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FIRST OCCURRENCE OF PLESIADAPIFORM PRIMATES FROM THE CHADRONIAN (LATEST EOCENE)

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ABSTRACT

The late early Chadronian Medicine Pole Hills local fauna of southwestern North Dakota preserves a diverse mammalian fauna. Included in the fauna are single specimens of a phenacolemurine and a uintasoricine primate. These represent the youngest record of the families Paromomyidae and Microsyopidae. These rare elements provide additional support for latest Eocene relict populations surviving in the Great Plains province after their disappearance from the Rocky Mountain province.

INTRODUCTION

Plesiadapiform primates are relatively abundant in North American Paleocene faunas, peaking in diversity during the late Paleocene (Tiffanian) and declining rather precipitously by the early Eocene (Wasatchian) (Maas et al. 1988). The latest previously reported occurrence of any plesiadapiform is *Ignacius mcgrewi* from the Duchesnean of Wyoming (Krishtalka 1978). This paper documents the occurrence of at least two plesiadapiform genera, a phenacolemurine paromomyid and a uintasoricine microsyopid, in the early Chadronian.

The Medicine Pole Hills local fauna is a diverse assemblage consisting of more than 4500 mammal specimens from the Chadron Formation in the southwestern corner of North Dakota (Pearson 1993, Pearson and Hoganson 1995, Schumaker and Kihm 2006, Kihm and Schumaker 2008, Kihm 2011, 2013). This fauna is heavily skewed toward small species with approximately 50% of all mammal specimens being eomyid rodents, and it appears to preserve a previously underrepresented sample of small-bodied, early Chadronian taxa. This interpretation is bolstered by the high diversity of both lizards (Smith 2006) and snakes (Smith 2013) in the fauna compared to other Chadronian assemblages.

Whereas the Medicine Pole Hills mammalian fauna contains *Leptomeryx yoderi* (Heaton and Emry 1996), considered an index fossil for the late early Chadronian (Prothero and Emry 2004), the rodent fauna is most similar to the middle Chadronian Calf Creek local fauna of Saskatchewan. However, the rodent fauna also includes the youngest occurrence of a sciuravid rodent (Kihm 2013). The phenacolemurine and uintasoricine plesiadaptiforms reported here represent a rare component of the Medicine Pole Hills local fauna, where each of these taxa is represented by a single tooth. These specimens are curated with the Pioneer Trails Regional Museum (PTRM) in Bowman, ND.

It is unlikely that the specimens described here are the result of contamination. The screens for processing the matrix were cleaned in an ultrasonic bath prior to use. Reworking is also considered unlikely. The specimens themselves are not different in the color of preservation from other specimens nor do they show any degree of surface erosion that might suggest transport (PTRM 10401 has both roots preserved). The sediments of the locality (V89002) lie unconformably on the Paleocene Fort Union Formation. Although *Ignacius* has been reported from the Fort Union Formation in North Dakota (Kihm and Hartman 2004), there are no other Paleocene mammalian or reptilian taxa among the more than 5000 specimens collected from the Medicine Pole Hills localities to date (a few chondrichthyan teeth may be the result of reworking). The only early or middle Eocene rocks in North Dakota are the Golden Valley Formation which has produced a limited Wasatchian fauna (West 1973). The nearest mapped occurrence of these rocks is more than 50 km to the north-northwest (Hickey 1977). The only reported occurrence of older late Eocene fossils from the region are from the Slim Buttes Formation of northwestern South Dakota (Bjork

1967), more than 70 km to the southeast of V89002. Seeland (1985) has reconstructed the late Eocene drainage of the northern Great Plains and described a generally northeasterly flow direction.

SYSTEMATIC PALEONTOLOGY

Order Primates Linnaeus, 1758
Infraorder Plesiadapiformes Simons and Tattersall, in Simons, 1972
Family Paromomyidae Simpson, 1940
Subfamily Phenacolemurinae Simpson, 1955
Phenacolemurine, cf. *Ignacius* sp.
(Figure 1)

Referred Specimen—PTRM 17483, LP4.

Description—The protocone is a low triangular cusp at the extreme anterolingual corner of the tooth. It is smaller than either of the external cusps. There is a weakly developed preprotocrista that runs along the anterior margin of the tooth, terminating about halfway between the protocone and paracone at a small paraconule. The preparaconule crista slants anterobuccally, terminating on the anterobuccal corner of the tooth just anterior to the lingual margin of the paracone. The postparaconule crista angles posterobuccally to the lingual margin of the paracone. No metaconule is present. The postprotocrista is also very weak and terminates before reaching the middle of the tooth. The paracone is only somewhat larger than the metacone in area but is considerably taller. The centrocrista connecting the external cusps is slightly invaginated. The paracone has a minor preparacrista that trends anteriorly to an expanded anterobuccal corner of the tooth. This expansion connects to a buccal cingulum that extends to the metacone. A small cuspule is developed on the cingulum anterobuccal to the metacone. There is an anterior cingulum on the buccal half of the tooth. The postprotocingulum extends posteriorly from the protocone to the posterobuccal corner of the tooth where the crest bends buccally, connecting to the metacone and enclosing a posterolingual basin. There is no distinct hypocone. The tooth has an anterior-posterior length of 1.94 mm, an anterior width of 2.13 mm and a posterior width of 2.10 mm.

Discussion—The specimen is clearly a paromomyid based on the characteristically formed posterolingual basin, lack of a hypocone and well developed conules. Silcox and Gunnell (2008) recognized five genera of North American paromomyids. Of these, *Elwynella* is known only from the lower dentition (Rose and Bown 1982). The P4 of *Acidomomys* (Bloch et al. 2002) is unknown, but the dP4 and upper molars show greater development of both pre- and postprotocristae and taller protocones. *Paromomys* has a reduced metacone on the P4 and a less inflated posterolingual basin (Simpson 1955). The three new paromomyid genera erected by Robinson and Ivy (1994) – *Simpsonlemur*, *Dillerlemur* and *Pulverflumen* – were considered by Silcox et al. (2008) to be synonyms of *Phenacolemur*. The recently named paromomyid genus *Edworthia* is known only from the lower dentition (Fox et al. 2010).

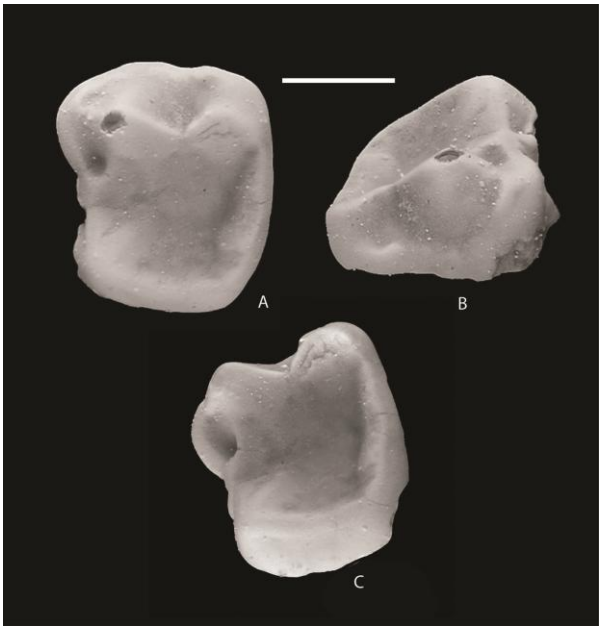

FIGURE 1. cf. *Ignacius* sp. from the Medicine Pole Hills local fauna. A-C, PTRM 17483 LP4, A, occlusal view, B, oblique buccal view; C, oblique lingual view. The bar scale represents approximately 1 mm.

The P4 of *Phenacolemur* is characterized by a straight centrocrista and an expanded posterolingual basin (Bown and Rose 1976) and is known primarily from Wasatchian or older species. Among earlier species of *Phenacolemur*, at least some specimens of *P. simonsi* are similar to the PTRM specimen in having a small P4 paraconule with well-defined, albeit small, pre and post paraconule cristae ("conule wings") and a lower P4 metacone relative to the paracone (Silcox et al 2008).

The latest occurring species is *Phenacolemur shifrae* from the Wagon Bed Formation (Uintan 3) of Wyoming (Krishtalka 1978), but the P4 of this species is unknown. *Phenacolemur* is also reported from the Sespe (Kelly 1990) and Mission Valley (Walsh 1991) Formations (both Uintan 3) of California. Unfortunately, this material has not been described.

Bown and Rose (1976) resurrected *Ignacius* and differentiated it from *Phenacolemur* based upon the

shape of the P4-M3 centrocrista, the relative expansion of the posterolingual basin and the P4 being shorter and narrower than the M1 (among other characteristics). PTRM 17483 is more similar to *Ignacius* in having the P4 centrocrista invaginated rather than straight and in having the posterolingual basin not extending posterior to the metacone. The expanded anterobuccal corner of the tooth and the development of the buccal cingulum are features that could be derived from *I. graybullianus.* However the specimen differs in having a small paraconule with conule wings, features indiscernible in *I. graybullianus* (Silcox et al 2008:fig. 6).

The youngest reported species of *Ignacius* is *I. mcgrewi* from the Wagon Bed Formation (Uintan 3 to Duchesnean) of Wyoming (Robinson 1968, Krishtalka 1978). Unfortunately, the known sample does not include a specimen with P4.

In addition to the North American genera, one European genus is included in the Paromomyidae. *Arcius* was named by Godinot (1984) and species assigned to this genus show considerable variation in the P4. The type species, *A. rougieri*, has a reduced P4 metacone, the posterolingual corner of the tooth is not as square as the PTRM specimen, and the anterior cingulum is not as developed. Godinot also assigned *A. lapparenti* and *A. fuscus*, which had previously been included in *Phenacolemur* (Russell et al. 1967; Bown and Rose 1976), to *Arcius*. Aumont (2004) described the P4 of *A. lapparenti* as having a broader lingual margin, than in *A. rougieri*, a condition more similar to the PTRM specimen. However, *Arcius lapparenti* differs from the PTRM specimen in having greater development of the P4 postprotocrista and in having the centrocrista relatively straight, a feature more similar to *Phenacolemur*. *Arcius fuscus* lacks a buccal cingulum on the P4 and the posterolingual corner is more rounded than in the PTRM specimen (Russell et al. 1967). The P4 material referred to *A. fuscus* by Aumont (2004) differs from that described by Russell et al. (1967) in its possession of a more squared occlusal outline, a larger metacone, a buccal cingulum with a distinct notch, and a posterior cingulum. PTRM 17483 lacks both a notch on the buccal cingulum and posterior cingulum. *Arcius zbyszewskii* has a P4 that is rectangular in occlusal outline and differs from the PTRM specimen in its better development of the pre- and postprotocristae, stronger development of the anterior and buccal cingula, and lack of any expansion of the anterobuccal corner (Estravis 2000).

Whereas lack of additional specimens precludes specific diagnosis, the PTRM specimen represents a paromomyid most similar to *Ignacius* and is assigned to that genus.

Family Microsyopidae Osborn and Wortman, 1892
Subfamily Uintasoricinae Szalay, 1969
Uintasoricine, genus uncertain
(Figure 2)

Referred Specimen—PTRM 10401 Rm1 or 2.

Description—Based on the location of the interproximal wear facet on the anterior surface of the tooth, the specimen is likely an m1, but this evidence is not definitive. The trigonid is shorter than the talonid but the same width. The protoconid is relatively lingual, almost on the midline of the tooth. The paracristid runs directly anterior from the protoconid to the anterior margin then turns lingually and curves and rises to meet the metaconid. There is no distinct paraconid cusp. The trigonid basin is fully enclosed and elongate anterobuccally-posterolingually. The metaconid is subequal to the protoconid and connected to it by the protocristid. There is no distinct notch between the protoconid and metaconid. The postvallid tilts slightly anteriorly. The trigonid is only somewhat higher than the talonid.

The talonid has two distinct cusps, a large triangular hypoconid and a laterally compressed and more cuspate entoconid. There is no distinct hypoconulid. The cristid obliqua is straight and attaches low on the posterior face of the protoconid. The entoconid is connected to the metaconid by a low entocristid. There is no talonid notch. The hypocristid trends posterolingually then turns lingually at the midline to connect to the entoconid, completely enclosing the talonid basin. A buccal cingulum extends from the hypoconid to the hypoflexid, flares buccally at the base of the protoconid and rises to merge with the paracristid at the anterior margin of the tooth. The tooth has an anterior-posterior length of 1.00 mm, an anterior width of 0.73 mm and a posterior width of 0.73 mm.

Discussion—A number of diminutive plesiadapiform genera have been described from the Paleocene and Eocene of North America. They have variably been assigned to the Picromomyidae, Paromomyidae, Micromomyidae and Microsyopidae. For convenience, the taxonomic framework by Silcox and Gunnell (2008) with more recent additions is followed here.

Picromomyids have a distinctive lower molar trigonid. *Picromomys* has a cuspid anterior to the protoconid in addition to a paraconid, and *Alveojunctus* has an open valley connecting the trigonid and talonid basins (Bown and Rose 1996). These features are unlike the trigonid of PTRM 10401, which lacks a paraconid and has a complete protocristid. Whereas paromomyid lower molars are similar to the PTRM specimen in the reduction or loss of the paraconid, paromomyids differ in their antero-posteriorly compressed, bucco-lingually broad trigonids and strong

anterior inclination of the postvallid (Silcox et al., 2008). Micromomyid lower molars have a distinct paraconid (Gunnell 1989), making assignment of PTRM 10401 to this family unlikely.

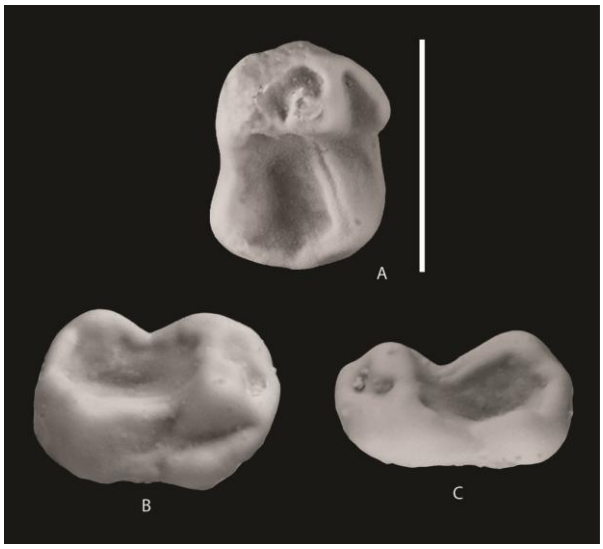

FIGURE 2. Uintasoricine, genus undetermined, from the Medicine Pole Hills local fauna. A-C, PTRM 10401, R m1 or 2, A, occlusal view; B, oblique buccal view; C oblique lingual view. The bar scale represents approximately 1 mm.

Microsyopids can be divided into three subfamilies, the microsyopines, navajovines and uintasoricines. The microsyopines tend to be larger than members of the other subfamilies (Gunnell 1985) and have a distinct notch between the entoconid and hypoconulid on the lower molars (Gunnell 1989). *Navajovius*, the only navajovine, has paraconids on the lower molars, a hypoconulid close to the entoconid, and a mesoconid on the cristid obliqua (Szalay 1969a). These characters differ from the condition of PTRM 10401.

Uintasoricines include *Niptomomys*, *Bartelsia*, *Uintasorex*, and possibly *Nanomomys* (Rose et al. 2012) and *Choctawius* (Beard and Dawson 2009). These taxa are considered in sequence from least to more similar.

Niptomomys is characterized by the reduction of the lower molar paraconid (Rose et al. 2012) with the trigonid basin opening posteriorly and a weak hypoconulid (McKenna 1960). The lack of a paraconid is similar to the PTRM specimen, but the protocristid is developed in PTRM 10401 and the trigonid basin is enclosed. The m1 of *Bartelsia pentadactyla* (only known specimen) differs from the PTRM specimen in having the protoconid twinned, having a mesially directed paracristid, and lacking a protocristid (Gunnell 2012). *Nanomomys thermophilus* (Rose et al. 2012) has a distinct paraconid on both the m1 and m3 (m2 is unknown), a narrow trigonid and a strong central hypoconulid on the m1. All of these features are absent in the PTRM specimen.

In *Uintasorex parvulus* the m1 has a distinct paraconid. On m2, the paraconid is reduced or appressed to the metaconid although as noted by Szalay (1969b) the degree of reduction is variable. Specimens of *U. parvulus* do show some development of buccal cingulids on the lower molars (Szalay 1969b, fig. 7; Gunnell 2012, fig. 3.1) but this feature is not as exaggerated as seen in PTRM 10401. Lower molars of *U. montezumicus* have the paraconid reduced or absent on most specimens, a reduced hypoconulid and a protocristid enclosing the trigonid basin (Lillegraven 1976). These features are similar to PTRM 10401, but *U. montezumicus* lacks the enlarged buccal cingulid of the Medicine Pole Hills specimen. *Choctawius* (Beard and Dawson 2009) has a reduced paraconid, lacks a talonid notch and has some development of a buccal cingulid on the lower molars, features which are in common or even more exaggerated in the PTRM specimen. PTRM 10401 differs from *Choctawius foxi* (the lower dentition of *C. mckennai* is unknown) in lacking both a distinct paraconid and hypoconulid and having an enlarged buccal cingulid.

PTRM 10401 shows the greatest similarity to *Uintasorex* and *Choctawius*, but is markedly different from species in either of these genera, the most distinctive feature being the enlarged buccal cingulid. PTRM 10401 is a uintasoricine, although it is distinct from any known form.

CONCLUSIONS

The Paromomyidae and Microsyopidae have been recognized as the last surviving families of plesiadapiform primates (Maas et al. 1988, Bloch et al. 2007), and the occurrence of both a phenacolemurine and uintasoricine in the Medicine Pole Hills local fauna extends the ranges of these lineages from the Duchesnean into the Chadronian. The fact that the same assemblage contains the latest known occurrence of the rodent family Sciuravidae (*Prolapsus* sp.; Kihm 2013) may be an indication that relict populations of some late Eocene groups survived in the Great Plains province after their disappearance from the Rocky Mountain province. Additional support for this suggestion can be seen in the persistence of the omomyid primates *Chumashius* (Ostrander 1987) and *Mytonius* (Krishtalka 1978), and the ischyromyid rodent genus *Leptotomus* (Ostrander 1980, Storer 1996) into the Chadronian of the Great Plains after their disappearances from the Rocky Mountains.

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