

**MAMMALS FROM THE BLUE ASH LOCAL FAUNA (LATE OLIGOCENE), SOUTH DAKOTA.
RODENTIA PART 6: FAMILY CASTORIDAE AND ADDITIONAL EOMYIDAE
WITH A SUMMARY OF THE COMPLETE RODENT FAUNA**

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ABSTRACT

A single beaver tooth (Castoridae) and several isolated teeth referable to the Eomyidae are described from the Blue Ash anthill fauna of South Dakota. The castorid tooth is referred to *Agnotocastor* sp. Four isolated upper molars are referred to a new species *Orelladjidaumo amplus*. It is distinguished from the only other known and type species of this genus *O. xylodes* (Orellan) by its much larger size and longer mesoloph. The remainder of the eomyid teeth are referred to *Paradjidaumo* sp. This species, reported previously from this fauna, may represent a new species distinguished by the crown-height of the cheek teeth, which is greater than in any other *Paradjidaumo* population. However, the record is too poor to establish this difference with confidence.

A total of 42 species of rodents have been recognized from the Blue Ash anthill fauna representing 10 different families. The rodent taxonomic composition suggests that it is more likely Whitneyan than Arikareean in age.

INTRODUCTION

Preliminary faunal lists of the Blue Ash local fauna of South Dakota (Martin, 1974; Simpson, 1985) recognized from 19 or 22 species of fossil rodents (also see Korth, 2007a:table 1). A large collection of predominantly isolated teeth was collected from anthills in the Blue Ash horizon in the 1970s and constituted more than 1000 specimens (in the permanent collections of the Carnegie Museum of Natural History [CM]). The vast majority of these specimens were of rodents. Recently, in a series of papers, 40 species of rodents have been described from the anthill fauna (Korth, 2007a, b, 2008a, 2009a, 2009b, 2010). The final sample of isolated molars of rodents from this fauna is described below and includes two additional species of rodents not previously recognized, bringing the total of rodent species to 42, nearly twice the number identified in the preliminary studies. The provincial age of the fauna has been in question, with disagreement over whether it represents late Whitneyan or early Arikareean North American Land Mammal Age (NALMA). Now, the complete rodent fauna can be compared to others and the age determined with greater likelihood.

Dental terminology for castorids follows Stirton (1935) and for eomyids follows Wood and Wilson (1936). Upper teeth are designated by capital letters, lower teeth are designated by lower-case letters (e.g., M1 and m1).

SYSTEMATIC PALEONTOLOGY

Family Castoridae
Agnotocastor Stirton, 1935
Agnotocastor sp. indet.
(Figure 1)

Referred Specimen—CM 84637, right M3.

Measurements—L = 2.68 mm; W = 2.60 mm.

Description—The single M3 is only slightly longer than wide, mesodont in crown-height, and rooted. It is squared on the buccal side, and tapers lingually along the posterior wall. The occlusal surface is complex. There is a distinct mesoflexus that extends more than half the width of the tooth and it curves posteriorly at its lingual end. The hypoflexus extends from the posterolingual corner of the tooth obliquely across the tooth to just lingual to its center. There are three small, complex fossettes on the surface of the tooth: one anterior to the mesoflexus and two posterior to it. A narrow flexus originates near the center of the anterior border of the tooth and extends posterolingually, isolating the protocone but not fusing with the hypoflexus.

Discussion—Species belonging to the Palaeocastorinae, Agnotocastorinae, and Anchi-theriomysinae have all been reported from the Whitneyan and Arikareean (Stirton, 1935; Martin, 1987; Korth, 1998, 2001a, 2001b). The Blue Ash M3, CM 84637, most closely approaches the morphology of *Agnotocastor* in its lower crown-height and complexity

of the occlusal pattern. *A. praeteraedens* has been reported from the Whitneyan (Stirton, 1935; Korth, 2001a), but the Blue Ash specimen is slightly smaller. The Blue Ash M3 is also smaller than those referred to the Orellan *A. coloradensis* and *A. readingi* (Korth, 1996, 2001a), and it is also markedly smaller and lower-crowned than the Whitneyan anchitheriomysine, *Oligotheriomys* (Korth, 1998).

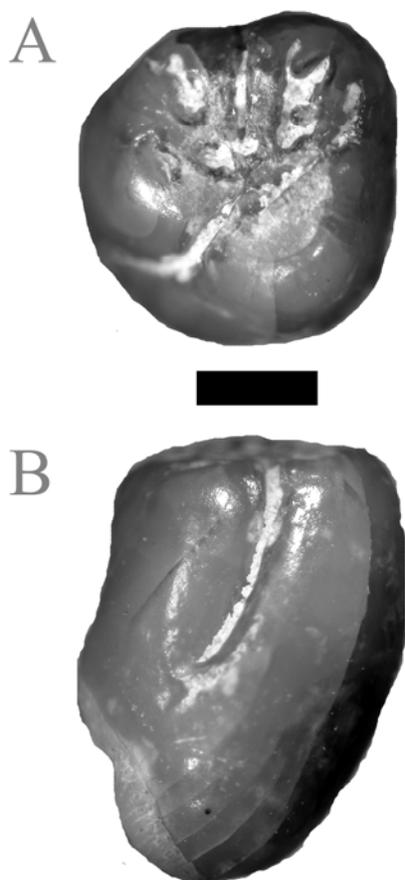


FIGURE 1. *Agnotocastor* sp. from the Blue Ash fauna. CM 84637, right M3. A, occlusal view. B, lingual view. Bar scale = 1 mm.

Family Eomyidae
Orelladjidaumo Korth, 1989
Orelladjidaumo amplus n. sp.
 (Figure 2A, B; Table 1)

Type Specimen—CM 84658, left M1 or M2.

Referred Specimens—CM 84662, CM 84659, and CM 84660, isolated M1 or M2.

Diagnosis—Upper molars larger than in type species, *O. xylodes*; mesoloph long on upper molars, extending to buccal margin of the tooth (short in *O. xylodes*).

Etymology—Latin, *amplus*, large.

Description—The upper molars referred here are larger than any other eomyid recognized from the Blue Ash fauna. They are nearly as long as wide and squared in occlusal outline (Table 1). The crowns are mesodont as in *Paradjidaumo*, but are higher crowned lingually than buccally (unilateral hypsodonty). CM 84662 is the least worn specimen; the lingual height of the tooth is 1.6 mm and the buccal height is only 0.8 mm, half the lingual height. On the more worn specimens, the lingual and buccal heights are not as disparate, but the lingual measurement is always greater.

The anterior cingulum is short, extending from the center of the anterior margin of the tooth to well short of the buccal border. The buccal cusp (paracone, metacone) are anteroposteriorly compressed and the lingual cusps (protocone and hypocone) are obliquely compressed (anterolingual-posterobuccal). The protoloph and metaloph run directly lingual from the paracone and metacone, respectively, joining their lingual cusps at their anteriobuccal corners. The mesoloph is long, extending to the buccal margin of the tooth and parallel to the major lophs. The posterior cingulum extends buccally from the hypocone, ending along the posterior margin of the metacone.

Discussion—These specimens are referred to *Orelladjidaumo* based on the diagnosis of the genus (Korth, 1989): upper molars mesodont and unilaterally hypsodont, and nearly as long as wide. They are distinguished from the type species from the Orellan of Nebraska, *O. xylodes*, by their 25-30% larger size and longer mesolophs.

The crown-height and occlusal morphology of *O. amplus* is very similar to that described for species of *Paradjidaumo* (Wood, 1937; Black, 1965; Setoguchi, 1978; Korth, 1980) but differs from those in having upper molars nearly as long as wide and being more hypsodont lingually than buccally. In species of *Paradjidaumo*, the M1 and M2 have anteroposterior lengths that range from 78 – 87% of the transverse width of the tooth. In both species of *Orelladjidaumo*, the lengths of the upper molars are 97-99% of their width.

Although it is unusual that only upper molars are preserved of *O. amplus*, there are no eomyid lower teeth from the Blue Ash fauna of the size expected for this species.

Korth (1994) listed “*Metadjidaumo*” *cedrus* (Korth, 1981) from the Orellan of Colorado as questionably referable to *Orelladjidaumo*. However, he later suggested that “*M.*” *cedrus* was more likely referable to the Arikareean genus *Neoadjidaumo* (Korth, 2008b). Therefore, the only two definite species of *Orelladjidaumo* are *O. xylodes* (type) and *O. amplus*.

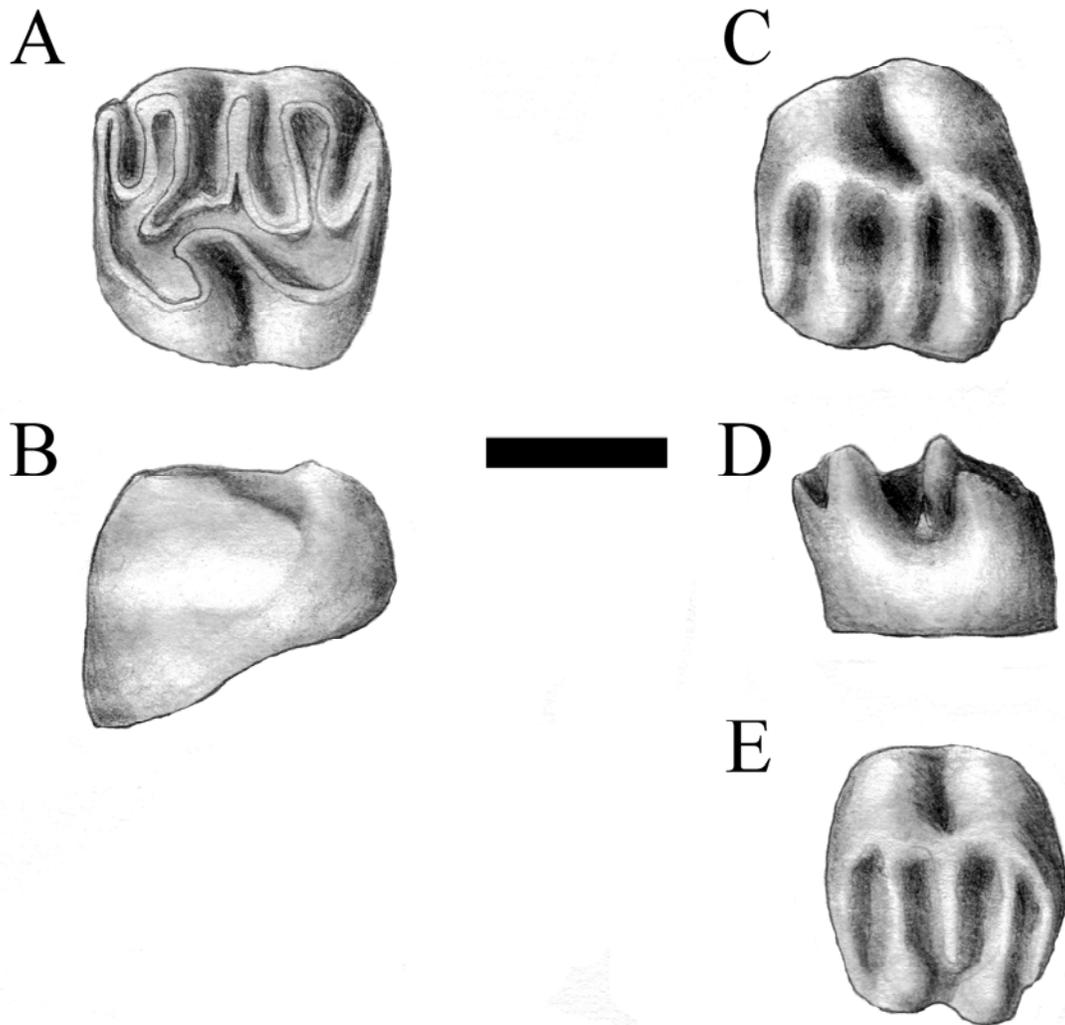


FIGURE 2. *Orelladjidaumo amplus* and *Paradjidaumo* sp. from the Blue Ash fauna. A, B, *O. amplus*, CM 84658, left M1 or M2 (holotype). A, occlusal view. B, posterior view (occlusal surface toward top of page). C-E. *Paradjidaumo* sp. C, D, CM 84663, right m1 or m2. C, occlusal view. D, lingual view. E, CM 84666, right m3 (occlusal view). Bar scale = 1 mm.

Paradjidaumo Burke, 1934

Paradjidaumo sp.

(Figure 2C-E; Table 1, 2)

Additional Referred Specimens—CM 84663, 84664 - m1 or m2; CM 84667 - m3; CM 84665 - M1 or M2; and CM 84666, M3. (Also see Korth, 2007:33.)

Discussion—The specimens referred to *Paradjidaumo* sp. do not differ in morphology or size from those previously identified from the Blue Ash fauna (Korth, 2007a); nor do they differ from the Orellan *P. trilophus* (Korth, 1980) except in crown-height of the lower molars. Dividing the height of the enamel on the lingual side of the tooth measured at the central valley by the maximum width of the tooth provides an index for crown-height. This method has

been used for heteromyid dentitions by Korth (1997) and Lindsay and Reynolds (2008). The lower molars from the Blue Ash fauna have an index that ranges from 0.37-0.43 (mean = 0.40; Table 2). The average crown-height for *P. trilophus* and the supposedly higher-crowned *P. hypsodus* is 0.35-0.36. However, some specimens referred to the latter two species range above the average height of the Blue Ash specimens. Despite overlap, the average height of specimens from the Blue Ash fauna is greater than the average of other samples of *Paradjidaumo*.

A larger sample from the Blue Ash fauna is necessary before it can be established with certainty that the molars are higher-crowned, thus representing a new species.

TABLE 1. Measurements of *Orelladjidaumo amplus* and *Paradjidaumo* sp. from the Blue Ash fauna. Abbreviations: L, anteroposterior length; W, transverse width; ht, lingual crown-height. Since the first and second molars cannot be distinguished, measurements listed as M1 and m1 should be read as M1 or M2 and m1 or m2. Measurements in mm.

	M1L	M1W	M3L	M3W	m1L	m1W	ht	ht/W	m3L	m3W
<i>Paradjidaumo</i>										
sp.										
	84665	1.35	1.47							
	76294	1.2	1.33							
	76294	1.24	1.40							
mean	1.26	1.40								
	84667		1.12	1.47						
	84663				1.50	1.40	0.6	0.43		
	84664				1.45	1.50	0.55	0.37		
mean					1.48	1.45	0.58	0.4		
	84666								1.30	1.40
<i>Orelladjidaumo amplus</i>										
	84662	1.55	1.62							
	84658	1.60	1.68							
	84659	1.65	1.70							
	84660	1.68	1.73							
mean	1.62	1.68								

CONCLUSIONS

With the addition of *Orelladjidaumo amplus* and *Agnotocastor* sp., the total number of rodent species recognized from the Blue Ash anthill fauna is 42 (Table 3). As noted previously, the fauna contains elements characteristic of Orellan, Whitneyan, and Arikareean North American Land Mammal Ages. However, with the full rodent fauna to consider, a more reliable age determination can be made.

Of the 42 rodent species, nearly half of them (19) are unique to this fauna. Four species are otherwise exclusive to the Whitneyan (*Cedromus wilsoni*, *Campestrallomys siouxensis*, *Kirkomys parvus*, *Eumys brachyodus*); two are limited to the late Orellan and Whitneyan (*Prosciurus magnus*, *Scottimus longiquus*); and two are previously known from the Whitneyan and Arikareean (*Scottimus kellamorum*, *Leptodontomys douglassi*). Two additional species are only known from the Orellan (*Protosciurus mengi*, *Eumys parvidens*). Both of these are listed as "cf." because they are slightly larger than the Orellan species.

TABLE 2. Crown-height index (ht/W) for species of *Paradjidaumo*. Abbreviation: N, number of specimens measured; MT, Montana; NE, Nebraska; WY, Wyoming. All other abbreviations as in Table 1.

m1 or m2 ht/W	mean	range	N
<i>P. trilophus</i> (Chadronian, MT)	0.36	0.20-0.48	26
<i>P. trilophus</i> (Orellan, NE)	0.35	0.24-0.40	19
<i>P. "hypsodus"</i> (late Orellan, WY)	0.35	0.27-0.49	16
<i>P. validus</i> (Orellan, NE)	0.38		1
Blue Ash <i>Paradjidaumo</i>	0.40	0.37-0.43	2

Seven species from the Blue Ash fauna are elsewhere restricted to the Arikareean, although three of these are listed as "cf." and are smaller or morphologically more primitive than the Arikareean species (*Florentiamys* sp., cf. *F. kingi*, *Pacculus* sp., cf. *P. nebraskensis*, *Leidymys* sp., cf. *L. blacki*). Similarly, nine species from Blue Ash that represent otherwise Arikareean genera are smaller or morphologically more primitive than the known Arikareean species (*Niglarodon brachyodon*, *Allomys* sp., *Ansomys cyanotephrus*, *Miospermophilus* sp.,

Zetamys sp., *Downsimus* sp., *Paciculus dakotensis*, *Geringia copiosus*, *Hitonkala martintau*). At the generic level, six have their last occurrence in the Whitneyan (*Prosciurus*, *Oligospermophilus*, *Agnotocastor*, *Cedromus*) or are limited to the Whitneyan (*Disallomys*, *Kirkomys*). There are only four species in the Blue Ash anthill fauna that are elsewhere restricted to the Arikareean (*Nototamias* sp., *Protosciurus rachelae*, *Tylionomys voorhiesi*, *Campestralomys dawsonae*).

Based on these occurrences, and stage of evolution of the species present, it appears most likely that the Blue Ash fauna is Whitneyan rather than Arikareean in age. Similar conclusions can be made when considering other mammalian groups such as marsupials, lagomorphs, and insectivorans (Korth, 2007b, 2009c). The only remaining part of the anthill fauna that is yet to be described is the Carnivora and a single artiodactyl tooth.

TABLE 3. Rodent species recognized from the Blue Ash anthill fauna of South Dakota. (Species in bold type are unique to the fauna.)

APLODONTIDAE

Prosciurus clausulus
P. magnus
Campestralomys siouxensis
C. dawsonae
Downsimus sp.
Disallomys robustus
D. intermedius
Ansomys cyanotephrus
Allomys sp.
Niglarodon brachyodon

SCIURIDAE

Hesperopetes jamesi
H. blacki
Nototamias sp.
Douglasciurus sapphirus
Protosciurus sp. cf. *P. mengi*
Protosciurus rachelae
Miospermophilus sp.
Cedromus wilsoni
Oligospermophilus emryi

EUTYPOMYIDAE

Eutypomys wilsoni

CASTORIDAE

Agnotocastor sp.

EOMYIDAE

Paradjidaumo sp.
Orelladjidaumo amplus
Leptodontomys sp. cf. *L. douglasi*
Zophoapeomys indicus

HELISCOMYIDAE

Heliscomys medius
Tylionomys voorhiesi
 (= *Heliscomys* sp.)

FLORENTIAMYIDAE

Florentiamys sp. cf. *F. kingi*
Kirkomys parvus
Hitonkala martintau

GEOMYIDAE

Geomyid undetermined

CRICETIDAE

Eumys brachyodus
E. sp., cf. *E. parvidens*
Scottimus kellamorum
S. sp., cf. *S. longiquus*
Leidymys juxtaparvulus
L. sp., cf. *L. blacki*
Paciculus dakotensis
P. sp., cf. *P. nebraskensis*
Geringia copiosus
 Cricetid indeterminate

FAMILY UNCERTAIN

***Zetamys* sp.**

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LITERATURE CITED

- Black, C. C. 1965. Fossil mammals from Montana. Pt. 2. Rodents from the early Oligocene Pipestone Springs local fauna. *Annals of Carnegie Museum* 38:1-48.
- Burke, J. J. 1934. New Duchesne River rodents and a preliminary survey of the Adjidaumidae. *Annals of Carnegie Museum* 23:391-398.
- Korth, W. W. 1980. Paradjidaumo (Eomyidae, Rodentia) from the Brule Formation, Nebraska. *Journal of Paleontology*, 54:943-951.
- Korth, W. W. 1981. Metadjidaumo (Eomyidae, Rodentia) from Colorado and Wyoming. *Journal of Paleontology*, 55:598-602.
- Korth, W. W. 1989. Geomyoid rodents (Mammalia) from the Orellan (Oligocene) of Nebraska. *Natural History Museum of Los Angeles County Science Series*, 33:31-46.
- Korth, W. W. 1994. The Tertiary Record of Rodents in North America. Plenum Press, 319 pp.
- Korth, W. W. 1996. Additional specimens of *Agnotocastor readingi* (Rodentia, Castoridae) from the Orellan (Oligocene) of Nebraska and a possible origin for the beavers. *Paludicola*, 1:16-20.
- Korth, W. W. 1997. A new subfamily of primitive pocket mice (Heteromyidae, Rodentia) from the middle Tertiary. *Paludicola*, 1:33-66.

- Korth, W. W. 1998. A new beaver (Rodentia, Castoridae) from the Orellan (Oligocene) of North Dakota. *Paludicola*, 1:127-131.
- Korth, W. W. 2001a. Cranial morphology of some early beavers (Rodentia, Castoridae) from the Oligocene (Orellan and Whitneyan) of South Dakota. *Paludicola*, 3:40-50.
- Korth, W. W. 2001b. Comments on the systematics and classification of the beavers (Rodentia, Castoridae). *Journal of Mammalian Evolution*, 8:279-296.
- Korth, W. W. 2007a. Mammals from the Blue Ash local fauna (late Oligocene), South Dakota. Rodentia, Part 1: Families Eutypomyidae, Eomyidae, Heliscomyidae, and Zetamys. *Paludicola*, 6:31-40.
- Korth, W. W. 2007b. Mammals from the Blue Ash local fauna (late Oligocene), South Dakota, Marsupialia and Lagomorpha. *Paludicola*, 6:111-117.
- Korth, W. W. 2008a. Mammals from the Blue Ash local fauna (late Oligocene), South Dakota. Rodentia, Part 2: Families Florentiamyidae and Geomyidae. *Paludicola*, 7:14-25.
- Korth, W. W. 2008b. Eomyid rodents (Mammalia) from the early Arikareean (Oligocene) of western Nebraska. *Paludicola*, 6:144-154.
- Korth, W. W. 2009a. Mammals from the Blue Ash local fauna (late Oligocene), South Dakota. Rodentia, Part 3: Family Sciuridae. *Paludicola*, 7:47-60.
- Korth, W. W. 2009b. Mammals from the Blue Ash local fauna (late Oligocene), South Dakota. Rodentia, Part 4: Family Aplodontidae. *Paludicola*, 7:89-106.
- Korth, W. W. 2009c. Mammals from the Blue Ash local fauna (late Oligocene), South Dakota. Lypotyphla and additional Marsupialia. *Paludicola*, 7:78-88.
- Korth, W. W. 2010. Mammals from the Blue Ash local fauna (late Oligocene), South Dakota. Rodentia, Part 5: Family Cricetidae. *Paludicola*, 7:117-136.
- Lindsay, E. H. and R. E. Reynolds. 2008. Heteromyid rodents from Miocene faunas of the Mojave Desert, southern California. *Natural History Museum of Los Angeles County Science Series*, 41: 213-235.
- Martin, L. D. 1974. New rodents from the Lower Miocene Gering Formation of western Nebraska. *Occasional Papers of the Museum of Natural history, University of Kansas* 32:1-12.
- Martin, L. D. 1987. Beavers from the Harrison Formation (Early Miocene) with a revision of *Euhapsis*, *Dakoterra*, 3:73-91.
- Setoguchi, T. 1978. Paleontology and geology of the Badwater Creek Area, central Wyoming. Part 16. The Cedar Ridge local fauna (late Oligocene). *Bulletin of the Carnegie Museum of Natural History* 9:1-61.
- Simpson, W. F. 1985. Geology and paleontology of the Oligocene Harris Ranch Badlands, southwestern South Dakota. *Dakoterra* 2:303-333.
- Stirton, 1935. A review of the Tertiary beavers. *University of California Publications in the Geological Sciences*, 23:391-458.
- Wood, A. E. 1937. The mammalian fauna of the White River Oligocene. Part 2, Rodentia. *Transactions of the American Philosophical Society* 28:155-262.
- Wood, A. E. and R. W. Wilson. 1936. A suggested nomenclature for the cusps of the cheek teeth of rodents. *Journal of Paleontology* 10:388-391.