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INSECTIVORANS FROM THE MEDICINE POLE HILLS LOCAL FAUNA (CHADRONIAN) OF BOWMAN COUNTY, NORTH DAKOTA

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ABSTRACT

Eleven species of insectivorans are described from the Chadronian Medicine Pole Hills fauna of North Dakota. Among these, three new species are described; the apatemyid *Sinclairella nanus*, the micropternodontid *Micropternodus bassidens*, and the oligoryctid *Oligoryctes amplissimus*. Humeri of the problematical insectivoran *Cryptoryctes* Reed, 1954, are present and differ from previously described specimens of the type and only species of the genus *C. kayi* Reed, 1954, in being slightly smaller and more slender. It is not formally named due the lack of association with identifiable dental elements. A single specimen of the erinaceid *Proterix* Matthew, 1903, is also described and represents the earliest occurrence of the genus. It is suggested that the leptictid *Leptictis acutidens* (Douglass, 1901) is a probable synonym of *L. montanus* (Douglass, 1905) and that *Micropternodus stophensis* (White, 1954) is a junior synonym of and *M. borealis* Matthew, 1901, based on additional topotypic specimens of the latter.

The overall number of insectivoran species from Medicine Pole Hills described here and elsewhere (13) is greater than any other Chadronian fauna and suggests a middle rather than early Chadronian age for the fauna.

INTRODUCTION

Over the past two decades, a number of articles have described many of the small mammals from the Chadronian-aged (latest Eocene) Medicine Pole Hills fauna, North Dakota: multituberculates (Schumaker and Kihm, 2002; 2006), marsupials (Kihm et al. 2001; Kihm and Schumaker, 2015), soricids (Schumaker, 2003; Kihm and Schumaker, 2008), rodents (Kihm, 2011; Kihm, 2013); and primates (Kihm and Tornow, 2014). Other than the shrews, the remainder of the insectivoran fauna has not yet been described. Approximately 350 specimens, mainly isolated teeth, representing eleven species of proteutherians, leptictids and lipotyphlans are described here.

METHODS

Dental terminology follows that of Van Valen (1966). Upper teeth designated by capital letters, lower teeth by lower-case letters (e.g. M1, m1). All dental measurements taken with an optical micrometer to the nearest 0.01 mm; L = anteroposterior length; W, transverse width; ht = maximum crown height.

Abbreviations for institutions: CM, Carnegie Museum of Natural History, Pittsburgh, Pennsylvania; NDGS, North Dakota Geological Survey, Bismarck, North Dakota; RAM, Raymond Alf Museum, the Webb School, Claremont, California; SDSM, South Dakota School of Mines and Technology, Museum of Geology, Rapid City, South Dakota.

SYSTEMATIC PALEONTOLOGY

Order Apatotheria Scott and Jepsen, 1936
Family Apatemyidae Matthew, 1909
Genus *Sinclairella* Jepsen, 1934
Sinclairella nanus n. sp.
(Figure 1; Table 1)

Type Specimen—NDGS 7587, left m1 (Figure 1E).

Referred Specimens—NDGS 7583, right P4; NDGS 7588, 7591, M1; NDGS 7585, left m1; NDGS 7582, 7590, m2; NDGS 7586, 7592, m3; NDGS 7584, right i1.

Diagnosis—Smaller than *S. dakotensis* and *S. simplicidens*; P4 with non-central labial cusp (?paracone) and distinct anterior cingulum; M1 with narrow labial cingulum; m1 with more prominent paraconid and accessory lingual cuspid on the trigonid; paraconid more prominent on m2 and m3.

Etymology—Latin, *nanus*, dwarf; in reference to its smaller size.

Description—The P4 is markedly smaller than the molars (Figure 1B; Table 1). It is ovate in occlusal

outline, the long axis running anteroposteriorly. There is a large conical cusp just posterior to the anterior margin of the tooth. A low ridge runs directly posteriorly from the apex to the posterior margin of the tooth. There is a second short ridge running directly lingually, and a more weakly developed ridge running anteriorly to the anterior margin of the tooth. The latter two smaller ridges enclose a small, circular basin at the anterolingual corner of the tooth. A second cusp is at the posterolingual corner of the tooth. It is markedly lower than the anterior cusp and has a rounded apex.

The anterolabial corner is lacking on both known specimens of M1 (Figure 1A). The three major cusps (paracone, metacone, protocone) are all transversely compressed and oval in occlusal outline. A distinct ridge runs directly anteroposteriorly from the anterior margin of the tooth through the apices of the paracone and metacone, then bends posterolabially, ending at a minute metastyle at the posterolabial corner of the tooth. The labial cingulum is narrow and appears to extend the width of the tooth, expanding slightly labially at the posterolabial corner. The protoconule is minute and continuous with the apex of the large protocone along the preprotocrista. There is no anterior cingulum on either specimen. A central valley separates the labial cusps from the protocone; it is oriented anterolabial to posterolingual, and deepens posteriorly. The hypocone is markedly smaller and lower in height than the protocone and is situated posterolingual to it and separated from it by an oblique valley.

The m1 is narrowest anteriorly and broadens posteriorly (Figure 1E). The paraconid is the smallest of the cusps of the trigonid, but is a distinct cusp at the anterolingual corner of the tooth. The postparacristid runs obliquely along the labial side of the trigonid and joins the obliquely compressed protoconid. The metaconid is the highest cusp of the trigonid at the posterolingual corner, and is more posterior than the protoconid, orienting the postprotocristed posterolingually. Anterior to the metaconid along the lingual border of the trigonid is a distinct cusp midway between the metaconid and paraconid. It is subequal in size to the paraconid with a low ridge connecting the latter two cusps along the anterolingual border of the trigonid. The talonid is a low basin. A distinct rim wraps around the lingual and posterior margins of the tooth enclosing the talonid basin. The only distinct cusp on the talonid is the hypoconid at the posterolabial corner of the talonid. A low cristid obliqua runs anteriorly from it along the labial border of the tooth and joins the posterior margin of the trigonid, just lingual to the apex of the protoconid.

The m2 is rectangular in occlusal outline; longer than wide (Figure 1D). There is a distinct paraconid at the anterolingual corner of the tooth. The trigonid has a low, flat area along the width of the anterior margin of the tooth. The protoconid and metaconid are equal in size along the labial and lingual borders of the tooth, respectively. The protoconid is situated more anteriorly than the metaconid. They are joined along their posterior borders by a postprotocristid that is only slightly bowed posteriorly. The talonid as in m1 is a deep broad valley. The only distinguishable cusp is the hypoconid along the labial border, just anterior to the posterolabial corner of the tooth. As in m1, the talonid basin is rimmed by a low ridge that wraps around the lingual and posterior margins of the tooth. However, unlike m1, there is a minute break (valley) along the lingual side near its midpoint. The cristid obliqua is as in m1, ending anteriorly at the posterior wall of the trigonid, just labial to the apex of the protoconid.

TABLE 1. Dental measurements of *Sinclairella nanus* from Medicine Pole Hills. Abbreviations: L, anteroposterior length; W, transverse width. Measurements in mm.

NDGS	m1L	m1W	m2L	m2W	m3L	m3W	i1L	i1W
7582			3.37	2.14				
7584							2.62	1.97
7585	3.10	1.88						
7586					4.55	2.27		
7587	3.31	1.92						
7590			3.13	2.22				
7592					4.62	2.36		
Mean	3.21	1.90	3.25	2.18	4.59	2.32	2.62	1.97
	P4L	P4W	M1L	M1W				
7583	1.72	1.17						
7588			2.57	2.91				
7591				2.89				

The m3 is markedly longer than the anterior molars (Figure 1C; Table 1). The trigonid is similar to that of m2, but relatively shortened, and its paraconid, just anterior to the metaconid at the anterolingual corner of the trigonid, is larger and more. The metaconid and protoconid are arranged as in m2. The trigonid is much higher than the talonid. The talonid is greatly expanded posteriorly, making the tooth nearly 1.5 times the length of m2. As in the anterior molars, the talonid basin is surrounded by a low rim. The only recognizable talonid cusps are the large hypoconulid at the posterior extent of the tooth at its center, and a hypoconid that appears as an elongated swelling along the labial border of the tooth, posterior to the protoconid, approximately one-third the total length of the talonid from the protoconid.

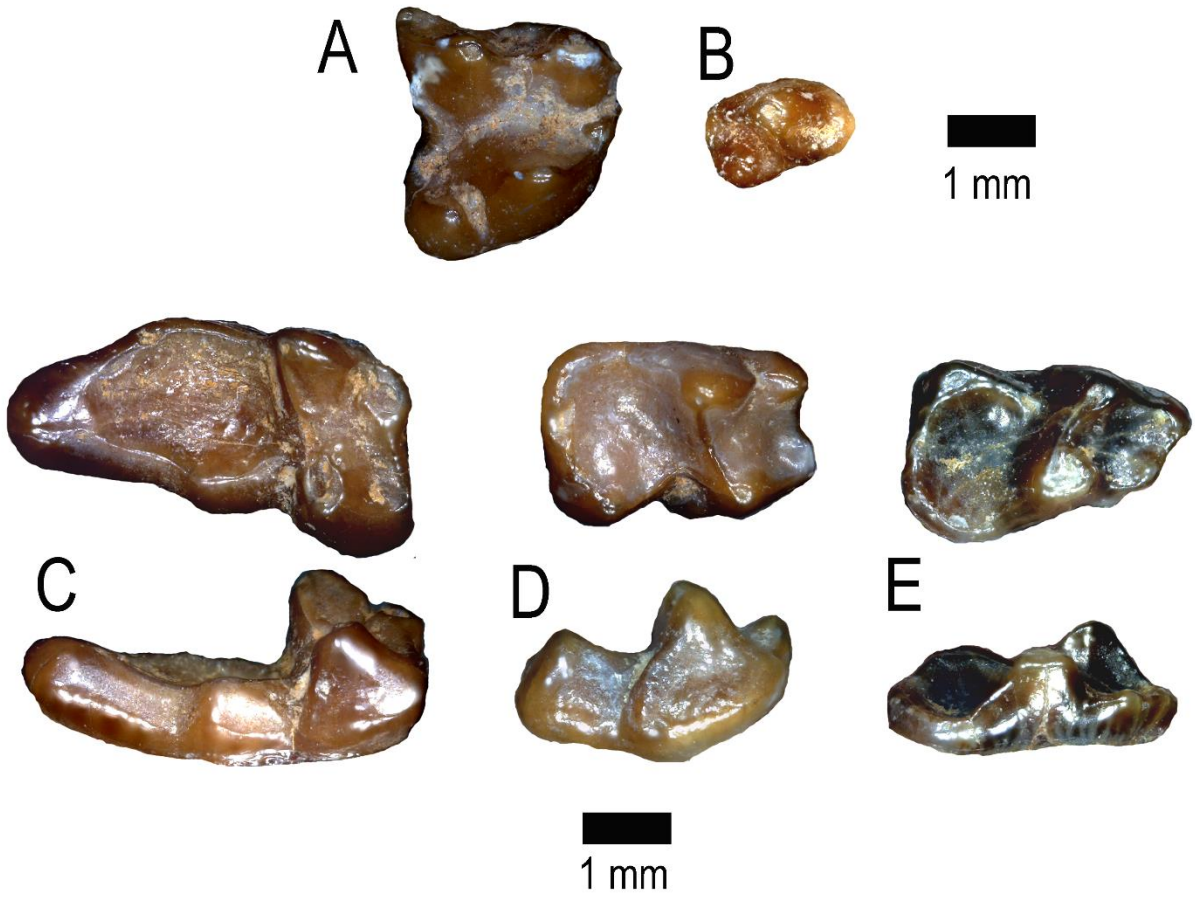

FIGURE 1. Cheek teeth of *Sinclairella nanus* from Medicine Pole Hills. A, NDGS 7588, right M1. B, NDGS 7583, right P4. C, NDGS 7592, right m3. D, NDGS 7590, right m2. E, NDGS, 7587 left m1 (type). C, D, occlusal view above, labial view below. E, occlusal view above, lingual view below.

Discussion—The type species of the genus, *S. dakotensis* Scott and Jepson, 1936, has been reported from the Chadronian through the early Arikareean from the northern Great Plains and Rocky Mountains (Gunnell et al., 2008a: 74). *Sinclairella nanus* differs from *S. dakotensis* in being smaller (Scott and Jepson, 1936: 29; Clemens, 1964: table 1; Czaplewski and Morgan, 2015: table 2; Tornow and Arbor, 2017: tables 1, 2), having a narrower labial cinglum on M1 (Clemens, 1964: fig. 1; Tornow and Arbor, 2017: fig. 6.4), a P4 with a noncentral principal labial cusp (central in *S. dakotensis*), a prominent paraconid on the lowers molars, and a larger accessory cusp on the trigonid of m1.

The only other recognized species of the genus, *S. simplicidens* Czaplewski and Morgan, 2015, is from the Arikareean of Florida. *Sinclairella nanus* differs from *S. simplicidens* in being slightly smaller (Czaplewski and Morgan, 2015: table 2) and having a more prominent cingulum and better developed hypocone on M1.

Ostrander (1987) described material of *S. dakotensis* from the Chadronian Raben Ranch fauna of Nebraska. One of the m1s cited (SDSM 10242) is markedly smaller than the other referred specimens (Ostrander, 1987: table 9) and also smaller than specimens of *S. nanus*. Korth (2020: 34) described lower molars of *Sinclairella* from the Whitneyan Blue Ash anthill fauna of South Dakota that also were markedly smaller than those of *S. dakotensis*. The specimens from both these localities also lack the prominent paraconid on the lower molars as well as the accessory cuspid on the trigonid of m1 of *S. nanus*. It appears likely that the Raben Ranch and the Blue Ash specimens represent a distinct smaller species of *Sinclairella*.

Order Leptictida McKenna, 1975
Family Leptictidae Gill, 1872
Genus *Leptictis* Leidy, 1868
Leptictis acutidens Douglass, 1901
(Figure 2; Table 2)

Referred Specimens—NDGS 7514, 7516, 7518, dP5; NDGS 7508, 7522, 7531, P4; NDGS 7499, 7502, 7515, 7530, 7532, 7533, P5; NDGS 7510, 7523, 7529, 7534, M1; NDGS 7511, 7528, M2; NDGS 7501, right p4; NDGS 7506, partial dp5; NDGS 7505, 7509, 7517, 7535, p5; NDGS 7497, 7498, 7500, 7504, 7507, 7512, 7519-7521, 7526, 7527, 7536, m1or m2; NDGS 7503, 7513, 7524, m3.

Description—The dental formula used here for leptictids follows that of McKenna (1975) and Novacek (1986) with the recognition of five premolars. Hence, reference to p5 or P5 below refers to the most posterior premolar (p4 or P4 of earlier authors) and the premolar anterior to it is referred to as p4 or P4 (p3 or P3 of earlier authors; also see Gunnell et al. 2008b: 82).

P4 is longer (anteroposteriorly) than wide (transversely) forming a T-shape (Figure 2A, B). There are three labial cusps, the central paracone is the largest, the anterior parastyle the smallest, and the metastyle is intermediate in size. On NDGS 7522, the parastyle is anteroposteriorly compressed and wider than on the other two specimens (Figure 2A). On the other specimens the cusp is oval in shape and slightly transversely compressed (Figure 2B). The parastyle is connected to the apex of the paracone via a low preparacrista. The paracone is larger and markedly higher than the other cusps. The metastyle is closely appressed to the posterior slope of the paracone with a postparacrista that is higher than the preparacrista and the cusp is slightly transversely compressed. A low labial cingulum runs along the labial side of the metastyle on NDGS 7531 and NDGS 7522, but is lacking on NDGS 7508. The protocone is at the center of the lingual side of the tooth, even with the paracone on NDGS 7531 and NDGS 7522, but slightly more posterior on NDGS 7508. NDGS 7522 has a thin posterior cingulum that wraps around the posterior and lingual side of the metastyle. The cingulum posterior to the protocone is absent on NDGS 7531, very thin on NDGS 7522, and NDGS 7508 has a distinct cusp (?hypocone) posterolingual to the protocone.

P5 is molariform and markedly wider than long (Figures 2D, E; Table 2). There is always a distinct parastyle at the anterolabial corner of the tooth that is continuous with a narrow labial cingulum that ends at the posterolabial corner in a small metastyle. The relative size of the stylar cusps and the labial cingulum is variable from relatively large to nearly absent. The paracone and metacone are closely placed, the paracone being only slightly larger to equal in size to the metacone. The centrocrista is essentially a straight but low ridge that runs from the apex of the paracone down its posterior side, then up the anterior slope of the metacone. A postmetacrista connects the metacone to the metastyle. The preparacrista between the paracone and parastyle is variably developed and absent on some specimens. The protocone is V-shaped. The preprotocrista extends from the apex of the protocone anterolabially ending just lingual to the base of the protocone in a minute protoconule. Similarly, the postprotocrista extends posterolabially and is continuous to the metastyle at the posterolabial corner of the tooth. A small metaconule is present along it, lingual to the base of the metacone. Along the anterior base of the protocone is a low, short anterior cingulum that varies in width and length. At the base of the posterior side of the tooth, originating at a point even with the metaconule, is a posterior cingulum that ultimately reaches the posterolingual edge of the tooth. A hypocone is variably present. On most specimens it is relatively large but clearly much smaller than the protocone (Figure 2D). On two specimens (NDGS 7525, NDGS 7532; Figure 2E) the hypocone is reduced to a minor swelling at the posterolingual corner of the posterior cingulum.

DP5 can be distinguished from P5 by the thinner enamel and lack of roots, or which are widely splayed when present (Figure 2C). DP5 is similar in morphology to P5 but is much lomger labially; the length nearly equaling the width of the tooth (Table 2) making it nearly triangular in occlusal outline. In all other features, it is similar to P5.

M1 and M2 can be separated by size (M1 being slightly larger; Table 2) and the shape of the labial cingulum. On M1 the labial cingulum is wider posteriorly than anteriorly and on M2 it is of equal width for the entire length of the tooth (Figures 2F, G). Other than size and the labial cingulum M1 and M2 do not differ in morphology. They are similar to P5 but the labial cusps (paracone, metacone) are more widely spaced. However, the metacone is generally slightly smaller and lower. The remainder of the tooth is very similar to that of P5 except the hypocone and posterior cingulum are larger and the conules are relatively smaller.

There is only a single p4 in the collection, NDGS 7501 (Figure 2H). It is transversely compressed and markedly longer than wide. There are three recognizable cusps aligned along the centerline of the tooth. The anterior-most cusp is minute (?anterostylid). The central cusp (?protoconid) is markedly larger than any of the others, giving the tooth a nearly triangular shape in lateral view. The most posterior cusp is larger than the anterior cusp but much lower than the central cusp. Low ridges run from the apex of the central cusp directly anteriorly and posteriorly to the other cusps.

The p5, as with P5, is molariform (Figure 2I). The protoconid is the tallest of the cusps. The paraconid is oval in outline, markedly lower than the protoconid, and oriented slightly obliquely, its posterior end continuous with the base of the protoconid on the labial side of the

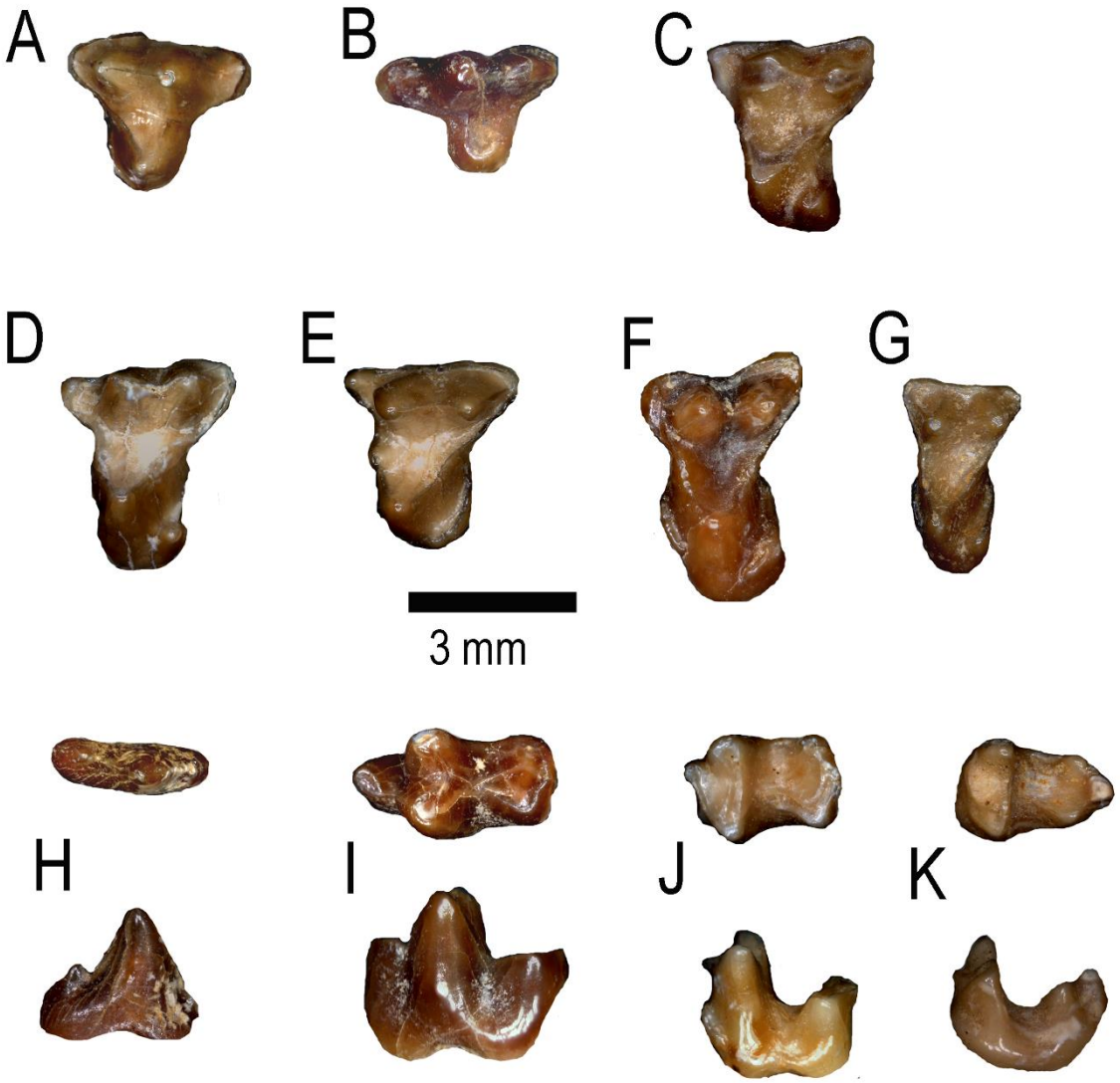

FIGURE 2. Cheek teeth of *Leptictis acutidens* from Medicine Pole Hills. A, NDGS 7522, right P4. B, NDGS 7531, left P4. C, NDGS 7518, left dP5. D, NDGS 7530, left P5. E, NDGS 7532, left P5. F, NDGS 7529, left M1. G, NDGS 7511, left M2. H, NDGS 7501, right p4. I, NDGS 7517, left p5. J, NDGS 7527, left m1 or m2. K, NDGS 7503, left m3. H-K, occlusal view above, labial view below.

tooth (preprotocristid). The protoconid is slightly taller than the metaconid and placed slightly more anteriorly. The postprotocristid is a low ridge that dips at its center, then rises to reach the apex of the metaconid. The talonid is much lower in height than the trigonid. The cristid obliqua originates anteriorly at the base of the center of the trigonid and runs obliquely to the posterolabial corner of the tooth where it ends at the hypoconid. The hypoconid is triangular in occlusal outline. There is a minute hypoconulid at the center of the posterior wall of the talonid adjacent to the hypoconid. The talonid basin is open lingually.

It was not possible to separate m1 from m2 by size or morphology. Unlike p5, the trigonid is short and anteroposteriorly compressed (Figure 2J). The paraconid is minute and at the center of the anterior margin of the tooth. The metaconid and protoconid are much larger and equal in size at the posterolingual and posterolabial corners of the trigonid, respectively. The preprotocristid is a low ridge that extends labially from the paraconid, bends posteriorly at the edge of the tooth, then rises to reach the apex of the protoconid. An anterior cingulid is along the base of the crown from a

TABLE 2. Dental measurements of *Leptictis acutidens* from Medicine Pole Hills. Abbreviations: L, anteroposterior length; W, transverse width; N, number of specimens; M, mean; Min, minimum measurement; Max, maximum measurement; SD, standard deviation; CV, coefficient of variation. Measurements in mm.

	dP5L	dP5W	P4L	P4W	P5L	P5W	M1L	M1W	M2L	M2W
N	3	3	3	3	6	6	3	4	2	2
M	3.06	3.35	3.38	2.68	2.96	3.36	2.95	4.21	2.41	3.91
Min	2.96	3.34	3.22	2.56	2.50	3.10	2.84	4.08	2.32	3.75
Max	3.25	3.37	3.65	2.87	3.26	3.51	3.09	4.34	2.49	4.07
SD	0.16	0.02	0.23	0.17	0.27	0.15	0.13	0.12	0.12	0.23
CV	5.29	0.46	6.88	6.21	9.02	4.61	4.38	2.87	5.00	5.79
	dp5L	dp5W	p4L	p4W	p5L	p5W	m1-2L	m1-2W	m3L	m3W
N		1	1	1	4	2	11	10	3	3
M		1.73	2.79	0.98	3.55	1.90	2.91	2.10	2.70	1.78
Min					3.46	1.86	2.76	1.96	2.64	1.70
Max					3.61	1.93	3.04	2.42	2.78	1.92
SD					0.07	0.05	0.10	0.14	0.07	0.12
CV					1.94	2.61	3.45	6.71	2.62	6.99

point just labial to the apex of the paraconid to the labial side of the protoconid. The talonid is much lower than the trigonid. It is similar in morphology to that of p5 except that the cusps of the talonid are larger and subequal in size. The entoconid and hypoconid are at the posterolingual and posterolabial corners of the talonid, respectively. The hypoconulid is at the center of the posterior margin of the tooth, slightly more posterior than the other talonid cusps.

The m3 can be distinguished from m1 and m2 by its smaller size and more elongated talonid (Figure 2K). The trigonid of m3 is similar to that of m1 or m2, but is slightly shorter. The talonid, as in the anterior molars, is much lower than the trigonid. The greatest difference between the m3 talonid and that of m1 or m2 is that the hypoconulid is extended farther posteriorly, and the entoconid and hypconid are relatively smaller and more transversely compressed.

Discussion—The specimens of *Leptictis* from Medicine Pole Hills are larger than those of *L. wilsoni* (Novacek, 1976: table 1) and smaller than those of *L. douglassi* (Novacek, 1976: table 2), *L. bullatus* (Scott and Jepsen, 1936: 21), *L. major* and the Orellan species *L. haydeni*, and *L. dakotensis* (Douglass, 1905: 223; Scott and Jepsen, 1936: 21). The Medicine Pole Hills specimens differ from those of *L. thompsoni* in having distinct anterior cingula and hypocone on the upper cheek teeth (Novacek, 1976). In terms of size, the Medicine Pole specimens best match those of *L. acutidens* and *L. montanus* (Table 2; Douglass, 1901: 247; Douglass, 1905: 223; Scott and Jepsen, 1936: 21). The dental characters that Douglass (1905: 222) and Novacek (1976) used to distinguish these species are variable in the Medicine Pole Hills sample (i.e., relative size of buccal cusps on P4 and P5, size of hypocone and posterior cingulum on P5-M2).

A cursory examination of topotypic specimens of *L. montanus* (Pipestone Springs) and *L. acutidens* (McCarty's Mountain) was based on the collections of the Carnegie Museum from these localities. As with the Medicine Pole sample, the defining characters appear to be variable in these populations (no data were recorded). No formal synonymy is proposed here pending a more detailed study. However, the referral of *L. acutidens* here is done informally based on the name having priority.

Order Lipotyphla Haeckel, 1866
Family Erinaceidae Fischer de Waldheim, 1817
Genus *Proterix* Matthew, 1903
Proterix sp.
(Figure 6A)

Referred Specimen—NDGS 7581, right m1.
Measurements—L = 1.55 mm; W = 1.10 mm.
Discussion—The morphology of NDGS 7581 is consistent with that of a *Proterix* (Macdonald, 1951 [identified as *Apernodus*]; Gawne, 1968; Korth, 2009, 2020). However, the size is markedly smaller than most recognized species (Gawne, 1968: table 1) and

approximately 20% smaller than the smallest known species, *P. minimus* (Korth, 2020: table 1). The Chadronian occurrence of *Proterix* from Medicine Pole Hills also predates the earliest occurrence of the genus that otherwise ranges from the Orellan to the Arikareean (Gunnell, et al.,2008c: fig. 7.4).

Family Geolabididae McKenna, 1960
Genus *Centetodon* Marsh, 1872
Centetodon chadronensis Lillegraven et al., 1981
(Figures 3A-F; Table 3)

Referred Specimens—NDGS 7698, right maxillary fragment with P4-M1; NDGS 7690, 7694, 7725, 7729, 7754, P4; NDGS 7669, 7672, 7682, 7688, 7720, 7728, 7737, 7748, 7751-7753, 7756, 7757, 7762-7764, 7776, M1; NDGS 7680, 7683, 7687, 7689, 7692, 7695, 7703, 7705, 7713, 7732, 7739, 7740, 7742, 7773, 7775, M2; NDGS 7673, 7681, 7693, 7707, 7718, 7724, 7749, 7761, 7766, 7775, M3; NDGS 7783, left I1; NDGS 7666, fragment of right dentary with m1, m3; NDGS 7767, 7772, i1; NDGS 7769, left dp4; NDGS 7781, left p3; NDGS 7539-7541, 7544, 7677-7679, 7706, 7708, 7710, p4; NDGS 7548, 7671, 7674, 7676, 7685, 7686, 7696, 7699-7702, 7704, 7709, 7715-7717, 7719, 7721, 7722, 7726, 7727, 7730, 7734, 7736, 7738, 7741, 7743, 7744, 7746, 7747, 7750, 7755, 7759, 7760, 7770, 7778, 7780, 7784, 7785, 7813, m1 or m2; NDGS 7543, 7549, 7668, 7670, 7691, 7712, 7714, 7723, 7733, 7735, 7745, 7758, 7768, 7771, 7782, 7809, 7820, m3.

Discussion—*Centetodon chadronensis* is the best represented of the lipotyphlans in the fauna with 120 specimens. Because nearly all specimens are isolated teeth, m1 and m2 could not be separated with confidence, so their measurements are combined in Table 3. The size and dental morphology of this species was described in detail by Lillegraven et al. (1981: table 1). Nothing needs to be added to that description. As the trivial name implies, elsewhere this species is limited to the Chadronian of North America (Lillegraven et al., 1981; Gunnell et al., 2008c).

Centetodon sp., cf. *C. magnus* (Clark, 1936)
(Figures 3G, H; Table 4)

Referred Specimens—NDGS 7684, right p4; NDGS 7545, 7765, 7774, 7777, m1 or m2; NDGS 7731, left m3.

Discussion—The specimens referred here to *Centetodon* cf. *magnus* are larger than those referred to *C. chadronensis* from the Medicine Pole Hills fauna (Table 3 versus Table 4). They clearly fall within the size range of *C. magnus* (Lillegraven et al., 1981: table 7). However, other than size, the diagnosis of *C. magnus* is based on the morphology of the upper molars and orientation of p3 (Lillegraven et al., 1981: 56). Since there are no upper molars or dentaries referable to *C. magnus* in the Medicine Pole fauna, the identification is only tentative. Elsewhere, *C. magnus* is known to range from the late Uintan through the late Arikareean (Lillegraven et al., 1981; Gunnell et al., 2008c).

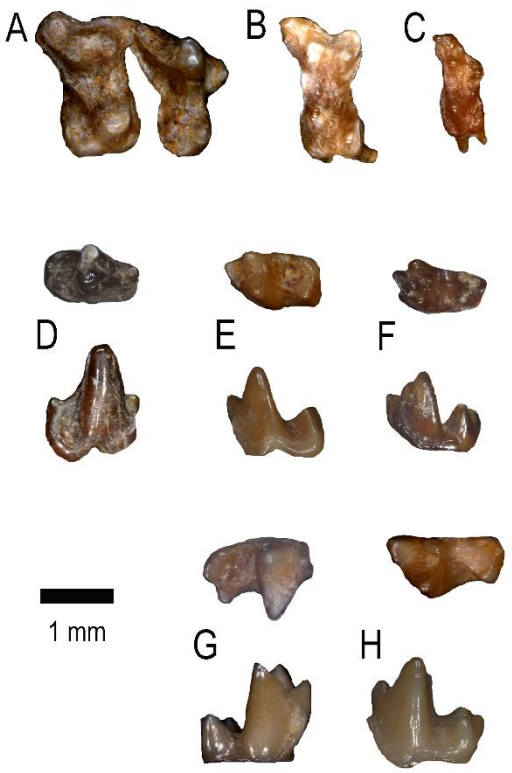

FIGURE 3. Cheek teeth of *Centetodon* from Medicine Pole Hills. A-F, *C. chadronensis*. A, NDGS 7698, right P4-M1. B, NDGS 7680, left M2. C, NDGS 7673, left M3. D, NDGS 7679, right p4. E, NDGS 7686, left m1 or m2. F, NDGS 7733, right m3. G-H, *C.* sp., cf. *C. magnus*. G, NDGS 7777, right m1 or m2. H, NDGS 7731 left m3. D-H, occlusal view above, labial view below.

Family Micropternodontidae Stirton and Rensberger, 1964
Genus *Micropternodus* Matthew, 1903
Micropternodus bassidens n. sp.
(Figure 4; Tables 5, 6)

Type Specimen— NDGS 7788, right dentary with m2-m3 (Figure 4G).

Referred Specimens—NDGS 7654, 7799, P3; NDGS 7794, 7837, dP4; NDGS 7797, 7836, P4; NDGS 7817, 7825, 7830, M1; NDGS 7791, 7792, 7798, 7801, 7802, 7807, 7814, 7826, 7827, M2; NDGS 7812, 7189, M3; NDGS 7835, right dentary with p4-m2; NDGS 7803, 7808, p3; NDGS 7800, p4; NDGS 7796, 7805, 7810, 7811, 7815, 7816, 7818, 7823, 7824, 7828, 7829,

7831, 7838, m1 or m2; NDGS 7711, 7779, 7787, 7793, 7804, 7806, 7821, 7822, 7832, 7834, m3.

Diagnosis—Similar in size to *M. borealis*; m3 smaller relative to m2 than in other species; cheek teeth lower crowned than all other species.

Etymology—Latin, *bassus*, low, and *dens*, tooth.

Description—P3 is represented by two specimens, NDGS 7654 and NDGS 7799 (Figure 4A). The latter is clearly longer than the other, but are nearly identical morphologically. The principal cusp is at the anterolabial corner of the tooth and is markedly higher than the remainder of the tooth. A slightly curved ridge runs posteriorly from the apex of the main cusp to the posterolabial corner of the tooth. There is no labial cingulum. Directly lingual to the principal cusp is a lingual extension of the tooth that is relatively larger in the smaller specimen (NDGS 7654) than the larger.

P4 is slightly wider than long (Figure 4C). The labial border is oriented at a slight angle, anterolingually-posterolabially. There is a small parastyle at the anterolabial corner of the tooth. The paracone is at the center of the labial margin of the tooth and is the largest cusp. There is a distinct postparacrista descending down its posterior slope angled parallel to the lingual edge of the tooth that ends posteriorly in a small metastyle. The protocone is only slightly smaller than the paracone and situated directly lingual to it. It is crescentic in occlusal outline, the labial edge being at an angle (anterolabial to posterolingual). Posterior to the protocone is a broad shelf (talon) that extends labially from the posterolingual corner of the tooth for approximately half the width of the tooth. At the posterolingual corner of the talon is a small but distinct hypocone. A distinct ridge extends along the posterior margin of the talon from the hypocone for its entire width.

M1 is markedly wider than long, its labial border as in P4 angled anterolingual-posterolabially (Figure 4D). The parastyle is at the anterolabial corner of the tooth. A low preparacrista extends posterolingually from it, and ends at the base of the paracone. The stylar shelf is continuous along the labial margin of the tooth but is markedly narrower labial to the paracone, and broadens posteriorly. There is a minute metastyle at the posterolabial corner of the tooth. The paracone and metacone are circular in occlusal outline and fuse with one another along their central margins just below the apices. The centrocrista is short but continuous between the two labial cusps. The postmetacrista runs from the apex of the metacone to the labial border of the tooth, just anterior to the metastyle. It is slightly curved anterolabially. There is no indication of any conules. The V-shaped protocone on the anterior margin of the tooth is approximately equidistant from the paracone and the lingual margin of the tooth. It is equal in height to the paracone. The preprotocrista extends from the apex of the protocone along the anterior margin of the tooth, ending labially at the parastyle. The hypocone and talon are similar to that of P4 except broader with a slightly larger hypocone that is anteroposteriorly compressed and transversely elongated. On the least worn specimen, NDGS 7817, there is a distinct but small cusp posterior and slightly labial to the hypocone that is also anteroposteriorly compressed.

M2 is slightly shorter and narrower than M1 (Figure 4E). There is a marked emargination at the center of the labial margin, and the anterolabial corner extends slightly more labially than the posterolabial corner. The parastyle is a small but distinct cusp at the

TABLE 3. Dental measurements of *Centetodon chadronensis* from Medicine Pole Hills. Abbreviations: L, anteroposterior length; W, transverse width. Statistical abbreviations as in Table 2. *, indicates m1 or m2 (not separated). Measurements in mm.

	P4L	P4W	M1L	M1W	M2L	M2W	M3L	M3W
N	5	5	15	17	8	12	10	10
M	1.87	1.94	1.66	2.52	1.38	2.45	0.92	2.04
Min	1.77	1.87	1.33	2.22	1.22	2.08	0.88	1.86
Max	2.04	2.01	2.00	2.80	1.53	2.73	1.00	2.19
SD	0.11	0.06	0.16	0.16	0.11	0.21	0.04	0.10
CV	5.94	3.03	9.79	6.35	7.86	8.62	4.12	4.76

	p4L	p4W	m1L*	m1W*	m3L	m3W
N	9	10	36	40	18	18
M	1.58	0.81	1.68	1.00	1.53	0.90
Min	1.44	0.72	1.48	0.82	1.31	0.76
Max	1.71	0.94	1.95	1.18	1.73	1.02
SD	0.10	0.07	0.14	0.10	0.12	0.08
CV	6.57	8.61	8.15	9.82	8.05	8.82

TABLE 4. Dental measurements of *Centetodon* sp., cf. *C. magnus* from Medicine Pole Hills. Abbreviations as in Table 1. *, indicates m1 or m2. Measurements in mm.

NDGS	p4L	p4W	m1L*	m1W*	m3L	m3W
7684	1.91	1.02				
7731					2.08	1.06
7774			2.01	1.20		
7777			1.94	1.24		
7765			1.88	1.31		
7545			1.74	1.23		
Mean			1.89	1.25		

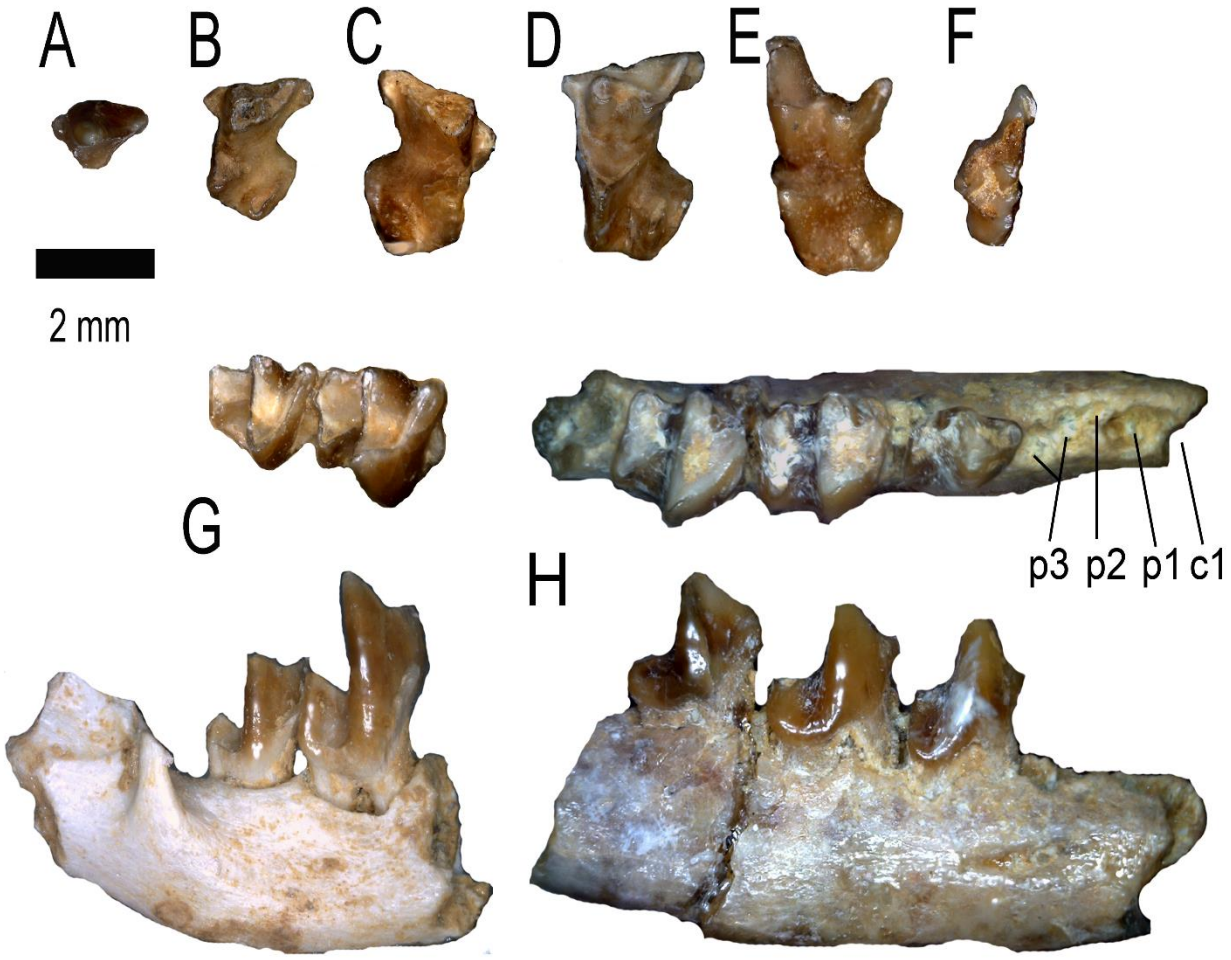

FIGURE 4. Cheek teeth and dentary of *Micropternodus bassidens* from Medicine Pole Hills. A, NDGS 7799, left P3. B, NDGS 7794, left dP4. C, NDGS 7836, left P4. D, NDGS 7817, left M1. E, NDGS 7791, left M2. F, NDGS 7812, right M3. G, NDGS 7788 (type), partial dentary with right m2-m3. H, NDGS 7835, right dentary with p4-m2. G and H, occlusal view above, labial view below. Alveoli for c1-p3 indicated on H.

anterolabial corner of the tooth but is isolated from the surrounding cusps. The paracone and metacone from a rounded W-shape (dilambdodonty). The preparacrista originates at the labial edge of the tooth just posterior to the parastyle, is continuous with the centrocrista that connects the posterolabial corner of the paracone with the anterolabial corner of the metacone. The postmetacrista mirrors the preparacrista and ends at the posterolabial corner of the tooth. As in M1, the protocone is V-shaped. However, the preprotocrista ends along the anterior margin of the tooth anterolingual to the base of the paracone. Similarly, the postprotocrista extends posterolabially, ending at the posterior edge of the tooth before reaching the base of the metacone. On little-worn specimens there is a minute protoconule at the labial end of the preprotocrista. There is only a faint thickening of the postprotocrista (=metaconule) lingual to the base of the metacone. The hypocone and talon are similar to that of M1, but the hypocone is not as strongly compressed, and there is no accessory cusp posterior to it.

M3 is markedly smaller than M1 and M2. It is widest along the anterior margin and tapers posteriorly (Figure 4F). The parastyle and paracone are similar to that of the anterior molars but the tooth is greatly reduced in its posterior half. On NDGS 7812, there is a much smaller metacone that is positioned more lingually. This cusp is lacking on the other M3 (NDGS 7819). The protocone is more rounded than in the anterior molars and at the anterolingual corner of the

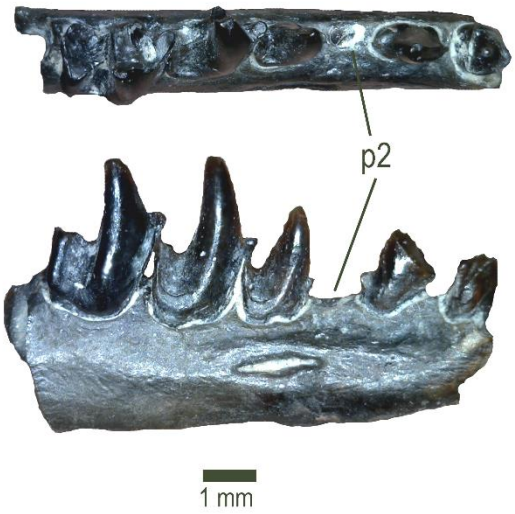

FIGURE 5. Topotypic specimen of *Micropternodus borealis* from Pipestone Springs, Montana, RAM 7266, right denary with c1(partial), p1, p3-m1. Occlusal view above, labial view below.

tooth. The pre- and postprotocristae are as in M2 but there is no indication of a metaconule. There is no hypocone.

The dentary is slender, being the shallowest below p4 and widening posteriorly (Figure 4H). The mental foramen is and elongated slit ventral to the anterior root of p4 and posterior alveolus of p3. There are four alveolae anterior to p4, the most anterior is very deep and clearly indicates the alveolus for the canine. Posterior to it is a relatively large alveolus, followed by three smaller alveoi anterior to p4. The anterior-most is the largest. Posterior to it is a minute alveolus that is slightly more medially placed than the rest. The final two alveoli are oval in outline and similar in size.

The p3 is represented by two isolated specimens (NDGS 7803, NDGS 7808). The paraconid is small, low and at the center of the anterior margin of the tooth. The protoconid and metaconid are fused together near their apices and are markedly taller. The protoconid extends higher than the metaconid. The tip of the metaconid is on the posterolignual slope of the protoconid. The talonid is markedly lower than the protoconid and metaconid and slightly lower than the paraconid. There is a central posterior cusp on the talonid of NDGS 7808 (hypoconulid) that appears to have been worn away on NDGS 7803. The cristid obliqua is a short ridge that extends directly anteriorly from the hypoconulid to the base of the trigonid. The talonid is open labially, but enclosed by a low ridge along its lingual side.

The p4 is slightly larger than p3 with a better developed talonid (Figure 4H). The trigonid is nearly identical to that of p3 with the metaconid and protoconid being slightly more distinct from one another. The talonid does not differ from that of p3 other than it is more elongated and the hypoconulid larger.

Isolated m1s and m2 cannot be separated from one another with certainty. However there are two specimens that preserve m2 in the dentary (NDGS 7788, NDGS 7835; Figure 4H); in NDGS 7835, the m1 is slightly longer and narrower than m2. The trigonid of m1or m2, as in the premolars, is markedly higher than the talonid. The ratio of the height of the trigonid to the total length of the tooth of the unworn to little-worn teeth (6 specimens) averages 1.11 (range 0.96-1.22). The trigonid forms a V-shape on the occlusal surface that is anteroposteirorly compressed. The protoconid is the highest cusp, the other two are slightly lower and equal in height. The paraconid and metaconid are anteroposteriorly compressed. Along the base of the anterior slope of the tooth is a short anterior cingulid near its center but does not reach either lingual or labial margin of the tooth. The hypoconid also has a V-shape, the cristid obliqua extending anterolingually and meeting the base of the trigonid near its center. The hypoconulid and entoconid are subequal in size, the former being at the center of the posterior margin of the tooth, the latter on the lingual side of the tooth directly opposite the hypoconid. On the labial side of the tooth, near the base of the enamel is a very fine ridge. This ridge is present on 10 of the 13 available specimens, faint to absent on two (NDGS 7818, NDGS 7824) and only partial on one specimen (NDGS 7835).

The m3 is nearly identical to m1 and m2 but smaller (Figure 4G; Table 5). The talonid is proportionally narrower than in m1 or m2, but proportionately longer. The cusps of the talonid are much smaller than in the more anterior molars.

Discussion—*Micropternodus bassidens* has cheek teeth similar in size and morphology to those of the other described Chadronian species. The greatest difference is the relative size of m3 (markedly smaller in *M. bassidens*) and the lesser crown height of the cheek teeth. In *M. bassidens* the average crown height index on unworn or little-worn specimens (maximum crown-height/ anteroposterior length) for m1 or m2 averages 1.11 (range 0.96-1.29), whereas in the type specimen of *M. strophensis* the crown height for m2 is 1.41, and for the sample of topotypic specimens of *M. borealis* it averages 1.34 (range 1.15-1.51). The length of m3 averages 83% that of m1 or m2 (range = 80-85%) in *M. bassidens*, whereas in the *M. borealis* sample it averages 94% (range = 86-1.03%), and on the holotype of *M. strophensis* it is 86%.

Russell (1960) argued that *Micropternodus (=Kentrogomphios) strophensis* (White, 1954) was a junior synonym of *M. borealis* Matthew, 1901, based on a sample of the latter from the type area. However,

TABLE 5. Dental measurements of *Micropternodus bassidens* from Medicine Pole Hills. Abbreviations: L, anteroposterior length; W, transverse width, h, labial height of crown. Statistical abbreviations as in Table 2. *, indicates m1 or m2 (not separated). Measurements in mm.

	dP4L	dP4W	P3L	P3W	P4L	P4W	M1L	M1W	M2L	M2W	M3L	M3W	
N	2	2	2	2	1	1	2	3	7	8	2	2	
M	1.64	2.10	1.28	0.92	2.11	2.43	2.28	3.04	2.07	2.67	1.25	2.19	
Min	1.49	2.08	1.01	0.80	2.11	2.43	2.27	2.90	1.95	2.33	1.18	2.09	
Max	1.79	2.12	1.54	1.04	2.11	2.43	2.29	3.19	2.24	2.96	1.32	2.29	
SD							0.01	0.15	0.13	0.26			
CV							0.62	4.78	6.22	9.61			
	p3L	p3W	p4L	p4W	m1L*	m1W*	m1h*	m2L	m2W	m2h	m3L	m3W	m3h
N	2	2	2	2	11	14	7	2	2	1	11	11	9
M	1.43	1.19	1.76	1.10	2.01	1.60	2.29	1.88	1.62	2.43	1.68	1.28	1.73
Min	1.09	0.71	1.69	1.05	1.93	1.45	2.00				1.54	1.18	1.29
Max	1.76	1.67	1.82	1.15	2.14	1.73	2.62				1.82	1.43	2.32
SD					0.07	0.08	0.26				0.10	0.08	0.31
CV					3.57	5.04	11.26				6.10	5.99	17.90

TABLE 6. Dental characters used to separate *M. borealis* from *M. strophensis* by Stirton and Rensberger (1964). "Sample" refers to the topotypic material of *M. borealis* in the collections of CM. Variable = range in morphology includes that of both species; same = identical in both species as well as the topotypic sample.

M. borealis	***M. strophensis***	**Sample**
more molariform P3	less molariform P3	variable
less prominent parastyle M1	more prominent parastyle M1	variable
less prominent metastyle M1	more prominent metastyle M1	same
more prominent anterior cingulid p4	less prominent cingulid p4	same
talonid < half height of trigonid m1-m2	talonid > half height of trigonid	same
labial cingulid m1-m2 (10 of 13)	no labial cingulid m1-m2	variable
M1 protocone-parastyle not connected	protocone-parastyle connected	variable

Stirton and Rensberger (1964) considered these species distinct based on several morphological differences in the cheek teeth (Table 6). *M. strophensis* is based on the holotype only. Since Russell's (1960) discussion, additional specimens of *M. borealis* have been collected from the type area (22 specimens) which allows a better sense of the variation. It appears that the features used by Stirton and Rensberger (1964) to distinguish these two species are all included in the range of variation now seen in the larger sample of *M. borealis* (Table 6), thus supporting the synonymy of these two species.

The number of lower premolars in *M borealis*, either three or four, has been in dispute since its original description because the number was based only on preserved alveoli (Matthew, 1903; Schlaikjer, 1933; McDowell, 1958; Russell, 1960; Stirton and Rensberger, 1964). One previously undescribed specimen from Pipestone Springs (RAM 7266) has all but one of the premolars preserved, and it is clear that there were four premolars, p1 and p2 being single rooted and p3 and p4 with two roots (Figure 5). The same number and relative size of alveoli are preserved in the most complete dentary of *M. bassidens* (NDGS 7835; Figure 4H).

Clinopternodus Clark, 1937
Clinopternodus sp., cf. *C. gracilis* (Clark, 1936)
(Figure 6B)

Referred Specimen—NDGS 7550, left m1.

Measurements—L = 2.57 mm; W = 1.66 mm; ht = 2.91 mm.

Description—The trigonid is larger and markedly higher than the talonid. The protoconid is slightly higher than the lingual cusps of the trigonid (paraconid, metaconid). The paraconid is slightly anteroposteriorly compressed. Along the anterior margin of the tooth, near its base is a short anterior cingulid that runs approximately half the width of the tooth from the base of the protoconid. The talonid is smaller than the

TABLE 7. Dental measurements of topotypic specimens of *Micropternodus borealis* from Pipestone Springs. Abbreviations: L, anteroposterior length; W, transverse width, h, labial height of crown. Statistical abbreviations as in Table 2. Measurements in mm.

CM#	P3L	P3W	P4L	P4W	M1L	M1W	M2L	M2W
8674			1.94	2.34	2.08	2.85	1.99	2.66
73008			1.93	2.34	2.31	2.97		
78014	1.67	0.96	2.19		2.21	2.87		2.55
87337					2.32	3.1		
M	1.67	0.96	2.02	2.34	2.23	2.95	1.99	2.61

	p3L	p3W	p4L	p4W	m1L	m1W	m1h	m2L	m2W	m2h	m3L	m3W	m3h
N	2	2	3	3	7	7	6	13	12	11	7	7	5
M	1.21	0.70	1.56	1.09	1.96	1.65	2.65	2.03	1.84	2.62	1.87	1.56	1.76
min	1.08	0.65	1.53	0.96	1.83	1.55	2.29	1.90	1.68	2.12	1.77	1.46	1.38
Max	1.33	0.74	1.60	1.16	2.19	1.77	3.30	2.26	1.94	3.06	1.97	1.71	2.16
SD					0.13	0.07	0.38	0.12	0.09	0.29	0.06	0.10	0.33
CV					6.85	4.37	14.38	5.73	4.70	11.05	3.44	6.21	18.60

trigonid and much lower on the crown. The only recognizable cusps are the entoconid and the hypoconid. A low ridge surrounds the lingual and posterior sides of the talonid. The entoconid is a minute swelling at the posterolingual corner of the talonid. The hypoconid is V-shaped at the posterolabial corner of the tooth. The cristid obliqua is short, directed anterolingually from the hypoconid, and joins the base of the trigonid near the center of the tooth.

Discussion—This molar best fits the description of that of *Clinopternodus gracilis* of Clark (1936, 1937). In length, this tooth is equal to that of the holotype of *C. gracilis* but is not quite as tall (holotype m1 height = 3.6 mm; Clark, 1937: 309). In all other aspects it is nearly identical to the holotype m1. The holotype, and only known specimen of *C. gracilis* is from the Chadron Formation of South Dakota. The only other questionable occurrence of the genus is from the Orellan of Wyoming (Gunnell et al., 2008c).

Family uncertain
Genus *Cryptoryctes* Reed, 1954
Cryptoryctes sp.
(Figure 7; Table 8)

Referred Specimens—NDGS 7576, nearly complete right humerus; NDGS 7573, 7574, 7575, 7577, partial humeri.

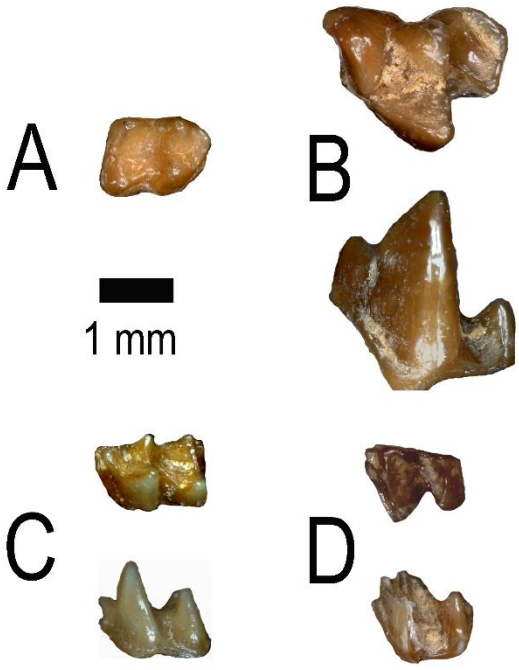

FIGURE 6. Cheek teeth of *Proterix*, *Clinopternodus*, and *Oligoscalops* from Medicine Pole Hills. A, *Proterix* sp., NDGS 7581, right m1. B, *Clinopernodus* sp. cf, *C. gracilis*, NDGS 7550, left m1. C-D, *Oligoscalops* sp. C, NDGS 7578, left m1 or m2. D, NDGS 7579, left m3. Figures B, C, D, occlusal view above, labial view below.

Discussion—The morphology of the humeri referred here differ from that of the type species *Cryptoryctes kayi* (Reed, 1954: fig. 3; Reed and Trunbull, 1965: fig. 24C) in being slightly smaller in overall size with a relatively narrower diaphysis (Table 8). The length and proximal width of the Medicine Pole Hills material are measurable on only one specimen NDGS 7576 (see Reed, 1954: fig. 1) and are 10 to 15 percent smaller than for *C. kayi* (Table 8; Reed, 1954: table 1). However, the distal width and proximal and distal shaft widths of the Medicine Pole Hills material ranges from 15 to 30 percent smaller; thus indicating a relatively narrower diaphysis than the type material.

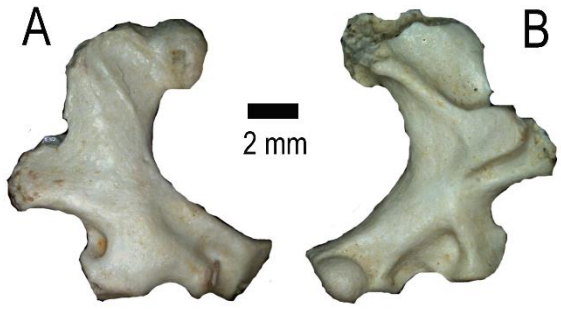

FIGURE 7. Right humerus of *Cryptoryctes* sp., NDGS 7576, from Medicine Pole Hills. A, posterior view. B, anterior view. Proximal end to top of page.

C. kayi has been reported from several localities from the Chadronian of Montana (Reed and Turnbull 1965, Barnosky 1981; Gunnell et al., 2008c). All of the previously reported material appears to represent a single species with specimens showing a limited range of size variation. The Medicine Pole Hills specimens do not represent *C. kayi* but, as noted by Barnosky (1981), the humerus is not a sufficiently diagnostic element on which to name a species without associated dentition.

Originally, Reed (1956) did not refer *Cryptoryctes* to a family but noted that it was clearly not a talpid or ancestral to the Talpidae. Since its description, *Cryptoryctes* has been considered either a distinct genus of proscalopid (Reed and Turnbull, 1965; Barnosky, 1981; Geisler, 2004) or the limbs of the mircropternodontid *Micropternodus* (Reed, 1956; Russell, 1960; Stirton and Rensberger, 1964; Gunnell et al. 2008c). Barnosky (1981) noted that there were significant differences in the humeri of *Cryptoryctes* and those of other proscalopids. McKenna and Bell (1997) and Rose (2006) went so far as to list *Cryptoryctes* as a synonym of *Micropternodus*.

Gunnell et al. (2008c) cited the occurrence of *Cryptoryctes* from six different Chadronian localities. Of these, specimens of *Micropternodus* are known from four. Contrarily, *Micropternodus* has been reported from an additional ten localities where *Cryptoryctes* has not. The direct association of postcranial material with dental or cranial material is necessary to verify the synonymy of these genera. The uniqueness of the Medicine Pole Hills specimens of *Cryptoryctes* and that the species of *Micropternodus* (described above) is new supports the association of the humeri with *Micropternodus* but this cannot be verified with any confidence.

TABLE 8. Measurements of humeri of *Cryptoryctes* sp. from Medicine Pole Hills. Measurements in mm.

NDGS #	Total length	proximal width	distal breadth	proximal shaft width	distal shaft width
7577					2.95
7576	9.84	4.95	8.91	2.19	3.32
7575				2.77	2.78
7574					3.08
7573			6.07	2.60	3.00
Mean	9.84	4.95	7.49	2.52	3.03

Family Oligoryctidae Asher, McKenna, Tabrum, and Kron, 2002
Genus *Oligoryctes* Hough, 1956
Oligoryctes altitalonidus (Clark, 1937)
(Figure 8; Table 9)

Apternodus altitalonidus Clark, 1937
Oligoryctes altitalonidus (Clark) Asher et al., 2002

Referred Specimens—NDGS 7657, left P3; NDGS 7637, 7641, 7642, 7645, 7650, 7653, 7661, P4; NDGS 7638, 7639, 7644, 7646-7649, 7651, 7655, 7658, 7660, 7662, 7663, M1; NDGS 7640, 7643, 7656, 7659, 7665, M2; NDGS 7652, right M3; NDGS 7601, left dentary with p3-m2; NDGS 7599, 7604, 7630, partial dentary with p4-m1; NDGS 7636, partial dentary with right m1-m2; NDGS 7603, 7610, 7612, 7635, partial dentary with m2-m3; NDGS 7615, right p3; NDGS 7593, 7597, 7618-7622, 7627, 7631, p4; NDGS 7596, 7602, 7606-7609, 7611, 7614, 7616, 7623, 7624, 7628, 7629, m1; NDGS 7634, m2; NDGS 7595, 7605, 7625, 7626, m3.

Discussion—This species has been described in detail elsewhere (Clark, 1937; Asher et al., 2002). The morphology of the material from Medicine Pole Hills does not differ from that of *O. altitalonidus* from other localities. The cheek teeth are smaller than those of the type species of the genus *O. cameronensis* (Table 9; Asher et al., 2002: table 2) and the size of m2 is not markedly smaller than m1 as in the latter. *O.*

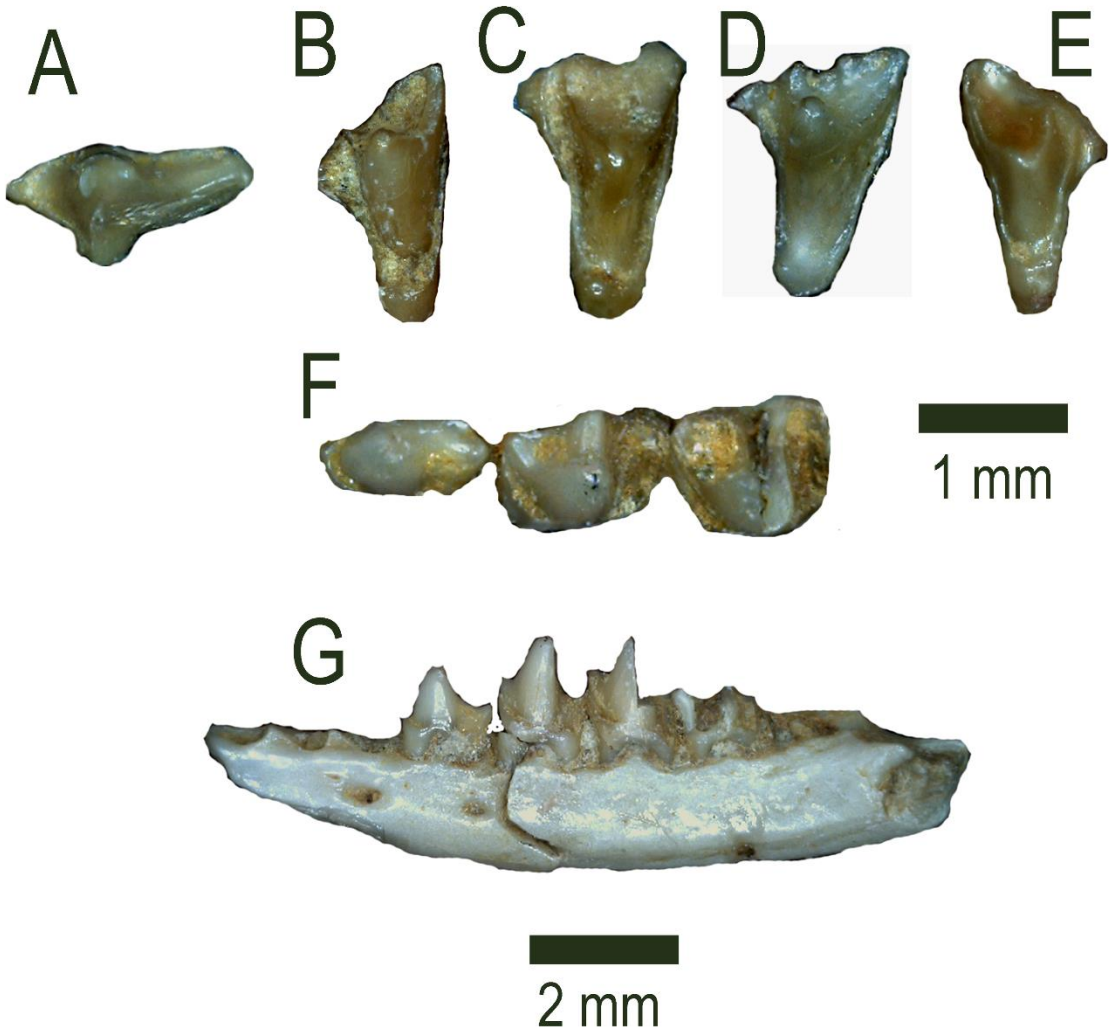

FIGURE 8. Dentary and cheek teeth of *Oligoryctes altitalonidus* from Medicine Pole Hills. A, NDGS 7657, left P3. B, NDGS 7641, right P4 (reversed). C, NDGS 7639, left M1. D, NDGS 7646, right M1 (reversed). E, NDGS 7652, left M3. F-G, NDGS 7601. F, occlusal view of left p3-m1. G, lateral view of dentary. Figures A-F to same scale (above); G to scale below.

Oligoryctes amplissimus n. sp.
(Figure 9; Table 10)

Syntype Specimens—NDGS 7571, right P3; NDGS 7557, right p4 (Figures 9A, F).

Referred Specimens—NDGS 7559, left P3; NDGS 7565, P4; NDGS, 7563, 7572, M1; NDGS 7568, right M2; NDGS 7551, 7555, M3; NDGS 7553, 7561, 7562, p4; NDGS 7554, 7556, 7558, m1; NDGS 7567, 7569, 7790, m2; NDGS 7560, 7564, 7570, m3.

Diagnosis—Largest species of the genus (measurements of cheek teeth average 1.5 to 2 times larger than other species); lower molars decrease in width from m1-m3 as in *O. cameronensis*; P3 lacking protocone (lingual cusp); trigon of P4 not as transverse as in other species (protocone near labiolingual center of tooth); talonid relatively longer on p4 than other species.

Etymology—Latin, *amplissimus*, largest.

Description—The single known P3 (NDGS 7571; syntype) is almost twice as long as wide (Figure 9A). The occlusal surface is dominated by a high, central, conical cusp (paracone). Anterior to it, at the anterolabial corner of the tooth, is a small, conical parastyle. A low, distinct lingual cingulum runs the length of the tooth. Running posteriorly from the apex

TABLE 9. Dental measurements of *Oligoryctes altitalonidus* from Medicine Pole Hills. Abbreviations: L, anteroposterior length; W, transverse width. Statistical abbreviations as in Table 2. Measurements in mm.

	P3L	P3W	P4L	P4W	M1L	M1W	M2L	M2W	M3L	M3W
N	1	1	7	7	13	9	5	5	1	1
M	1.36	0.60	1.07	1.49	0.98	1.50	0.77	1.44	1.03	1.42
Min			0.95	1.33	0.86	1.39	0.74	1.34		
Max			1.13	1.64	1.11	1.56	0.82	1.55		
SD			0.07	0.10	0.07	0.06	0.03	0.08		
CV			6.93	6.83	7.38	3.66	4.03	5.74		

	p3L	p3W	p4L	p4W	m1L	m1W	m2L	m2W	m3L	m3W
N	2	2	13	13	18	18	6	6	6	8
M	0.78	0.42	0.95	0.59	0.93	0.74	0.84	0.75	1.13	0.65
Min	0.67	0.36	0.81	0.53	0.87	0.58	0.78	0.70	1.08	0.59
Max	0.88	0.47	1.02	0.65	1.02	0.84	0.90	0.79	1.17	0.74
SD			0.06	0.04	0.04	0.07	0.04	0.04	0.04	0.05
CV			5.86	6.47	4.71	9.25	4.82	4.86	3.34	7.13

of the paracone is a high ridge (postparacrista) the extends to the posterolabial corner of the tooth, bowing slightly lingually at its center. A cingulum runs from the posterolabial corner of the tooth along the lingual edge and ends at a point even with the apex of the paracone.

P4 is transversely elongated (Figure 9B). There is a small anteroposteriorly compressed parastyle at the anterolabial corner of the tooth. A narrow cingulum runs along the base of the tooth from the parastyle and wraps around the lingual margin, and continues along the base of the tooth along the posterior margin, then rises slightly at its posterolabial end where is meets the base of the metacone. There is a minute cuspule at the lingual-most point of the tooth along the cingulum. The metacone extends much more labially than the paracone. The paracone is the smallest of the major cusps. The protocone is near the center of the occlusal surface of the tooth and is markedly higher than the other cusps.

M1 is triangular in occlusal outline. There is a prominent parastyle at the anterolabial corner of the tooth (Figure 9C). It is transversely elongated and separated from the paracone by a transverse valley. The paracone is in the anterolabial corner, situated much more lingually than the metacone at the posterolabial corner of the tooth. There is a large parastyle at the anterolabial corner of the tooth separated from the paracone by a wide transverse valley. The protocone is the highest of the cusps, and at the apex of the lingual point of the triangle. There are narrow posterior and anterior cingula that run along the base of the tooth. M2 is shorter and slightly less wide (transversely) than M1, its parastyle is smaller and, the paracone is not lingually displaced (Figure 9D).

M3 is markedly smaller than the other molars but retains the triangular occlusal outline. The anterolabial corner (parastyle) extends much farther labially than the rest of the tooth. The protocone is the highest cusp. There is no distinct paracone, the preprotocrista runs directly from the parastyle to the apex of the protocone. A distinct metacone is also absent; the postprotocrista ends at the posterolabial corner of the tooth with no indication of a cusp. There are no cingula.

The p4 is longer than wide (Figure 9F). The trigonid is markedly higher than the talonid. There is a minute paraconid at the anterolingual corner of the tooth. The metaconid and protoconid are distinct at their apices but fuse together just below. The preprotocrista descends rapidly from the apex of the protoconid to the paraconid. The talonid is markedly lower than the paraconid. The only specimen with identifiable talonid cusps is the syntype NDGS 7557. A postmetacristid descends down the lingual side of the metaconid and ends at a minute entoconid at the posterolingual corner of the talonid. Just labial to it is an equally small hypoconulid, near the center of the posterior margin of the tooth. The talonid is open widely labially to the base of the crown.

The first and second lower molars were separated by size, m1 being distinctly wider than m2 (Table 10). The morphology, however, is not markedly different

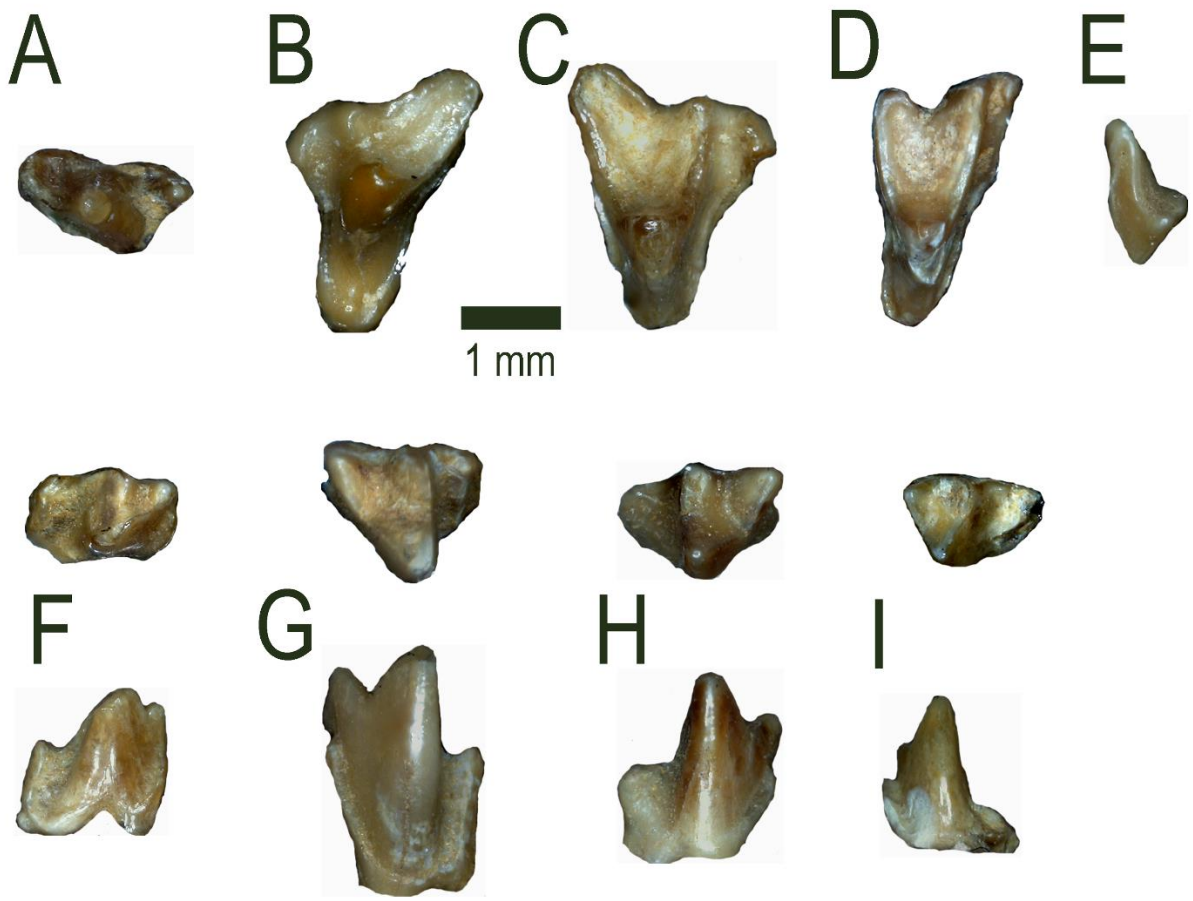

FIGURE 9. Cheek teeth of *Oligoryctes amplissimus* from Medicine Pole Hills. A, NDGS 7571, right P3 (syntype). B, NDGS 7565, left P4. C, NDGS 7563, right M1. D, NDGS 7568, right M2. E, NDGS 7555, left M3. F, NDGS 7557, right p4 (syntype). G, NDGS 7556, left m1. H, NDGS 7790, right m2. I, NDGS 7570, left m3. Figures F-I, occlusal view above, labial view below.

between these two molars. Typical of the genus, the molars are dominated by a very high trigonid and a very small, and considerably lower talonid (Figures 9G, H). On the trigonid, the protoconid is the highest cusp, the paraconid the lowest. A cingulid wraps around the base of the crown, descending labially along the anterior margin of the tooth, wrapping around the labial base of the protoconid, then forms a narrow ledge extending along the posterior base of the tooth, and ends in a small entoconid at the posterolingual corner of the tooth, well below the level of the trigonid.

The m3 is markedly smaller than m1 and m2 (Table 10; Figure 9I). The trigonid is similar to that of the anterior molars, but is slightly more anteroposteriorly compressed. The talonid is a low posterior extension of enamel from the base of the tooth. It is markedly narrower than the trigonid and no cusps are distinguishable on it. Although smaller than m1 and m2, the talonid of m3 extends more posteriorly than on anterior molars, making the tooth nearly as long.

Discussion—Although the diagnostic cheek teeth (premolars) have not been found in direct association with molars, they are assigned here because of their *Oligoryctes*–like morphology and the lack of any other species in the fauna to which they could be attributed. Other than size, there is no difference between the molars of *O. amplissimus* and those of the other recognized species of *Oligoryctes*. However, the P3 of all other species has a distinct lingual cusp (protocone) not present in P3 of *O. amplissimus* (Figure 9A). The

TABLE 10. Dental measurements of *Oligoryctes amplissimus* from Medicine Pole Hills. Abbreviations: L, anteroposterior length; W, transverse width. Statistical abbreviations as in Table 2. Measurements in mm.

NDGS#	P3L	P3W	P4L	P4W	M1L	M1W	M2L	M2W	M3L	M3W
7551									0.80	
7555									0.92	1.85
7563					2.31	2.52				
7565			2.17	2.57						
7568							1.68	3.02		
7571	1.93	1.02								
7572					2.12	2.32				
7559	1.54	1.26								
Mean	1.74	1.14	2.17	2.57	2.22	2.42	1.68	3.02	0.86	1.85
NDGS	p4L	p4W	m1L	m1W	m2L	m2W	m3L	m3W		
7790					1.82	1.36				
7553	1.81	1.01								
7554			1.75	1.61						
7556			1.80	1.52						
7557	1.68	0.86								
7558			1.88	1.76						
7560							1.53	0.86		
7561	1.67	0.85								
7562		0.82								
7564							1.31	1.07		
7567					1.54	1.28				
7569					1.7	1.36				
7570							1.55	1.02		
Mean	1.72	0.89	1.81	1.63	1.69	1.33	1.46	0.98		

protocone of P4 is near the center of the crown in *O. amplissimus* and more lingually placed in other species (Figure 9B), and the talonid of p4 is relatively longer in *O. amplissimus* than in those of other species (Figure 9F).

In size, the cheek teeth of *O. amplissimus* resemble those of the smallest species of *Apternodus*, *A. baladonis* from the Chadronian of Montana (Asher et al., 2002: table 2) but the latter has greatly inflated premolars (a diagnostic feature of the genus) not present in the *O. amplissimus* sample.

Family Proscalopidae Reed, 1961
Genus *Oligoscalops* Reed, 1961
Oligoscalops sp.
(Figures 6C, D)

Referred Specimens—NDGS 7578, left m1; NDGS 7579, left m3.

Discussion—The morphology of these two lower molars matches that of *Oligoscalops* in being dilambdodont and mesodont; clearly lower crowned than those of *Proscalops* (Reed, 1961; Gunnell et al., 2008c). However, the odd sizes of these specimens do not match other described molars of *Oligoscalops*. The m1 (NDGS 7578) is smaller (L = 1.55 mm; W = 0.85 mm) and the m3 (NDGS 7579) is larger (L = 1.40 mm; W = 0.99 mm) than any specimens previously referred to this genus (Reed, 1961: 475; Korth, 2020: table 6). It is possible that there is more than one species present but due to the scarcity of material from Medicine Pole Hills, as well as elsewhere, this cannot be established.

CONCLUSIONS

The Medicine Pole Hills fauna is both abundant (with more than 5000 identifiable mammalian specimens) and diverse (an estimated 51 mammalian species). In addition, it includes a diverse reptilian fauna, of which only the lizards have been described (Smith 2006), along with amphibian, avian and fish material. Overall, the taxa represented in the fauna are small, the large majority less than 10kg in life.

This small body size bias in the fauna is reflected in the diversity of insectivorans. The eleven taxa described herein, along with the additional two species of the soricid *Domnina* described elsewhere (Kim and Schumaker, 2008) totals 13 taxa. Reported early Chadronian faunas, the McCarty's Mountain local fauna has the greatest diversity with five insectivoran taxa (Tabrum et al 1996), Flagstaff Rim (portion 50 feet below Ash B) has three (Emry 1992) and the Yoder local fauna has only one taxon (Kihm 1987) [Clark 1937, Clark et al 1967, did not report any insectivorans from the Ahearn Member of the Chadron Formation]. The somewhat older Little Egypt local fauna has only a single insectivoran (Novacek 1976). Whereas the diversity seen in middle Chadronian faunas is typically greater. Tabrum et al (1996) reported 11 insectivoran taxa from the Pipestone Springs local fauna; Ostrander (1987) reported 11 in the Raben Ranch local fauna; Meyer (2007) reported 12 in the Calf Creek local fauna; and Emry (1992) reported 8 from Flagstaff Rim (portion from 50 feet below Ash B to Ash G). For a comparison, the Duchesnean Lac Pelletier local fauna (Storer 1995) contains approximately 12 insectivoran taxa in groups comparable to those here. The greater diversity of insectivorans from Medicine Pole Hills suggests a middle Chadronian age for the fauna.

The Medicine Pole Hills local fauna includes a number of first and last appearances. Among the last appearances are the acrodontan lizard *Tinosauus* (Pearson, 1998), the sciuravid rodent *Prolapsus* (Kihm 2013), and the paromomyid (cf. *Ignacius*) and microsyopid (Uintasoricine) primates (Kihm and Tornow 2014). The specimen of *Proterix*, described here represents the earliest known occurrence of that genus. The range extensions may also be attributed, in part to the bias toward small species in the Medicine Pole Hills local fauna.

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