

MAMMALS FROM THE BLUE ASH LOCAL FAUNA (LATE OLIGOCENE), SOUTH DAKOTA. RODENTIA PART 5: FAMILY CRICETIDAE

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ABSTRACT

Ten species of cricetid rodents are identified from the Blue Ash fauna including three new species, *Eumys brachyodus*, *E. parvidens*, *Scottimus* sp., cf. *S. longiquus*, *S. kellamorum*, *Leidymys* sp., cf. *L. blacki*, *L. juxtaparvulus* n. sp., *Paciculus dakotensis* n. sp., *P. sp.*, cf. *P. nebraskensis*, *Geringia copiosus* n. sp., and an indeterminate species. The cricetids are the best represented and one of the most diverse families of rodents from the Blue Ash anthill fauna. Some of the genera of cricetids present in the fauna are more characteristic of the Arikareean land mammal age (*Leidymys*, *Paciculus*, *Geringia*), but the species are either smaller or morphologically more primitive than those from the Arikareean. However, three species in the fauna (*E. brachyodus*, *E. parvidens*, *S. longiquus*) are currently only known from the Orellan or Whitneyan. It appears that the age of the Blue Ash fauna, based on the cricetid rodents, is somewhere near the Whitneyan-Arikareean boundary.

INTRODUCTION

Previously, a number of taxa from the Blue Ash fauna have been identified that are elsewhere known from the Arikareean, as well as other taxa that are more typical of earlier Orellan and Whitneyan ages (see Korth, 2009 and references therein). The cricetids are the most abundant family of rodents in the Blue Ash fauna, being represented by over 500 specimens. Distinct cricetid characterize the land mammal ages Orellan, Whitneyan, and Arikareean. The suites of genera represented from these adjacent levels are therefore diagnostic of their respective land mammal ages. The earlier horizons (Orellan and Whitneyan) are dominated by species of *Eumys*, *Scottimus*, *Wilsonium*, and *Eoemys*; the Arikareean fauna is dominated by species of *Leidymys*, *Geringia*, and *Paciculus* with rare occurrences of *Eumys* (Wood, 1937, 1980; Martin, 1980; Korth, 1994). The distinctiveness of the Whitneyan and Arikareean cricetid faunas, and the great number of specimens, suggests that the cricetids should be quite valuable in determining the biostratigraphic horizon of the fauna.

Dental terminology modified from that of Wood and Wilson (1936). Capital letters indicate upper teeth and lower-case letters represent lower teeth (e.g. M1 or m1). Abbreviations for institutions: AMNH, American Museum of Natural History; FAM, Frick Collections, American Museum of Natural History; CM, Carnegie Museum of Natural History; MCZ, Museum of Comparative Zoology, Harvard University; ROM,

Royal Ontario Museum; UNSM, University of Nebraska State Museum; YPM-PU, Yale Peabody Museum, Princeton Collection.

SYSTEMATIC PALEONTOLOGY

Order Rodentia Bowdich, 1821
Family Cricetidae Fischer de Waldheim, 1817
Eumys Leidy, 1856

Type Species—*Eumys elegans* Leidy, 1856 (= *Eumys obliquidens* Wood, 1937; = *Cricetodon nebraskensis* Wood, 1937; = *Eumys pristinus* Russell, 1972).

Referred Species—*Eumys brachyodus* Wood, 1937; *Eumys parvidens* Wood, 1937; *Eumys cricetodontoides* White, 1954 (= *E. latidens* White, 1954; = *E. spokaneensis* White, 1954; = *E. elegans* [in part] Martin, 1980); *Eumys eliensis* Black, 1961a (= *E. brachyodus* [in part] Martin, 1980; = *Leidymys eliensis* Lindsay, 2008).

Range—Orellan to early Arikareean (early to late Oligocene) western North America.

Discussion—Thirteen species of *Eumys* have been named from North America. Of these, five have been referred to other genera (Table 1). In his review of Oligocene and early Miocene cricetids, Martin (1980) recognized only four species, *E. elegans*, *E. brachyodus*, *E. parvidens* and *E. pristinus*. He synonymized *E. obliquidens*, *E. cricetodontoides*, *E. latidens*, *E. spokaneensis* and *Cricetodon nebraskensis*

under *E. elegans*. Martin (1980) also included the only Arikareean species, *E. eliensis*, under *E. brachyodus*. Most recently, Lindsay (2008) did not recognize any of Martin's synonymies and transferred *E. eliensis* to *Leidymys*. Probable synonymies of the species of *Eumys* are discussed below.

TABLE 1. Previously named species of *Eumys* from North America referred to other genera.

SPECIES	REFERRAL
<i>E. exiguus</i> Wood, 1937	<i>Scottimus exiguus</i> (Black, 1961b)
<i>E. planidens</i> Wilson, 1949	<i>Wilsonium planidens</i> (Martin, 1980)
<i>E. woodi</i> Macdonald, 1963	<i>Pacculus woodi</i> (Martin, 1980)
<i>E. blacki</i> Macdonald, 1963	<i>Leidymys blacki</i> (Martin, 1980)
<i>E. gloveri</i> Macdonald, 1970	<i>Geringia gloveri</i> (Martin, 1980)

Galbreath (1953) considered *Cricetodon nebraskensis* as just a morphological variation of *Eumys elegans*. Wood (1980) agreed that it was referable to *Eumys*, but included it as a synonym of *E. cricetodontoides*. Martin (1980) followed Galbreath (1953) and included *Cricetodon nebraskensis* as a synonym of *Eumys elegans*. Lindsay (2008:465) recognized it as a distinct species of *Eumys*, *E. nebraskensis* stating that "...it is now considered a species of *Eumys* by most authorities (Wood, 1980)." However, Wood (1980) considered *C. nebraskensis* as a synonym of another species (*E. cricetodontoides*) and no references could be found to verify its recognition as a distinct species. Galbreath's (1953) arguments are followed here and the size of specimen referred to *C. nebraskensis* (Wood, 1937:257) is within the range of samples of *E. elegans* from Nebraska (see Appendix). Therefore, it is considered here as a junior synonym of *E. elegans*.

Russell (1972) named *Eumys pristinus* from the Chadronian of Saskatchewan. In his description, he misidentified two specimens: ROM 6323 was identified as a dp4 of an eomyid, but is a right m1 of *Eumys*; and ROM 6326, was identified as a left M3 of *E. pristinus* but is a lower molar of *Ischyromys* (Russell, 1972:fig. 10I and fig. 11A, respectively). The characters used to diagnose *E. pristinus* (size of the anteroconid on M1, orientation of the posterior arm of protoconid on lower molars, and relative size of the anterior cingulum on the lingual side of the lower molars) are clearly variable within populations of *E. elegans* from the Orellan. The size of the specimens is also well within the size range of *E. elegans* (Russell, 1972:41-42; Appendix, this paper). More recently, it has been demonstrated that the fauna described by Russell contained Chadronian species but also included specimens mixed from later horizons (Storer and Bryant, 1993; Storer, 1996). The most recently

published faunal list from the Chadronian of Saskatchewan by Storer (1996:252) does not include *Eumys*, but it does occur in later Orellan faunas of the same area. It is proposed here, that *E. pristinus* is a junior synonym of *E. elegans* and the earliest record of the genus remains the Orellan.

White (1954) named three species of *Eumys* from the Orellan of Montana, *E. cricetodontoides*, *E. latidens*, and *E. spokaneensis*. Martin (1980) included all of them under *E. elegans*, noting the morphological differences cited by White (1954) were minor variations that could be found in samples of *E. elegans*, and that the size of the specimens overlapped that of *E. elegans* as well, but provided no tables for comparison. Wood (1980) similarly noted that the morphological differences among the Montana species were not significant and retained *E. cricetodontoides* as the senior synonym of the other two Montana species. The greatest difference between *E. cricetodontoides* and *E. elegans* is the size of the cheek teeth. The dimensions of the lower molars are much larger in the Montana species than in specimens of *E. elegans* (Wood, 1937:521; Galbreath, 1953:table 14; White, 1954:412-414), but there is some overlap in size ranges. A large sample of *Eumys elegans* from the Orellan of Sioux County, Nebraska was also measured for comparison (see Appendix). The Student's t-test and Mann-Whitney non-parametric test were applied to the two populations (Nebraska and Montana) and were shown to be statistically significantly different ($p < 0.001$) for each of the dimensions of each tooth and the total length of the tooth row. This demonstrates that the Montana specimens definitely constituted a population distinct from the *E. elegans* sample. Therefore, *Eumys cricetodontoides* is recognized here as a distinct species based on its larger size.

Black (1961a) named *Eumys eliensis*, from the Arikareean of Montana. He diagnosed the new species as: 1) having teeth proportionally larger than other species relative to the depth of the mandible; 2) teeth increase in size from m1 to m3; 3) posterior arm of the protoconid joining the metaconid on its lingual side on the molars; 4) no lingual cingulum anterior to the metaconid on m2 and m3; and 5) mental foramen near the inferior border of the mandible below anterior root of m1. Martin (1980) synonymized *E. eliensis* with the otherwise Whitneyan *E. brachyodus* because the diagnostic characters of the former all occurred in specimens of the latter. However, Martin (1980) did not provide any figures, tables of measurements, or cite any specimens of *E. brachyodus* that had these characters of *E. eliensis*. He also mistakenly listed the presence of a lingual anterior cingulum as one of Black's (1961a) characters instead of the absence of the cingulum. The character of the relative size of the mandible and position of the mental foramen cannot be

verified in the Blue Ash sample. However the morphologies and relative sizes of the molars can be determined. The morphology of the posterior arm of the protoconid and the presence or absence of the lingual anterior cingulum does appear to be variable in the Blue Ash sample and other reported specimens of *E. brachyodus* (Wood, 1937; Galbreath, 1953). However, in the sample from Blue Ash and other specimens of *E. brachyodus*, it is evident that m1 is the largest of the lower molars. The mean length of m1 from Blue Ash is the same as the maximum length of any of the m3s (Table 2). Wood (1937:253) identified two referred specimens of *E. brachyodus* that had m3s longer than m1, but the difference was 3-6% the total length of m3, much less than in the type of *E. eliensis* (10%). The length of m2 and m3 of the holotype of *E. eliensis*, YPM 14022 (2.6 mm; 2.75 mm, respectively), is far larger than the length of any previously reported specimen of *E. brachyodus* (Wood, 1937:253; Galbreath, 1953:table 14; Table 2 and Appendix, this paper). It is evident, based on size and proportions of the lower molars that *E. eliensis* is distinct from *E. brachyodus* and should be considered a separate species. Lindsay (2008) referred *E. eliensis* to the genus *Leidymys*, because of the greater lophodonty of *Leidymys* compared to *Eumys*. However, the degree lophodonty and crown height of the molars in *Eumys* are greater than in species of *Leidymys*. *E. eliensis* also lacks the diagnostic doubled mesolophid on m2 and m3 of *Leidymys*. Therefore, *E. eliensis* is retained in *Eumys*.

As a result of these synonymies, five species of *Eumys* are recognized: *E. elegans*, *E. parvidens*, and *E. cretodontoides* from the Orellan; *E. brachyodus* from the Whitneyan; and *E. eliensis* from the Arikarean.

Eumys brachyodus Wood, 1937
(Figure 1A-F; Table 2)

Type Specimen—MCZ 5069, mandible with right m1-m3.

Referred Specimens—CM 73530, partial maxilla with M1-M2; CM 73560, 73576, partial maxillae with M2-M3; CM 73532, 73533, 73536, 73538, 73542, 73553, 73554, 73562, 73564, 73581-73583, 73596-73598, 76110, 83735-83740 – M1; CM 73535, 73537, 73541, 73547, 73549, 73551, 73555, 73556, 73565, 73568-73570, 73578, 73585, 73588, 73594, 73595, 76102, 76103, 76113, 76116, 76119 – M2; CM 73544, 73557-73559, 73580, 73584, 73590, 73599, 76100, 83741-83745 – M3; CM 73531, 73534, 73539, 73540, 73543, 73548, 73563, 76108, 76109, 76111, 76112, 76120-76122, 76125-76128, 76130 – m1; CM 73529, 73561, 73571, 73572, 73574, 73577, 73586, 73589, 73591, 73592, 76101, 76104-76106, 76114, 76115, 76124, 76131, 83800 – m2; CM 73545,

73546, 73550, 73552, 73566, 73567, 73573, 73575, 73579, 73587, 76117, 76118 – m3.

Amended Diagnosis—Similar in size to *Eumys elegans* but molars wider relative to length than other species; anteroconid on m1 minute; double connection of the metalophid with the anteroconid variably present on m1 (never present in other species); lingual half of the anterior cingulum greatly reduced on m2-m3; mesolophids (-ids) minute to absent on all molars; anterocone on M1 smaller than in other species; parastyle variably present on M1 (absent in all other species); M3 slightly longer (anteroposteriorly) relative to width than in other species.

Description—M1 has surprisingly little variation in the sample. The anterocone is large, but relatively smaller than in specimens of *E. elegans*. In a sample of 15 specimens of *E. elegans* (Wahlert, 2004:2), the width of the anterocone averaged 66% of the maximum width of M1. In the Blue Ash sample, the anterocone averaged 63% the maximum width of M1, slightly less. The anterocone is D-shaped in outline, the flat surface forms the posterior wall. On 70% of the Blue Ash specimens a distinct parastyle is present at the posterobuccal corner of the anterocone. In most specimens it is a small swelling, separated from the anterocone by a small, shallow valley. In a few specimens it is a distinct cusp. The four major cusps of the tooth are nearly equal in size and height. The anterior width of the tooth (protoloph) is just slightly greater than the posterior width (metaloph). The buccal cusps, paracone and metacone, are oval and anteroposteriorly compressed. The lingual cusps, protocone and hypocone, are obliquely compressed. The anterior arm of the protocone extends anteriorly to join the center of the posterior wall of the anterocone. Very short accessory lophules extend posteriorly from the anterocone on seven specimens (32%). They do not extend the entire length of the valley separating the anterocone from the protoloph. They can occur either buccal or lingual to the connection of the anterior arm of the protocone with the anterocone. The protoloph extends lingually from the paracone, attaching to the posterior arm of the protocone. Here again, on five specimens (23%) there are short lophules that run into the valley between the protocone and paracone. The endoloph runs posteriorly from the point where the protoloph connects to the posterior arm of the protocone, then bends lingually to join the hypocone. At the bend in the endoloph there is usually a short mesoloph. Only about 20% of the specimens lack a mesoloph, but it can be very small (tiny spur) in some specimens that have it. The metaloph is parallel to the protoloph and runs lingually from the metacone, joining the buccal end of the anterior arm of the hypocone. The posterior cingulum runs from the apex of the hypocone along the posterior margin of the

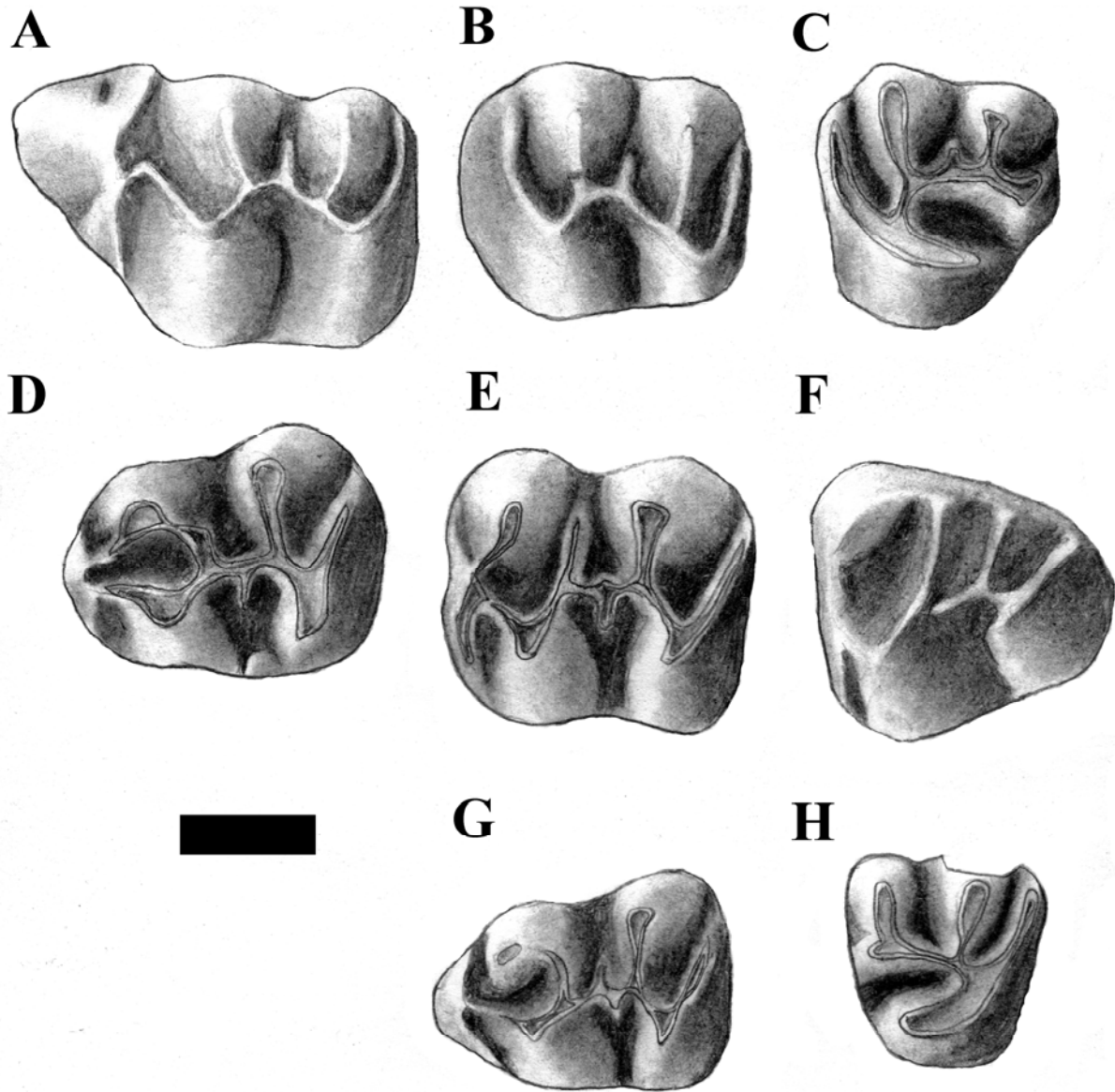


FIGURE 1. Molars of *Eumys* from the Blue Ash local fauna. A-F, *Eumys brachyodus*. A, CM 73533, left M1. B, CM 73547, left M2. C, CM 83743, left M3. D, CM76112, left m1. E, CM 76105, left m2. F, CM 73575, left m3. G-H, *Eumys* sp., cf. *E. parvidens*. G, CM 76123, left m1. H, CM 84645, right M3. Bar scale = 1 mm.

tooth, ending posterior and lingual to the metacone. The valley between the posterior cingulum and the metaloph and metacone is very deep.

M2 has the least amount of variation of any of the cheek teeth. It is very similar in morphology to that of M1 without the anterocone. M2 is nearly equal in length and width and the anterior and posterior widths are almost exactly the same. The lingual cusps are more dramatically obliquely compressed than on M1.

The anterior arm of the protocone extends along the anterior edge of the tooth to the buccal border, forming the anterior cingulum. The protoloph runs from the paracone, always joining the endoloph posterior to the protocone. A mesoloph is present on all specimens, but does vary in length and never extends more than half the way to the buccal edge of the tooth. The configuration of the hypocone, metacone, and posterior cingulum of M2 is identical to that of M1.

TABLE 2. Dental measurements of *Eumys brachyodus* from the Blue Ash fauna. Abbreviations: L, length; W, width; N, number of specimens; M, mean; Min, minimum measurement; Max, maximum measurement; SD, standard deviation; CV, coefficient of variation. Measurements in mm.

	M1L	M1W	M2L	M2W	M3L	M3W	L/W M1	L/W M2	L/W M3
N	15	23	24	24	15	16	14	22	13
M	2.91	1.98	2.05	1.90	1.69	1.83	1.45	1.08	0.94
Min	2.64	1.77	1.91	1.71	1.45	1.65	1.34	0.97	0.85
Max	3.18	2.30	2.28	2.25	1.92	1.95	1.64	1.20	1.04
SD	0.15	0.15	0.09	0.13	0.13	0.09	0.09	0.07	0.04
CV	5.09	7.54	4.20	6.59	7.49	4.72	6.07	6.18	4.47
	m1L	m1W	m2L	m2W	m3L	m3W	L/W m1	L/W m2	L/W m3
N	21	21	18	18	11	12	21	18	11
M	2.34	1.78	2.21	1.97	2.24	1.97	1.31	1.12	1.14
Min	2.12	1.59	2.07	1.84	2.13	1.84	1.20	1.04	1.09
Max	2.53	1.98	2.35	2.09	2.33	2.13	1.41	1.25	1.24
SD	0.11	0.11	0.09	0.08	0.08	0.10	0.06	0.05	0.06
CV	4.49	5.99	3.93	3.89	3.57	4.85	4.83	4.87	4.85

M3 is the smallest of the upper molars. It is much narrower posteriorly than anteriorly. The length of M3 is the most variable measurement of all of the molars of the sample (Table 2). The protocone is an obliquely oriented swelling at the anterolingual corner of the tooth, continuous with the anterior cingulum that runs the entire width of the tooth. The paracone is greatly anteroposteriorly compressed, forming a transverse ridge that joins the posterior arm of the protocone. The endoloph runs posteriorly from the connection of the protoloph and the posterior arm of the protocone, curves lingually and ends posteriorly in a small hypocone. The metacone, similar to the paracone, is greatly anteroposteriorly compressed. The metaloph runs lingually from it, meeting the endoloph anterior to the hypocone. Only three of the 15 specimens have a small mesoloph. The size and position of the hypocone (more lingually or buccally placed) are variable. A posterior cingulum is usually present, but is variable in length depending on the position of the hypocone. Specimens with more lingually placed hypocones usually have a longer posterior cingulum, while others that are more buccally placed have no posterior cingulum at all.

The first lower molar is longer than wide, and wider posteriorly than anteriorly. The anteroconid on all specimens is at most a small swelling at the center of the anterior cingulum, not a distinct cusp as in *E. elegans*. The anterior cingulum extends both buccally and lingually from the center of the anterior margin of the tooth about equal distances, and does not fuse posteriorly with the bases of the protoconid or metaconid until extremely late stages of wear. The

protoconid and metaconid are subequal in size, with the metaconid positioned slightly more anteriorly than the protoconid. The protoconid is oval in occlusal outline and slightly crescentic. The connection of the metaconid and protoconid to the anterior cingulum (or anteroconid) is variable. On 50% of the specimens, the anterior arm of the protoconid runs directly anteriorly to meet the anterior cingulum at its center. There is an anterior arm of the metaconid that extends anteriorly to meet the anterior cingulum as well, forming a double connection, on 38% of the specimens. The other specimens have differing morphologies. On two specimens, the anterior arm of the metaconid joins the anterior arm of the protoconid, forming a single loph that ultimately joins the anterior cingulum. One specimen, CM 73539, has no connection between the protoconid and anterior cingulum, but there is a connection with the anterior arm of the metaconid instead. The posterior arm of the protoconid extends lingually, joining the posterolingual corner of the metaconid on all but four of the m1s. On three of these specimens, the posterior arm of the protoconid ends just short of meeting the metaconid. On CM 76107, the posterior arm of the protoconid is a small stub extending lingually from the ectolophid. The ectolophid runs between the protoconid and hypoconid, along the center-line of the tooth. The ectolophid does not connect on CM 76130. On 63% of the specimens, a very short mesolophid is at the center of the ectolophid. It is never long. The remainder of the m1s completely lack a mesolophid. On CM 73540, a metastylid is present along the lingual margin of the tooth between the lingual cusps. It is transversely

elongated, but does not reach the ectolophid or mesolophid. On the buccal side of the ectolophid a short buccal mesolophid that is variable in length, is always present. In a little more than half of the m1s it is just a small stub. In the remainder it is slightly longer, but never reaches the buccal edge of the tooth. The posterior half of m1 has little variation. The entoconid and hypoconid are subequal in size, and the entoconid is just slightly more anterior than the hypoconid. As in the anterior cusps, the entoconid is oval in outline, whereas the hypoconid is slightly crescentic. The hypolophid runs buccally from the entoconid and joins the hypoconid at its anterolingual corner. The posterior cingulum runs lingually from the posterior margin of the hypoconid along the posterior edge of the tooth, ending just before meeting the posterior edge of the entoconid. In very late stages of wear, the lingual end of the posterior cingulum fuses with the entoconid forming an enclosed basin.

The second lower molar is nearly equidimensional, being barely longer than wide. The shape of the four major cusps and ectolophid is the same as in m1: the protoconid and metaconid are spaced slightly farther apart, making the anterior width of the tooth equal to the posterior width. The anterior arm of the protoconid extends anteriorly to the anterior margin of the tooth as in m1. A buccal cingulum extends from the point where the anterior arm of the protoconid meets the anterior margin of the tooth, and reaches the buccal margin of the tooth, turning slightly posteriorly at the corner of the tooth. A lingual cingulum, extending from the same point along the anterior edge of the tooth is present on 72% of the specimens. When present, it is very weakly developed anterior to the metaconid and never reaches the lingual edge of the tooth. On the remainder of the m2s, there is no lingual extension of the anterior cingulum. The posterior arm of the protoconid extends lingually as in m1, but ends short of joining the metaconid on 68% of the specimens. On the rest of the specimens it joins the posterior side of the metaconid as in m1. The posterior arm of the protoconid joins the metaconid on its buccal side in one specimen (CM 76115) but a short lophule extends lingually from that point into the valley between the lingual cusps. A mesolophid is only present on a single specimen (CM 76511) as a short spur. The buccal mesolophid is present on all but one specimen and is of variable length, but never extending more than half the distance from the ectolophid to the buccal edge of the tooth. The configurations of the entoconid, hypoconid, hypolophid and posterior cingulum of m2 are the same as in m1.

The m3 is much narrower posteriorly than anteriorly. It is usually longer than wide, but the length of m3 is more variable than the width, so on some specimens the width is nearly equal to the length. Both

the protoconid and metaconid are similar to those of m1 and m2, but are anteroposteriorly compressed. The anterolingual corner of the protoconid meets the anterior margin of the tooth, rather than forming a distinct arm as in the anterior molars. The anterior cingulum varies in length, but is only anterior to the protoconid and never extends lingually. The posterior arm of the protoconid meets the metaconid on half of the specimens, and falls just short of the metaconid on the rest. A small swelling (metastylid) is at the lingual end of the posterior arm of the protoconid only if the arm reaches the edge of the tooth without meeting the metaconid. On one specimen, CM 73573, the posterior arm of the protoconid extends more posteriorly, meeting with the entoconid lingually. The ectolophid is oriented obliquely (posterolingually) rather than directly anteroposterior as in the other molars, joining the hypolophid just buccal to the entoconid, at the same point as the anterior arm of the hypoconid. None of the specimens have a mesolophid. On 10 of the 12 specimens of m3, a buccal mesolophid is present as just a small spur. On one of these specimens, CM 73579, has a second spur. The entoconid is anteroposteriorly compressed and smaller than the anterior cusps. The hypoconid forms the center of the posterior margin of the tooth and is reduced to a swelling along the posterior cingulum.

Discussion—Wood (1937) diagnosed *Eumys brachyodus* as having molars that were broader than in other species, a greatly reduced anteroconid on m1, a double connection of the metalophid to the anteroconid on m1, small or absent mesolophids, weak lingual anterior cingulum on m2-m3, and more robust mandible and lower incisor. Martin (1980) generally followed this diagnosis, but eliminated the character of the double connection of the anteroconid because it was variable in occurrence. The specimens from Blue Ash are referable to *E. brachyodus* because the lower molars are proportionally wider than in other species, although not quite as proportionally wide as those of previously reported of *E. brachyodus* (Table 2, Appendix). The double connection of the anteroconid occurs in about 1/3 of the m1s from Blue Ash. While this character does not occur in all specimens of *E. brachyodus*, it does not occur in any other species. All of the other diagnostic characters of the lower molars for *E. brachyodus* are also present in the Blue Ash sample.

The only upper molars of *E. brachyodus* that were reported previously consisted of a heavily-worn M1-M3 (Martin, 1980:fig. 3) for which no measurements were provided and a specimen with anomalous, heavily-worn upper teeth of uncertain identification (Korth, 1981a:fig. 2). Setoguchi (1978) referred several isolated upper molars to *E. brachyodus* from what he believed to be the Whitneyan of Wyoming.

However, the fauna is Orellan in age and the cited specimens are referable to *Wilsonneumys planidens* (Korth, 1980, 1981b, 1989). Martin (1980) added the presence of a smaller anterocone on M1 to his revised diagnosis of *E. brachyodus* based on his cited specimen. The upper molars from Blue Ash referred to *E. brachyodus* have M1s with slightly smaller anterocones than have been reported for *E. elegans* (Wahlert, 2004) and are relatively wider than those of other species, but only slightly so (Table 2). However, the M3s from Blue Ash are relatively more elongated than those of other species. The only other feature, other than proportions, that distinguishes the Blue Ash sample from other species of *Eumys* is the presence of a distinct parastyle on M1. This occurs in 70% of the Blue Ash specimens, thus it is not always present, but this feature has not been reported for any other species of the genus.

Eumys parvidens Wood, 1937
(Figure 1G, H)

Type Specimen—UNSM 10036, partial skull with associated mandibles; complete dentition.

Referred Specimens—CM 76123, left m1; CM 76129, right m1; and CM 84645, right M3.

Measurements—CM 76123 (m1): L = 2.21 mm; W = 1.66 mm. CM 76129 (m1): L = 2.19 mm; W = 1.77 mm. CM 84645 (M3): L = 1.50 mm; W = 1.58 mm.

Discussion—Morphologically, these three Blue Ash molars do not differ from those previously described for *Eumys parvidens* (Wood, 1937; Martin, 1980). However, the specimens are slightly larger than previously reported for *E. parvidens* (Wood, 1937:525) and clearly smaller than specimens of *E. elegans* (see Appendix). This is the latest record of *E. parvidens*, which is elsewhere limited to the Orellan (Wood, 1937, 1980; Martin, 1980; Korth, 1994).

Scottimus Wood, 1937
Scottimus kellamorum Black, 1961b
(Figure 2A-F; Table 3)

Scottimus sp. Korth, 1981a

Type Specimen—MCZ 7342, partial maxilla with left M1-M2.

Referred Specimens—CM 83747-83755, 83757-83759, 83765, 83766, 83768-83771, 83882, 84655 – M1; CM 83772, 83773, 83775-83781, 83783-83786, 83822, 84656 – M2; CM 83788, 83790, 84654 – M3; CM 83791-83796, 83799, 83802, 83834, 83835 – m1; CM 83805, 83806, 83808, 83810-83815, 83817-83819, 83821, 83823, 83825-83829, 84657 – m2; CM 83830, 83831, 83833, 83837, 83838 – m3.

Emended Diagnosis—Molars similar in length to those of *S. exiguus*, but much narrower relative to length than any other species; molars more lophate than *S. ambiguus* and *S. viduus*; transverse lophs (protoloph and metaloph) weak on upper molars; posterior arm of the protoconid usually joins posteriorly running loph from the metaconid on m1.

Description—M1 and M2 of the holotype has been fully described by Black (1961b). The following descriptions of M1 and M2 are based on variations observed on the referred Blue Ash specimens. On the anterocone of M1, there is a small basin at the posterobuccal corner of the tooth as in *S. exiguus* (Wood, 1937:fig. 63; Korth, 1981a:fig. 9B). In approximately 25% of the Blue Ash M1s, there is an accessory spur extending into the valley between the anterocone and the protoloph. On two specimens there are two accessory lophules. These lophules occur randomly and can originate in the anterocone and extend posteriorly, or originate from the paracone or anterior arm of the protocone and extend anteriorly, buccally or lingually. The connection of the paracone to the protocone (protoloph) runs from the posterolingual corner of the paracone to the posterior arm of the protocone, as in the holotype. On two specimens, there is an additional connection from the paracone to the anterior arm of the protocone. On CM 83882 there is no connection between the paracone and protocone. All of the specimens of M1 have a mesoloph present, but on about 20% of the specimens the mesoloph does not extend far enough buccally to fuse with the ectoloph. Black (1961b) noted that the metaloph connected to the posterobuccal corner of hypocone. In the Blue Ash sample, the attachment of the metacone varies from the position in the holotype, to the center of the hypocone (one specimen), or directly to the posterior cingulum (72% of the specimens).

On M2, the mesoloph is present on over 80% of the specimens, and on 25% the mesoloph reaches the ectoloph, whereas on the remainder it ends lingual to it. The metaloph of M2 on the holotype is weak and connects from the metacone to the center of the buccal side of the hypocone. This morphology occurs on 30% of the Blue Ash specimens. On the remainder of the specimens the metacone connects to the posterior cingulum as in M1. On one specimen, CM 83784, there is a weak connection between the paracone and protocone (protoloph) similar to the protoloph of M1.

As with the anterior molars, M3 is proportionally longer relative to width than in other species of *Scottimus* (Table 3). The occlusal morphology of M3 is very similar to that of *S. exiguus* (Wood, 1937:fig. 63; Korth, 1981a:fig. 9B). It differs from *S. exiguus* in being greatly expanded posterolingually, and the hypocone is reduced to a small cuspule.

The lower molars referred to *S. kellamorum* are proportionally longer than wide, as in the upper molars (Table 3). Although there are no mandibles with complete lower dentitions, based on the measurements

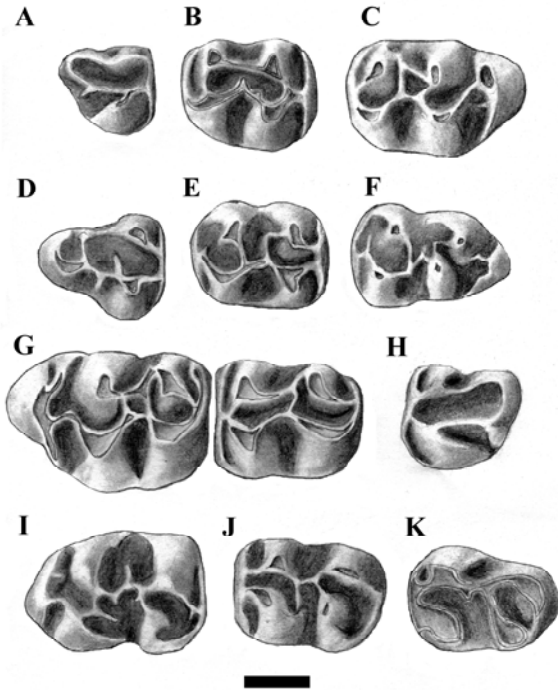


FIGURE 2. Molars of *Scottimus* from the Blue Ash local fauna. A-F, *S. kellamorum*. A, CM 83788, right M3. B, CM 83775, right M2. C, CM 83749, right M1. D, CM 83837, right m3. E, CM 83806, right m2. F, CM 83795, right m1. G-K, *S. sp.*, cf. *S. longiquus*. G, CM83761, left M1-M2. H, CM 83789, left M3. I, CM 83798, right m1. J, CM 83316, right m2. K, CM 83836, right m3. Bar scale = 1 mm.

of the isolated referred specimens, the molars decrease in length from m1 to m3. The m1 is the largest lower molar and is approximately 15% longer than m2, and m3 is slightly shorter than m2. The first molar tapers anteriorly. The anteroconid is central, conical, and nearly has large as the other major cusps of the tooth. The anteroconid is separated from the metaconid and protoconid by a deep valley but is always connected to a loph that is continuous with the anterobuccal slope of the metaconid. On half of the m1s in the sample, there are one or two short spurs that extend into the valley between the anteroconid and protoconid, usually originating from the anteroconid, but also from the protoconid or even the loph connecting the metaconid to the anteroconid. The major cusps are obliquely compressed except the entoconid. The posterior arm of the protoconid extends lingually and is usually joined by a short loph extending posteriorly from the apex of the metaconid. On some specimens the loph continues

more lingually from the junction. On only two specimens, CM 83792, CM 83802, there is no posterior loph from the metaconid and the posterior arm of the protoconid ends in the valley between the metaconid and entoconid short of the lingual edge of the tooth. A distinct loph runs posteriorly along the lingual side of the tooth from the apex of the metaconid, ending in the valley between the metaconid and entoconid. The anterior arm of the hypoconid extends lingually, then turns anteriorly, forming the ectolophid. It joins the protoconid at its posterolingual corner. On half of the specimens, a mesolophid is present but is only a short stub extending lingually from the ectoloph. Rarely, there is a similar spur extending buccally from the ectolophid between the protoconid and hypoconid. The entoconid is slightly anteroposteriorly compressed and the anterobuccal slope of the cusp joins the lingual end of the anterior arm of the hypoconid. The posterior cingulum is high, wrapping around the posterior end of the tooth and enclosing a deep basin between the entoconid and hypoconid. There is a very short buccal extension of the posterior cingulum running from the junction of the posterolingual arm of the hypoconid and the lingual posterior cingulum. There is always a short loph (spur) extending lingually into the basin from the posterolingual corner of the hypoconid.

The m2 is rectangular in occlusal shape, being longer than wide. The anterior cingulum extends the entire width of the tooth and is joined separately by anterior extensions of both the protoconid and metaconid, forming a J-shaped basin between the cusps. The posterior arm of the protoconid is the most variable character of m2. It extends posterolingually and usually joins the metaconid posterior to its apex, however, can extend to the lingual edge of the tooth and not join the metaconid at all. The edge of the tooth on the buccal side between the protoconid and hypoconid is often high and forms an anteroposterior loph. The posterior ridge of the metaconid is the same as in m1, and usually joins the lingual end of the posterior arm of the protoconid. The compression of the major cusps and their connections are the same as in m1. The only difference in the posterior part of m2 compared to m1 is the presence of a buccal spur from the ectolophid on about half the specimens, and the lack of the spur from the hypoconid into the posterior basin of the tooth on most of the specimens. The buccal extension of the posterior cingulum is more prominent on m2 than on m1.

The anterior half of m3 is very similar to that of m2. The tooth tapers posteriorly. The posterior arm of the protoconid extends to the lingual edge of the tooth. The hypoconid is much smaller than in m2 and the entoconid is only a small cuspule at the lingual end of the loph extending lingually from the anterolingual corner of the hypoconid. There is no buccal extension

TABLE 3. Dental measurements of *Scottimus* from the Blue Ash fauna. Abbreviations as in Table 2. Measurements in mm. Measurements in mm.

<i>Scottimus kellamorum</i>									
	M1L	M1W	M2L	M2W	M3L	M3W	L/W M1	L/W M2	L/W M3
N	14	18	14	13	2	2	13	13	2
M	2.59	1.66	1.82	1.46	1.47	1.23	1.55	1.24	1.20
Min	2.35	1.52	1.68	1.28	1.45	1.19	1.46	1.11	1.22
Max	2.81	1.78	1.95	1.60	1.48	1.26	1.66	1.40	1.17
SD	0.13	0.08	0.10	0.09			0.07	0.09	
CV	5.15	4.65	5.48	6.00			4.28	6.86	
	m1L	m1W	m2L	m2W	m3L	m3W	L/W m1	L/W m2	L/W m3
N	10	10	17	19	5	5	10	17	5
M	2.27	1.40	1.94	1.48	1.83	1.35	1.62	1.31	1.36
min	2.14	1.28	1.77	1.33	1.70	1.22	1.51	1.20	1.30
max	2.52	1.51	2.09	1.64	1.92	1.42	1.76	1.38	1.43
SD	0.11	0.08	0.10	0.09	0.08	0.08	0.08	0.05	0.06
CV	4.94	5.65	5.37	6.18	4.41	5.93	4.79	3.92	4.52
<i>Scottimus</i> sp., cf. <i>S. longiquus</i>									
	M1L	M1W	M2L	M2W	M3L	M3W	L/W M1	L/W M2	L/W M3
N	6	6	1	1	1	1	6	1	1
M	2.97	2.01	2.16	1.69	1.78	1.43	1.48	1.28	1.24
Min	2.87	1.90					1.42		
Max	3.07	2.16					1.52		
SD	0.07	0.09					0.04		
CV	2.21	4.47					2.42		
	m1L	m1W	m2L	m2W	m3L	m3W	L/W m1	L/W m2	L/W m3
N	3	3	4	4	1	1	3	4	1
M	2.68	1.73	2.18	1.60	2.17	1.58	1.55	1.37	1.37
Min	2.60	1.72	2.17	1.53			1.50	1.25	
Max	2.75	1.75	2.22	1.73			1.60	1.42	
SD	0.08	0.02	0.03	0.09			0.05	0.08	
CV	2.82	0.88	1.15	5.75			3.14	5.59	

of the posterior cingulum which is greatly shortened due to the reduction in the posterior width of the tooth.

Discussion—The specimens from Blue Ash are referable to *Scottimus kellamorum* based mainly on the proportions of the molars. In his diagnosis, Black (1961b) noted that the upper molars of *S. kellamorum* were similar in size to those of *S. exiguus*, but were clearly not as wide relative to length. These same proportions are true for both the upper and lower molars referred here to *S. kellamorum*.

The type of *Scottimus kellamorum* is from the Arikarean of Montana. The only other specimen referable to this species other than the Blue Ash material is a single partial maxilla with M2-M3 from the Whitneyan of South Dakota, YPM-PU 23264, originally identified as *Scottimus* sp. (Korth, 1981a).

The latter specimen was distinct from *S. exiguus* in its narrower M2 (Korth, 1981a:table 3), a character of *S. kellamorum*. YPM-PU 23264 should be referred to *S. kellamorum* and extends the range of the species to the Whitneyan.

Scottimus sp. cf. *S. longiquus* Korth, 1981a
(Figure 2G-K; Table 3)

Scottimus longiquus Korth, 1981a (in part)

Referred Specimens—CM 83761, partial maxilla with M1-M2; CM 83756, 83763, 83764, 83767– M1; CM 83789 – M3; CM 83897, 83898, 83801, 84653 – m1; CM 83809, 83816, 83820, 83824 – m2; CM 83836 – m3.

Description—The only tooth not previously described for *S. longiquus* is M3. All of the remaining cheek teeth in the Blue Ash fauna have the same morphology as described for the type and referred material (Korth, 1981a). M3 is very similar to that of *S. lophatus* (Wood, 1937:fig. 66), but is proportionally longer. The anterior cingulum extends the entire anterior width of the tooth and wraps around both the anterolingual and anterobuccal corners of the tooth. The paracone is conical and connected to the anterior cingulum anteriorly at its lingual side. The ectoloph extends posterior from the paracone, curving buccally and completely wrapping around the posterobuccal part of the tooth, forming a large loop. At the posterolingual side of the loop is a small hypocone. An anterior loph runs directly to the buccal side of the protocone, isolating an anteroposteriorly oriented basin in the center of the tooth. The protocone is obliquely compressed into a ridge that extends posteriorly from its lingual end toward the hypocone, defining another basin lingual to the large central one.

Discussion—The larger specimens of *Scottimus* from Blue Ash are morphologically indistinguishable from *S. longiquus* described from the Orellan of Montana (Korth, 1981a). However, they are slightly larger in size than the latter and slightly smaller than those of *S. lophatus* from the Whitneyan of Nebraska (Wood, 1937). Korth (1981a) referred two specimens from the Whitneyan of South Dakota questionably to *S. longiquus*. These specimens are slightly larger than the type specimen (Korth, 1981a:table 4) and likely represent the same species that is present in the Blue Ash fauna. Besides the differences noted by Korth (1981a) that separate *S. longiquus* from *S. lophatus*, it appears that the relative length of M3 is also greater in the former than in the latter.

Leidymys Wood, 1936

Leidymys juxtaparvulus n. sp.

(Figure 3A-E; Table 4)

Type Specimen—CM 83852, left M1.

Referred Specimens—CM 83842, 83844, 83846, 83848, 83853-83858, 83971 – M1; CM 83861, 83865, 83866, 83871, 83874, 83876, 83877 – M2; CM 83883, 83884, 83888-83890, 83892, 83893, 83895, 83896, 83899, 83901, 84648 – m1; CM 83803, 83917, 83924, 83926 – m2; CM 83832, 83928, 83930 – m3.

Diagnosis—Small species similar in size to *L. korthi*, smaller than all other species except *L. parvus*; differs from *L. korthi* in having M1 the protocone never attaching to anterocone and in possessing a small anterostyle; differs from other species in having upper molars with a long but weak mesoloph that is much lower than the other lophes; differs from *L. korthi* and *L. alicae* in having a small spur present lingual to

hypoconid on m1 within the posterior basin (as in *L. nematodon* and *L. blacki*); differs from *L. nematodon* and *L. blacki* in lacking a connection between the protoconid and anteroconid on m1.

Etymology—Latin, *juxta*, next to; and *parvulus*, smallest.

Description—M1 is the largest of the upper molars. The anterocone is semicircular in occlusal outline and extends anteriorly well beyond the paracone. The anterocone is limited to the buccal half of the tooth. The valley between the anterocone and protoloph is deep. Lingual to the anterocone, anterior to the protocone is a small, distinct anterostyle. On a few M1s it is modified into a high anteroposteriorly running loph between the protocone and the posterolingual corner of the anterocone. The paracone and metacone are oval (anteroposteriorly compressed), and the lingual cusps (protocone and hypocone) are slightly crescentic in outline. The anterior arm of the protocone extends anterobuccally, ending in the valley between the paracone and anterocone. On one specimen, CM 83853, the anterior arm of the protocone continues to the posterior wall of the anterocone. This connection is very weak, not strongly developed as in specimens of *L. korthi* (Williams and Storer, 1998). One specimen, CM 83857, has the anterior arm of the protocone running directly buccally and ending at the anterobuccal corner of the paracone. The paracone is isolated or only weakly connected to the protocone. After moderate wear, there is a thin connection between the paracone and the posterobuccal side of the protocone. On only one specimen, CM 83857, the connection is with the anterobuccal side of the protocone. The mesoloph extends to the buccal margin of the tooth, ending in a small mesostyle. The mesoloph is much lower than the metaloph and surrounding cusps. On only two of the eleven M1s, the mesoloph is extremely short, but the mesostyle is present with a short lingual extension. The metacone connects to the hypocone via the metaloph that meets the hypocone at the anterobuccal corner of the cusp. The posterior cingulum is high and extends from the apex of the hypocone around the posterior end of the tooth, ending lingually posterior to the metacone.

M2 is similar in morphology to M1, but lacks the anterocone. The protocone is obliquely compressed rather than crescentic as in M1. The anterior cingulum extends from the buccal edge of the tooth to the junction with the anterior arm of the protocone. Lingual to this junction, the anterior cingulum is variable, ranging from almost nonexistent to nearly as high as the buccal half and extending nearly to the lingual edge of the tooth. The paracone connects directly lingually with the protocone on all specimens. On one specimen, CM 83877, there is a second posterior connection. The mesoloph is variable in

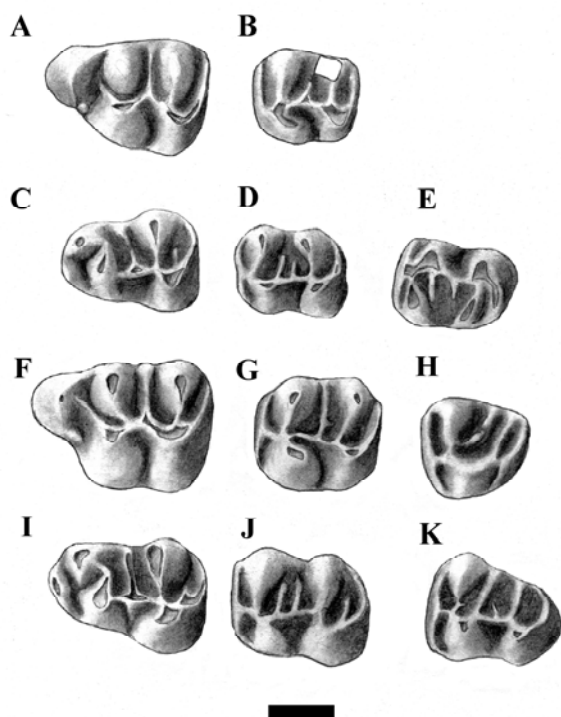


FIGURE 3. Molars of *Leidymys* from the Blue Ash local fauna. A-E, *L. juxtaparvulus*. A, CM 83852, left M1 (type). B, CM 83874, left M2. C, CM 83901, left m1. D, CM 83917, left m2. E, CM 83928, right m3. F-K, *L. sp.*, cf. *L. blacki*. F, CM 83847, left M1. G, CM 83879, left M2. H, CM 83880, left M3. I, CM 83897, left m1. J, CM 87915, left m2. K, CM 83929, left m3. Bar scale = 1 mm.

length, from very short to reaching the buccal margin of the tooth. The arrangement of the metacone, hypocone and posterior cingulum is identical to that of M1.

No specimens of M3 have been referred to this species. The m1 is anteroposteriorly elongated and narrower anteriorly than posteriorly. The anteroconid is small and crescentic, wrapping around the anterior margin of the tooth. The anteroconid is isolated or weakly connected to the metaconid but never connected to the protoconid. The metaconid is circular in occlusal outline; the entoconid is anteroposteriorly compressed; and the buccal cusps (protoconid, hypoconid) are slightly crescentic. The posterior arm of the protoconid extends across the tooth, uniting with the metaconid posteriorly. The ectolophid extends directly posteriorly, from the protoconid to the hypoconid. A small mesoconid is present at the center of the ectolophid. The mesolophid is usually long, but can be variable in length. A buccal extension from the mesoconid is present on only two of the m1s. The hypolophid runs from the entoconid directly buccally, joining the hypoconid at its anterolingual corner. The posterior cingulum runs from the apex of the

hypoconid around the back end of the tooth, joining the entoconid at its posterolingual corner, isolating a posterior valley. Within the posterior valley is a short lophule (spur) that runs lingually from a point just posterior to the hypoconid on the posterior cingulum. On some specimens, this is just an enlarged cusplule rather than a distinct lophule.

TABLE 4. Dental measurements of *Leidymys* from the Blue Ash fauna. Abbreviations as in Table 2. Measurements in mm.

<i>Leidymys juxtaparvulus</i>						
	M1L	M1W	M2L	M2W	M3L	M3W
N	11	12	7	7		
M	1.99	1.40	1.47	1.34		
Min	1.82	1.27	1.42	1.20		
Max	2.11	1.51	1.54	1.41		
SD	0.10	0.08	0.04	0.08		
CV	4.87	5.45	2.82	5.78		
<i>Leidymys sp.</i> , cf. <i>L. blacki</i>						
	m1L	m1W	m2L	m2W	m3L	m3W
N	11	11	4	4	3	3
M	1.79	1.26	1.50	1.22	1.56	1.18
Min	1.73	1.18	1.44	1.16	1.49	1.13
Max	1.85	1.33	1.56	1.27	1.63	1.21
SD	0.04	0.05	0.05	0.05	0.07	0.04
CV	2.16	3.95	3.54	3.97	4.49	3.54
<i>Leidymys sp.</i> , cf. <i>L. blacki</i>						
	M1L	M1W	M2L	M2W	M3L	M3W
N	10	10	14	14	4	4
M	2.25	1.57	1.67	1.53	1.43	1.46
Min	2.08	1.45	1.58	1.44	1.38	1.41
Max	2.37	1.73	1.82	1.68	1.49	1.49
SD	0.09	0.08	0.07	0.08	0.05	0.04
CV	3.91	5.31	3.95	5.09	3.19	2.46
<i>Leidymys sp.</i> , cf. <i>L. blacki</i>						
	m1L	m1W	m2L	m2W	m3L	m3W
N	9	9	24	24	8	8
M	1.98	1.45	1.80	1.45	1.78	1.42
Min	1.86	1.34	1.63	1.33	1.65	1.30
Max	2.09	1.55	1.91	1.64	1.90	1.55
SD	0.06	0.07	0.08	0.07	0.08	0.07
CV	3.19	4.59	4.19	4.75	4.44	5.09

The second lower molar is rectangular in occlusal outline, longer than wide. The anterior cingulum runs the entire width of the tooth. The metaconid and entoconid are anteroposteriorly compressed; the protoconid is crescentic; and the hypoconid is obliquely compressed. The metalophid curves

anteriorly from the metaconid to join the anterior cingulum. The anterior arm of the protoconid joins the anterior cingulum at the same point. The ectolophid runs posteriorly and slightly lingually from the protoconid to the hypoconid. The posterior arm of the protoconid (=anterior mesolophid) is variable in length, usually running about half the distance from the ectolophid to the lingual edge of the tooth, but can extend longer. The second mesolophid is always short, extending to about the center of the valley separating the metaconid and entoconid. The entoconid, hypoconid, and posterior cingulum are similar to those in m1, but there is no cuspule or small spur extending into the posterior basin.

The m3 is the smallest of the lower molars and narrower posteriorly than anteriorly. The anterior cingulum and cusps of the metalophid are nearly identical to that of m2. The entoconid and hypoconid are greatly reduced in size and the mesolophid (second mesolophid) is lacking. The posterior cingulum extends more posteriorly than in the anterior molars, making the tooth look more elongated.

Discussion—The morphology of the molars of *Leidymys juxtaparvulus* is most similar to that of *L. blacki* from the Arikareean of South Dakota and Nebraska (Macdonald, 1963, 1970; Martin, 1980), but it is much smaller, being almost exactly the same size as *L. korthi* from the Arikareean of Saskatchewan (Williams and Storer, 1998:table 2). The molars of *L. juxtaparvulus* differ from those of *L. korthi* in lacking the strong connection between the anterior arm of the protocone and the anterocone on M1, possessing a short lophule (spur) extending lingually into the posterior basin of m1, and weaker development of the mesoloph on the upper molars.

Leidymys juxtaparvulus is easily distinguished from *L. sp.*, cf. *L. blacki* from Blue Ash by its smaller size (Table 4), weaker development of the mesoloph on the upper molars, and lack of a connection between the protoconid and anteroconid on m1.

Leidymys sp., cf. *L. blacki* (Macdonald, 1963)
(Figure 3F-K; Table 4)

Referred Specimens—CM 83840, 83841, 83845, 83847, 83849-83851, 83859, 83870, 83972 – M1; CM 838774, 83822, 83860, 83862-83864, 83867-83869, 83873, 83875, 83878, 83879, 83969 – M2; CM 83787, 83880-83882 – M3; CM 83885-83887, 83891, 83894, 83897, 83898, 83900 – m1; CM 83804, 83904-83916, 83918-83923, 83925, 83927, 83973, 84525 – m2; CM 83929, 83931-83937, 83970 – m3.

Description—The morphology of the Blue Ash sample is smaller in size but indistinguishable from teeth described and figured elsewhere for *Leidymys blacki* (Macdonald, 1963, 1970; Martin, 1980). There

is very little variation in the occlusal morphology of the molars. There is a small bump in the endoloph posterior to the protoloph on both M1 and M2 that is variable in size from absent to nearly forming a double connection with the paracone. On M2, the lingual half of the anterior cingulum is always present, but the height ranges from very low to nearly as high as the protoloph. M3 is the most variable of the upper molars. The size of the hypocone and metacone are the most variable characters.

On m1, the anteroconid is usually connected lingually with the metaconid, but on some specimens a short loph connects the protoconid to the anteroconid. Otherwise there is no variation m1. The relative lengths of the two mesolophids on m2 vary slightly. Generally, the anterior mesolophid (=posterior arm of the protoconid) is longer than the posterior mesolophid, but the former is variable in length and may reach the lingual border of the tooth or be shorter than the posterior mesolophid. On a few specimens of m2, the lingual ends of the two mesolophids fuse. The only other variation on m2 is the presence of a short spur into the basin formed by the posterior cingulum and hypolophid. This lophule is present on about 25% of the specimens. On a few specimens, there is a small cuspule (hypoconulid) in its place. The size of the entoconid and the posterior mesolophid are the most variable characters on m3. The entoconid may be nearly as large as the metaconid on some specimens, but may be completely absent on others. Similarly, the posterior mesolophid is never very long and may be completely absent on some specimens.

Discussion—Although there is very little difference in the occlusal morphology of the molars from Blue Ash referred to *Leidymys sp.*, cf. *L. blacki* and *L. blacki* from the Arikareean of Nebraska and South Dakota, the average dimensions of the molars from Blue Ash are consistently 9% smaller than those reported for *L. blacki* (Macdonald, 1963:99, 1970:table 32; Martin, 1973:table 9; Table 4, this paper). However, the size of the molars from Blue Ash are still larger than the next smallest species of *Leidymys*, *L. alicae* (Black, 1961c:74; Rasmussen, 1977:tables 60, 61). Due to the minor differences in size, the Blue Ash material cannot be definitely referred to *L. blacki*.

Pacculus Cope, 1879
Pacculus dakotensis n. sp.
(Figure 4A-F; Table 5)

Type Specimen—CM 83942, right M1.

Referred Specimens—CM 83843, 83943, 83953, 83954, 83967, 83975, 83977, 83978, 83983, 83992-83995 – M1; CM 83872, 83987, 84549, 84556, 84558, 84566, 84568 – M2; CM 84569, 84570 –M3; CM 84500, 84503, 84506, 84516-84520, 84523, 84526,

84527, 84531, 84532, 84534-84536, 84540, 84543-84545 – m1; CM 84586, 84594-84596, 84600, 84601, 84603, 84610, 84611, 84620 – m2; CM 84628, 84639 – m3.

Diagnosis—Smaller than all other species except *P. woodi*; M3 longer than wide (wider than long in other species); upper molars not as wide relative to length as in *P. insolatus*; anterocone on M1 similar to that of *P. insolatus*, not as anteriorly expanded as in other species.

Etymology—Dakota, reference to the state where the type and referred specimens were recovered (South Dakota) and the Greek suffix, *-ensis*, referring to location.

Description—The molars are mesodont in crown height, higher crowned than the other cricetids from Blue Ash except *Geringia* (described below). The upper molars decrease in size from M1 to M3. M1 is longer than wide, similar to *P. nebraskensis* and *P. montanus* in proportions, not proportionally as wide as in *P. insolatus*. The anterocone is a large, distinct cusp that projects anteriorly as in other species. The anterior extent of the anterocone is similar to that of *P. insolatus* and does not extend as far anteriorly as in *P. montanus* or *P. nebraskensis*. The anterocone is attached lingually to the anterior arm of the protoconid. In approximately one-third of the M1s, there is a short lophule extending buccally or anterobuccally into the valley between the protoloph and the anterocone. This is just a small spur that is always free at the end, not fusing with any other cusp or loph. The buccal cusps (paracone and metacone) are anteroposteriorly compressed, and the protocone and hypocone are obliquely compressed. The paracone attaches via the protoloph, directly to the posterobuccal corner of the protocone. The endoloph is continuous posteriorly with the hypocone. The mesoloph is long, always reaching the lingual edge of the tooth. The metaloph is similar to the protoloph; the metacone attaching to the posterobuccal corner of the hypocone. The posterior cingulum runs from the apex of the hypocone the entire width of the tooth along its posterior margin, ending posterior to the metacone. A narrow valley separates the lingual end of the posterior cingulum and the metacone. On two specimens, CM 83995 and CM 83967, there is an anterior cingulum, anterior to the protocone, low on the crown. There is no anterior cingulum on any of the other specimens.

M2 is rectangular in outline, being longer than wide. The occlusal morphology is very similar to that of M1, but lacking the large anterocone. The anterior cingulum extends the anterior width of the tooth, arising from the protocone. The lingual cusps (protocone, hypocone) are obliquely compressed to a greater degree than in M1, but the attachments of the lophs and cusps are identical to that of M1.

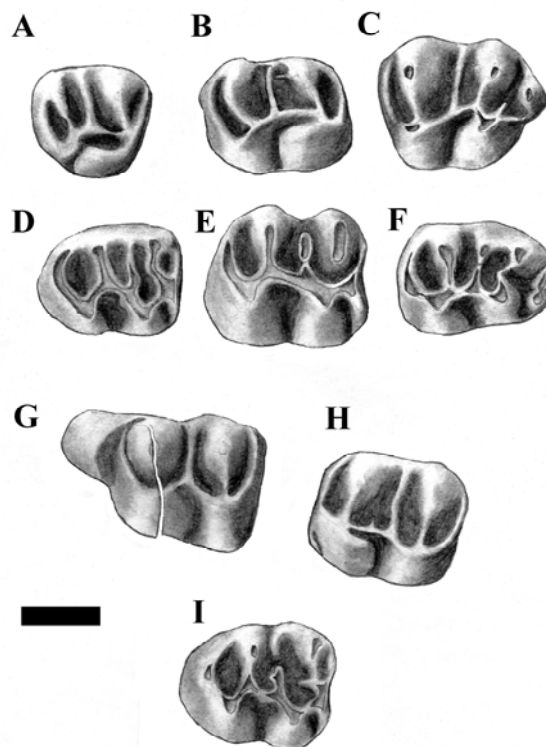


FIGURE 4. Molars of *Paciculus* from the Blue Ash local fauna. A-F, *P. dakotensis*. A, CM 84570, right M3. B, CM 84566, right M2. C, CM 83942, right M1 (type). D, CM 84628, right m3. E, CM 84620, right m2. F, CM 84527, right m1. G-I, *P. sp.*, cf. *P. nebraskensis*. G, CM 83839, left M1. H, CM 84565, left M2. I, CM 84573, right m3. Bar scale = 1 mm.

There are only two specimens referable to M3. The tooth is roughly triangular in occlusal outline, and slightly longer than wide (Table 4). M3 is smaller than the other upper molars. The occlusal morphology of CM 84570 is similar to that of M2s except that the hypocone and metacone are greatly reduced in size, making the tooth taper posteriorly. The other M3, CM 84569, has a less reduced metacone, a protocone that is not obliquely compressed, and the mesoloph connects directly with the protocone rather than arising from the endoloph. There is no endoloph on CM 84569.

The m1 is similar in size to m2, but narrower anteriorly than posteriorly. The anteroconid is very small or completely absent. It is situated on the buccal side of the anterior edge of the tooth, even with or slightly anterior to the metaconid. The anteroconid is isolated from the metaconid and protoconid on 35% of the m1s, and connected lingually to the metaconid on 35% of the specimens. Only on four of the 20 specimens is there a connection with the anteroconid and both the metaconid and protoconid. Any

connection with the protoconid is a very weak, thin loph. In advanced stages of wear the anteroconid is continuous with both the metaconid and protoconid. The protoconid is circular in occlusal outline and positioned anterior to the protoconid. The protoconid is obliquely compressed. There are three transverse lophs on m1. The most anterior is the posterior arm of the protoconid that is slightly curved, and joins the posterior side of the metaconid at the lingual edge of the tooth. On 80% of the specimens this loph is complete or nearly complete. In the remainder (four specimens) the posterior arm of the protoconid is a short loph, extending only about half the width of the tooth. The second transverse loph is the mesolophid. It is usually a complete loph from the ectolophid to the lingual margin of the tooth, ending in a distinct metastylid. Commonly, the mesolophid is short, but is complemented by a buccally directed lophule from the metastylid. Only on three specimens is the mesolophid short (half the width of the tooth) without a matching metastylid. The third transverse loph is the hypolophid that runs from the anteroposteriorly compressed entoconid to a point on the ectolophid anterior to the hypoconid. The posterior cingulum extends the width of the tooth along its posterior side from the hypoconid to a point posterior to the entoconid. With wear, the posterior cingulum always joins the entoconid.

The m2 is similar in dimensions to m1, but is rectangular in occlusal outline, being as wide anteriorly as posteriorly. The anterior cingulum extends the entire anterior width of the tooth, both ends being free. The metaconid and protoconid are even with one another and both join the anterior cingulum just lingual to the protoconid in a small anteroconid. The metalophid curves slightly anteriorly to meet the anterior cingulum. The posterior arm of the protoconid extends lingually to a point posterior to the metaconid, but never reaches the lingual edge of the tooth. The ectolophid runs diagonally from the protoconid to a point on the hypolophid, just buccal to the entoconid. The ectolophid bends buccally from this point to join the hypoconid. The hypolophid is angled slightly anteriorly. The hypolophid and posterior cingulum are the same as in m1.

The m3 is slightly smaller than the anterior molars, and only represented by two specimens. The tooth tapers posteriorly due to the reduction of the hypoconid and entoconid. CM 84628 has an occlusal morphology very similar to that of m2, but with the reduced posterior cusps and a posteriorly extended posterior cingulum. The other specimen of m3, CM 84639, differs in the complete lack of an entoconid and hypolophid.

Discussion—*Pacculus dakotensis* is clearly referable to this genus because of the crown-height of

the molars (mesodont), slightly reduced anterocone on M1, and generally simplified occlusal morphology of the molars. It is distinct from other species of the genus in its size. It is smaller than any other species except *P. woodi*, the smallest described species (Wood, 1936:table I; Black, 1961a:12; Nichols, 1979:table 8). The reduction of the anterocone on M1 in *P. dakotensis* is similar to the condition in the type species *P. insolatus* (Wood, 1936:fig. 4; Martin, 1980:fig. 20A), but *P. dakotensis* does not have upper molars as wide relative to the length as in the former. The small lophule in the valley between the protoloph and the anterocone on M1 of *P. dakotensis* occurs in only about a third of the specimens, but is unknown in any other species of the genus. Its presence is believed to be a primitive condition because this loph is commonly present and often complete to the anterocone in a number of eumyine cricetids. *Pacculus dakotensis* also differs from other species of the genus in that M3 is longer than wide. In all other species M3 is wider than long.

Specimens referable to *Geringia* from the Blue Ash fauna can be separated by their smaller size from those of *Pacculus dakotensis* as well as other morphologies of the molars, especially m1 and M1 (see below discussion of *Geringia*).

TABLE 5. Dental measurements of *Pacculus dakotensis* from the Blue Ash fauna. Abbreviations as in Table 2. Measurements in mm.

	M1L	M1W	M2L	M2W	M3L	M3W
N	13	13	7	7	2	2
M	2.11	1.58	1.70	1.44	1.52	1.37
Min	2.06	1.43	1.63	1.34	1.5	1.3
Max	2.18	1.75	1.77	1.51	1.53	1.43
SD	0.03	0.09	0.05	0.06		
CV	1.63	5.62	2.87	4.17		
	m1L	m1W	m2L	m2W	m3L	m3W
N	20	19	10	10	1	1
M	1.88	1.35	1.83	1.83	1.73	1.43
Min	1.78	1.24	1.76	1.46		
Max	2.01	1.46	1.95	1.66		
SD	0.06	0.06	0.06	0.06		
CV	3.06	4.12	3.37	3.37		

Pacculus sp., cf. *P. nebraskensis* Alker, 1969
(Figure 4G-I)

Referred Specimens—CM 83839, fragmentary maxilla with left M1; CM 84565, left M2; and CM 84573, right m3.

Measurements—CM 83839 (M1): L = 2.45 mm; W = 1.63 mm. CM 84565 (M2): L = 1.81 mm; W = 1.60 mm. CM 84573 (m3): L = 1.97 mm, W = 1.57 mm.

Discussion—The morphologies of the molars referred to *Paciculus* cf. *P. nebraskensis* are similar to those of *P. dakotensis* but differ in being larger and slightly lower crowned than *P. dakotensis*, and having the molars more anteroposteriorly elongated. These specimens most closely approach *P. nebraskensis* from the Arikareean in size and morphology (Korth, 1992), but appear slightly lower crowned.

Geringia Martin, 1980
Geringia copiosus n. sp.
(Figure 5A-E; Table 6)

Paciculus nebraskensis Alker, Martin, 1980 (in part)

Type Specimen—CM 83964, partial left maxilla with M1-M2.

Referred Specimens—CM 84512 - partial maxillae with M1-M2; CM 54082, 83938-83941, 83944-83952, 83955-83963, 83965, 83966, 83968, 83974, 83979-83982, 83984-83986, 83988-83991, 83996-83998, 84542 - M1; CM 84546-84548, 84550-84555, 84557, 84559-84564, 84567, 84668-84671 - M2; CM 84571, 84572, 84574-84582 - M3; CM 83902, 83999, 84501, 84502, 84504, 84505, 84507-84511, 84513-84515, 84521, 84522, 84524, 84528, 84530, 84533, 84537-84539, 84541 - m1; CM 54081, 54089, 84583-84585, 84587-84593, 84597-84599, 84602, 84604-84609, 84612-84619, 84621-84625 - m2; CM 84626, 84627, 84629-84638, 84640-84644 - m3.

Diagnosis—Largest species of the genus; M1 with anterocone larger than in other species and with accessory lophule between anterior cingulum and protoloph; M2 and m2 longer than wide (equidimensional in other species); m3 shorter than m2 (longer than m2 in other species).

Etymology—Latin, *copiosus*, abundant.

Description—M1 is similar to that of *Geringia mcgregori* described by Martin (1980). The M1s of Blue Ash *Geringia* differ from those of *G. mcgregori* in being slightly longer (anteroposteriorly), having a larger anterocone, and having an accessory lophule. The anterocone in the Blue Ash material is always a small cusplule or swelling at the buccal end of the anterior cingulum; this is likely why the M1s from Blue Ash are longer than those reported for *G. mcgregori* (Martin, 1973:table 10). On specimens from Blue Ash, an accessory lophule is present between the anterior cingulum and protoloph. It arises from the anterobuccal corner of the protocone and extends buccally or anterobuccally into the valley. The lophule is usually short, only extending a short

distance. However, on one specimen, CM 83947, the lophule connects to the anterocone forming a small fossette between it and the anterior cingulum.

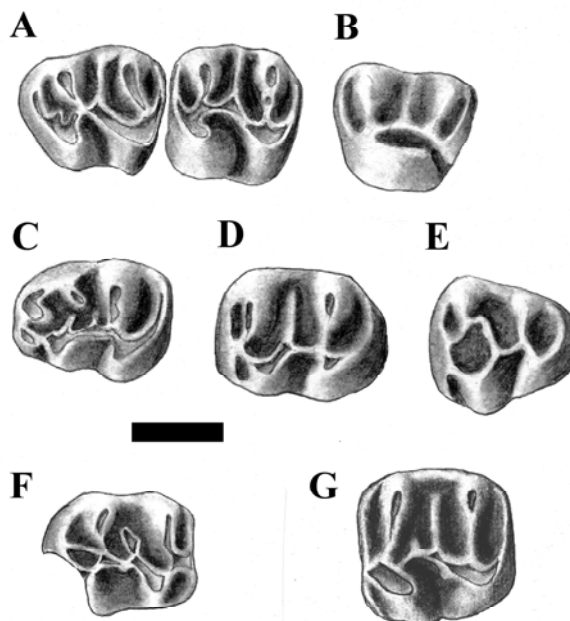


FIGURE 5. Molars of *Geringia copiosus* and indeterminate cricetids from the Blue Ash local fauna. A-E, *G. copiosus*. A, CM 83964, left M1-M2 (type). B, CM 84571, left M3. C, CM 84522, left m1. D, CM 84584, left m2. E, CM 86435, left m3. F, Cricetid Indeterminate sp., CM 83807, right m2. Bar scale = 1 mm.

M2 is similar to M1, as noted by Martin (1980) for *G. mcgregori*. However, there is no anterocone or accessory lophule present as in M1. The only difference between the Blue Ash specimens of *G. copiosus* and those of *G. mcgregori* is in the proportions of the tooth. In the latter, M2 is nearly square (equidimensional), but the M2s of *G. copiosus* are longer than wide and more rectangular in occlusal outline (Table 6).

M3 is the smallest of the upper molars and typically reduced posteriorly to a nearly triangular shape. The posterior cusps (metacone and hypocone) are reduced in size, however, the metacone is only slightly smaller than the paracone, making the tooth slightly longer than wide (wider than long in *G. mcgregori*). The mesoloph is long and the protoloph and metaloph are as in M2. The valley separating the hypocone and protocone is very narrow, and even absent in some specimens. The protocone and hypocone fuse lingually after only minimal wear, forming a lingual fossette.

The m1 is tapered anteriorly and is similar in size to m2. The anteroconid is very small and connects to both the metaconid and protoconid on 73% of the specimens. The few without the connection have very little wear. This connection isolates a small anterior fossettoid as described by Martin (1980) for the genus.

TABLE 6. Dental measurements of *Geringia copiosus* from the Blue Ash fauna and comparative measurements of *G. mcgregori*. *G. mcgregori* based on measurements listed in Martin (1973:table 10) from the Gering Formation of Nebraska. Abbreviations as in Table 2. Measurements in mm.

<i>Geringia copiosus</i>						
	M1L	M1W	M2L	M2W	M3L	M3W
N	45	45	18	18	11	11
M	1.78	1.45	1.48	1.30	1.32	1.22
Min	1.55	1.16	1.37	1.17	1.27	1.19
Max	2.00	1.74	1.55	1.42	1.40	1.26
SD	0.11	0.12	0.05	0.08	0.04	0.02
CV	6.42	8.03	3.60	6.17	3.28	1.87
	m1L	m1W	m2L	m2W	m3L	m3W
N	25	25	34	35	17	16
M	1.65	1.20	1.66	1.37	1.59	1.32
Min	1.5	0.98	1.55	1.17	1.44	1.20
Max	1.77	1.37	1.75	1.48	1.68	1.43
SD	0.07	0.09	0.06	0.07	0.06	0.06
CV	4.10	7.19	3.40	5.15	4.07	4.77
<i>Geringia mcgregori</i>						
	M1L	M1W	M2L	M2W	M3L	M3W
N	4	4	4	4	3	3
M	1.53	1.33	1.42	1.41	1.15	1.21
Min	1.47	1.20	1.33	1.36	1.12	1.18
Max	1.57	1.39	1.46	1.48	1.18	1.26
SD	0.05	0.09	0.06	0.05	0.03	0.04
CV	3.20	6.75	4.10	3.88	2.65	3.43
	m1L	m1W	m2L	m2W	m3L	m3W
N	4	4	4	4	3	3
M	1.71	1.28	1.56	1.49	1.71	1.36
Min	1.63	1.22	1.49	1.43	1.60	1.11
Max	1.75	1.41	1.63	1.61	1.79	1.56
SD	0.06	0.09	0.06	0.08	0.10	0.23
CV	3.37	7.09	3.84	5.56	5.69	16.85

The posterior arm of the protoconid is almost always complete, or nearly complete to the lingual margin of the tooth, usually fusing with the posterior side of the metaconid, and rarely with the metastylid. A

mesolophid is usually present but is almost always very short or even absent. On three of 26 specimens, the mesolophid extends the entire width of the tooth. Martin (1980) diagnosed the genus as having the mesolophid and hypolophid of m1 forming a V-shape. However, it appears that what he was referring to as a mesolophid is the posterior arm of the protoconid. The ectolophid connects the protoconid to the hypoconid and the entoconid is attached to the ectolophid anterior to the hypoconid via the hypolophid. The posterior cingulum encircles a posterior basin as described by Martin (1980) for *G. mcgregori*.

The m2 is rectangular in occlusal outline and nearly identical in size to m1 (Table 6). In other species of *Geringia*, the m2 is nearly square in outline and shorter than m1. The morphology of m2 of *G. copiosus* differs little from that described for *G. mcgregori* (Martin, 1980). The anterior cingulum has a short lingual extension anterior to the protoconid, and both the metaconid (via the metalophid) and protoconid join the anterior cingulum buccal to its center. The mesolophid (which consists of the posterior arm of the protoconid) is always long, but does not always extend the entire width of the tooth. The remainder of the morphology of m2 is the same as in m1.

Unlike the m3 of *G. mcgregori*, the m3 of *G. copiosus* is shorter than m2. The morphology of the anterior cingulum, protoconid, and metaconid are similar to that of m2. The m3 is tapered and expanded posteriorly. The hypoconid is greatly reduced and the entoconid variable reduced. There are always two transverse lophs: the posterior arm of the protoconid and the hypolophid. The hypolophid is always complete but the posterior arm of the protoconid (mesolophid) does not always reach the lingual edge of the tooth as in m2.

Discussion—*Geringia copiosus* is the best represented rodent in the Blue Ash fauna, being known from more than 150 specimens. It is referable to *Geringia* mainly based on its mesodont molars and the marked reduction of the anterocone on M1. It is easily distinguishable from the other species of *Geringia* by the lesser reduction of the anterocone on M1, its larger size, presence of a short mesolophid on m1, and the proportions of the teeth (M2, m2 longer than wide; m3 shorter than m2). All specimens of M1 of *G. copiosus* have a short lophule that extends buccally from the protocone into the valley separating the protoloph and anterior cingulum that is unknown in other species.

Specimens of *Geringia copiosus* are easily separable from those of *Pacculus dakotensis* by size (Tables 5, 6) and molar morphology, especially M1 and m1. The M1s of *G. copiosus* have a much smaller anterocone and always have the distinct accessory lophule between the protoloph and anterior cingulum.

On *P. dakotensis*, the anterocone is larger and the accessory lophule is present on only some of the specimens. The m1 of *G. copiosus* usually has two transverse lophes (posterior arm of the protoconid and hypolophid), whereas m1 of *P. dakotensis* has three (posterior arm of protoconid, mesolophid, hypolophid). There is usually a mesolophid on m1 of *G. copiosus*, but it is very short and does not reach the lingual side of the tooth as in *P. dakotensis*. The anteroconid is almost always connected to the protoconid on specimens of *G. copiosus*, but in *P. dakotensis*, this connection is never until the tooth is in a late stage of wear. These differences between *Geringia* and *Paciculus* from Blue Ash also appear to be distinctions between other species of these genera (see Black, 1961a:fig. 4; Nichols, 1979:pl. 6, figs. 7, 8; Martin, 1980:figs. 16-18; Korth, 1992:fig. 16).

Martin (1980:fig. 21A) figured a partial maxilla with M1-M2 that he identified as *Paciculus nebraskensis*. Later, Korth (1992) described a large sample of *P. nebraskensis* and noted that the specimen figured by Martin did not belong to that species and was likely a specimen of *Geringia*. The specimen figured by Martin, UNSM 11527, is of appropriate size to belong to *G. copiosus*, and has the accessory lophule on M1 diagnostic of the species. It is very likely that UNSM 11527 is referable to *G. copiosus*.

Cricetid indeterminate sp.
(Figure 5F)

Referred Specimens—CM 83807, right m2; and CM 86472, CM 84661, left M2s.

Measurements—CM 83807 (m2): L = 1.61 mm, W = 1.38 mm. CM 86472 (M2): L = 1.66, W = 1.60 mm. CM 84661 (M2): L = 1.70; W = 1.61.

Description—The m2 (CM 83807) is rectangular, longer than wide. It is very low crowned, much lower than the other cricetids reported from Blue Ash. The anterior cingulum extends the entire width of the anterior margin of the tooth, joining the metaconid lingually, and wrapping around the anterobuccal corner of the tooth. The lingual cusps are anteroposteriorly compressed and the buccal cusps are obliquely compressed. The metalophid curves anteriorly from the metaconid and is joined by the anterior arm of the protoconid just before it joins the anterior cingulum just lingual to the protoconid. The connection of the metalophid to the anterior cingulum is wide, but there is no distinct cuspule. The ectolophid runs only slightly diagonally from the protoconid to the hypoconid. There is a small mesoconid along it, just anterior to the hypoconid. The mesolophid is a continuation of the posterior arm of the protoconid and ends in the center of the valley separating the metaconid and entoconid. The lingual end of the

mesolophid is a triangular cusp. A minute metastylid is at the base of the posterior slope of the metaconid along the lingual edge of the tooth. A low ridge runs along the lingual edge of the tooth between the metaconid and entoconid. The hypolophid runs buccally from the entoconid, joining the ectolophid just posterior to the mesoconid. A small, thin lophule runs directly posteriorly from the junction of the ectolophid and the hypolophid and joins the posterior cingulum, forming a triangular fossette lingual to the hypoconid and ending posteriorly at a hypoconulid. The posterobuccal corner of the hypoconid is broken away, but the posterior cingulum runs from the hypoconid along the posterior margin of the tooth and is continuous with the posterior wall of the entoconid, enclosing another triangular basin lingual to the first.

The M2 is nearly square in occlusal outline, just slightly longer than wide. It is brachyodont, but slightly higher-crowned lingually than buccally. The anterior cingulum extends the entire width of the tooth. The protoloph joins the anterior cingulum lingual to the center of the tooth via the anterior arm of the protocone. The buccal cusps are anteroposteriorly compressed and the protoloph and metaloph are parallel and directed transversely across the tooth. The lingual cusps (protocone and hypocone) are obliquely compressed. There is a high anteroposteriorly directed ridge along the buccal border of the tooth, connecting the paracone and metacone, and enclosing a basin between the protoloph and metaloph. The enoloph runs anterobuccally from the hypocone and joins the buccal side of the protocone by a narrow connection. Just posterior to the junction of the entoloph with the protocone is a small spur that extends buccally. The mesolophis lang and parallel to the metaloph and protoloph, but ends just before meeting the buccal anteroposterior ridge. The posterior cingulum extends the entire width of the tooth from the apex of the hypocone along the posterior margin of the tooth, ending at the buccal edge of the tooth, just posterior to the metacone.

Discussion—The occlusal morphology of the molars referred to an indeterminate cricetid most closely approaches those of *Geringia* and *Paciculus* but are much lower crowned. On m2, the distinctive accessory loph dividing the posterior basin of the in two and the triangular cusp at the lingual end of the mesolophid are unique among the Blue Ash cricetids.

The M2s are referred to the same species as the lower molar due to their similar size and crown-height. Also, both molars have a distinct anteroposteriorly directed loph isolating a central basin. On the M2 it is along the buccal margin and on the m2 it is along the lingual margin. At present, these specimens cannot be referred to any known genus or species of cricetid from North America.

CONCLUSIONS

The age of the Blue Ash anthill fauna has been questioned because of the combination of Arikareean, Whitneyan, and earlier taxa (see Korth, 2009). The cricetid fauna is similarly ambiguous. At the level of genus, the Blue Ash fauna appears to be Arikareean with the presence of otherwise Arikareean and younger genera such as *Pacculus*, *Geringia*, and *Leidymys* (Martin, 1980; Korth, 1994; Lindsay, 2008). However, the species from Blue Ash referable to these genera are either smaller or morphologically more primitive. *G. copiosus* has a less reduced anterocone on M1 than Arikareean species, *P. dakotensis* and *L. juxtaparvulus* are both smaller than nearly all of the Arikareean species. The species from Blue Ash that occur in the Arikareean cannot be definitely referred to these species, *Leidymys* sp., cf. *L. blacki* and *Pacculus* sp., cf. *P. nebraskensis*, because they are either smaller (as in the former) or lower crowned (as in the latter).

Similarly, *Scottimus kellamorum* was originally reported from the Arikareean (Black, 1961b). However, it appears that it is also from the Whitneyan (= *Scottimus* sp., Korth, 1981a).

Two species, *Eumys parvidens* and *Scottimus longiquus*, were previously known from the Orellan (Wood, 1937, Korth, 1981a, 1994). However, *S. longiquus* also has been reported from the Whitneyan (Korth, 1981a). *Eumys brachyodus* is restricted to the Whitneyan (excluding synonymy of *E. eliensis*: see above discussion of *Eumys*).

The cricetid fauna from Blue Ash is similar to that of other groups described in that the provincial ages Whitneyan and Arikareean cannot be definitely assigned. The cricetids suggest that this fauna is either the earliest Arikareean (marked the first occurrence of *Leidymys*, *Geringia*, and *Pacculus*) or the latest Whitneyan (presence of relict species *Eumys brachyodus*, *E. parvidens* and *Scottimus longiquus*).

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APPENDIX

Comparative dental measurements of *Eumys*. *E. elegans* uppers from AMNH collections (FAM) from the Orellan of North Dakota (Wahlert, 2004:table 1). *E. elegans* lowers from two samples of UNSM specimens from the Orellan of Sioux County Nebraska (UNSM localities Sx – 6 and Sx - 14). *E. brachyodus* from Wood (1937:253), Galbreath (1953:table 14), and AMNH and CM collections from the Whitneyan of North Dakota and Nebraska, respectively. Abbreviations as in Table 2. Measurements in mm.

Eumys elegans

	M1L	M1W	M2L	M2W	M3L	M3W	L/W M1	L/W M2	L/W M3
N	15	14	15	15	14	13	14	15	13
M	2.99	1.97	2.04	1.97	1.56	1.74	1.51	1.04	0.90
Min	2.80	1.80	1.90	1.80	1.30	1.60	1.45	0.95	0.81
Max	3.20	2.10	2.20	2.10	1.80	1.90	1.60	1.17	1.06
SD	0.15	0.08	0.11	0.10	0.14	0.10	0.05	0.06	0.06
CV	4.88	4.19	5.17	4.96	8.90	5.53	3.19	5.54	6.76

	m1L	m1W	m2L	m2W	m3L	m3W	L/W m1	L/W m2	L/W m3
N	34	33	34	33	34	34	33	32	34
M	2.34	1.72	2.11	1.93	2.25	1.86	1.36	1.13	1.21
Min	2.10	1.60	1.90	1.80	1.95	1.65	1.24	1.02	1.03
Max	2.60	1.90	2.40	2.20	2.50	2.15	1.56	1.24	1.37
SD	0.12	0.08	0.10	0.09	0.12	0.11	0.07	0.06	0.08
CV	5.06	4.59	4.77	4.83	5.49	5.96	5.19	5.28	6.64

	m1L	m1W	m2L	m2W	m3L	m3W	L/W m1	L/W m2	L/W m3
N	32	35	44	42	41	40	32	42	40
M	2.42	1.75	2.17	1.93	2.17	1.85	1.38	1.13	1.18
Min	2.10	1.55	1.90	1.70	1.95	1.65	1.21	1.02	1.08
Max	2.75	2.10	2.55	2.25	2.50	2.10	1.48	1.24	1.32
SD	0.16	0.12	0.14	0.13	0.12	0.10	0.06	0.06	0.05
CV	6.80	6.82	6.31	6.84	5.50	5.22	4.22	5.18	4.48

Eumys brachyodus

	m1L	m1W	m2L	m2W	m3L	m3W	L/W m1	L/W m2	L/W m3
N	9	10	12	12	10	10	9	12	10
M	2.36	1.89	2.27	2.13	2.28	2.00	1.26	1.07	1.14
Min	2.10	1.71	2.02	1.90	1.92	1.72	1.18	0.97	1.08
Max	2.62	2.11	2.47	2.28	2.50	2.10	1.32	1.17	1.21
SD	0.14	0.13	0.14	0.11	0.17	0.12	0.05	0.06	0.05
CV	6.06	6.88	6.05	4.98	7.44	6.21	3.91	5.18	4.25