
A NEW HEMPHILLIAN (LATE MIOCENE) MAMMALIAN FAUNA FROM HOYE CANYON, WEST CENTRAL NEVADA

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ABSTRACT. A new late Hemphillian (late Miocene) fossil mammalian assemblage, the Hoye Canyon Local Fauna, is now recognized from an unnamed formation exposed along the western flanks of the Wellington Hills, Douglas County, Nevada. The fauna was recovered from the lower part of the unnamed formation and consists of the following taxa: Leporidae, *Pronotolagus nevadensis* n. sp.; Sciuridae, *Spermophilus wellingtonensis*; Sciuridae, *Marmota korthi* n. sp.; Geomyidae, *Parapliosacomys oregonensis*; Camelidae, *Hemiauchenia vera*; ?Antilocapridae, gen. and sp. indet.; Rhinocerotidae, gen. and sp. indet.; and Equidae, *Dinohippus* sp. indet. The middle and upper portions of the unnamed formation previously yielded late Blancan (late Pliocene) and early Irvingtonian (early Pleistocene) faunas. Discovery of the Hoye Canyon Local Fauna now indicates that the formation spans the late Hemphillian to the early Irvingtonian or about 7 to 1.8 million years before present.

INTRODUCTION

Kelly (1997) documented the first records of fossil vertebrates from the Wellington Hills–Antelope Valley area of Douglas County, Nevada. The fossils were recovered from an unnamed formation exposed along the western flanks of the Wellington Hills from the vicinity of Hoye Canyon in the north to Risue Canyon in the south (Fig. 1). Kelly (1997) provisionally recognized two late Cenozoic mammalian faunas from the unnamed formation: the late Blancan Wellington Hills Local Fauna and the early Irvingtonian Topaz Lake Local Fauna. Kelly (1997) reported only one locality in the Hoye Canyon area, UCMP V-95013 (= LACM 6993), that did not yield any age-diagnostic fossils at the time. Because the northern outcrops of the unnamed formation in the Hoye Canyon area are isolated from the southern outcrops by foothills covered with Quaternary alluvium, Kelly (1997, fig. 3) only questionably correlated UCMP V-95013 with the late Blancan localities to the south.

Quarrying at LACM 6993 and the discovery of an additional locality, LACM 6994, that occurs slightly higher in the section above LACM 6993, has resulted in the recovery of age-diagnostic fossils. These new fossils indicate that the fauna from the Hoye Canyon localities is late Hemphillian (late Miocene) in age and, thus, considerably older than the fauna from the late Blancan (late Pliocene) localities of the southern outcrops. The assemblages from LACM 6993 and LACM 6994 are herein named the Hoye Canyon Local Fauna.

The purpose of this report is to document the new records of Hemphillian mammalian fossils from the Hoye Canyon area and reevaluate the biostratigraphy of the unnamed formation exposed along the western flanks of the Wellington Hills.

METHODS

Larger mammal teeth and appendicular elements were measured with a vernier caliper to the nearest 0.1 mm and those of smaller mammals were measured with an optical micrometer disc to the nearest 0.01 mm. All teeth were measured along their greatest anteroposterior and transverse enamel dimensions. Metric abbreviations, dental terminology, and dental formulas follow standard usage. Measurements and calculations of the degree of deflection of the posterior external reentrants in the rabbit lower premolars follows those of White (1987, 1991). Specimens previously collected from the unnamed formation of the Wellington Hills–Antelope Valley area reported on by Kelly (1997) are housed in the University of California, Berkeley, Museum of Paleontology, whereas all new specimens recovered during this study have been deposited in the Vertebrate Paleontology Section of the Natural History Museum of Los Angeles County.

Abbreviations are as follows: AER, anterior external reentrant; AIR, anterior internal reentrant; ANT, anterior; A-P, greatest anteroposterior dimension; AR, anterior reentrant; d, deciduous; D-V, dorsoventral; L, left; Ma, million years before present; PER, posterior external reentrant; PIR, posterior internal reentrant; POST, posterior; R, right; s. s., sensu stricto; TR, greatest transverse dimension. Institutional acronyms are as follows: LACM, Natural History Museum of Los Angeles County; UCMP, University of California, Berkeley, Museum of Paleontology; V-, UCMP vertebrate fossil locality.

GEOLOGY AND FOSSIL OCCURRENCES

Halsey (1953) first reported the occurrence of a thick deposit of Tertiary sediments along the west-

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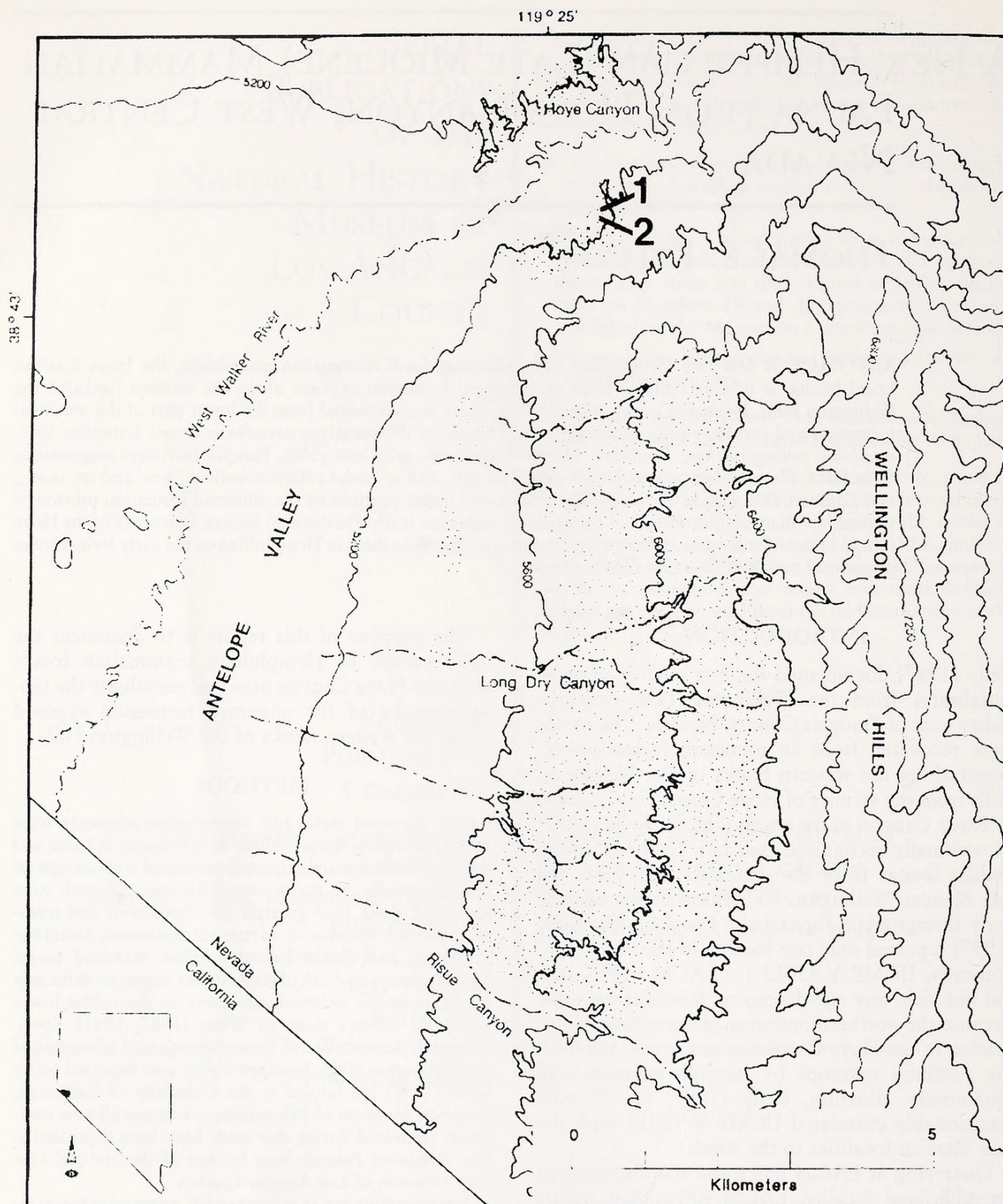


Figure 1. Map of Antelope Valley-Wellington Hills area showing geographic extent of unnamed formation (stippled areas) and locations of Hoyer Canyon fossil localities (1 = LACM 6994, 2 = LACM 6993). Base map: U.S.G.S. 15 minute series, Desert Creek Peak, Nevada-California Quadrangle (scale = 1:62,000, contour interval = 400 ft).

ern flanks of the Wellington Hills from Risue Canyon northward to Hoyer Canyon. Moore (1969) regarded these sediments as probably middle or early late Miocene (Barstovian or Clarendonian) in age. However, Kelly (1997) provided biostratigraphic evidence that these sediments are, in part, late Pliocene to early Pleistocene (late Blancan to early Ir-

vingtonian) in age. Kelly (1997) regarded these sediments as an unnamed formation because they are a single continuously deposited rock unit comprised of stream and lake deposits of relatively homogeneous lithologies.

The unnamed formation of the Wellington Hills area is comprised of alternating sequences of lacus-

trine, braided fluvial, and overbank sediments that are composed of tuffaceous mudstone, diatomaceous shale, siltstone, sandstone, and conglomerate (Kelly, 1997). In Hoyo Canyon, the unnamed formation unconformably overlies Miocene andesite interbedded with minor sedimentary deposits, probably a correlative of the Kate Peak Formation of Gianella (1936), and is unconformably overlain by Quaternary alluvium.

The mammalian fossils were recovered from lacustrine deposits exposed on the south side of Hoyo Canyon (detailed locality data on file at the LACM). Locality LACM 6993 occurs about 170 m above the contact with the Miocene andesite in a 1.6-m-thick sandstone bed that contains small mudstone clasts and thin lenses of conglomerate. The precise stratigraphic position of LACM 6993 relative to the base of the formation is difficult to determine because a small alluvium-filled valley separates the section that contains LACM 6993 from the lowermost portion of the formation. Locality LACM 6994 occurs near the top of a 3.9-m-thick bentonitic clay and mudstone bed, about 30 m stratigraphically higher in the section than LACM 6993.

SYSTEMATIC PALEONTOLOGY

Order Lagomorpha Brandt, 1855

Family Leporidae Fischer de Waldheim, 1817

Genus *Pronotolagus* White, 1991

Pronotolagus nevadensis, new species

Figure 2, Table 1

HOLOTYPE. Partial dentary with L P_3 – M_3 , LACM 145952.

TYPE LOCALITY. LACM 6993.

HYPODIGM. From LACM 6993: partial dentary with L dP_{3-4} , M_{1-3} , LACM 145953; partial dentary with L P_4 – M_3 , LACM 145954; partial dentary with R P_4 – M_2 , LACM 145955; R P_3 , LACM 145956.

DISTRIBUTION AND AGE. Known only from the type locality, late Hemphillian.

ETYMOLOGY. Named for its occurrence in Nevada.

DIAGNOSIS. *Pronotolagus nevadensis* differs from *Pronotolagus albus* Voorhies and Timperley, 1997, by the following characteristics: (1) much smaller size (mean P_3 A-P 62% smaller than that of *P. albus*); (2) better developed and deeper P_3 AIR (depth averages 22.2% of TR occlusal dimension); (3) a distinct P_3 PIR present and cement filled; (4) deeper P_3 AER (depth averages 23% of TR occlusal dimension); and (5) shallower P_3 PER (depth averages 44.2% of TR occlusal dimension). It differs from *Pronotolagus apachensis* (Gazin, 1930) by the following characteristics: (1) much smaller size (mean P_3 A-P 50% smaller than that of *P. apachensis*); (2) deeper P_3 AIR; (3) more distinct and

deeper P_3 PIR (depth averages 8.5% of TR occlusal dimension). It differs from *Pronotolagus whitei* Korth, 1998, by the following characteristics: (1) much smaller size (mean P_3 A-P 53% smaller than that of *P. whitei*); (2) deeper P_3 AIR; (3) better developed P_3 PIR; (4) deeper P_3 AER; and (5) shallower P_3 PER that is inclined posteriorly.

DESCRIPTION. Of the five specimens of *Pronotolagus nevadensis*, LACM 145953 retains dP_{3-4} , indicating that this specimen represents an immature individual, whereas P_3 s of the holotype and the referred specimen (LACM 145956) are in early wear indicating that these specimens represent young adults. Although P_3 s of LACM 145954 and LACM 145955 are missing, the remaining cheek teeth are in early wear and early moderate wear, respectively, indicating that they also represent young adults. The dentary is of typical leporid structure. The anterior margin of the masseteric fossa extends to a point below the middle of M_1 . Numerous small foramina are present on the lateral side of the horizontal ramus below P_3 .

DP_3 is molariform and rooted, with the trigonid and talonid being transversely expanded. An oval-shaped anterior conid is present that is connected to the middle of the anterior face of the trigonid by an isthmus. Likewise, the trigonid is connected to the middle of the anterior face of the talonid by an isthmus. DP_4 also is molariform and rooted but differs from dP_3 by having an anterior marginal crest along the anterior border of the trigonid instead of a distinct conid. Thin enamel bands are present along the posterolabial margins of the dP_{3-4} trigonids and talonids. Hypoconulids are lacking on both deciduous premolars.

P_3 of the holotype (LACM 145952, Fig. 2B) exhibits the following characteristics: (1) size small, as compared with other species of *Pronotolagus*; (2) an AIR and PIR are present with the AIR shallower than the PIR; (3) the AIR depth is 20.8% of the TR occlusal dimension; (4) the PIR depth is 8.3% of the TR occlusal dimension; (5) the AER depth is 25% of the TR occlusal dimension; (6) the PER is 45.8% of the TR occlusal dimension; (7) an AR is lacking; (8) the thick enamel of the PER is relatively straight with a slight posterior deflection (9.2 degrees); (9) the thin enamel of the PER is smooth, lacking crenulations; and (10) cement is present in the AIR, PIR, AER, and PER. P_3 of the holotype was broken off 2.8 mm from the crown at the alveolar border during preparation that allowed examination of the enamel pattern farther down the crown. The enamel pattern (Fig. 2C) at this point is very similar to the occlusal enamel pattern, primarily differing by a slight increase in the depth of the AIR and PIR (21.2% and 10.2% of the TR occlusal dimension, respectively) and a slightly more posteriorly deflected PER (9.3 degrees). The P_3 occlusal enamel pattern of LACM 145956 (Fig. 2D) is very similar to the holotype, primarily differing by having a slightly shallower

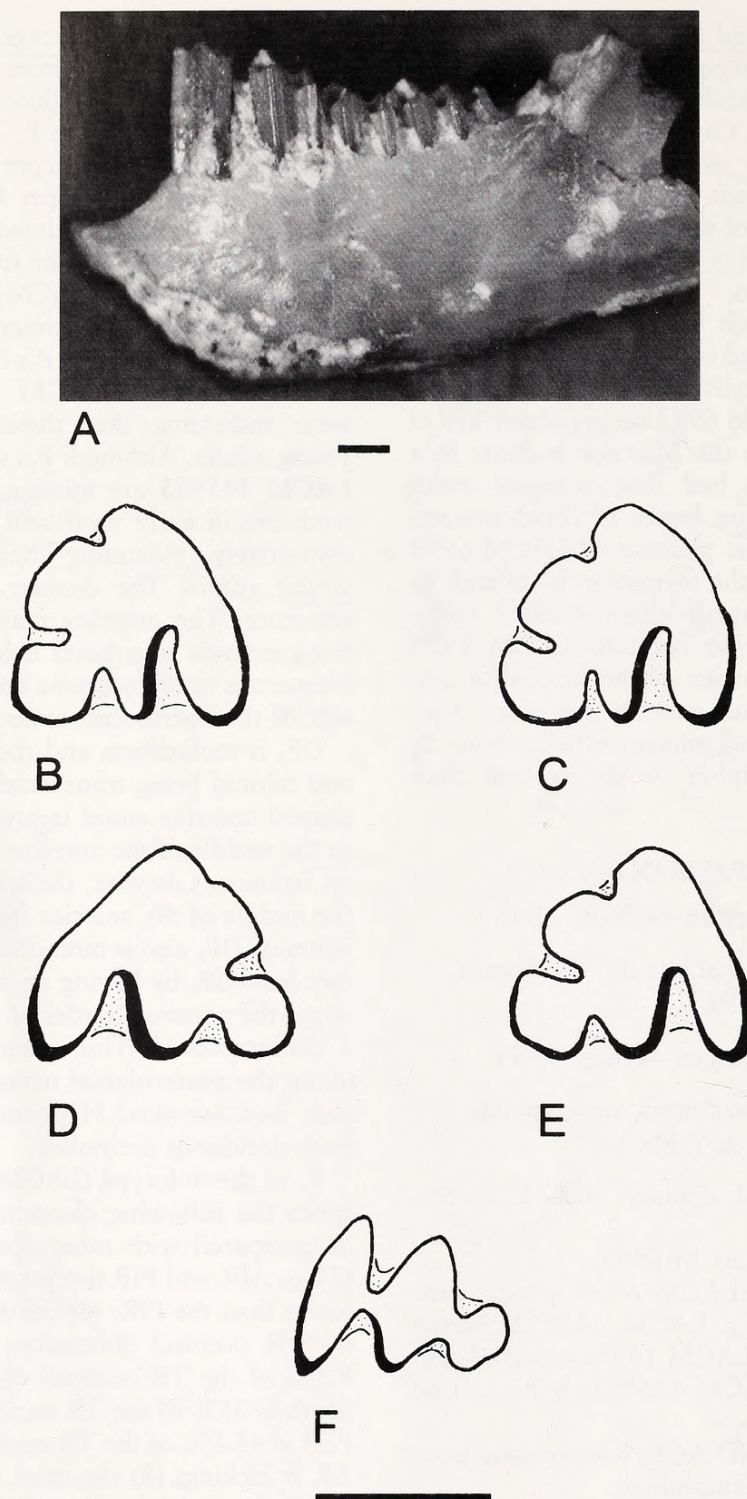


Figure 2. *Pronotolagus nevadensis* new species. A, partial dentary with L P₃–M₃, holotype, LACM 145952, lateral view. B, L P₃, holotype, LACM 145952, occlusal view, anterior left. C, L P₃, holotype, LACM 145952, cross-section 2.8 mm below crown, anterior left. D, R P₃, LACM 145956, occlusal view, anterior right. E, R P₃, LACM 145956, enamel pattern at base of tooth, anterior left. F, R dP₃, LACM 145953, occlusal view, anterior right. Upper scale for A = 1 mm, lower scale for B–F = 1 mm.

PIR, AER, and PER. The reentrants at the occlusal surface of LACM 145956 exhibit the following characteristics: (1) the AIR is 20.9% of the TR occlusal dimension; (2) the PIR is 4.3% of the TR occlusal dimension; (3) the AER is 20.9% of the TR occlusal dimension; (4) the PER is 43% of the TR occlusal dimension; (5) the thick enamel of the

PER is almost straight with a slight posterior deflection (10 degrees); and (6) cement is present in the AIR, PIR, AER, and PER. The enamel pattern at the base of LACM 145956 (Fig. 2E) is similar to the occlusal enamel pattern, primarily differing by having a deeper AIR, PIR, AER, and PER (26.1%, 11.3%, 21.7%, and 43.5% of the TR di-

Table 1. Measurements (in mm) of specimens of *Pronotolagus nevadensis* new species from Hoyo Canyon.

Tooth position/ dimension	Holotype				
	LACM 145953	LACM 145952	LACM 145954	LACM 145955	LACM 145956
dP ₃ A-P	1.06				
ANT-TR	0.70				
POST-TR	1.01				
dP ₄ A-P	1.00				
ANT-TR	1.05				
POST-TR	1.06				
P ₃ A-P		1.20			1.19
TR		1.10			1.04
P ₄ A-P		1.28	1.34	1.33	
ANT-TR		1.33	—	1.34	
POST-TR		1.21	1.55	1.31	
M ₁ A-P	1.02	1.45	1.32	1.33	
ANT-TR	1.09	1.35	1.50	1.45	
POST-TR	1.10	1.30	1.45	1.44	
M ₂ A-P	1.05	1.36	1.33	1.39	
ANT-TR	1.06	1.34	1.36	1.35	
POST-TR	1.04	1.23	1.33	1.34	
M ₃ A-P	0.46	0.68	0.70		
TR	0.50	1.00	0.99		
dP ₃ -M ₃ alveolar A-P	5.25				
P ₃ -M ₃ alveolar A-P		6.31	6.61		
Depth of dentary below P ₄	3.98	5.05	4.91	5.09	

mension, respectively) and a less posteriorly deflected PER (9.7 degrees).

The lower molars are of typical leporid structure with oval-shaped trigonids and talonids that are connected by an isthmus, prominent anterior marginal crests along the anterior borders of the trigonids, and enamel along the posterolabial borders of the trigonids and talonids. In all of the partial dentaries, the molar crowns are well above their alveolar borders.

DISCUSSION. Species of rabbits are primarily differentiated by the morphologies of P² and P₃ (White, 1987, 1991). Recently, Voorhies and Timperley (1997) emended the diagnosis of *Pronotolagus*, wherein they listed the following diagnostic characteristics: (1) small- to medium-sized leporines; (2) an AR is lacking on P₃; (3) the P₃ AIR is more deeply incised than the PIR when the latter is present; (4) the P₃ AER is shallow and wide; and (5) the P₃ PER ranges from 40 to 58% of the transverse occlusal surface. The Hoyo Canyon rabbit specimens exhibit all of these diagnostic characters and can be assigned confidently to *Pronotolagus*.

Although only two P₃s are known for *Pronotolagus nevadensis*, they both exhibit very similar occlusal enamel patterns. These enamel patterns also remain rather consistent down the crown as indicated by the cross-sectional pattern of the holotype 2.8 mm below the occlusal surface and by the enamel pattern at the base of LACM 145956 4.5

mm below the occlusal surface (Fig. 2B-E). Also, the A-P and TR dimensions vary little down the crowns. In the holotype, the P₃ A-P and TR dimensions vary from 1.20 mm and 1.10 mm at the occlusal surface to 1.23 mm and 1.12 mm at the alveolar border, respectively. In LACM 145956, the A-P and TR dimensions vary from 1.19 mm and 1.04 mm at the occlusal surface to 1.21 mm and 1.06 mm at the base of the crown, respectively. Thus, even though P₃s are in early wear, their occlusal dimensions and enamel patterns would change little with additional wear. Dalquest (1979) noted that P₃ is diagnostic in almost all instances, even in immature rabbits where the occlusal surface is unworn by using the enamel pattern at the base of the tooth or cross-sectioned patterns.

The dimensions of rabbit cheek teeth vary with age, wherein P₃s of immature individuals usually exhibit a marked increase in size from the occlusal surface to the base of the tooth (Dice and Dice, 1935, 1941; Wood, 1940; White, 1991). This is true especially for immature P₃s that are unworn or just beginning to wear. For example, in an immature P₃ of *Nekrolagus progressus* (Hibbard, 1939), the A-P dimension at the base of the tooth is 38% larger than the occlusal dimension (Hibbard, 1963, fig. 1b-d). Similarly, in an immature P₃ of *Pratilepus kansasensis* Hibbard, 1939, the A-P dimension at the base of the tooth is 38% greater than the crown dimension (Hibbard, 1963, fig. 2a-a'). In an

unworn P₃ of *Pronotolagus whitei*, the A-P crown dimension is about 22% smaller than the mean A-P dimension of adult P₃s (Korth, 1998, fig. 14D-G, table 14). In *Palaeolagus* Leidy, 1856, and *Lepus* Linnaeus, 1758, the P₃ occlusal dimensions in early wear average about 18% and 10% smaller, respectively, than those of well-worn teeth (Dice and Dice, 1935; Wood, 1940; Hibbard, 1963). As noted above, P₃s of *Pronotolagus nevadensis* do not exhibit any significant differences in the A-P and TR dimensions from the occlusal surface to the base of the crowns. However, because of the small sample size, the possibility that older individuals could have larger P₃s cannot be ruled out. Even if the P₃ A-P dimensions of more mature individuals of *P. nevadensis* were discovered to be 30% larger than those of the holotype and referred specimen, they would still be 45%, 40%, and 30% smaller than the means of those of *Pronotolagus albus*, *Pronotolagus whitei*, and *Pronotolagus apachensis*, respectively. Moreover, the fact that the A-P dimension of dP₄ of *P. nevadensis* is 48% smaller than the mean dP₄ A-P of *P. whitei* (Korth, 1998, table 14) further supports the conspicuous size difference between *P. nevadensis* and the other species of *Pronotolagus*.

Voorhies and Timperley (1997) noted the following evolutionary trends in *Pronotolagus* with decreasing geologic age: (1) a decrease in body size; (2) a deepening of the P₃ AIR; (3) an increase in the amount of cement in the P₃ AIR; and (4) a more distinct P₃ PIR. At the time, only two species of *Pronotolagus* were known, *Pronotolagus albus* from the late Barstovian of Nebraska and *Pronotolagus apachensis* from the Clarendonian of California and the early Hemphillian of Nebraska. Subsequently, Korth (1998) described a third species, *Pronotolagus whitei* from late Clarendonian Pratt Quarry of the Merritt Dam Member of the Ash Hollow Formation, Nebraska. Although *P. whitei* is similar in size to *P. apachensis*, it differs from it by having a deeper P₃ PER that is inclined anteriorly instead of posteriorly (Korth, 1998). Korth (1998) noted that the early Hemphillian specimens from the LeMoyne Quarry of Nebraska that White (1991) referred to *P. apachensis* differ from the topotypic Clarendonian sample of *P. apachensis* from California by having anteriorly inclined P₃ PERs, like those of *P. whitei*. The P₃ AIRs of the LeMoyne Quarry specimens are also deeper and more persistent than the topotypic samples of *P. apachensis* and *P. whitei* (White, 1991; Korth, 1998). Korth (1998) suggested that the LeMoyne Quarry sample might represent a distinct species more closely related to *P. whitei* than *P. apachensis*. P₃s of *P. nevadensis* differ from those of the early Hemphillian LeMoyne Quarry sample by having the following: (1) smaller size; (2) more persistent PIRs; and (3) shallower PERs that are inclined posteriorly rather than anteriorly.

Pronotolagus nevadensis is the smallest species of the genus and its P₃ AIR and PIR are particularly well developed, as compared with those of *Prono-*

tolagus albus, *Pronotolagus whitei*, and *Pronotolagus apachensis* (White, 1991; Voorhies and Timperley, 1997; Korth, 1998). If the evolutionary trends noted by Voorhies and Timperley (1997) actually represent derived character transformations, then *P. nevadensis* is the most derived species of *Pronotolagus*. As noted above, the age of the Hoyo Canyon Local Fauna is late Hemphillian and, therefore, *P. nevadensis* is also the youngest known species of *Pronotolagus*.

Order Rodentia Bowdich, 1821
Family Sciuridae Fischer de Waldheim, 1817
Genus *Spermophilus* Cuvier, 1825
Spermophilus wellingtonensis Kelly, 1997

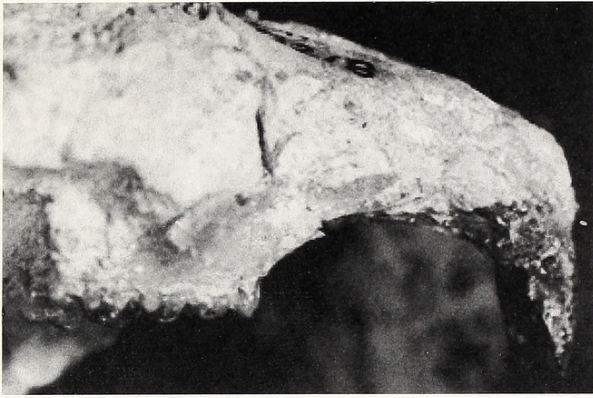
Figure 3, Table 2

SPECIMENS. From LACM 6993: partial skull with L and R I¹-M³ and associated appendicular elements, LACM 145957; partial dentary with R I₁, LACM 145958.

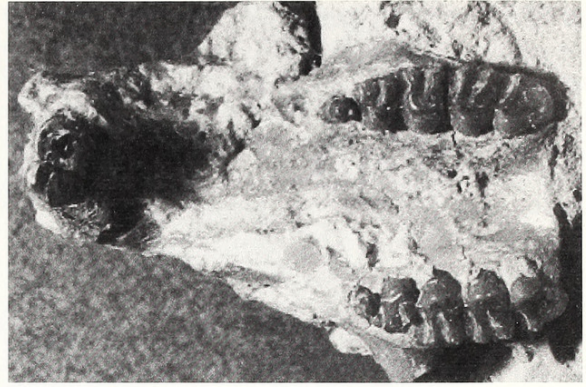
DESCRIPTION. The cranial morphology and upper dentition of *Spermophilus wellingtonensis* were previously unknown. The posterior portion of the partial skull is missing, being broken off dorsally across the parietals and ventrally across the palatines (Fig. 3A, B). The anterior tips of the nasals and premaxillaries and the zygomatic arches are also missing. Many small fractures are present, making it difficult to identify sutures and individual bones. The nasals taper posteriorly and the nasofrontal sutures form an obtuse angle with the apex pointing posteriorly. The partial parietals are slightly depressed, but the skull roof appears to have been relatively flat. The rostrum is elongate, tapering slightly anteriorly. The infraorbital foramen is an oval slit (2.3 mm D-V, 1.3 mm A-P) on the maxilla and positioned 1.4 mm anteriorly from the anterior margin of the P³ alveolus. The maxillary root

Table 2. Measurements (in mm) of upper dentition of *Spermophilus wellingtonensis* from Hoyo Canyon.

Tooth position/ dimension		LACM 145957	
		Right	Left
P ³	A-P	1.28	1.29
	TR	1.25	1.27
P ⁴	A-P	2.36	2.28
	TR	2.74	2.79
M ¹	A-P	2.59	2.71
	TR	3.17	3.20
M ²	A-P	2.64	2.63
	TR	3.34	3.42
M ³	A-P	3.11	3.13
	TR	3.17	3.16
P ³⁻⁴	A-P	3.23	3.32
M ¹⁻³	A-P	8.09	8.12
P ⁴ -M ³	A-P	10.17	10.20
P ³ -M ³	A-P	10.77	11.35



A



B



C



Figure 3. *Sperophilus wellingtonensis*. A-C, partial skull, LACM 145957. A, right lateral view. B, palatal view. C, L P³-M³, occlusal view, anterior left. Upper scale for A, B = 10 mm; lower scale for C = 1 mm.

of the zygomatic arch extends from a point above the anterior portion of P⁴ to one above the middle of M¹. The palate is broad, and the tooth rows are nearly parallel. The anterior margin of the palatine-maxillary suture extends to a point below the middle of M¹. The posterior palatine foramen is positioned below the middle of M². The matrix within the orbits was not removed to allow the morphology of the foramina to be observed because of the fragile condition of the skull.

The teeth of LACM 145957 are well preserved and only moderately worn (Fig. 3C). P³ is single-rooted and has an oval occlusal outline. A single prominent cusp is positioned anteriorly, and a well-developed posterior cingulum is present along the posterolingual border of the tooth.

P⁴ is trapezoidal in occlusal outline and moderately reduced in size relative to M¹⁻². The P⁴ anterior cingulum extends anterolabially from the anterior base of the protocone to the anterolabial corner of the tooth where a distinct, well-developed parastyle is present. The protoloph is complete, connecting the protocone and paracone. A small,

but distinct, mesostyle is present. The metaloph is almost complete, separated from the protocone by a very shallow notch that would disappear with slightly more wear. The protoloph and metaloph are separated by a deep valley and are distinctly taller than the anterior and posterior cingulae. The metaconule is well developed. The posterior cingulum extends from the posterolabial base of the protocone to the metacone with a narrow valley separating it from the metaloph.

M¹ has a trapezoidal occlusal outline. The anterior cingulum extends from the anterolabial base of the protocone to the anterolabial corner of the tooth, where a moderately well-developed parastyle is present. The protoloph and metaloph are complete, connecting the protocone to the paracone and the protocone to the metacone, respectively. The loph connecting the protocone to the metaconule is narrower than the loph that connects the protocone to the protoloph. A small, but distinct, mesostyle is present. A metaconule is developed as a distinct swelling on the metaloph. The metalophs and protolophs are considerably taller than the an-

terior and posterior cingulae. The posterior cingulum is similar in morphology to that of P^4 with a narrow valley between it and the metaloph. M^2 is very similar in structure to M^1 but differs in having an anterior cingulum that is not as anteriorly expanded at its anterolabial margin and a narrower valley between the protoleph and metaloph.

M^3 is expanded anteroposteriorly, almost as long as it is wide. The anterior cingulum is very similar in structure to that of M^2 , but the parastyle is not as prominent. The protoleph is complete. A small protoconule is developed as a slight swelling on the protoleph. A short metaloph is present and extends posterolabially from the protocone to a little more than a third of the way across the occlusal surface. The posterior cingulum extends posterolabially from the middle of the posterior base of the protocone to form a posterolabially expanded shelf and then curves anteriorly where it continues to the base of the paracone as a low loph. A metacone is lacking.

The partial dentary (LACM 145958) is damaged, with the posterior portion broken off at about the level of the M_2 alveolus. The diastema between the lower incisor and P_4 is 7.9 mm. Kelly (1997) already has described the morphology of the lower incisor of *Spermophilus wellingtonensis*.

DISCUSSION. Kelly (1997) described *Spermophilus wellingtonensis* from LACM 6993 (= UCMP V-95013) based on the holotype (a partial dentary with P_4 - M_3 , UCMP 141314) and an additional partial dentary (UCMP 141341). The partial skull (LACM 145957) was recovered from the quarry at LACM 6993 within 0.5 m of where the holotype of *S. wellingtonensis* was discovered. Because both the holotype dentary and partial skull were recovered from the same locality and the size of their dentitions is compatible, the partial skull is referred to *S. wellingtonensis*.

Based on dental morphology, Kelly (1997) regarded *Spermophilus wellingtonensis* as most closely related to the late Hemphillian *Spermophilus shotwelli* (Black, 1963) of the McKay Reservoir Local Fauna of Oregon. Although similar in dental morphology, Kelly (1997) noted that *S. wellingtonensis* can be easily distinguished from *S. shotwelli* by the following characteristics: (1) the P_4 anteroconid is well developed; (2) the P_4 protoconid and metaconid are separated by a relatively deep notch or groove; (3) the M_{1-3} metalophids are less complete, with the trigonids open to the talonids at an earlier wear stage; and (4) M_3 is larger relative to M_{1-2} . With the discovery of the upper dentition of *S. wellingtonensis*, the following additional characteristics can now be used to distinguish *S. wellingtonensis* from *S. shotwelli*: (1) much greater anterior expansion of the P^4 anterior cingulum; (2) the presence of a well-developed P^4 parastyle; (3) more complete M^{1-2} metalophs, attaching to the protocones at an earlier wear stage; and (4) slightly more prominent M^{1-2} mesostyles.

Genus *Marmota* Blumenbach, 1779

Marmota korthi new species

Figures 4, 5, Table 3

Marmota or *Cynomys*, sp. indet.: Kelly, 1997:15.

HOLOTYPE. Associated partial maxilla with partial $L P^4$ - M^1 , complete $L M^{2-3}$, and partial dentary with partial $L I_1$, complete $L P_4$ - M_2 , and partial $L M_3$, LACM 145959.

TYPE LOCALITY. LACM 6993.

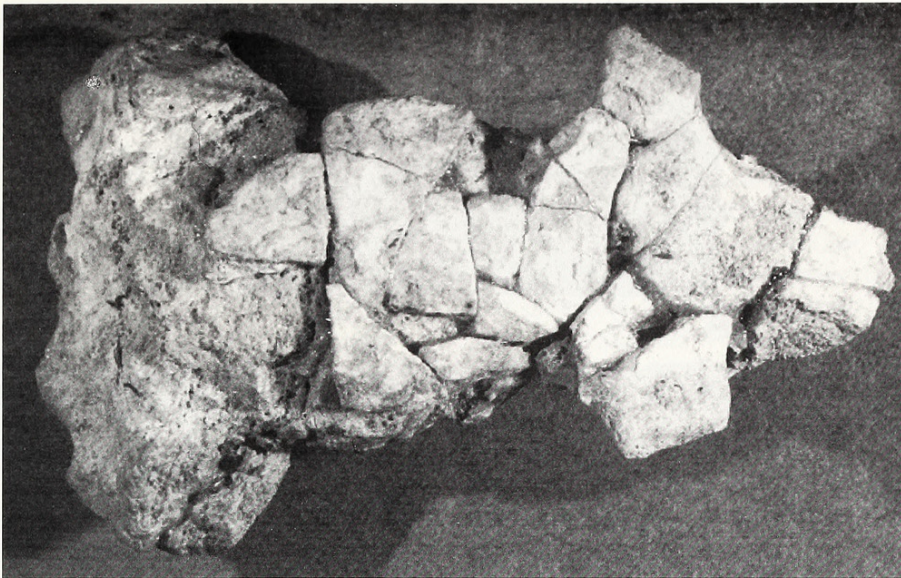
HYPODIGM. From LACM 6993: partial skull with $L M^{1-3}$, isolated $R M^2$, and associated partial skeleton, LACM 145961; partial maxilla with $L P^4$ - M^1 , LACM 145960; partial dentary with broken $R P_4$ - M_2 , UCMP 141313.

DISTRIBUTION AND AGE. Known only from the type locality, late Hemphillian.

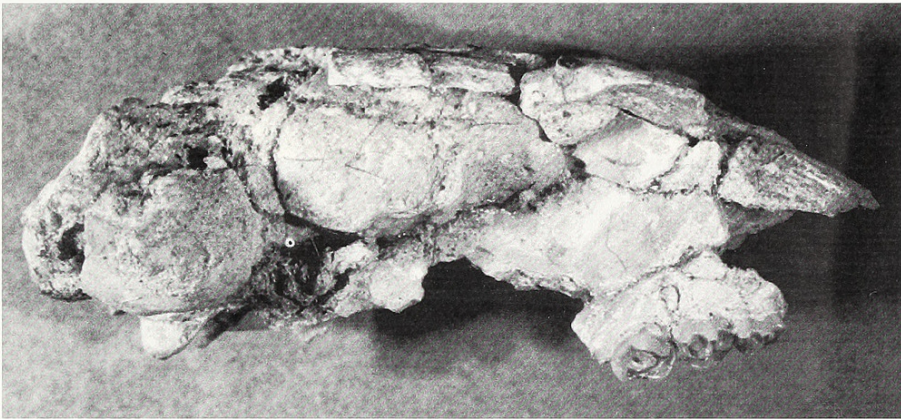
ETYMOLOGY. Named in honor of William W. Korth of the Rochester Institute of Vertebrate Paleontology in recognition of his many contributions to our understanding of rodent phylogeny.

DIAGNOSIS. *Marmota korthi* differs from *Marmota vetus* (Marsh, 1871) by the following characteristics: (1) size larger (mean P_4 A-P 38% larger than that of *M. vetus*); (2) I - P_4 diastema relatively longer; (3) lower incisor lacking median groove; (4) P_4 with incipient mesoconid present and more elongated anteroposteriorly relative to M_{1-2} anteroposterior lengths and wider transversely relative to M_{1-2} transverse widths; and (5) M_{1-2} metalophids more complete with better developed and deeper trigonid valleys that are completely closed off from talonids. It differs from *Marmota minor* (Kellogg, 1910) by the following characteristics: (1) size larger (mean P_4 A-P 12% larger than that of *M. minor*); (2) P^4 anterior cingulum less expanded anteriorly; (3) M^{1-3} metaconules better separated from protocones; (4) M^3 metaloph better developed; (5) P_4 trigonid open anteriorly and relatively narrower transversely; (6) P_4 less elongated anteroposteriorly relative to M_{1-2} anteroposterior lengths and transverse width narrower relative to M_{1-2} transverse widths; (7) M_{1-2} metalophids more complete with trigonid valleys completely closed off from talonids; (8) M_{1-2} relatively less anteroposteriorly compressed; and (9) M_2 anteroposterior length more elongated relative to M_1 anteroposterior length. *Marmota korthi* can be easily distinguished from all other late Blancan to Recent species of *Marmota* by the following characteristics: (1) cheek teeth lower crowned; (2) M^{1-2} metalophs less complete and distinctly separated from protocone until late wear; (3) P_4 less molariform, trigonid less transversely expanded, and less elongated anteroposteriorly relative to M_{1-2} anteroposterior lengths; and (4) M_{1-2} relatively less anteroposteriorly compressed.

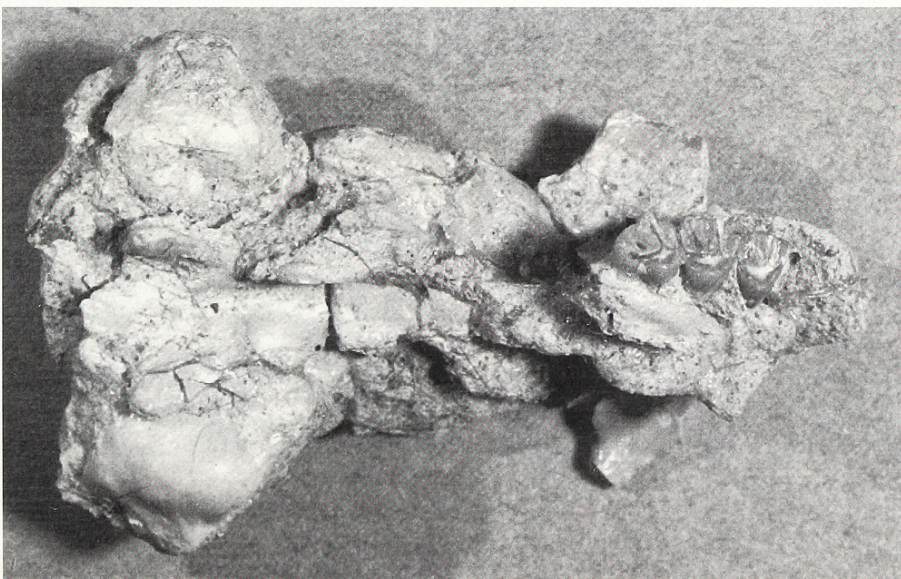
DESCRIPTION. The partial skull (LACM 145961) of *Marmota korthi* is badly damaged (Fig. 4). $L M^{1-3}$ of the skull are well worn. An isolated $R M^2$ was found within the small block of matrix



A



B



C

Figure 4. *Marmota korthi* new species. A–C, partial skull, LACM 145961. A, dorsal view. B, right lateral view. C, ventral view. Scale = 10 mm and all have anterior right.



A



B



C



D



E

Figure 5. *Marmota korthi* new species. A, L P⁴-M¹, LACM 145960, occlusal view. B, L P⁴, partial M¹, M²⁻³, holotype, LACM 145959, occlusal view. C, L P₃-M₂, partial M₃, holotype, LACM 145959, occlusal view. D, partial dentary, holotype, LACM 145959, lateral view. E, partial dentary, holotype, LACM 145959, occlusal view. Upper scale for A-C = 1 mm; lower scale for D, E = 10 mm, and all have anterior left.

Table 3. Measurements (in mm) of dentition of *Marmota korthi* new species from Hoye Canyon (e = estimated).

Tooth position/ dimension		Holotype		LACM	
		LACM	LACM	LACM	
		145959	145960	145961	
				Right	Left
P ⁴	A-P	4.30e	4.27		
	TR	4.68	4.64		
M ¹	A-P	4.55e	4.62		4.50
	TR	—	5.14		5.33
M ²	A-P	4.99		4.87	4.86
	TR	5.34		5.48	5.49
M ³	A-P	5.48			5.63
	TR	5.25			5.55
M ¹⁻³		14.64e			14.65
P ⁴ -M ³		18.75e			
P ₄	A-P	4.87			
	ANT-TR	3.67			
	POST-TR	4.42			
M ₁	A-P	4.42			
	ANT-TR	4.81			
	POST-TR	4.94			
M ₂	A-P	4.83			
	ANT-TR	5.54			
	POST-TR	5.56			
M ₃	A-P	—			
	ANT-TR	—			
	POST-TR	—			
P ₄ -M ₃	A-P	18.69e			

that yielded the skull. It is indistinguishable in wear and morphology from M² attached to the skull and is assumed to have broken off from the skull prior to or during burial. Because of the poor condition of the skull, it provides only limited information on the cranial morphology of *M. korthi*. The overall morphology of the partial skull appears to be very similar to those of Recent species of *Marmota*. The total A-P length of the specimen from the occipital condyles to the anterior edge of the broken nasals is 72.4 mm. The TR widths across the auditory bullae and the postorbital constriction of the frontals are 44.8 mm and 19.5 mm, respectively. Although broken off at the tips, the supraorbital processes of the frontals are well developed. Weakly developed frontal crests extend posteriorly from the supraorbital processes to converge with the sagittal crest. These crests appear to be slightly less developed than those of late Blancan to Recent species of *Marmota*. The auditory bullae are moderately inflated. The pterygoid processes are well developed.

P⁴ of the holotype (Fig. 5B) is damaged with part of the anterior cingulum and paracone missing, whereas, in the referred specimen, P⁴ is missing only a portion of the enamel along the lingual border. P⁴ is molariform with a trapezoidal-shaped occlusal outline. The anterior cingulum extends anterolabially from the protocone to a distinct para-

style, which is separated from the paracone by a shallow notch. A deep valley is present between the protoloph and anterior cingulum. The well-developed protoloph extends labially from the large protocone to connect with the paracone. There is no indication of a protoconule on the protoloph. The protoloph is slightly lower in height than the metaloph. The metaloph is short and thick, connecting the well-developed metaconule to the metacone. The metaconule is well separated from the protocone by a distinct valley between the trigon and talon. A well-developed mesostyle is present between the paracone and metacone. The posterior cingulum is well developed and extends lingually from the protocone to connect with the posterior base of the metacone. The posterior cingulum is lower in height than the protoloph and metaloph.

In the holotype, M²⁻³ are complete, but M¹ is damaged, with part of the paracone, metacone, and anterior cingulum broken off (Fig. 5B). In the referred specimens, M¹s are complete (Figs. 4C, 5A). M¹ and M² are almost identical in structure, whereas M³ differs from M¹⁻² primarily by having an enlarged and posteriorly expanded posterior cingulum. All the upper molars exhibit the following characteristics: (1) the anterior cingulum is a low, complete crest that extends labially from the protocone to the paracone, forming a distinct valley between the anterior cingulum and the protoloph; (2) a parastyle is present as a small cusplule on the anterior cingulum; (3) the well-developed protoloph extends from the large protocone to the paracone and is the tallest loph on the occlusal surface; (4) a protoconule is lacking; and (5) the well-developed metaconule is connected to the paracone by a thick metaloph but is separated from the protocone by a distinct valley until late wear. A small distinct mesostyle is present on M¹⁻², whereas, on M³, only a very small mesostyle is present. The M¹⁻² posterior cingulae are low, complete crests that connect the protocones to the metacones. On M³, the posterior cingulum extends posterolabially from the protocone to about the middle of the tooth, where a slight notch occurs and after which the cingulum thickens and increases in height along its posterolabial border. The enlarged M³ posterior cingulum is separated from the metaloph by a deep valley.

The dorsal surface of the dentary drops steeply anterior to P₄, forming a sharply curved diastema (Fig. 5D). The anterior margin of the masseteric fossa is somewhat bulbous and ends anteriorly below the anterior margin of M₁. The enamel band on the lower incisor extends laterally from the anteromedial edge to the dorsal lateral border, and its anterior surface is smooth, with no indication of a median groove.

P₄ is moderately enlarged relative to M₁₋₂ (Fig. 5C). A small, low anterior cingulid extends lingually from the base of the protoconid to the base of the metaconid, resulting in an anteriorly open trigonid. The protoconid and metaconid are the

tallest cusps and positioned relatively close to each other, resulting in a small trigonid. The metalophid is slightly damaged but appears to have been complete with a slight notch near its attachment to the metaconid. A small metastylid is present along the lingual border near the metaconid. The talonid is open lingually but closed off labially by a complete ectolophid between the protoconid and hypoconid. A shallow talonid trench is present just lingual to the ectolophid. A small, but distinct, mesoconid is present on the ectolophid between the protoconid and hypoconid. The hypoconid is well developed, whereas the entoconid is represented only by a very small cuspid on the posterior cingulid. The posterior cingulid is a continuous, low lophid that extends from the hypoconid to the entoconid. A very low lophid extends anteriorly from the entoconid toward the metastylid but is separated from the metastylid by a small notch.

M_{1-2} have parallelogram-shaped occlusal outlines and are essentially identical in structure, except that M_2 is larger than M_1 (Fig. 5C). The metaconid is the tallest primary cusp, followed by, in decreasing height, the protoconid, hypoconid, and entoconid. The anterior cingulid is lower than the metalophid but is complete, connecting the protoconid to the metaconid and closing off the trigonid anteriorly. The metalophid is a high lophid connecting the metaconid to the protoconid, resulting in a deep and well-developed trigonid basin that is completely closed off from the talonid. A complete, well-developed ectolophid is present and positioned deep in from the labial border of the tooth. A mesoconid is lacking on the ectolophid. A shallow talonid trench is present along the ectolophid and metalophid margins. The posterior cingulid extends lingually as a low lophid from the well-developed hypoconid to the posterolingual corner of the tooth wherein it turns anteriorly and extends as a low lophid to a very small metastylid. Because of the low lophid along the lingual border, the talonid is open lingually. The entoconid is a relatively indistinct cuspid on the posterior cingulid near the posterolingual corner of the tooth.

M_3 is badly damaged, with only the anterior cingulid and part of the trigonid present. The trigonid appears to have been similar to those of M_{1-2} with a complete anterior cingulid and metalophid, resulting in a deep, completely enclosed trigonid valley.

DISCUSSION. Kelly (1997) referred a partial right dentary with badly damaged teeth (UCMP 141313) from LACM 6993 (= UCMP V-95013) to an indeterminate species of *Marmota* Blumenbach, 1779, or *Cynomys* Rafinesque, 1817. He could not make a definitive generic diagnosis because of the poor condition of the teeth. With the new marmot specimens reported here, UCMP 141313 can now be referred confidently to *Marmota korthi*.

Marmota korthi exhibits certain similarities to species of *Paenemarmota* Hibbard and Schultz (1948). Hibbard and Schultz (1948) described the

type species *Paenemarmota barbouri* from the Blacan Rexroad Formation of Kansas. In a detailed review of *P. barbouri*, Repenning (1962) synonymized *Marmota mexicanus* Wilson, 1949, with *P. barbouri*. Voorhies (1988) referred *Marmota sawrockensis* Hibbard, 1964, to *Paenemarmota* and provided a revised diagnosis of the genus. The following characteristics have been used previously to distinguish *Paenemarmota* from *Marmota* (Hibbard and Schultz, 1948; Repenning, 1962; Voorhies, 1988): (1) the cheek teeth are much larger; (2) the cheek teeth are relatively more hypsodont and have more inflated cusps; (3) the P^4 - M^2 posterior cingulae are high crests that are separated from the metalophs by deep valleys; (4) P^4 is larger than M^1 ; (5) the P^4 metaconule is slightly more developed; (6) the M^3 metaloph is a distinct, high loph that is separated from the protocone until late wear; (7) the lower incisors have distinct longitudinal striations and their bases extend well behind M_3 ; (8) the P_4 - M_3 protoconids are large, equaling or exceeding the metaconids in height and basal area; (9) P_4 - M_3 have deep talonid trenches present along the metalophid and ectolophid margins; and (10) the P_4 - M_3 talonid basins have well-developed accessory ridges and cuspules resulting in strongly rugose surfaces. *Marmota korthi* is similar to *P. sawrockensis* and *P. barbouri* by having a well-developed M^3 metaloph that is separated from the protocone until late wear and lower cheek teeth with talonid trenches present. However, the talonid trenches of *M. korthi* are not as well developed as those of *P. sawrockensis* and *P. barbouri*. Talonid trenches are also present in species of *Cynomys* and *Spermophilus* Cuvier, 1825. *Marmota korthi* differs from *P. sawrockensis* and *P. barbouri* by the following characteristics: (1) the cheek teeth are much smaller; (2) P^4 is smaller than M^1 ; (3) the P^4 - M^2 posterior cingulae are not as well developed and lack deep valleys between the cingulae and metalophs; (4) the lower incisors lack prominent longitudinal grooves; (5) the P_4 protoconid and metaconid are less well separated; (6) the M_{1-3} metalophids are more complete; (7) the P_4 - M_3 ectolophids are relatively deeper; and (8) the P_4 - M_3 talonid basins lack heavy rugosity. It further differs from *P. barbouri* by having a much less molariform P_4 . Except for the more complete M_{1-3} metalophids, all of the characters that distinguish *M. korthi* from *P. sawrockensis* and *P. barbouri* are also present in other species of *Marmota* and support its referral to the genus. Thus, well-developed M^3 metalophs and P_4 - M_3 talonid trenches no longer appear to represent valid diagnostic characters to differentiate *Paenemarmota* from *Marmota*.

Kellogg (1910) described *Marmota nevadensis* based on a partial dentary with P_4 - M_1 from the middle Hemphillian Thousand Creek Formation of Nevada. Subsequent investigators (Hibbard and Schultz, 1948; Repenning, 1962; Black, 1963; Voorhies, 1988) have noted the following similari-

ties in the lower cheek teeth of *M. nevadensis* and species of *Paenemarmota*: (1) large size; (2) prominent longitudinal grooves on the lower incisors; (3) well-developed talonid trenches on P_4 - M_1 ; and (4) heavy rugosity in the P_4 - M_1 talonid basins. Voorhies (1988, p. 171) stated that, when better known, *M. nevadensis* "may eventually prove to represent *Paenemarmota* rather than *Marmota*." *Marmota nevadensis* differs from and appears less derived than *Paenemarmota sawrockensis* and *Paenemarmota barbouri* by its slightly smaller size and by having a less molariform P_4 that is smaller relative to M_1 . Until better known and following Korth (1994), it appears best to refer *M. nevadensis* to ?*Paenemarmota*. *Marmota korthi* differs from ?*P. nevadensis* by the following characteristics: (1) much smaller cheek teeth; (2) lack of prominent longitudinal grooves on the lower incisors; (3) lack of heavy rugosity in the P_4 - M_1 talonid basins (M_{2-3} unknown for ?*P. nevadensis*); (4) a more complete M_1 metalophid; (5) a relatively deeper M_1 ectolophid; and (6) a less developed M_1 posterior cingulid.

Pre-Pleistocene marmot fossils are rare (Black, 1963). *Marmota* first appears in the Clarendonian, where it is represented by a single species, *Marmota vetus* (Marsh, 1871; Black, 1963; Korth, 1994). Prior to this study, the only described species of *Marmota* from the Hemphillian was *Marmota minor* from the middle Hemphillian Thousand Creek Local Fauna of Nevada (Black, 1963). Hay (1921) described a third pre-Pleistocene species, *Marmota arizonae*, based on a partial skull from the late Blancan Anita Fauna of Arizona (Kurten and Anderson, 1980). Morphologically, *M. arizonae* is very similar to the late Rancholabrean to Recent *Marmota flaviventris* (Audubon and Bachman, 1841), differing only in the morphology of the snout (Kurten and Anderson, 1980). The only other North American species of *Marmota* recorded from the Pleistocene (late Irvingtonian to late Rancholabrean) is extant *Marmota monax* Linnaeus, 1758.

Black (1963) regarded the following dental transformations as derived for *Marmota* based on the Pleistocene to Recent species: (1) an increase in size; (2) an enlargement of P_4 relative to the lower molars; (3) a reduction of the posterior portion of M_3 ; and (4) further anteroposterior compression of M_{1-2} . Additionally, the Pleistocene to Recent species exhibit a moderate increase in crown height of the cheek teeth relative to the Clarendonian and Hemphillian species. Black (1963) regarded *Marmota minor* as having the following synapomorphies with Recent species of *Marmota*: (1) P_4 is longer than M_{1-2} ; (2) the metalophids of M_{1-3} are reduced; (3) the posterior portion of M_3 is reduced; and (4) the diastemal depression is deep anterior to P_4 . *Marmota korthi* is derived relative to *Marmota vetus* by having the following characteristics: (1) increased size; (2) higher crowned cheek teeth; (3) greater enlargement of P_4 relative to M_{1-2} ; and (4)

more complete M_{1-3} metalophids, with the trigonids completely separated from the talonids. *Marmota korthi* and *M. vetus* exhibit about the same degree of anteroposterior compression of M_{1-2} . *Marmota korthi* is derived relative to *M. minor* by the following characteristics: (1) increased size; and (2) more complete M_{1-2} metalophids with the trigonids completely separated from the talonids, resulting in deep, enclosed trigonid valleys. *Marmota korthi* further differs from *M. minor* by the following characteristics: (1) the P_4 anterior cingulum is less expanded anteriorly; (2) the M^{1-3} metaconules are better separated from the protocones; (3) the M^3 metaloph is better developed, forming a continuous crest from the metaconule to the metacone; (4) the ratio of the P_4 anteroposterior length to the M_{1-2} anteroposterior lengths is slightly less (averaging 1.06 for *M. korthi* versus 1.14 for *M. minor*); (5) the ratio of the P_4 transverse width relative to the M_{1-2} greatest transverse widths is slightly less (averaging 0.84 for *M. korthi* versus 0.93 for *M. minor*); and (6) M_{1-2} are slightly less anteroposteriorly compressed (the ratio of the M_{1-2} greatest transverse widths to the M_{1-2} anteroposterior lengths averaging 1.14 for *M. korthi* versus 1.26 for *M. minor*). *Marmota korthi* can be easily distinguished from all late Blancan to Recent species of *Marmota* by the following characteristics: (1) cheek teeth and body size slightly smaller; (2) cheek teeth lower crowned; (3) the M^{1-3} metalophs are well separated from the protocones by distinct valleys until late wear; (4) P_4 is less enlarged relative to M_{1-2} ; and (5) M_{1-2} are less anteroposteriorly compressed.

Family Geomyidae Bonaparte, 1845

Genus *Parapliosacomys* Shotwell, 1967

Parapliosacomys oregonensis

Shotwell, 1967

Figure 6, Table 4

SPECIMENS. From LACM 6993: R P^4 , LACM 145962; L M^1 or 2 , LACM 145963; partial dentary with L I_1 , d P_4 - M_3 , LACM 145964; R d P_4 , LACM 145965; partial dentary with R I_1 - P_4 , LACM 145966; R P_4 , LACM 145967; R P_4 , LACM 145968; R P_4 , LACM 145969; L P_4 , LACM 145970; L P_4 , LACM 145971; R M_1 or 2 , LACM 145972; R M_1 or 2 , LACM 145973.

DISCUSSION. The dental sample of *Parapliosacomys* from Hoyo Canyon (Fig. 6) is indistinguishable from the topotypic sample of *Parapliosacomys oregonensis* from McKay Reservoir, Oregon, and can be referred confidently to this species. Because Shotwell (1967) has already provided detailed descriptions of the dental morphology of *P. oregonensis*, a morphological description of the dental sample from Hoyo Canyon is not included here. It should be noted that the occlusal dimensions of the cheek teeth of *P. oregonensis* vary with

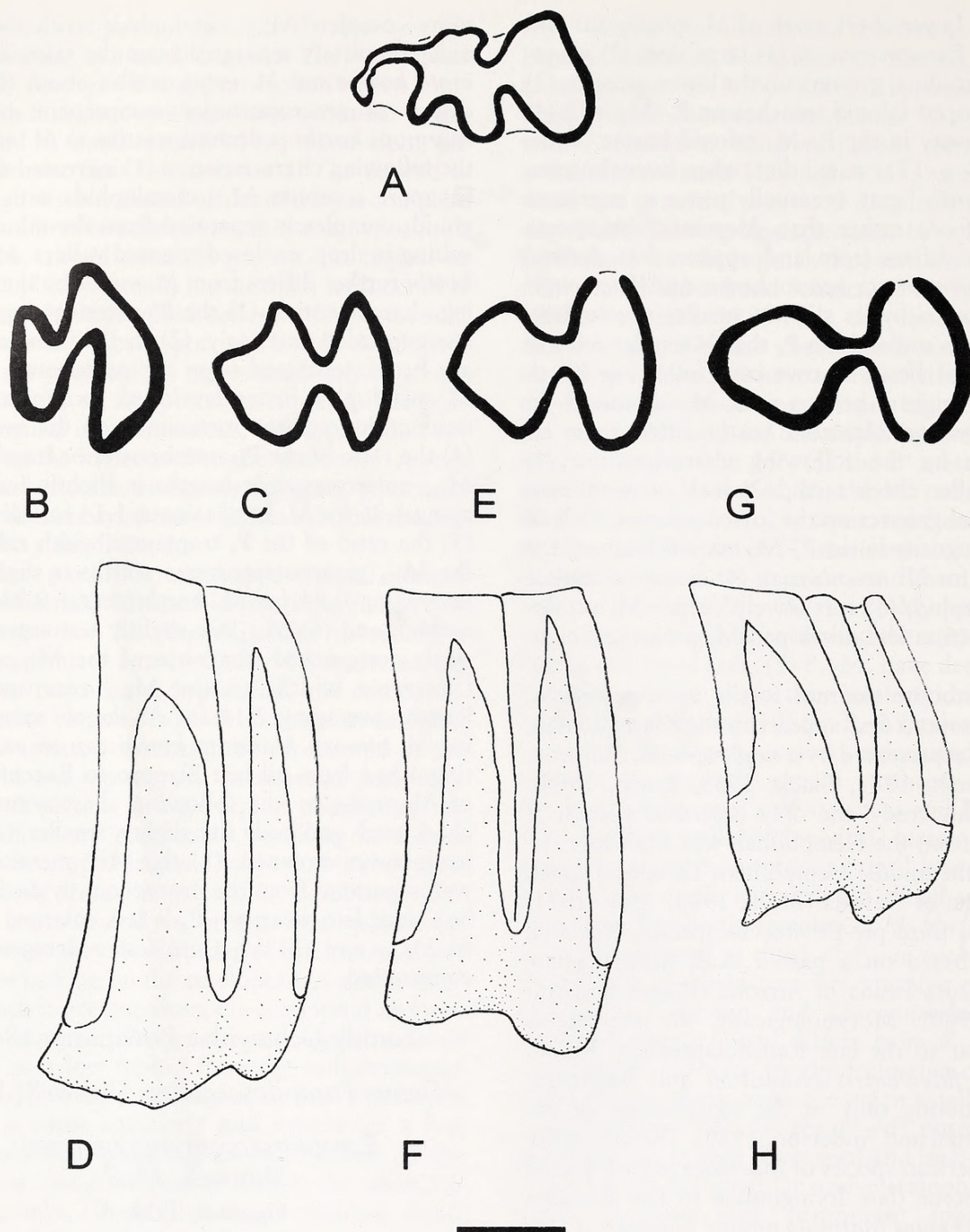


Figure 6. *Parapliosacomys oregonensis*. A, R dP₄, LACM 145964, occlusal view, reversed, B, R P₄, LACM 145962, C, D, L P₄, LACM 145970. E, F, R P₄, LACM 145968. G, H, R P₄, LACM 145969. B, C, E, and G, occlusal views; D, labial view; F and H, lingual views, and all have anterior left. Scale = 1 mm.

wear, so that teeth in early wear have significantly smaller occlusal dimensions than those in late wear (Shotwell, 1967; Kelly and Lugaski, 1999).

Kelly (1997) questionably referred UCMP 141344 (L P₄, well worn) and UCMP 141343 (L P₄) from LACM 6993 (= UCMP V-95013) to ?*Nerterogeomys* sp. indet. and ?*Thomomys* sp. indet., respectively. With the discovery of the additional geomyid material from LACM 6993, these specimens can now be assigned confidently to *Parapliosacomys oregonensis*.

Three species have been assigned previously to *Parapliosacomys*: the type species, *Parapliosacco-*

mys oregonensis, from the late Hemphillian McKay Reservoir Fauna of Oregon and the late Hemphillian Churchill Butte Local Fauna of Nevada; *Parapliosacomys hibbardi* (Storer, 1973) from the Clarendonian WaKeeney Local Fauna of Kansas; and *Parapliosacomys annae* Korth, 1987, from the Barstovian Crookston Bridge Member of the Valentine Formation of Nebraska. However, Korth and Reynolds (1994) recently described the genus *Phelosacomys* and referred *P. hibbardi* and *P. annae* to their new genus. Thus, *Parapliosacomys* is a monotypic genus restricted to the late Hemphillian. The presence of *P. oregonensis* in the Hoye

Table 4. Measurements (in mm) of teeth of selected specimens of *Parapliosacomys oregonensis* from Hoye Canyon; all measurements taken at the occlusal surface (a = approximate, r = tooth just erupting).

Tooth position/ dimension	LACM 145962	LACM 145963	LACM 145964	LACM 145965	LACM 145968	LACM 145969	LACM 145970	LACM 145966	LACM 145967	LACM 145971
P ⁴ A-P	1.44									
ANT-TR	1.22									
POST-TR	1.60									
M ^{1 or 2} A-P		0.87								
TR		1.66								
dP ₄ A-P			2.20	2.24						
ANT-TR			1.10	1.07						
POST-TR			1.26	1.35						
P ₄ A-P					1.93	2.47	1.71	1.39	1.73	1.50
ANT-TR					1.23	1.15	1.25	1.30	1.46	1.26
POST-TR					1.66	1.60	1.36	1.61	1.80	1.49
M ₁ A-P				1.09						
TR				1.63a						
M ₂ A-P				1.10						
TR				1.67						
M ₃ A-P				0.99r						
TR				1.55r						

Canyon Local Fauna indicates the fauna is late Hemphillian in age.

Order Artiodactyla Owen, 1848

Family Camelidae Gray, 1821

Genus *Hemiauchenia* Gervais and Ameghino, 1880

Hemiauchenia vera (Matthew, 1909)
Figure 7

SPECIMENS. From LACM 6993: partial dentary with partial L P₃₋₄, complete M₁, LACM 146521. From LACM 6994: partial first phalanx, LACM 145975; partial first phalanx, LACM 145976.

DISCUSSION. The partial dentary (LACM 146521) has the P₃ crown broken off at the alveolus, the anterior portion of the P₄ crown missing, and M₁ complete (Fig. 7). The partial dentary can be confidently referred to *Hemiauchenia vera* (Matthew, 1909, in Matthew and Osborn, 1909) because the teeth exhibit the following diagnostic characters (Webb, 1974; Kelly, 1998b): (1) relatively low-crowned and small in size, as compared with all other species of *Hemiauchenia*; (2) P₃ is two-rooted; (3) P₄ has a single posterior fossettoid and appears to have had a simple triangular occlusal outline; (4) P₄ is anteroposteriorly compressed and indented into the anterior occlusal surface of M₁; and (5) M₁ has very weak internal stylids and a small protostylid present. Measurements of the cheek teeth of LACM 146521 are as follows: P₃ alveolar A-P = 7.2 mm; P₄ A-P = 11.7 mm (estimated), TR = 6.6 mm; M₁ A-P = 20.3 mm, TR = 12.9 mm.

The partial first phalanges are characterized by their small size, as indicated by the following measurements: LACM 145975, distal condylar A-P = 10.5 mm, distal condylar TR = 12.6 mm; LACM 145976, distal condylar A-P = 11.5 mm, distal condylar TR = 11.8 mm, and midshaft A-P = 13.4 mm. The camel phalanges from Hoye Canyon are indistinguishable from those of *Hemiauchenia vera* (Kelly, 1998b). The presence of a dental specimen of *H. vera* in the Hoye Canyon Local Fauna strongly suggests that the phalanges also represent this species. For these reasons, the Hoye Canyon phalanges are provisionally referred to *H. vera*.

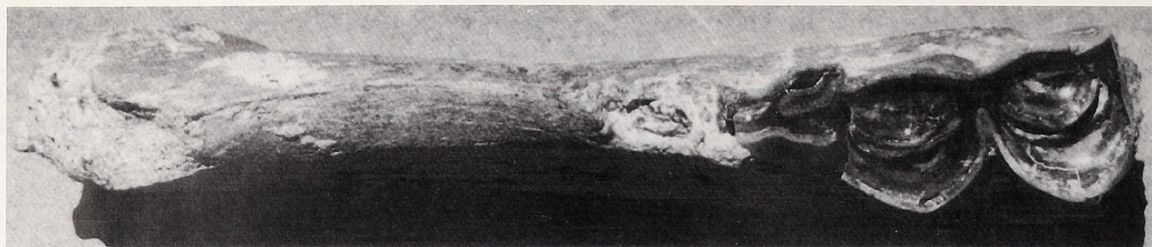
Hemiauchenia vera has been recorded previously from the type locality in Hemphillian deposits of the Ogallala Group of Long Island, Kansas, the late Hemphillian Yerington and Silver Springs local faunas of Nevada, the latest Hemphillian Buis Ranch Local Fauna of Oklahoma, and the late Hemphillian Upper Bone Valley Fauna of Florida (Webb, 1974; Tedford et al., 1987; Kelly, 1998b). The presence of *H. vera* in the Hoye Canyon Local Fauna indicates the fauna is Hemphillian in age, probably late Hemphillian.

Family Antilocapridae Gray, 1866

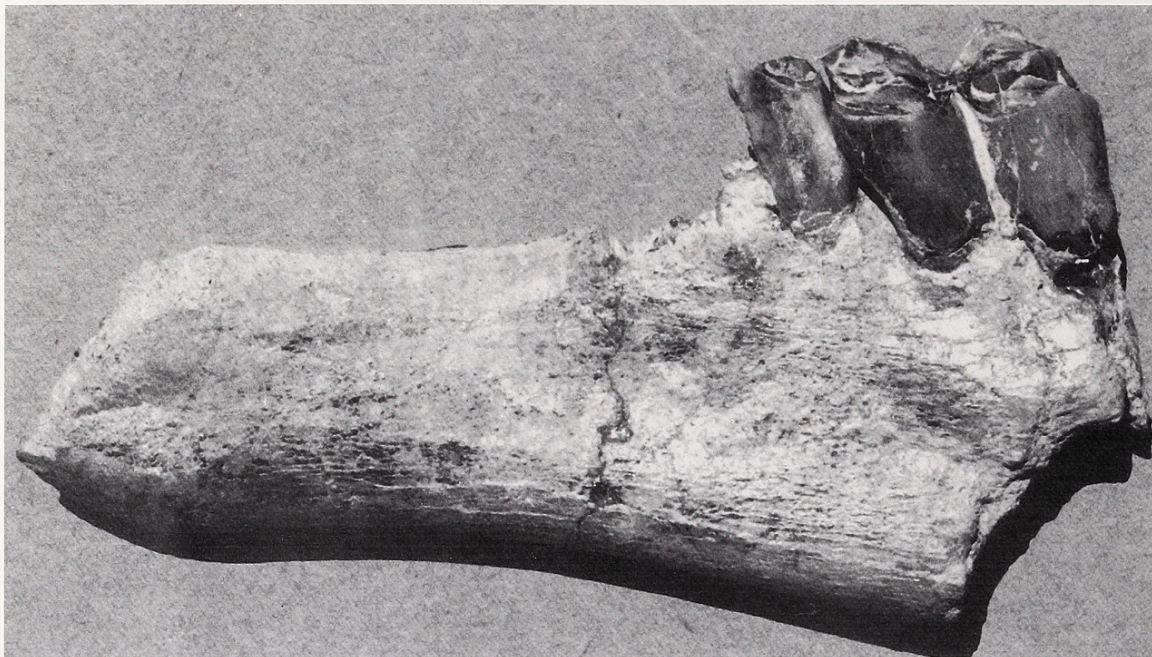
?Antilocapridae, gen. and sp. indet.

SPECIMEN. From LACM 6994: partial lower L I_{2 or 3}, LACM 145977.

DISCUSSION. The partial lower incisor is complete, except that the tip of the root has been broken off. The root is robust relative to the crown, indicating that the tooth is not a deciduous incisor. The small, spatulate incisor is most similar to those of the Antilocapridae. The tooth differs from those



A



B

Figure 7. *Hemiauchenia vera*. A, B, partial dentary with partial L P_{3-4} , M_1 , LACM 146521. A, occlusal view, anterior left. B, labial view, anterior left. Scale = 10 mm.

of the smallest Hemphillian camel, *Hemiauchenia vera*, by its smaller size and differs from those of the Tayassuidae by its smaller size and more spatulate shape. The lower incisor probably represents a member of the Antilocapridae, to which it is assigned very questionably.

Order Perissodactyla Owen, 1848

Family Rhinocerotidae Owen, 1845

Rhinocerotidae, gen. and sp. indet.

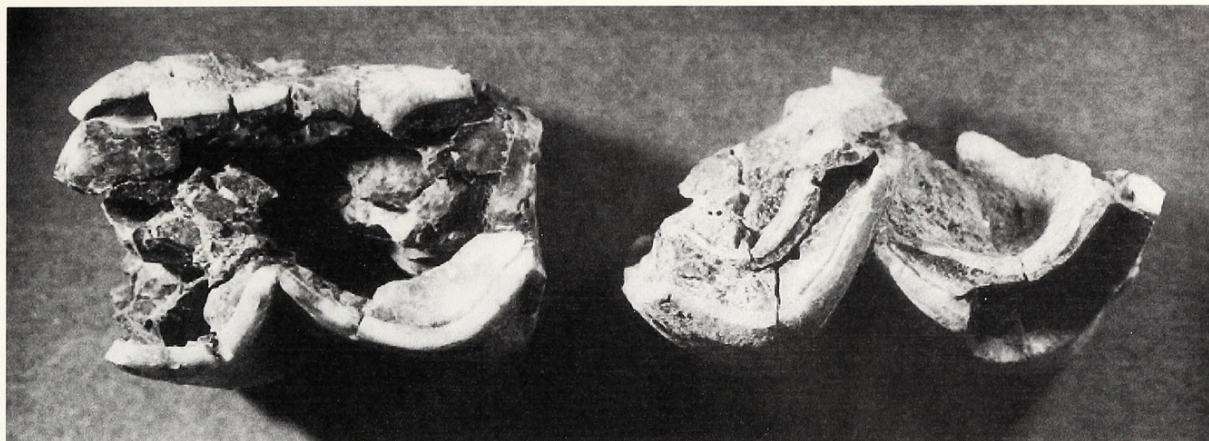
Figure 8

SPECIMEN. From LACM 6994: associated partial L lower premolar, partial L M_{1-3} , LACM 145978.

DISCUSSION. The teeth are badly damaged (Fig. 8). M_1 and M_3 are fairly complete, but the partial lower premolar only consists of a partial ectolophid and M_2 by only the posterior enamel wall. M_1 and M_3 exhibit the following characteristics: (1)

size small, as compared with other early to middle Hemphillian rhinos; (2) moderately hypsodont, considering their degree of wear; and (3) lingual cingulids lacking. Measurements of the lower molars are as follows: M_1 A-P = 50.2 mm, TR = 33.3 mm; M_3 A-P = 52.9 mm (broken), TR = 36.2 (broken).

The Hoyo Canyon rhino teeth are most similar in size and morphology to those from the late Hemphillian Washoe Local Fauna of Nevada that were referred to *Teleoceras* sp. indet. by Kelly (1997). A small species of *Teleoceras* Hatcher, 1894, also occurs in the late Hemphillian Silver Springs Local Fauna of Nevada (Kelly, 1998b). It appears that a dwarf species of *Teleoceras* occurred during the late Hemphillian in Nevada (Kelly, 1997, 1998b). Premolar and molar lingual cingulids are generally lacking in *Teleoceras* but commonly present in *Aphelops* Cope, 1873 (Osborn, 1904; Douglas, 1908; Matthew, 1932; Tanner, 1967, 1975). The Hoyo Canyon rhino teeth lack lingual cingulids,



A



B

Figure 8. Rhinocerotidae, gen. indet. A, B, L. M₁ and M₃, LACM 145978. A, occlusal views, anterior left. B, labial views, anterior left. Scale = 10 mm.

suggesting that they might represent *Teleoceras*. It is possible that the Hoyo Canyon rhino is conspecific with the small, late Hemphillian species of *Teleoceras*. However, a generic assignment cannot be made without determining if the Hoyo Canyon rhino possessed upper incisors. As such, the Hoyo Canyon rhino is referred to Rhinocerotidae, gen. and sp. indet.

Family Equidae Gray, 1821
Genus *Dinohippus* Quinn, 1955

Dinohippus sp. indet.

Figure 9, Table 5

SPECIMEN. From LACM 6993: associated partial L I₁₋₂, P₂-M₃, LACM 145974.

DISCUSSION. The teeth are somewhat damaged, with most having some part of the base missing (Fig. 9). The crowns are complete in all respects but the following: (1) I₂ is missing a small portion of the enamel at the lateral edge of the tooth; (2) P₃ is missing a small portion of the anterior hypoconid; and (3) M₁ is missing part of the posterior half of the tooth, broken off 22.5 mm below the occlusal surface. P₂₋₄ and M₃ are unworn, and M₁₋₂ are in early wear, which, in the extant domestic horse, would indicate an age of about 2 years old.

The lower incisors are of typical equid structure, with well-defined central cusps, convex anterior enamel borders, and notable lateral tapering of the occlusal outlines. When placed together, the inci-



Figure 9. *Dinohippus* sp. indet. A, B, partial P_2 – M_3 , LACM 145974. A, occlusal view, anterior left. B, labial view, anterior left. Scale = 10 mm.

sors appear to have formed a rounded dental arcade.

The cheek teeth of the Hoyo Canyon horse are characterized by having the following: (1) size large, estimated P_2 – M_3 A–P about 170 mm; (2) hypsodont (mesostylar crown height of P_4 = 64.6 mm, estimated crown height of M_1 about 70 mm); (3) the cement layer is thick; (4) the P_{2-4} ectolophids do not penetrate the isthmuses between metaconids and metastylids; (5) the M_{1-2} occlusal enamel patterns are simple (the other teeth are unworn, but appear also to have simple enamel patterns, based on the cross-sectional patterns at the broken bases); (6) the M_{1-3} metaconids are notably smaller than

metastylids (especially evident about half way down the crowns from the occlusal surfaces and at the bases of the teeth); and (7) the M_{1-3} ectoflexids are deep, completely penetrating the isthmuses between the metaconids and metastylids.

The cheek teeth of the Hoyo Canyon horse are indistinguishable in size and morphology from those of the late Hemphillian “*Dinohippus*” *interpolatus* and *Dinohippus leidymanus*. These two species have very similar lower cheek teeth and are differentiated from each other primarily by the morphology of the facial fossae (Kelly, 1998a), which is unknown for the Hoyo Canyon horse. Previous investigators have suggested that these two species are conspecific, but their taxonomic status must await a complete revision of *Dinohippus* (Hulbert, 1993; Kelly, 1998a). The lower cheek teeth of the Hoyo Canyon horse differ from those of *Equus* Linnaeus, 1758, by having the M_{1-3} metastylids notably smaller than the metaconids. They differ from those of the Hipparionini Quinn, 1955, by having the following characteristics: (1) larger size; (2) lacking protostylids; (3) relatively smaller and less separated P_2 – M_3 metaconids and metastylids with the M_{1-3} metastylids notably smaller than the metaconids; and (4) deeper M_{1-3} ectoflexids, completely penetrating the isthmuses between the metaconids and metastylids. They differ from those of the Protohippini Quinn, 1955, by having

Table 5. Measurements (in mm) of lower teeth of *Dinohippus* sp. indet. (LACM 145974) from Hoyo Canyon (a = approximate).

Tooth position	A-P	TR
P_2	31.8	17.2
P_3	29.2	15.1
P_4	30.7	15.9
M_1	27.6a	14.5
M_2	31.2	12.1
M_3	24.0	10.0

the following characteristics: (1) larger size; (2) more hypsodont; (3) protostylids lacking; and (4) the P_{3-4} metaconids and metastylids are about equal in size and position. The Hoyo Canyon horse appears to represent either "*D.*" *interpolatus* or *D. leidymanus*. However, a definitive specific assignment must await the discovery of more complete material.

AGE OF FAUNA

The Hoyo Canyon Local Fauna consists of the following taxa: the rabbit *Pronotolagus nevadensis* n. sp.; the ground squirrel *Spermophilus wellingtonensis* Kelly, 1997; the marmot *Marmota korthi* n. sp.; the gopher *Parapliosacomys oregonensis* Shotwell, 1967; the camel *Hemiaucheria vera*; ?Antilocapridae, gen. and sp. indet.; Rhinocerotidae, gen. and sp. indet.; and the horse *Dinohippus* sp. indet.

The age of the Hoyo Canyon Local Fauna can be determined by the shared occurrences of certain taxa within the fauna. The geomyid, *Parapliosacomys oregonensis*, previously was known only from the late Hemphillian McKay Reservoir Fauna of Oregon and the late Hemphillian Churchill Butte Local Fauna from the Desert Mountains of west central Nevada (Shotwell, 1967; Kelly and Lugaski, 1999). *Marmota korthi* n. sp. is more derived than the only known Clarendonian species, *Marmota vetus* (Kellogg, 1910), but less derived than the Blancan to Recent marmot species. Similarly, *Pronotolagus nevadensis* n. sp. appears to be more derived than the Clarendonian to early Hemphillian *Pronotolagus apachensis* (Gazin, 1930). The camel, *Hemiaucheria vera*, is restricted to the Hemphillian (Webb, 1974). Most investigators generally regard the extinction of the Rhinocerotidae in North America as one of the events to mark the end of the Hemphillian (Tedford et al., 1987). However, Madden and Dalquest (1990) reported finding a single fragment of a rhinoceros tooth as a result of screen washing matrix from the Blancan Yellow Quarry, Scurry County, Texas (Beck Ranch Local Fauna). With the exception of this record, no other Blancan occurrence of the Rhinocerotidae is known (Prothero, 1998). *Dinohippus* sp. indet. from Hoyo Canyon appears to represent either "*Dinohippus*" *interpolatus* (Cope, 1893) or *Dinohippus leidymanus* (Osborn, 1918), both of which are known only from the late Hemphillian (Azzaroli, 1988; Hulbert, 1993; Kelly, 1998a). The combined presence of the Rhinocerotidae, *Pronotolagus nevadensis* n. sp., *Marmota korthi* n. sp., *Parapliosacomys oregonensis*, *Hemiaucheria vera*, and *Dinohippus* sp. (either "*D.*" *interpolatus* or *D. leidymanus*) indicates that the fauna is late Hemphillian (late Miocene) in age.

CONCLUSIONS

An unnamed formation exposed along the western flanks of the Wellington Hills, Douglas County, Nevada, has previously yielded two mammalian fau-

nas: the late Blancan Wellington Hills Local Fauna and the early Irvingtonian Topaz Lake Local Fauna (Kelly, 1997). The northern outcrops of this unnamed unit occur in the Hoyo Canyon area, and the southern outcrops occur from Risue Canyon to about 3 km north of Long Dry Canyon (Kelly, 1997). Foothills covered with Quaternary alluvium separate the northern outcrops from the southern outcrops. Previously, only a single locality (LACM 6993 = UCMP V-95013) was known from the Hoyo Canyon area, and this locality did not produce any age-diagnostic fossils. Because the section containing LACM 6993 is isolated and cannot be traced laterally, Kelly (1997) only questionably correlated LACM 6993 with the late Blancan localities in the southern exposures. Quarrying at LACM 6993 and the discovery of an additional locality in the Hoyo Canyon area has now produced new specimens that indicate the assemblage from Hoyo Canyon is late Hemphillian and not Blancan in age. This assemblage is named the Hoyo Canyon Local Fauna.

The recognition of a late Hemphillian fauna from the Hoyo Canyon section allows a reevaluation of the geologic history and biostratigraphy of the unnamed formation of the Wellington Hills. Based on the faunas, the unnamed formation appears to have been deposited from at least the late Hemphillian (late Miocene) to the early Irvingtonian (early Pleistocene) or about 7 to 1.8 Ma. The Hoyo Canyon localities of the northern outcrops must occur stratigraphically below the late Blancan localities of the southern outcrops. This fact indicates that Kelly (1997) underestimated the total thickness of the unnamed formation by at least several hundred meters.

The unnamed formation of the Wellington Hills dips westward and, in the northern exposures, unconformably overlies uplifted Miocene andesitic rocks, while, in the southern exposures, it unconformably overlies uplifted Mesozoic granitic and metavolcanic basement rocks (Kelly, 1997). The steep escarpment along the eastern border of the Wellington Hills demarcates the position of a large northerly-trending normal fault zone that extends from the Stillwater Range in the south to the Virginia Range in the north (Gilbert and Reynolds, 1973). Gilbert and Reynolds (1973) proposed that Quaternary activity along the frontal fault zone resulted in the uplifting of the Wellington Hills. As the Wellington Hills were uplifted, so was the unnamed formation, as indicated by its westward tilting. Based on biostratigraphic and lithologic evidence, Kelly (1997) proposed that the major uplifting of the Wellington Hills could have occurred from sometime prior to the late Blancan, the age of the oldest known fauna at the time, to as late as or later than the early Irvingtonian, the age of the youngest fauna. With the recognition of a late Hemphillian fauna from the lower part of the unnamed formation of the Wellington Hills, it now appears that the major uplifting could have oc-

curred from the late Hemphillian to as late as or later than the early Irvingtonian.

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LITERATURE CITED

- Audubon, J.J., and J. Bachman. 1841. Descriptions of new species of quadrupeds inhabiting North America. *Proceedings of the Academy of Natural Sciences, Philadelphia* 1:92–104.
- Azzaroli, A. 1988. On the equid genera *Dinohippus* Quinn 1955 and *Pliohippus* Marsh 1874. *Bollettino della Societa Palaeontologica Italiana* 27:61–72.
- Black, C.C. 1963. A review of the North American Tertiary Sciuridae. *Bulletin of the Museum of Comparative Zoology* 130:109–248.
- Blumenbach, J.F. 1779. *Handbuch der Naturgeschichte*. Göttingen: Johann Christian Dieterich, 559 pp.
- Cope, E.D. 1873. On some new fossil Ungulata. *Proceedings of the Academy of Natural Sciences, Philadelphia* 19:258–263.
- . 1893. A preliminary report on the vertebrate paleontology of the Llano Estacado. *Geological Survey of Texas Annual Report* 4:1–136.
- Cuvier, F. 1825. *Des dents des mammiferes considerees comme caracteres zoologiques*. Paris: Deterville, 255 pp.
- Dalquest, W.W. 1979. Identification of genera of American rabbits of Blancan age. *Southwestern Naturalist* 24:275–278.
- Dice, L.R., and D.S. Dice. 1935. The lower cheek teeth of the fossil hare *Palaeolagus haydeni*. *Papers of the Michigan Academy of Science, Arts, and Letters* 20: 455–463.
- . 1941. Age changes in the teeth of the cottontail rabbit. *Papers of the Michigan Academy of Science, Arts, and Letters* 26:219–228.
- Douglas, E. 1908. Rhinoceroses from the Oligocene and Miocene deposits of North Dakota and Montana. *Annals of the Carnegie Museum* 4:256–266.
- Gazin, C.L. 1930. A Tertiary vertebrate fauna from the upper Cuyama drainage basin, California. *Carnegie Institution of Washington, Publication* 404:55–76.
- Gervais, H., and F. Ameghino. 1880. *Les mammiferes fossiles de L'Amerique du Sud*. Paris: Sary, 225 pp.
- Gianella, V.P. 1936. Geology of the Silver City district and the southern portion of the Comstock Lode, Nevada. *University of Nevada, Bulletin* 30:1–108.
- Gilbert, C.M., and M.W. Reynolds. 1973. Character and chronology of basin development, western margin of the Basin and Range Province. *Geological Society of America, Bulletin* 84:2489–2510.
- Halsey, J.H. 1953. Geology of parts of the Bridgeport, California, and Wellington, Nevada, Quadrangles. Ph.D. dissertation, University of California, Berkeley, 498 pp.
- Hatcher, J.B. 1894. A median-horned rhinoceros from the Loup Fork beds of Nebraska. *American Geologist* 13:149–150.
- Hay, O.P. 1921. Descriptions of Pleistocene Vertebrata, types or specimens of which are preserved in the United States National Museum. *Proceedings of the United States National Museum* 59:617–638.
- Hibbard, C.W. 1939. Four new rabbits from the upper Pliocene of Kansas. *American Midland Naturalist* 21:506–413.
- . 1963. The origin of the P_3 pattern of *Sylvilagus*, *Caprolagus*, *Oryctolagus*, and *Lepus*. *Journal of Mammalogy* 44:1–15.
- Hibbard, C.W., and C.B. Schultz. 1948. A new sciurid of Blancan age from Kansas and Nebraska. *Bulletin of the University of Nebraska State Museum* 3:19–29.
- Hulbert, R.C. 1993. Taxonomic evolution in North American Neogene horses (subfamily Equinae): The rise and fall of an adaptive radiation. *Paleobiology* 19: 216–234.
- Kellogg, L. 1910. Rodent fauna of the late Tertiary beds of Virgin Valley and Thousand Creek, Nevada. *University of California, Bulletin of the Department of Geological Sciences* 5:411–437.
- Kelly, T.S. 1997. Additional late Cenozoic (latest Hemphillian to earliest Irvingtonian) mammals from Douglas County, Nevada. *Paleobios* 18:1–31.
- . 1998a. New Miocene equid crania from California and their implications for the phylogeny of the Equini. *Natural History Museum of Los Angeles County, Contributions in Science* 473:1–44.
- . 1998b. New Miocene mammalian faunas from west central Nevada. *Journal of Paleontology* 72: 137–149.
- Kelly, T.S., and T. Lugaski. 1999. A Hemphillian (late Miocene) fauna from the Desert Mountains, west central Nevada. *Bulletin of the Southern California Academy of Science* 98:1–14.
- Korth, W.W. 1987. New rodents (Mammalia) from the late Barstovian (Miocene) Valentine Formation, Nebraska. *Journal of Paleontology* 61:1058–1064.
- . 1994. *The Tertiary record of rodents in North America, topics in geobiology* 12. New York: Plenum Press, xi + 319 pp.
- . 1998. Rodents and lagomorphs (Mammalia) from the late Clarendonian (Miocene) Ash Hollow Formation, Brown County, Nebraska. *Annals of the Carnegie Museum* 67:299–348.
- Korth, W.W., and R. Reynolds. 1994. A hypsodont gopher (Rodentia, Geomyidae) from the Clarendonian (Miocene) of California. *San Bernardino County Museum Association Special Publication* 94-1:91–95.
- Kurten, B., and E. Anderson. 1980. *Pleistocene mammals of North America*. New York: Columbia University Press, 442 pp.
- Leidy, J. 1856. Notices of remains of extinct Mammalia, discovered by Dr. F. V. Hayden in Nebraska Territory. *Proceedings of the Academy of Natural Sciences, Philadelphia* 8:88–90.
- Linnaeus, C. 1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis*. Tomus I. Editio decima, reformata. Stockholm: Laurentii Salvii, 824 pp.
- Madden, C.T., and W.W. Dalquest. 1990. The last rhi-

- noceros in North America. *Journal of Vertebrate Paleontology* 10:266-267.
- Matthew, W.D. 1932. A review of the rhinoceroses with a description of *Aphelops* material from the Pliocene of Texas. *University of California, Bulletin of the Department of Geological Sciences* 20:411-444.
- Matthew, W.D., and H.F. Osborn. 1909. Faunal lists of the Tertiary Mammalia of the West. *United States Geological Survey, Bulletin* 361:91-138.
- Marsh, O.C. 1871. Notice of some new fossil mammals and birds from the Tertiary formation of the West. *American Journal of Science* 2:120-127.
- Moore, J.G. 1969. Geology and mineral deposits of Lyon, Douglas, and Ormsby Counties, Nevada. *Nevada Bureau of Mines and Geology, Bulletin* 75:1-45.
- Osborn, H.F. 1904. New Miocene rhinoceroses with revision of known species. *Bulletin of the American Museum of Natural History* 13:307-326.
- . 1918. Equidae of the Oligocene, Miocene, and Pliocene of North America, iconographic type revision. *Memoirs of the American Museum of Natural History* 2:1-326.
- Prothero, D.R. 1998. Rhinocerotidae. In *Evolution of Tertiary mammals of North America*, ed. C.M. Janis, K.M. Scott, and L.L. Jacobs, 595-605. Cambridge, New York: Cambridge University Press, x + 691 pp.
- Quinn, J.H. 1955. Miocene Equidae of the Texas Gulf Coastal Plain. *University of Texas, Bureau of Economic Geology Publication* 5516:1-102.
- Rafinesque, C.S. 1817. Extracts from the journal of Mr. Charles Le Røge. *American Monthly Magazine* 2:45.
- Repenning, C.A. 1962. The giant ground squirrel *Paenemarmota*. *Journal of Paleontology* 36:540-556.
- Shotwell, J.A. 1967. Late Tertiary geomyoid rodents of Oregon. *University of Oregon, Bulletin of the Museum of Natural History* 9:1-51.
- Storer, J.E. 1973. The entoptychne geomyid *Lignimus* (Mammalia: Rodentia) from Kansas and Nebraska. *Canadian Journal of Earth Sciences* 10:72-83.
- Tanner, L.G. 1967. A new species of rhinoceros, *Aphelops kimballensis*, from the latest Pliocene of Nebraska. *Bulletin of the University of Nebraska State Museum* 6:1-16.
- . 1975. Cenozoic mammals from the central Great Plains, part 2. Stratigraphic occurrences of *Teleoceras*, with a new Kimballian species from Nebraska. *Bulletin of the University of Nebraska State Museum* 10:23-33.
- Tedford, R.H., T. Galusha, M.F. Skinner, B.E. Taylor, R.W. Fields, J.R. Macdonald, J.M. Rensberger, S.D. Webb, and D.P. Whistler. 1987. Faunal succession and biochronology of the Arikareean through Hemphillian interval (late Oligocene through earliest Pliocene), North America. In *Cenozoic mammals of North America*, ed. M.O. Woodburne, 153-210. Berkeley: University of California Press, 336 pp.
- Voorhies, M.R. 1988. The giant marmot *Paenemarmota sawrockensis* (new combination) in Hemphillian deposits of northeastern Nebraska. *Transactions of the Nebraska Academy of Sciences* 16:165-172.
- Voorhies, M.R., and C.L. Timperley. 1997. A new *Pronotolagus* (Lagomorpha: Leporidae) and other leporids from the Valentine Railway Quarries (Barstovian, Nebraska), and the archaeolagine-leporine transition. *Journal of Vertebrate Paleontology* 17:725-737.
- Webb, S.D. 1974. Pleistocene llamas of Florida, with a brief review of the Lamini. In *Pleistocene mammals of Florida*, ed. S.D. Webb, 170-213. Gainesville: University Presses of Florida, 270 pp.
- White, J.A. 1987. The Archaeolaginae (Mammalia, Lagomorpha) of North America, excluding *Archaeolagus* and *Panolax*. *Journal of Vertebrate Paleontology* 7:425-450.
- . 1991. North American Leporinae (Mammalia, Lagomorpha) from the late Miocene (Clarendonian) to latest Pliocene (Blancan). *Journal of Vertebrate Paleontology* 11:67-89.
- Wilson, R.W. 1949. Rodents of the Rincon Fauna, western Chihuahua, Mexico. *Carnegie Institution of Washington, Publication* 584:165-176.
- Wood, A.E. 1940. The mammalian fauna of the White River Oligocene, part III. Lagomorpha. *Transactions of the American Philosophical Society, new series* 28: 271-362.

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