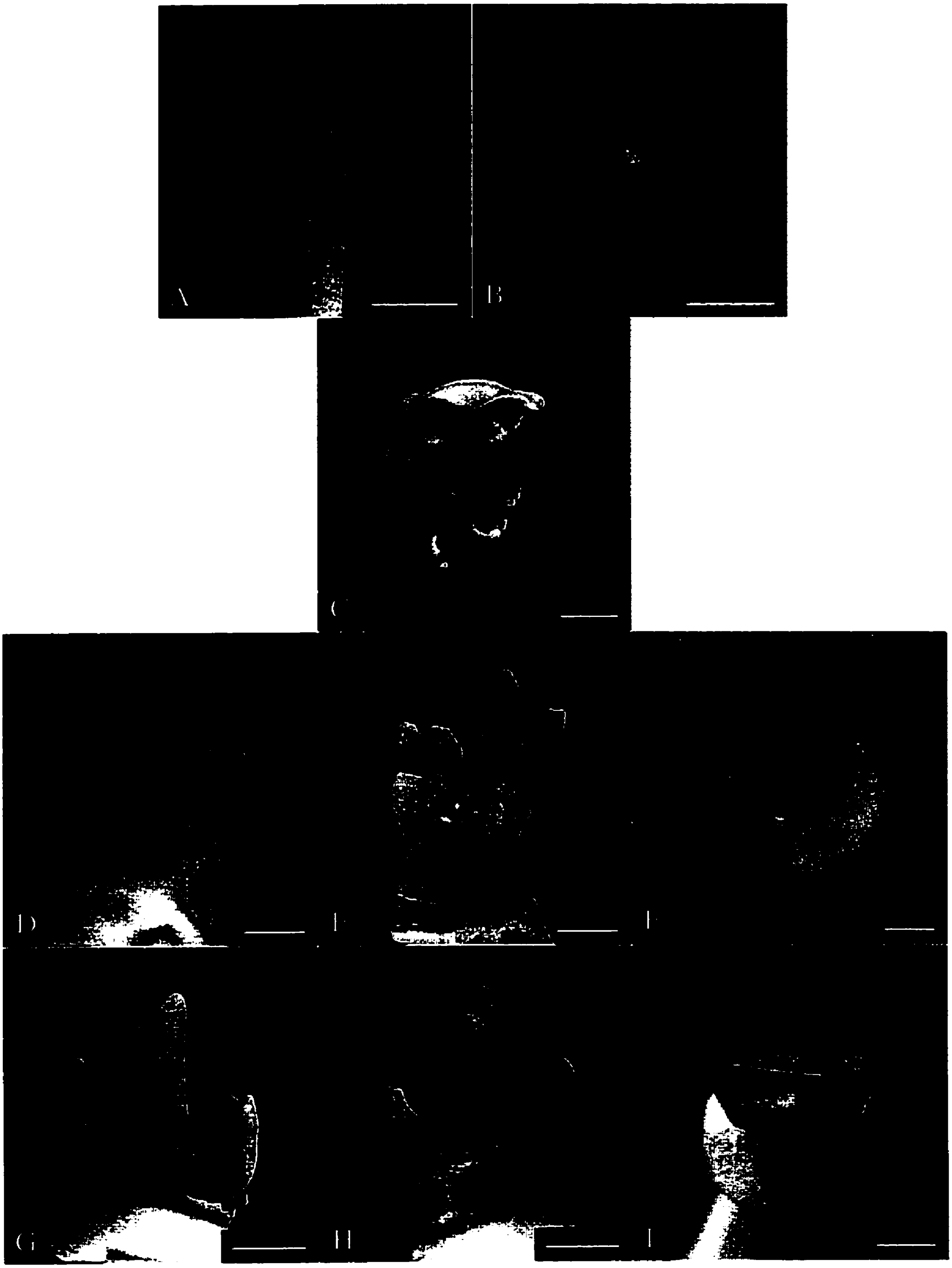
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Figure 18.

Elpidophorus sp., cf. E. minor

A. Labial view, UALVP 44149, Rp4, scale bar=1.0 mm.

B. Lingual view, UALVP 44149, Rp4, scale bar=1.0 mm.

C. Occlusal view, UALVP 44149, Rp4, scale bar=1.0 mm.

D. Labial view, UALVP 44160, incomplete right dentary having m1-m3 and alveoli for p3-p4, scale bar=2.0 mm.

E. Lingual view, UALVP 44160, incomplete right dentary having m1-m3 and alveoli for p3-p4, scale bar=2.0 mm.

F. Occlusal view, UALVP 44160, incomplete right dentary having m1-m3 and alveoli for p3-p4, scale bar=2.0 mm.

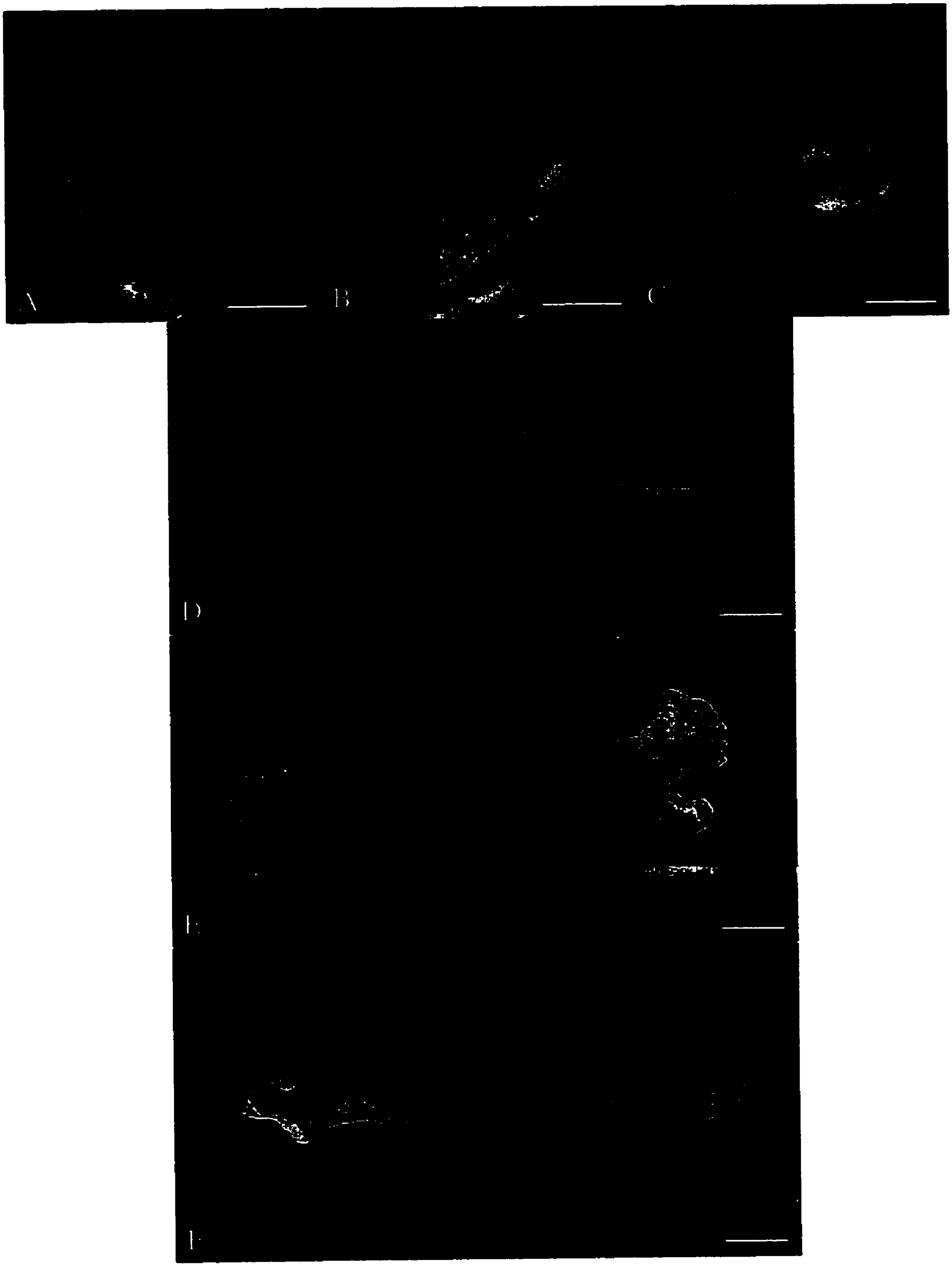
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Figure 19.

Ignacius fremontensis

A. Occlusal view, UALVP 43287, RP4, scale bar=1.0 mm.

B. Occlusal view, UALVP 43289, RM1, scale bar=0.5 mm.

C. Labial view, UALVP 43288, Rp4, scale bar=0.5 mm.

D. Lingual view, UALVP 43288, Rp4, scale bar=0.5 mm.

E. Occlusal view, UALVP 43288, Rp4, scale bar=0.5 mm.

F. Labial view, UALVP 43291, Lm1, scale bar=0.5 mm.

G. Lingual view, UALVP 43291, Lm1, scale bar=0.5 mm.

H. Occlusal view, UALVP 43291, Lm1, scale bar=0.5 mm.

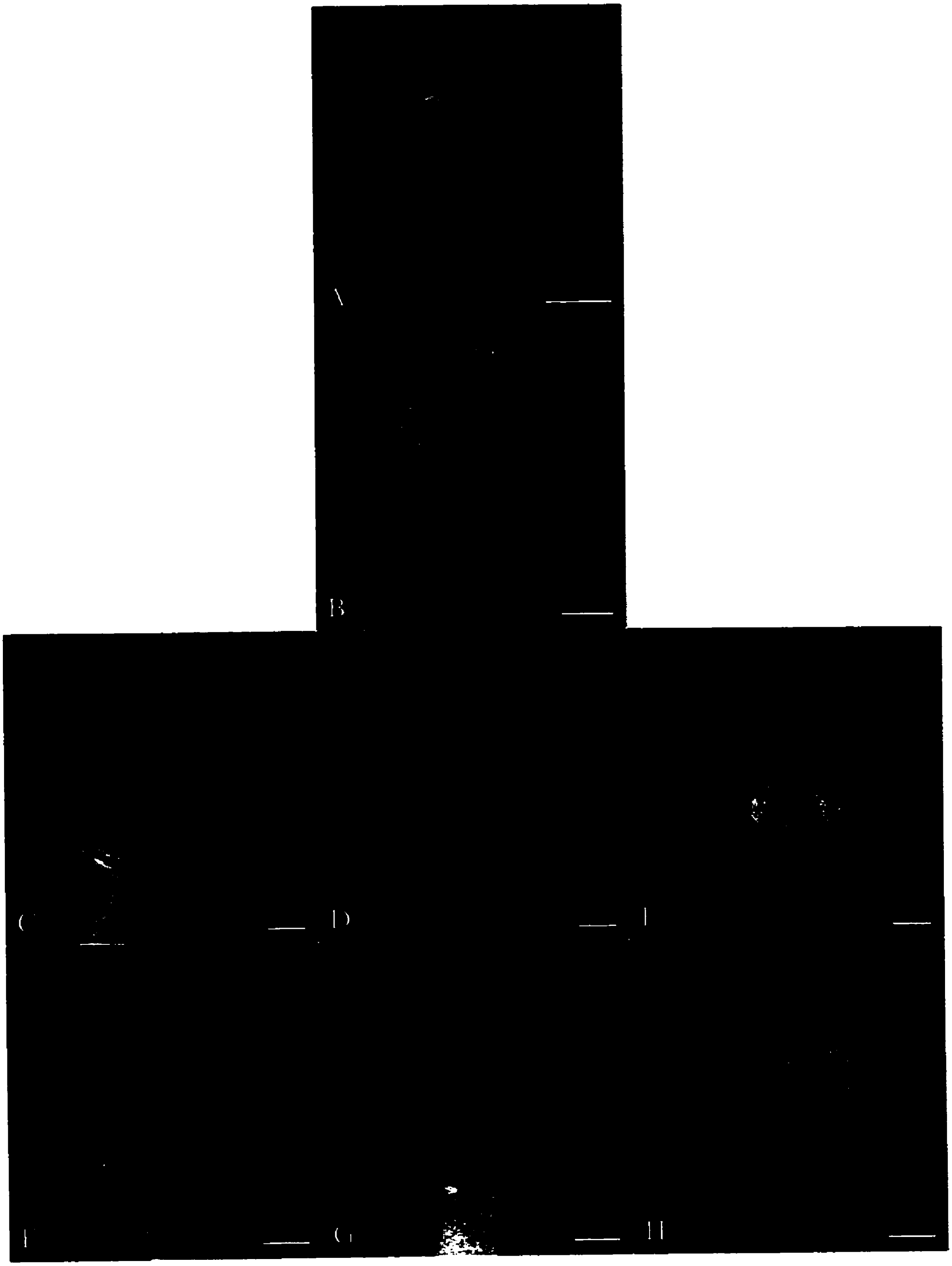
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Figure 20.

cf. Ignacius sp.

A. Labial view, UALVP 43303, Rm1, scale bar=0.5 mm.

B. Lingual view, UALVP 43303, Rm1, scale bar=0.5 mm.

C. Occlusal view, UALVP 43303, Rm1, scale bar=0.5 mm.

Paromomyidae, genus and species unidentified

D. Labial view, UALVP 43302, Lm2, scale bar=0.5 mm.

E. Lingual view, UALVP 43302, Lm2, scale bar=0.5 mm.

F. Occlusal view, UALVP 43302, Lm2, scale bar=0.5 mm.

Palenochtha sp., cf. P. minor

G. Labial view, UALVP 43301, Rm2, scale bar=0.5 mm.

H. Lingual view, UALVP 43301, Rm2, scale bar=0.5 mm.

I. Occlusal view, UALVP 43301, Rm2, scale bar=0.5 mm.

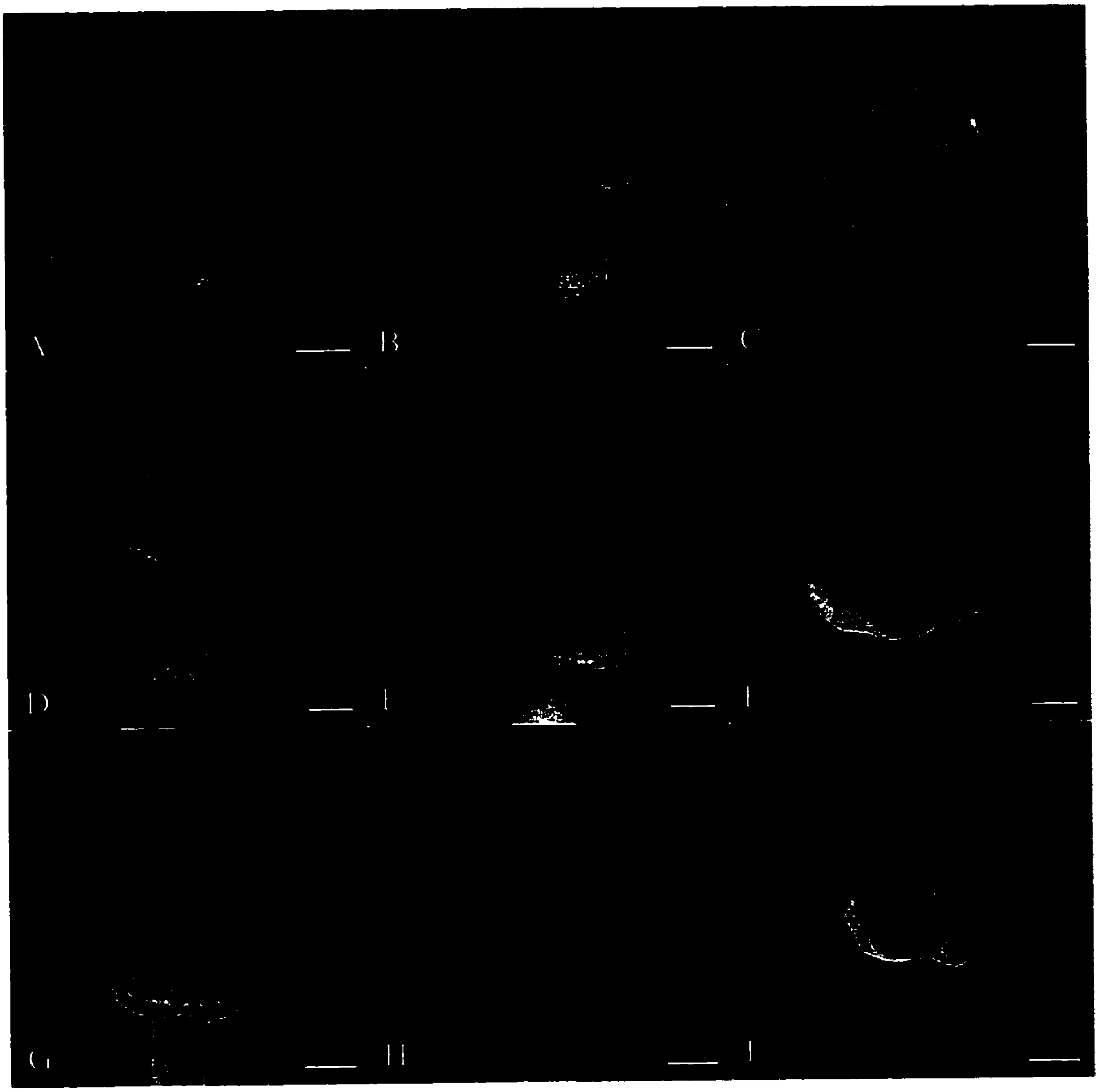

Figure 21.

Plesiolestes problematicus

A. Labial view, UALVP 43296, RM2, scale bar=1.0 mm.

B. Occlusal view, UALVP 43296, RM2, scale bar=1.0 mm.

C. Distal view, UALVP 43296, RM2, scale bar=1.0 mm.

D. Labial view, UALVP 43297, LM3, scale bar=1.0 mm.

E. Occlusal view, UALVP 43297, LM3, scale bar=1.0 mm.

F. Distal view, UALVP 43297, LM3, scale bar=1.0 mm.

?Torrejonia sirokyi

G. Occlusal view, UALVP 43305, LM3, scale bar=1.0 mm.

cf. Navajovius sp.

H. Labial view, UALVP 43299, Lp4, scale bar=0.5 mm.

I. Lingual view, UALVP 43299, Lp4, scale bar=0.5 mm.

J. Occlusal view, UALVP 43299, Lp4, scale bar=0.5 mm.

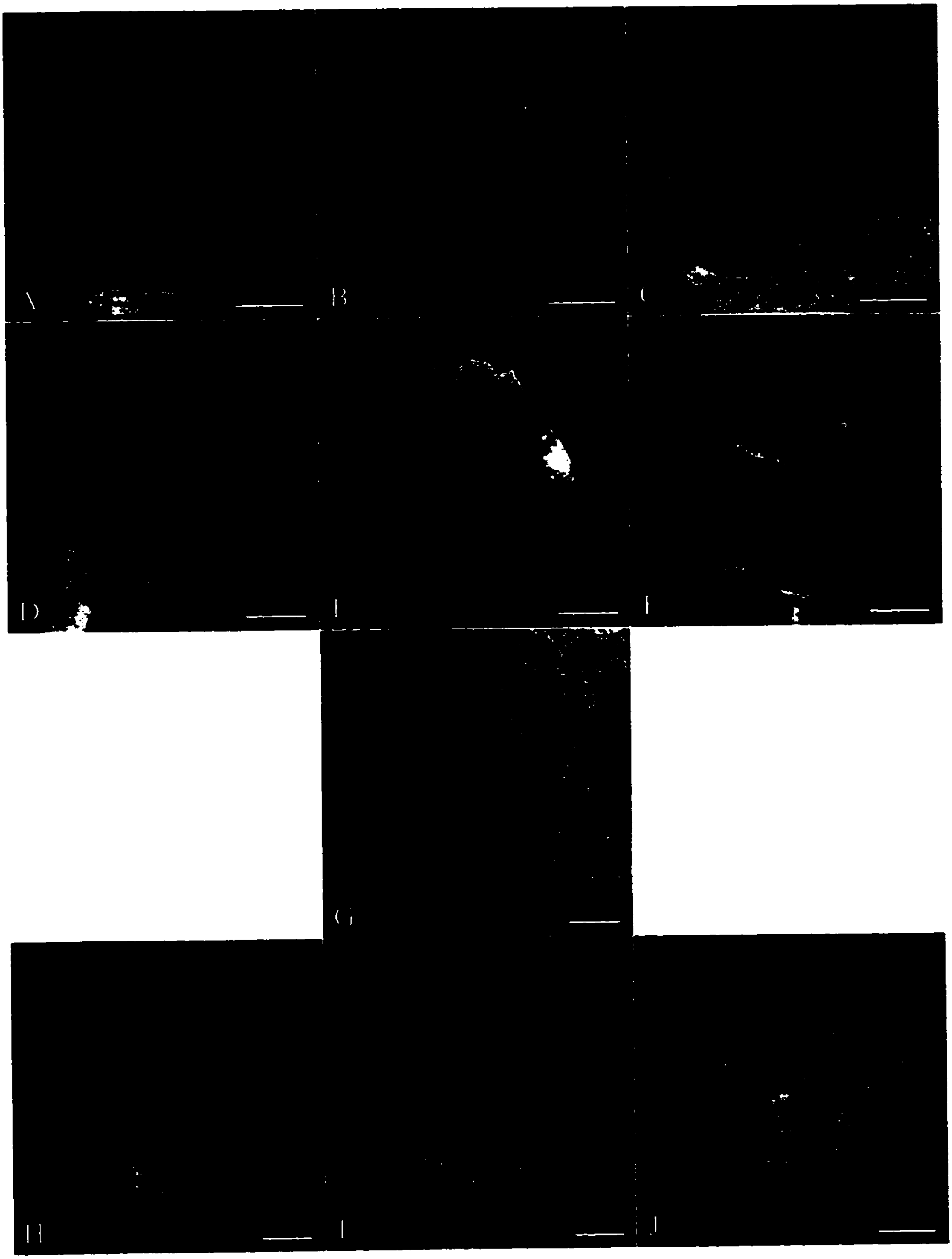

Figure 22.

Pronothodectes matthewi

A. Occlusal view, UALVP 43284, LI1, scale bar=0.5 mm.

B. Occlusal view, UALVP 43280, RP4, scale bar=1.0 mm.

C. Labial view, UALVP 43275, incomplete left dentary having p4-m3 with alveoli for p3, scale bar=3.0 mm.

D. Lingual view, UALVP 43275, incomplete left dentary having p4-m3 with alveoli for p3, scale bar=3.0 mm.

E. Occlusal view, UALVP 43275, incomplete left dentary having p4-m3 with alveoli for p3, scale bar=3.0 mm.

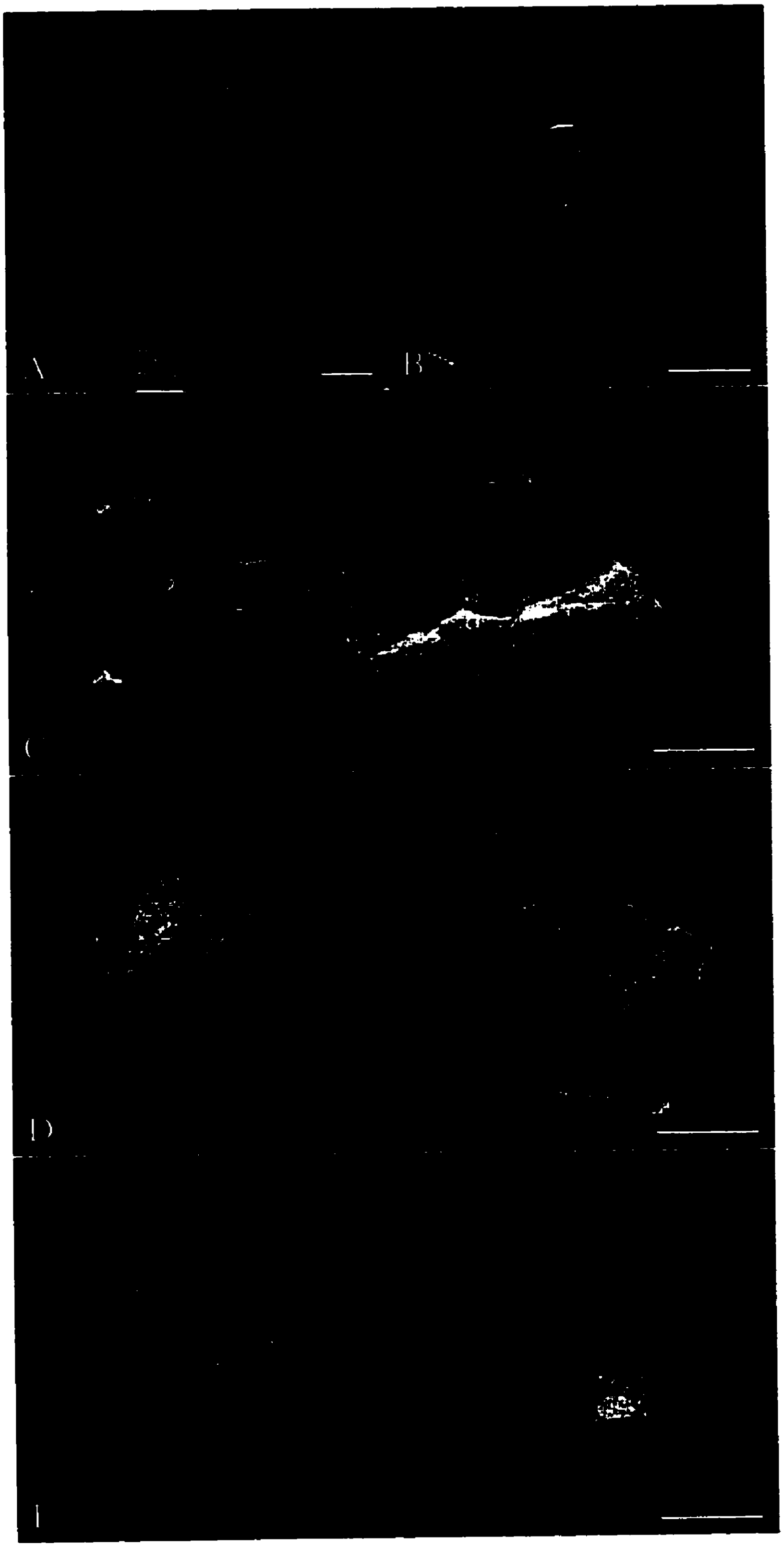

Figure 23.

Picrodus silberlingi

A. Labial view, UALVP 43294, incomplete left dentary having i1, p4-m2, with alveoli for c, p3, and m3, scale bar=2.0 mm.

B. Lingual view, UALVP 43294, incomplete left dentary having i1, p4-m2, with alveoli for c, p3, and m3, scale bar=2.0 mm.

C. Occlusal view, UALVP 43294, incomplete left dentary having i1, p4-m2, with alveoli for c, p3, and m3, scale bar=2.0 mm.

?Chriacus sp.

D. Labial view, UALVP 44168, Lp4, scale bar=2.0 mm.

E. Lingual view, UALVP 44168, Lp4, scale bar=2.0 mm.

F. Occlusal view, UALVP 44168, Lp4, scale bar=2.0 mm.

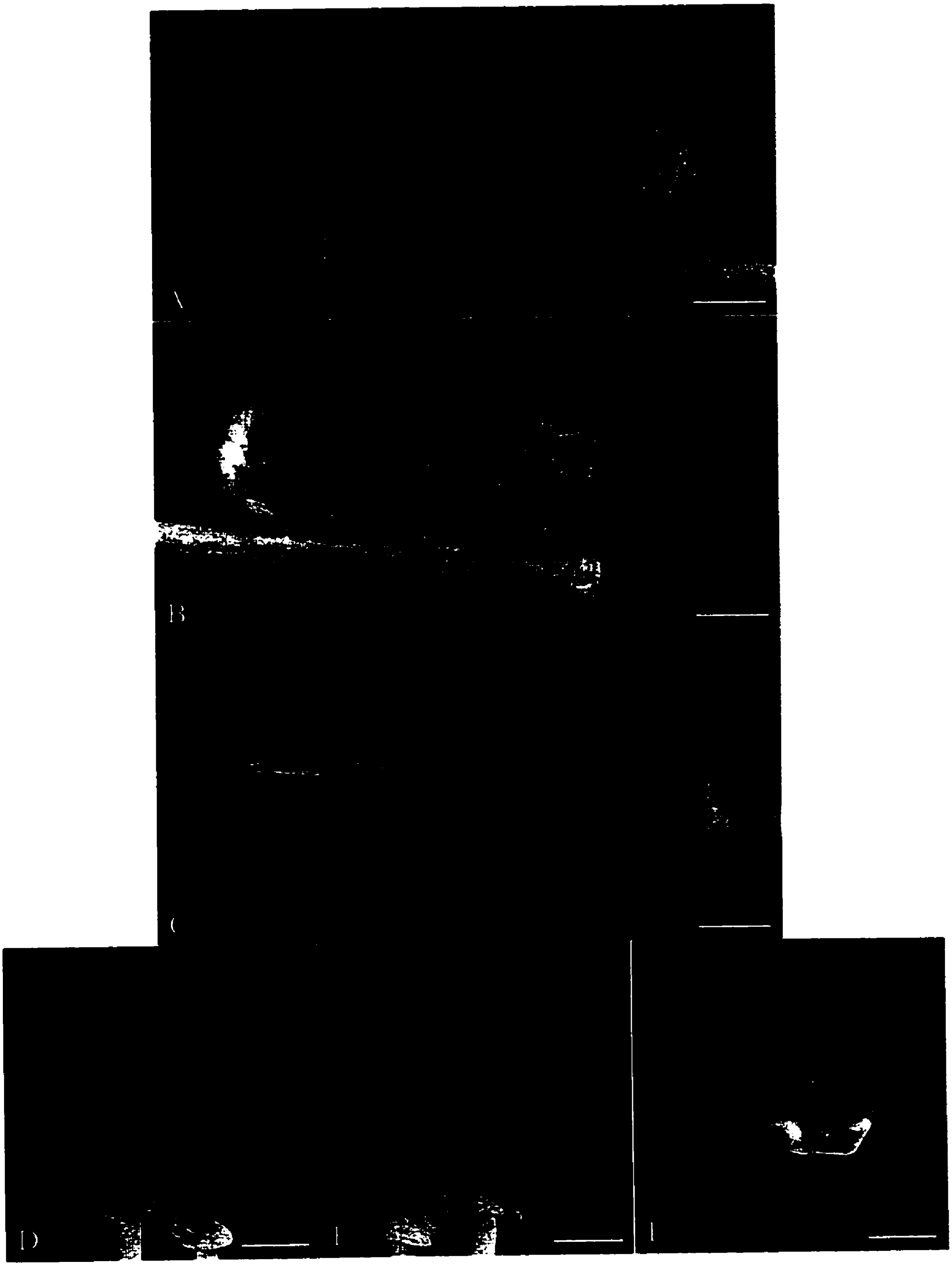

Figure 24.

Prothryptacodon albertensis

A. Labial view, UALVP 44170, Rp4, scale bar=1.0 mm.

B. Lingual view, UALVP 44170, Rp4, scale bar=1.0 mm.

C. Occlusal view, UALVP 44170, Rp4, scale bar=1.0 mm.

D. Labial view, UALVP 44171, Rm1, scale bar=2.0 mm.

E. Lingual view, UALVP 44171, Rm1, scale bar=2.0 mm.

F. Occlusal view, UALVP 44171, Rm1, scale bar=2.0 mm.

G. Labial view, UALVP 44172, Lm2, scale bar=2.0 mm.

H. Lingual view, UALVP 44172, Lm2, scale bar=2.0 mm.

I. Occlusal view, UALVP 44172, Lm2, scale bar=2.0 mm.

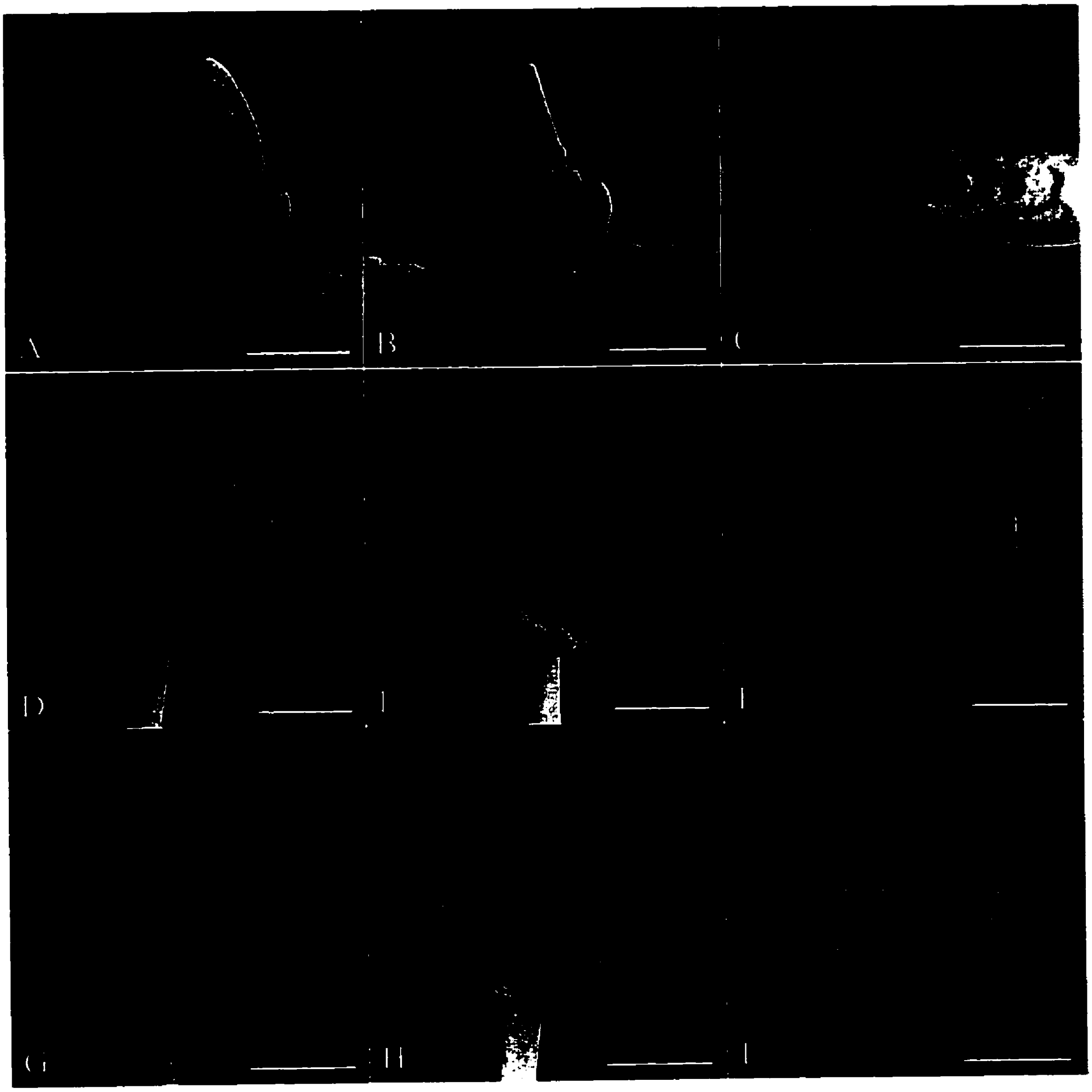
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Figure 25.

Colpoclaenus sp., cf. C. procyonoides

A. Labial view, UALVP 44173, Lm3, scale bar=2.0 mm.

B. Lingual view, UALVP 44173, Lm3, scale bar=2.0 mm.

C. Occlusal view, UALVP 44173, Lm3, scale bar=2.0 mm.

cf. Promioclaenus acolytus

D. Labial view, UALVP 44175, LM2, scale bar=1.0 mm.

E. Lingual view, UALVP 44175, LM2, scale bar=1.0 mm.

F. Occlusal view, UALVP 44175, LM2, scale bar=1.0 mm.

G. Labial view, UALVP 44178, incomplete right dentary having m2-m3, scale bar=2.0 mm.

H. Lingual view, UALVP 44178, incomplete right dentary having m2-m3, scale bar=2.0 mm.

I. Occlusal view, UALVP 44178, incomplete right dentary having m2-m3, scale bar=2.0 mm.

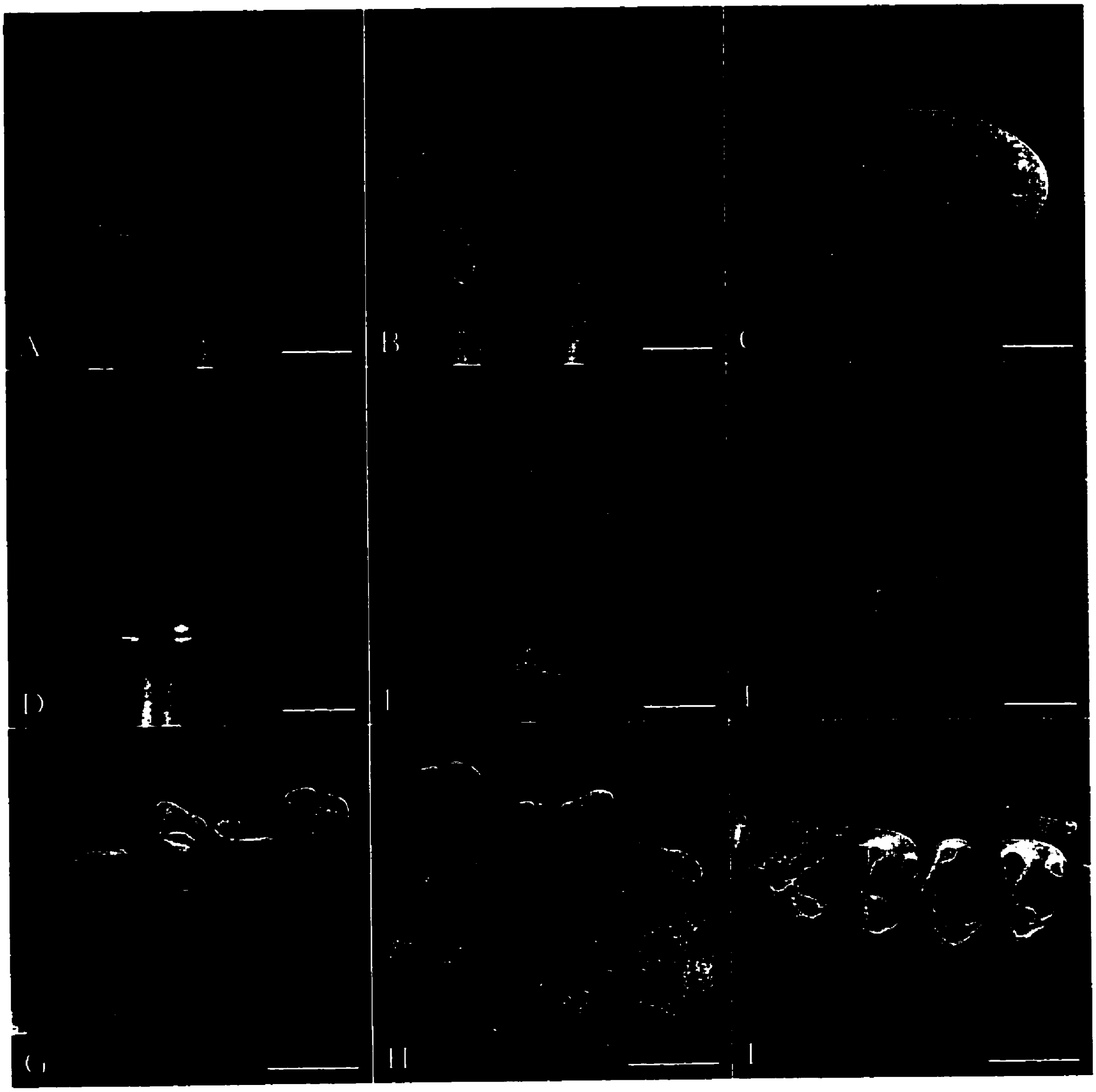
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Figure 26.

cf. Promioclaenus acolytus

A. Labial view, UALVP 44177, incomplete left dentary having p2-m3, scale bar=5.0 mm.

B. Lingual view, UALVP 44177, incomplete left dentary having p2-m3, scale bar=5.0 mm.

C. Occlusal view, UALVP 44177, incomplete left dentary having p2-m3, scale bar=5.0 mm.

Litomylus sp.

D. Occlusal view, UALVP 44174, LM1, scale bar=1.0 mm.

E. Occlusal view, UALVP 44183, RM2, scale bar=1.0 mm.

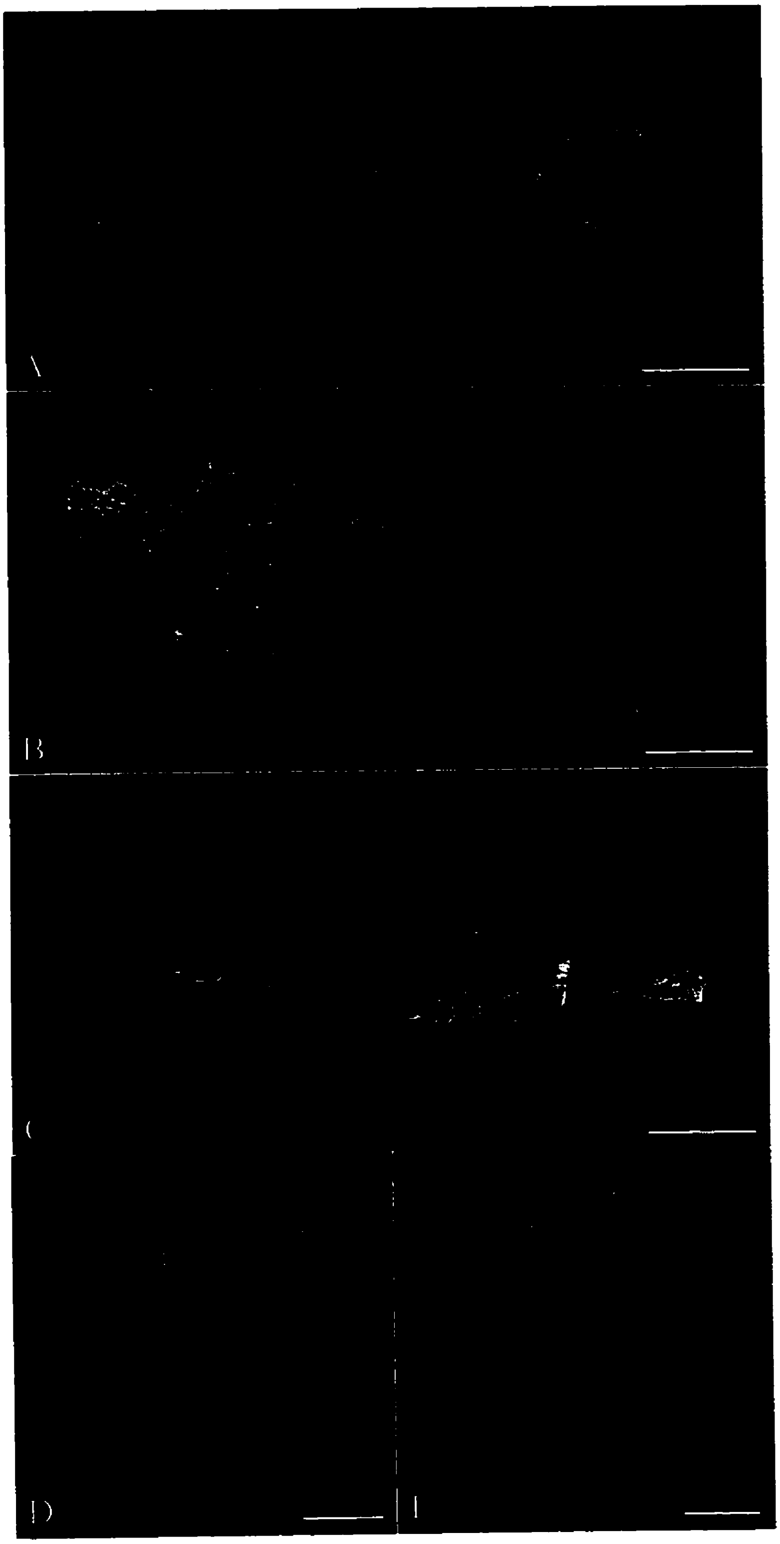

Figure 27.

Protictis sp.

A. Labial view, UALVP 44186, Lm1, scale bar=2.0 mm.

B. Lingual view, UALVP 44186, Lm1, scale bar=2.0 mm.

C. Occlusal view, UALVP 44186, Lm1, scale bar=2.0 mm.

Simpsonictis sp., cf. S. jaynanneae

D. Labial view, UALVP 44187, LM1, scale bar=1.0 mm.

E. Lingual view, UALVP 44187, LM1, scale bar=1.0 mm.

F. Occlusal view, UALVP 44187, LM1, scale bar=1.0 mm.

G. Mesial view, UALVP 44187, LM1, scale bar=1.0 mm.

H. Distal view, UALVP 44187, LM1, scale bar=1.0 mm.

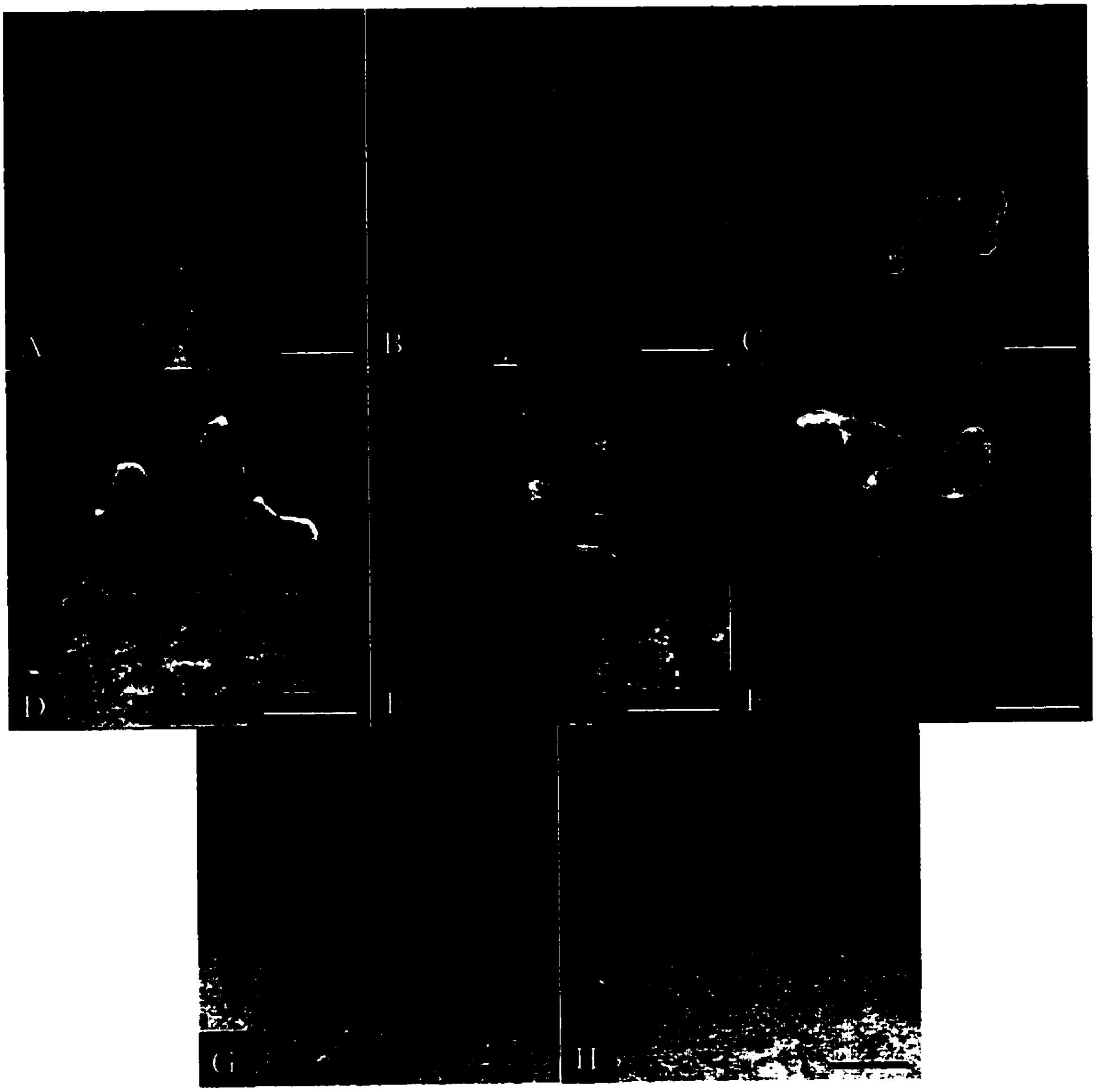
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Figure 28.

Simpsonictis sp., cf. S. jaynanneae

A. Labial view, UALVP 44188, Lm2, scale bar=0.5 mm.

B. Lingual view, UALVP 44188, Lm2, scale bar=0.5 mm.

C. Occlusal view, UALVP 44188, Lm2, scale bar=0.5 mm.

Carnivora, genus and species unidentified

D. Labial view, UALVP 44189, incomplete left dentary having m2, scale bar=1.0 mm.

E. Lingual view, UALVP 44189, incomplete left dentary having m2, scale bar=1.0 mm.

F. Occlusal view, UALVP 44189, incomplete left dentary having m2, scale bar=1.0 mm.

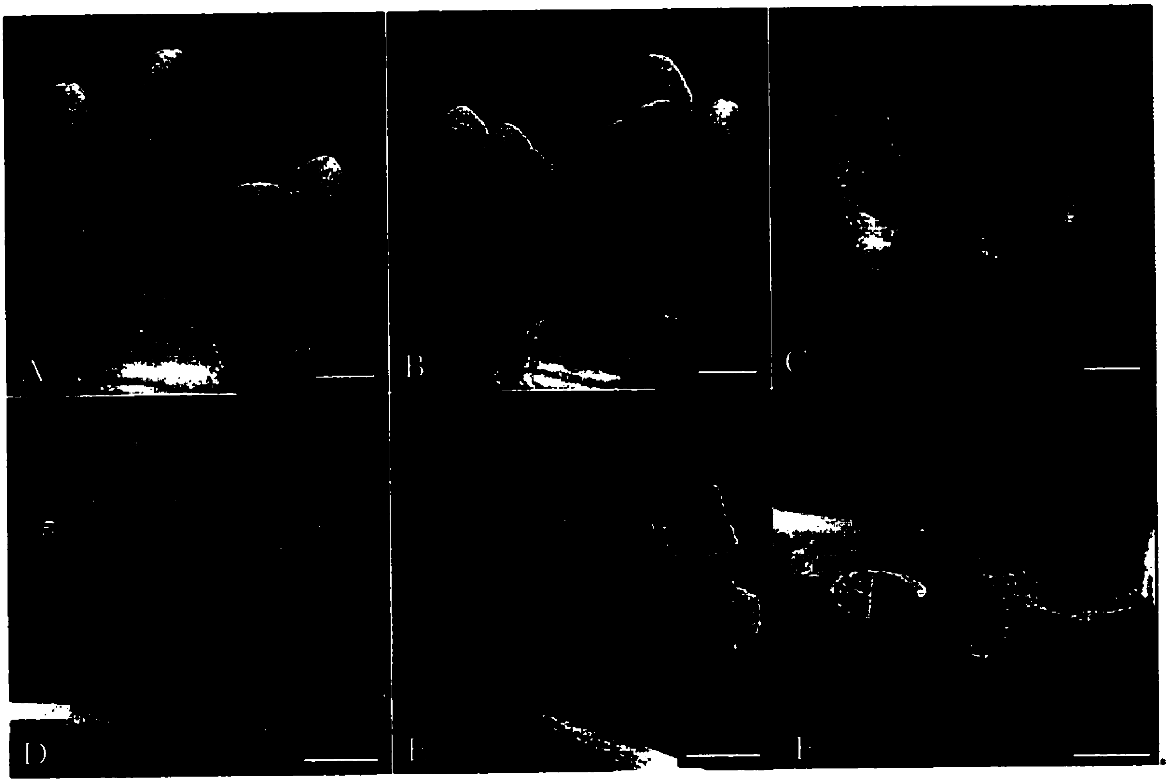

Figure 29.

Palaeoryctidae, genus and species unidentified 1

A. Labial view, UALVP 44195, Rp4, scale bar=0.5 mm.

B. Lingual view, UALVP 44195, Rp4, scale bar=0.5 mm.

C. Occlusal view, UALVP 44195, Rp4, scale bar=0.5 mm.

D. Labial view, UALVP 44196, Rm1 or Rm2, scale bar=0.5 mm.

E. Lingual view, UALVP 44196, Rm1 or Rm2, scale bar=0.5 mm.

F. Occlusal view, UALVP 44196, Rm1 or Rm2, scale bar=0.5 mm.

Palaeoryctidae, genus and species unidentified 2

G. Labial view, UALVP 44197, ?RM1, scale bar=0.5 mm.

H. Occlusal view, UALVP 44197, ?RM1, scale bar=0.5 mm.

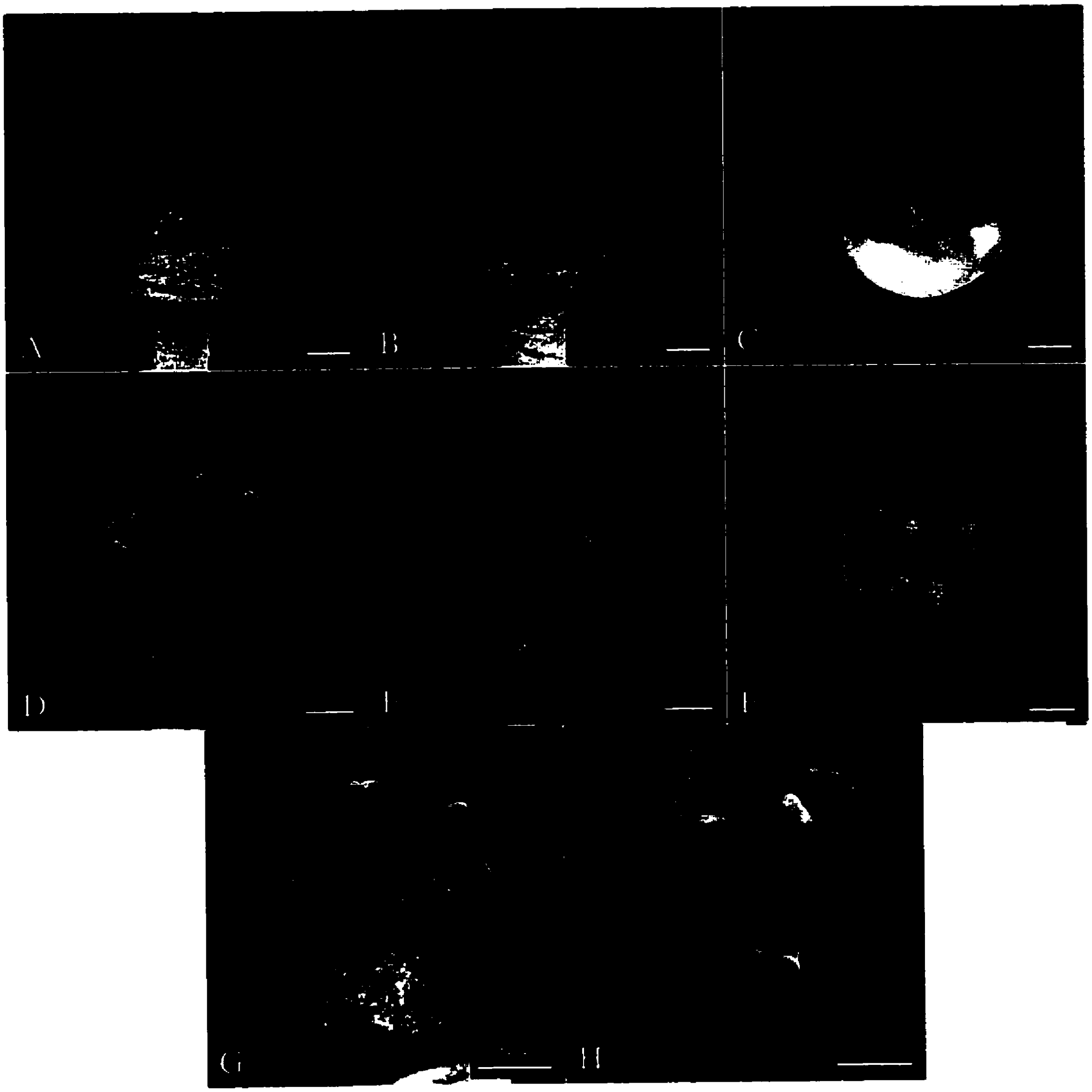

Figure 30.

Paleotomus "junior"

A. Occlusal view, UALVP 44219, LDP4, scale bar=1.0 mm.

B. Labial view, UALVP 44221, Lp3, scale bar=1.0 mm.

C. Lingual view, UALVP 44221, Lp3, scale bar=1.0 mm.

D. Occlusal view, UALVP 44221, Lp3, scale bar=1.0 mm.

E. Labial view, UALVP 44223, Ldp4, scale bar=1.0 mm.

F. Lingual view, UALVP 44223, Ldp4, scale bar=1.0 mm.

G. Occlusal view, UALVP 44223, Ldp4, scale bar=1.0 mm.

H. Labial view, UALVP 44222, Lp4, scale bar=1.0 mm.

I. Lingual view, UALVP 44222, Lp4, scale bar=1.0 mm.

J. Occlusal view, UALVP 44222, Lp4, scale bar=1.0 mm.

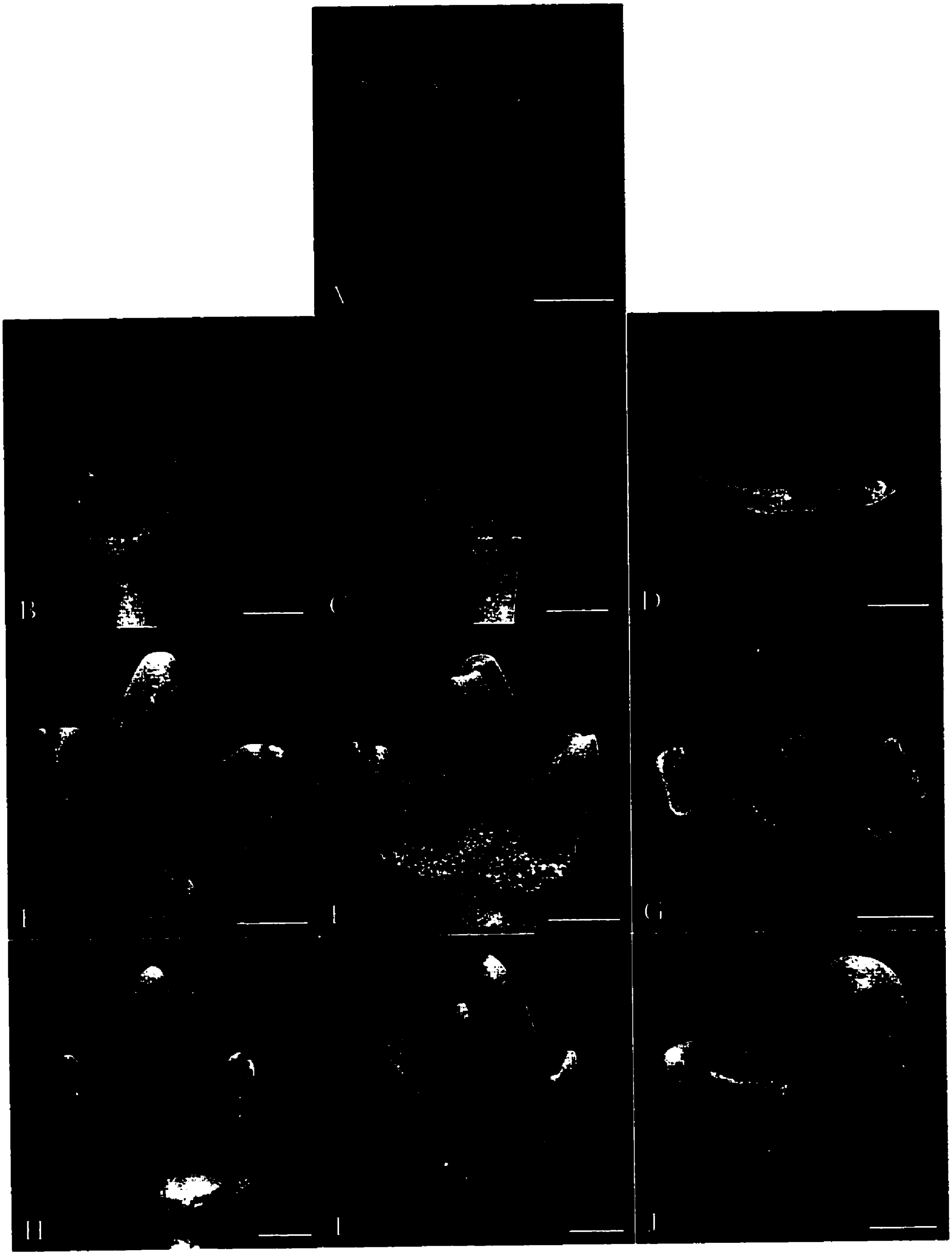

Figure 31.

Paleotomus "junior"

A. Labial view, UALVP 44224, Lm1, scale bar=1.0 mm.

B. Lingual view, UALVP 44224, Lm1, scale bar=1.0 mm.

C. Occlusal view, UALVP 44224, Lm1, scale bar=1.0 mm.

D. Labial view, UALVP 44225, Lm2, scale bar=1.0 mm.

E. Lingual view, UALVP 44225, Lm2, scale bar=1.0 mm.

F. Occlusal view, UALVP 44225, Lm2, scale bar=1.0 mm.

cf. Procerberus sp.

G. Labial view, UALVP 44190, Lm3, scale bar=1.0 mm.

H. Lingual view, UALVP 44190, Lm3, scale bar=1.0 mm.

I. Occlusal view, UALVP 44190, Lm3, scale bar=1.0 mm.

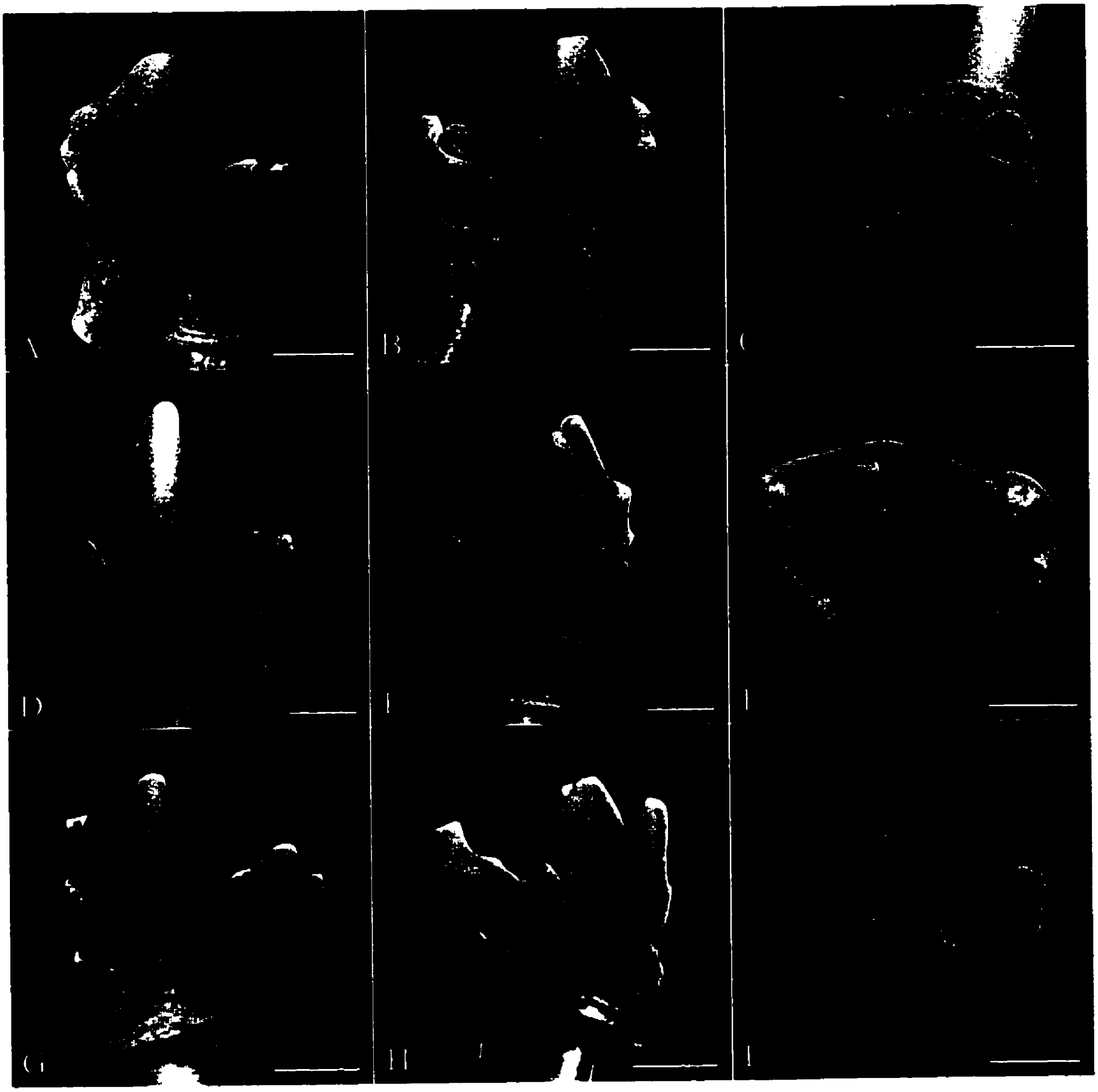

Figure 32.

Cimolestidae, genus and species unidentified

A. Labial view, UALVP 44192, LP4, scale bar=1.0 mm.

B. Occlusal view, UALVP 44192, LP4, scale bar=1.0 mm.

C. Occlusal view, UALVP 44191, LP4, scale bar=1.0 mm.

D. Labial view, UALVP 44193, RM2, scale bar=1.0 mm.

E. Occlusal view, UALVP 44193, RM2, scale bar=1.0 mm.

F. Labial view, UALVP 44194, ?Rm3, scale bar=0.5 mm.

G. Lingual view, UALVP 44194, ?Rm3, scale bar=0.5 mm.

H. Occlusal view, UALVP 44194, ?Rm3, scale bar=0.5 mm.

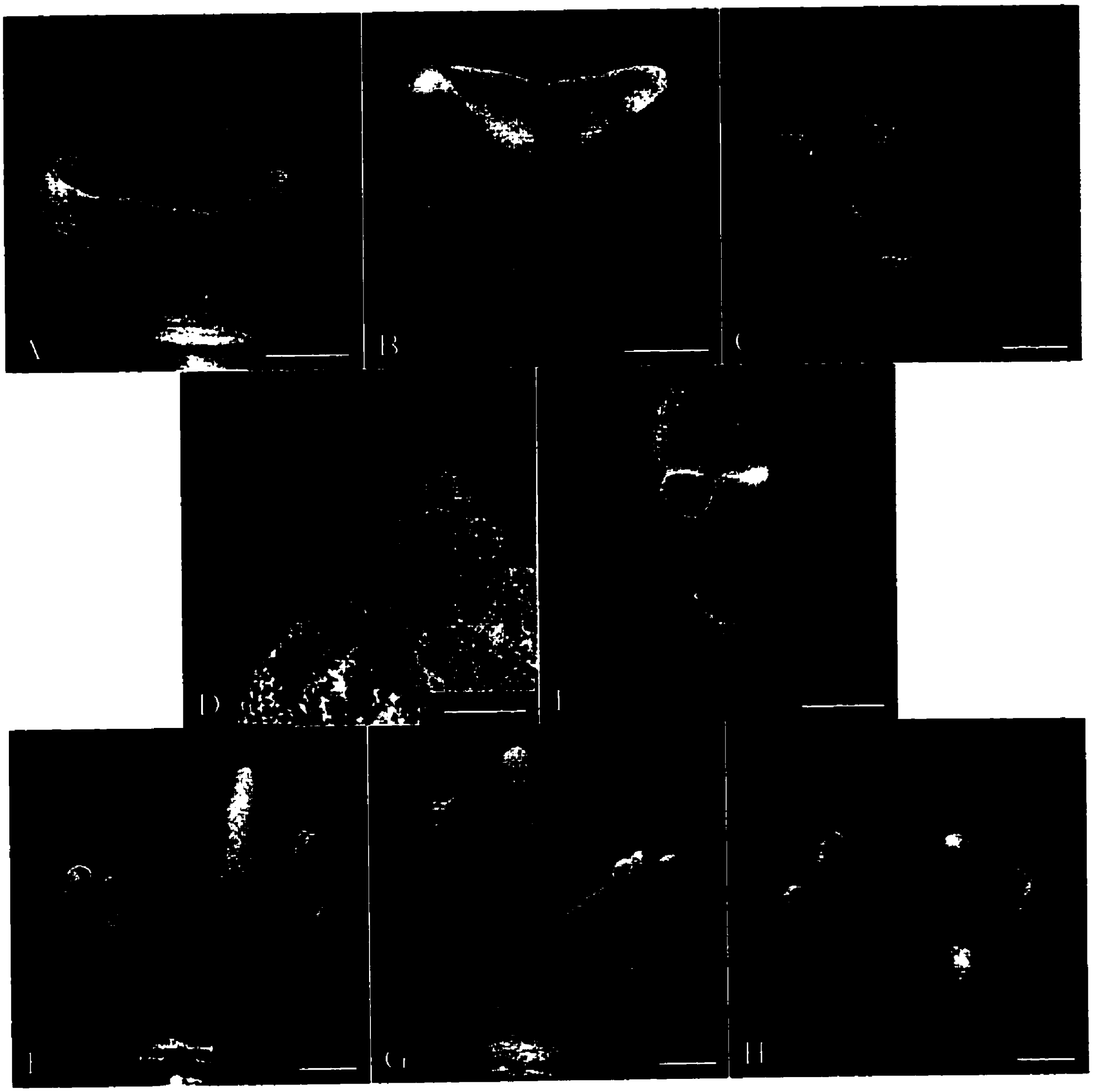
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Figure 33.

Jepsenella sp., cf. J. praepropera

A. Labial view, UALVP 44200, LI1, scale bar=2.0 mm.

B. Lingual view, UALVP 44200, LI1, scale bar=2.0 mm.

cf. Cyriacotherium sp.

C. Occlusal view, UALVP 44185, RP3, scale bar=2.0 mm.

?Aphronorus sp.

D. Labial view, UALVP 44271, Lm1, scale bar=0.5 mm.

E. Lingual view, UALVP 44271, Lm1, scale bar=0.5 mm.

F. Occlusal view, UALVP 44271, Lm1, scale bar=0.5 mm.

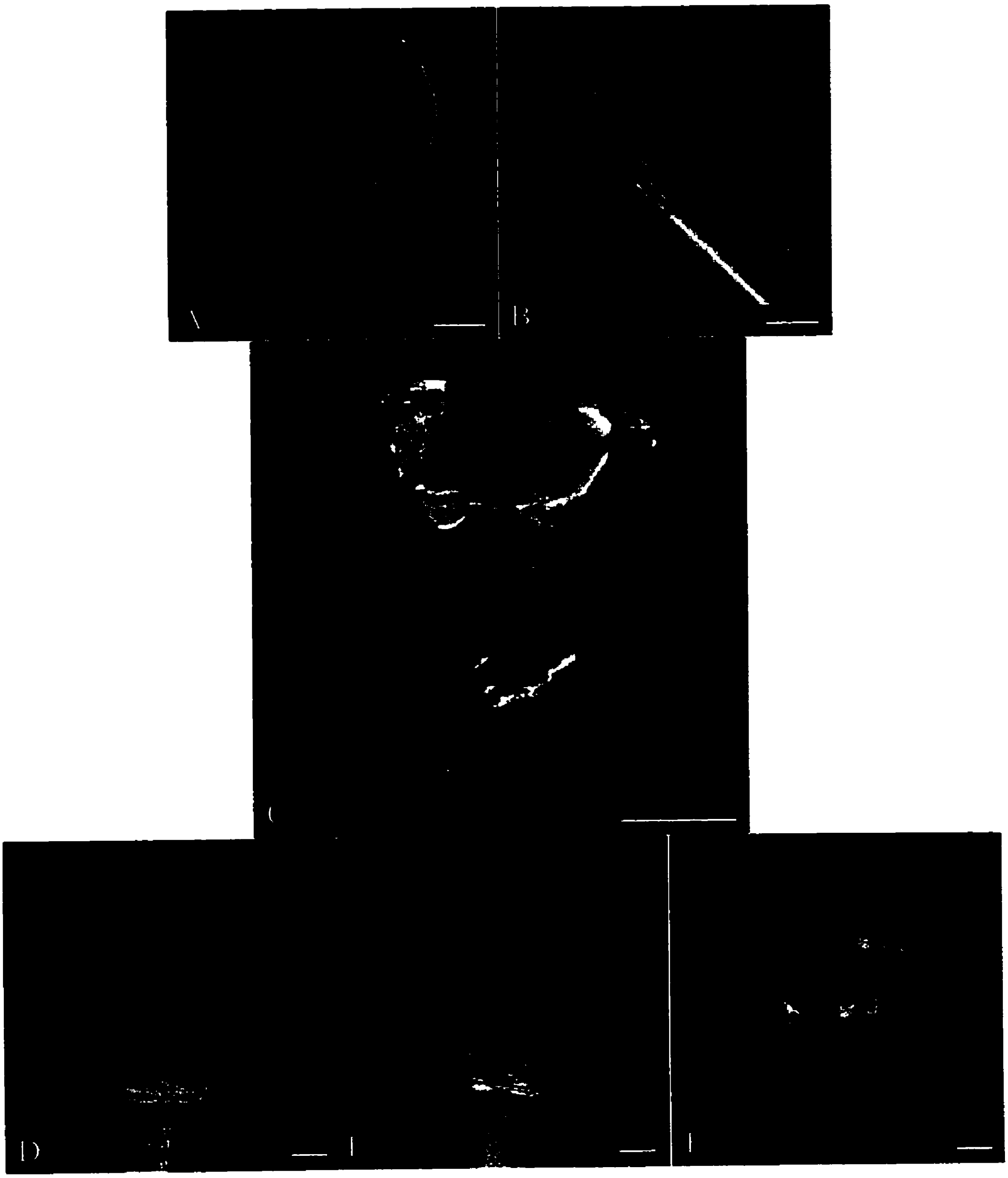
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Figure 34.

Propalaeosinopa "septentrionalis"

A. Occlusal view, UALVP 44202, RP4, scale bar=1.0 mm.

B. Occlusal view, UALVP 44204, LM1, scale bar=1.0 mm.

C. Occlusal view, UALVP 44206, RM2, scale bar=1.0 mm.

D. Labial view, UALVP 44234, Lp4, scale bar=0.5 mm.

E. Lingual view, UALVP 44234, Lp4, scale bar=0.5 mm.

F. Occlusal view, UALVP 44234, Lp4, scale bar=0.5 mm.

G. Labial view, UALVP 44210, Lm1, scale bar=0.5 mm.

H. Lingual view, UALVP 44210, Lm1, scale bar=0.5 mm.

I. Occlusal view, UALVP 44210, Lm1, scale bar=0.5 mm.

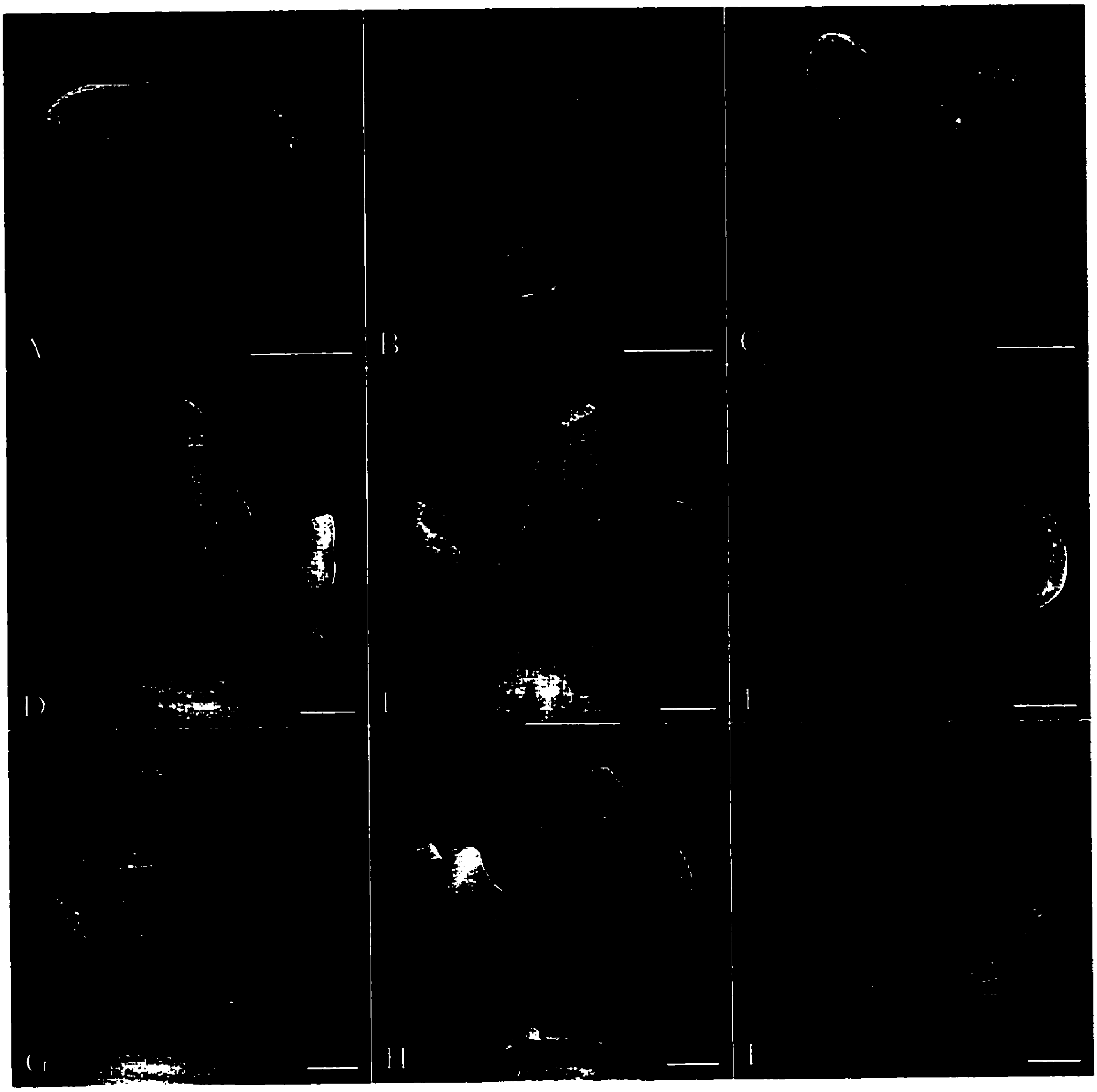
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Figure 35.

Propalaeosinopa "septentrionalis"

A. Labial view, UALVP 44212, Lm2, scale bar=0.5 mm.

B. Lingual view, UALVP 44212, Lm2, scale bar=0.5 mm.

C. Occlusal view, UALVP 44212, Lm2, scale bar=0.5 mm.

Propalaeosinopa sp. 1

D. Labial view, UALVP 44216, Lm2, scale bar=1.0 mm.

E. Lingual view, UALVP 44216, Lm2, scale bar=1.0 mm.

F. Occlusal view, UALVP 44216, Lm2, scale bar=1.0 mm.

Propalaeosinopa sp. 2

G. Labial view, UALVP 44218, ?Lm2, scale bar=0.5 mm.

H. Lingual view, UALVP 44218, ?Lm2, scale bar=0.5 mm.

I. Occlusal view, UALVP 44218, ?Lm2, scale bar=0.5 mm.