UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO

INSTITUTO DE GEOLOGIA

DIRECTOR: DR. JOSE C. GUERRERO

PALEONTOLOGIA MEXICANA NUMERO 51

PLIOCENE SMALL MAMMAL FOSSILS FROM CHIHUAHUA, MEXICO

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CONTENTS

ILLUSTRATIONS

ABSTRACT

Pliocene deposits in the valley of Río Papigochic of Chihuahua have yielded 16 taxa of small mammals, including two new genera and eight new species. These fossils are derived from the previously known Yepómera fauna of late Hemphillian age, and a superposed faunal assemblage, named the Concha fauna, of early Blancan age. Seven species (five of them new) of cricetid rodent, including five species of sigmodontine rodent, in these faunas reflect a late Cenozoic radiation of cricetids in southwestern North America. Absence of South American mammals in these faunal assemblages indicates they predate the closing of the Panamanian land bridge, and the Great American Exchange.

RESUMEN

Los depósitos pliocénicos en el valle del Río Papigochic de Chihuahua proporcionaron 16 taxa de pequeños mamíferos, incluyendo dos nuevos géneros y ocho nuevas especies. Estos fósiles provienen de la fauna Yepómera anteriormente conocida y de edad henfiliana tardía, y de un conjunto faunístico superpuesto, nombrado como la fauna Concha, de edad blancana temprana. La presencia de siete especies (cinco nuevas) de roedores cricétidos, incluyendo cinco especies de roedores sigmodontinos en estas faunas, refleja la radiación cenozoica tardía de cricétidos en la parte suroccidental de Norte América. La ausencia de mamíferos sudamericanos en esos conjuntos faunísticos indica que ésta ocurrió antes de que se cerrara el puente terrestre panameño y el gran intercambio americano.

INTRODUCTION

Terrestrial deposits of Pliocene age in the valley of the Río Papigochic, about 160 km northwest of Ciudad de Chihuahua (Figure 1) have attracted the attention of vertebrate paleontologists for over 40 years. Fossils were collected from that area by paleontologists from the California Institute of Technology (CIT) in the 1930's and 1940's (Stock, 1948a, and 1948b; Lance, 1950). These large and diverse collections, primarily of large mammals, are now curated at the Museum of Natural History of Los Angeles County. These collections are referred to in earlier literature as the Rincón or Yepómera fauna of Hemphillian (early Pliocene) age, and the Miñaca fauna of Blancan (late Pliocene) age. Ferrusquía (1978) summarized the published literature on the Yepómera fauna in his review of Middle American Cenozoic vertebrate faunas. A summary list of the Yepómera fauna and published references are given in Table 1.

Beginning in 1971, field parties from the University of Arizona Laboratory of Palentology (UALP) began wet screening the Pliocene sediments of western Chihuahua to recover small mammals. Approximately 4.5 tons of sediment have been screen-washed from deposits near Yepómera. Some of the sites that produced small mammals by wet screening are the same as, or are adjacent to, those collected earlier by paleontologists from the California Institute of Technology. Other sites, especially those high in the section, are new. We report here the small mammals (Table 2) recovered by wet screening, and distinguish among them two biochronologically distinct assemblages; *i.e.*, the Yepómera and Concha faunas.

Pliocene sediments in western Chihuahua are exposed primarily in arroyos separated by extensive covered intervals. Most of the exposed sediments are flat-lying siltstones and sandstones, usually poorly sorted, with discontinuous marls. Near La Concha, north of Yepómera, diatomite beds are common in the upper part of the section. Precise correlation of fossil sites in different arroyos is difficult because of the limited exposure between arroyos. There is little evidence of late Cenozoic tectonic activity in that area, although a fault with displacement of about three meters is exposed in S.H. arroyo. Late Pleistocene sediments unconformably and discontinuously cap Pliocene sediments in the banks of the arroyos. The Pliocene wet screening sites are arranged in a relative stratigraphic sequence in Figure 2.

Most of the fossil sites in the vicinity of Yepómera have yielded early Pliocene (Hemphillian) fossils; however, late Pliocene (Blancan) fossils are recorded from diatomites high in the section, above the 35 m level in our relative stratigraphic sequence (Figure 2). These Hemphillian and Blancan sites are superposed with no observable break in deposition. A pronounced faunal change occurs between localities CH-13 and CH-15. These two fossil sites are close geographically, but are separated by a covered interval; locality CH-17 is superposed above CH-15. The transition between Hemphillian and Blancan land mammal ages occurs between localities CH-13 and CH-15. Fauna from the Hemphillian sites (CH-11, CH-15, and CH-16) are included in the Yepómera faunas (which equals the Rincón faunas of previous authors). Fauna from the Blancan sites (CH-13, CH-14, and CH-17) are included in the Concha fauna, new term. The Concha fauna is distinct from the Blancan Miñaca fauna of previous authors, located in the valley of the Río Papigochic near La Junta. Blancan age is assigned to the Concha fauna because two genera (*Pliophenacomys* and *Geomys*) common in North American Blancan faunas, but absent from known Hemphillian faunas, are recorded from that assemblage. We also record a large horse, *?Equus*, represented by a lower dentition (P_3-M_3), in the Concha fauna. *Pliohippus* is well known in the Yepómera fauna and is unknown in Blancan faunas which are characterized by *Equus*. The large

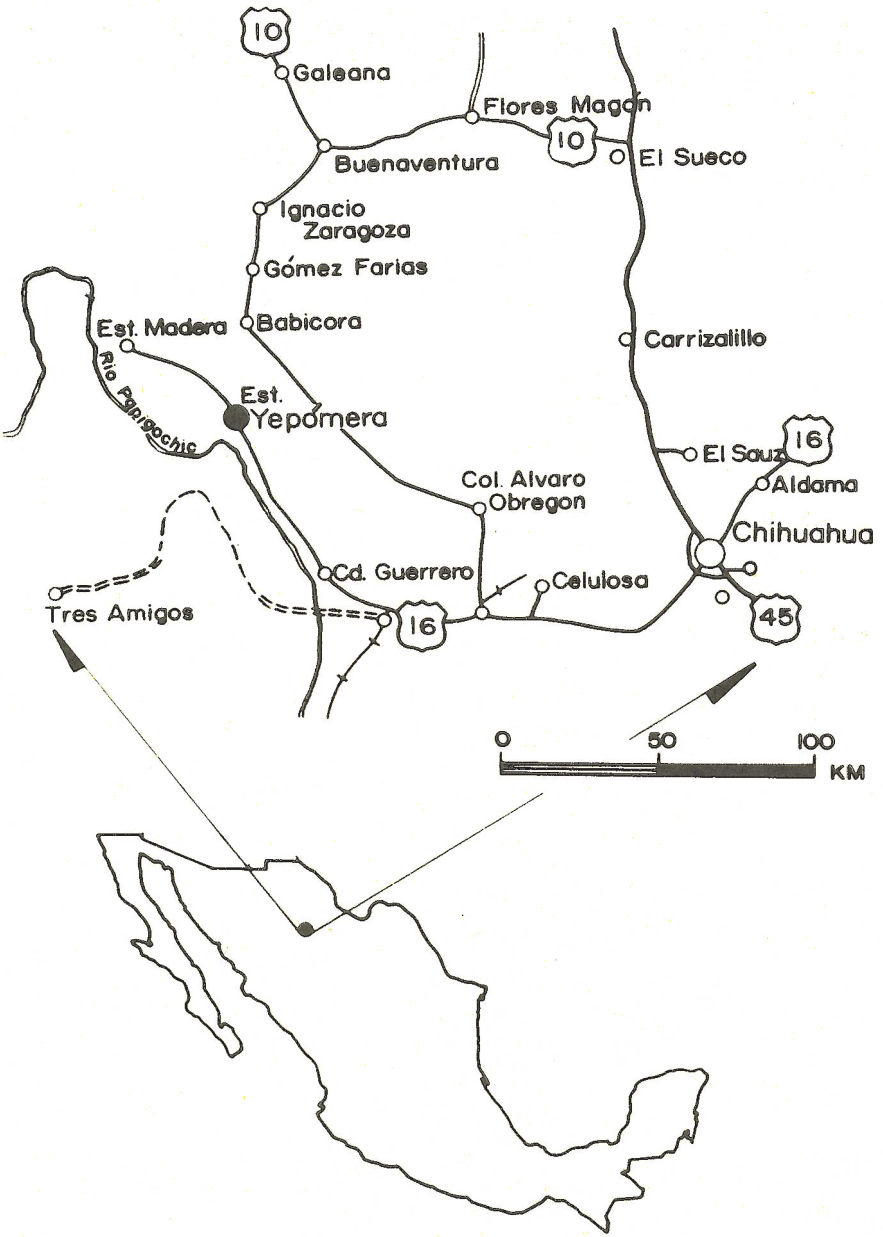

Figure 1.—Location map of Yepómera area, Chihuahua.

Table 1.—Terrestrial vertebrate fauna previously reported from Pliocene deposits near Yepómera, Chihuahua.

AMPHIBIA		
Bufonidae		
	Bufo campi	Brattstrom (1955)
AVES		
Phoenicopteridae		
	Phoenicopterus stocki	Miller (1944) Howard (1966)
Anatidae		
	Eremochen cf. *russelli*	Howard (1966)
	Wasonaka yepomerae	Howard (1966)
	Anas bunkeri	Howard (1966)
	Oxyura sp.	Howard (1966)
Scolopacidae		
	Erolia? sp.	Howard (1966)
Mimidae?		
	gen. indet.	Howard (1966)
Fringillidae		
	cf. *Passerina*	Steadman & McKitrick (1982)
MAMMALIA		
Leporidae		
	Notolagus velox	Wilson (1937)
Rodentia		
	Paenemarmota barbouri	Wilson (1949) Repenning (1962)
	Spermophilus pattersoni	Wilson (1949) Black (1963)
	Spermophilus matachicensis	Wilson (1949) Black (1963)
	Spermophilus sp.	Wilson (1949)
	Prosigmodon oroscoi	Jacobs & Lindsay (1980)
Canidae		
	Vulpes?	Lance (1950)
	Osteoborus?	Lance (1950)
	canid (?coyote)	Lance (1950)
Ursidae		
	Agriotherium cf. *A. schneideri*	Stock (1950)
Mustelidae		
	Taxidea mexicana	Drescher (1939) Stock (1948)
Felidae		
	?Pseudaelurus (=Metailurus)	Lance (1950)
Machairodontidae		
	Machairodus catacopis	Lance (1950)
Gomphotheriidae		
	cf. *Stegomastodon*	Lance (1950)

Table 1.—Terrestrial vertebrate fauna previously reported from Pliocene deposits near Yepómera, Chihuahua (*continued*).

Equidae		
	Pliohippus (Astrohippus) stocki	Lance (1950)
	Pliohippus (Pliohippus) mexicanus	Lance (1950)
	Neohipparion arellanoi	Stirton (1955)
	Neohipparion floresi	Stirton (1955)
	Nannippus cf. *minor*	Lance (1950)
Rhinocerotidae		
	genus & species indet.	Lance (1950)
Tayassuidae		
	Prosthennops sp.	Lance (1950)
Camelidae		
	?Paracamelus (=Megatylopus)	Lance (1950)
Antilocapridae		
	Hexobelomeryx fricki	Furlong (1941)

Table 2.—Small mammals from Pliocene sites near Yepómera collected by wet screening.

	Yepómera fauna				*Concha fauna*		
	Y13 CH-16	Y3 CH-11	Y39 CH-15	Y30 CH-12	Y35 CH-13	Y37 CH-14	Y40 CH-17
Insectivora							
Soricidae							
Notiosorex repenningi n.sp.							X
genus & species indet.			X				
Chiroptera							
Vespertilionidae							
Plionycteris trusselli n.gen. & n.sp.			X				
Lagomorpha							
Leporidae							
Notolagus velox		X	X				
Rodentia							
Sciuridae							
Spermophilus sp.indet.	X	X					
Heteromyidae							
Perognathus sp.indet.		X					
Prodipodomys idahoensis	X	X	X				

Table 2.—Small mammals from Pliocene sites near Yepómera collected by wet screening (*continued*).

	Yepómera fauna				*Concha fauna*		
	Y13 CH-16	Y3 CH-11	Y39 CH-15	Y30 CH-12	Y35 CH-13	Y37 CH-14	Y40 CH-17
Geomyidae							
Pliogeomys carranzai n.sp.			X				
Geomys minor					X		X
Cricetidae							
Copemys near *C. valensis*		X	X				
Calomys (Bensonomys) elachys n.sp.		X	X		X		
Calomys (Bensonomys) baskini n.sp.		X	X	X	X		
Baiomys kolbi		X	X		X		
Prosigmodon oroscoi		X	X		X		X
Prosigmodon chihuahuensis n.sp.			X			X	X
Pliophenacomys wilsoni n.sp.					X		

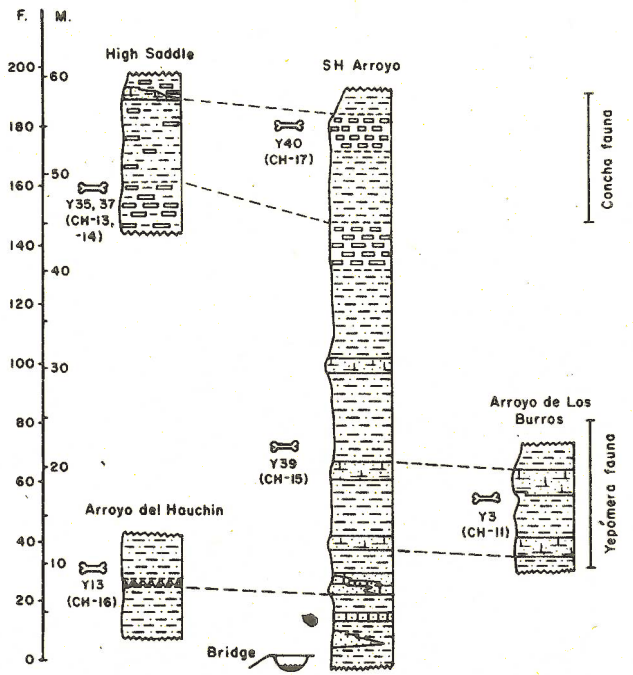

Figure 2.—Stratigraphic sections of fossiliferous strata near Yepómera, Chihuahua. Dots: sandstone; dashes and dots: siltstone, small rectangles: diatomite, small triangles: tuffaceous siltstone.

horse of the Concha fauna is apparently distinct from those of the Yepómera fauna. We consider the Concha fauna the earliest known Blancan fauna. North American Blancan and Hemphillian mammal faunas, including the Yepómera and Concha faunas, were recently reviewed by Lindsay and others (1984).

Description of a new sigmodontine rodent *(Prosigmodon)* from these sites in Chihuahua, and its significance relative to the expansion of sigmodontine rodents (and other mammals) in South America during the late Pliocene is published elsewhere (Jacobs and Lindsay, 1981). Purpose of this paper is to describe other small mammals of the Yepómera and Concha faunas collected by wet screening. A list of these small mammals and their distribution is given in Table 2. Measurements given in taxonomic descriptions are in millimeters.

SYSTEMATIC PALEONTOLOGY

Order Insectivora
Family Soricidae
Notiosorex Baird 1877
Notiosorex repenningi, new species

(Figure 3a, c, d; Plate 1a)

TYPE.—IGCU 2736, right dentary fragment with M_{1-3}.

REFERRED SPECIMEN.—Posterior fragment of right dentary with mandibular condyle preserved.

RANGE.—Known only from UALP locality Y40 (CH-17) Chihuahua, Mexico; Concha fauna, Blancan land mammal age.

DIAGNOSIS.—A relatively large shrew with talonid of M_3 reduced. Hypoconid of M_3 is a distinct cusp located at the posterior margin of the tooth, entocoid is indistinct on the low entoconid crest. Hypoonid V not developed (see Repenning, 1967).

DESCRIPTION.—The mandibular condyle has a deep lingual emargination and relatively narrow interarticular area between the lower and upper articular surfaces. The molars have trenchant trigonid cusps, and a prominent hypoconid on M_{1-2}. The entoconid is small but distinct and isolated from the hypoconid on M_{1-2}. Tooth size decreases posteriorly. The M_3 talonid is reduced to a posterior distinct hypoconid and a low entoconid ridge on the lingual side. Labial cingulum present on M_{1-3}. The mental foramen is located below the anterior portion of the talonid of M_1. Pigment cannot be distinguished. Length of M_{1-3} = 4.33. Length of M_3 = 1.25. All measurements in mm.

DISCUSSION.—*Notiosorex repenningi* is larger than other species of *Notiosorex* (*eg. N. crawfordi* and *N. jacksoni*) but the teeth are only slightly smaller than in *Megasorex gigas*. *N. repenningi* differs from *M. gigas* in reduction of the talonid of M_3, and smaller entoconid on lower molars. The coronoid process is narrower in *N. repenningi* than *M. gigas*, and the articular condyles are smaller in *N. repenningi*. Baskin (1979) reported *Notiosorex* sp. from the White Cone fauna (Hemphillian) of Arizona. The *Notiosorex* from White Cone is smaller than *N. repenningi* and represents the oldest known record of the genus.

Soricidae, genus and species indeterminate

(Figure 3c, d)

Seven isolated and fragmentary specimens that include two upper incisors, two right P^4, and two lower molars from UALP locality Y39 (CH-15) are identified as soricid. Further identification is insecure without more complete and associated specimens. These seven isolated teeth may represent a single taxon, although they represent more than a single individual. The specimens resemble *Notiosorex* and *Sorex*, but diagnostic characters for both genera are lacking in the available sample.

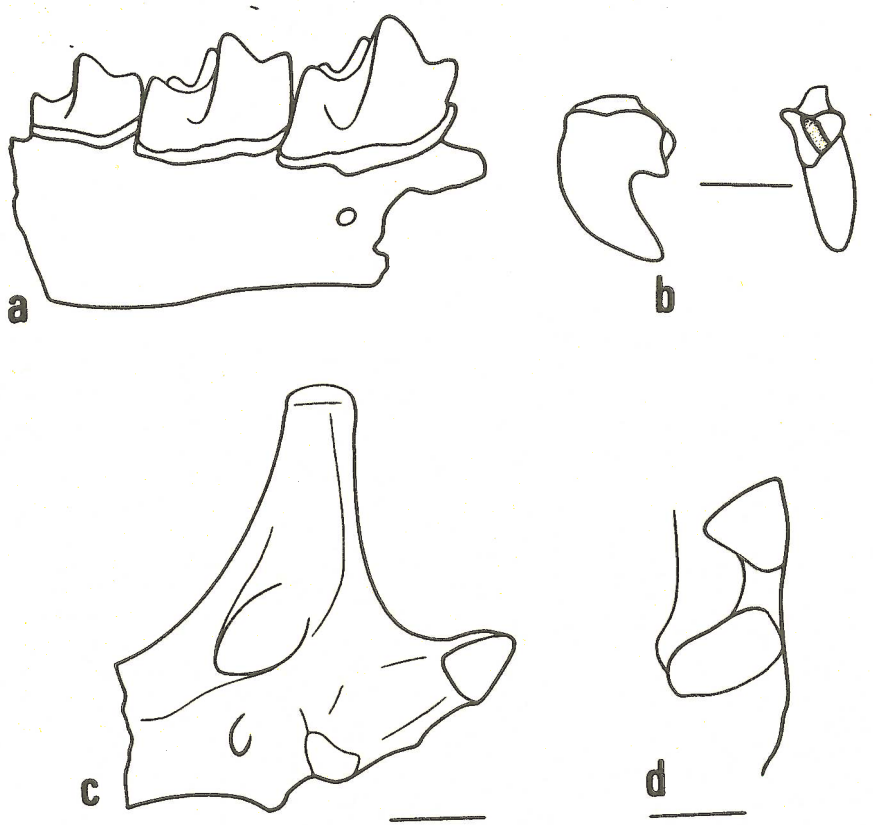

Figure 3.—Insectivores from Chihuahua faunas. (a) *Notiosorex repenningi*, n. sp., TYPE, labial view of right dentary (IGCU 1736); (b) Soricidae, indeterminate, upper incisor (IGCU 2735); (c and d) *Notiosorex repenningi*, n. sp., posterior portion of left dentary fragment (IGCU 2736). Bars equal 1 mm.

Order Chiroptera
Family Vespertilionidae
Plionycteris trusselli, n. gen. and n. sp.

(Plate 1b)

TYPE.—IGCU 1165, right maxillary fragment with right P^4M^1.

RANGE.—Known only from locality CH-15 (UALP loc. Y39), Chihuahua, Mexico; Yepómera fauna, Hemphillian land mammal age.

DIAGNOSIS (for both the genus and species).—Vespertilionid bat having a straight posterior margin and a prominent parastylar shelf on P^4; central basin of M^1 is closed between the protocone and metacone by the postprotocrista, and the hypocone is small but rounded, distinct from the postprotocrista and protocone.

DESCRIPTION.—The only known specimen is a right maxillary fragment with moderately worn P^4M^1. The labial margin of P^4 is directed slightly anterolingually. M^1 length = 1.22; M^1 width = 1.50. P^4 length = 1.0; P^4 width = .94. All measurements in mm.

P^4 is triangular with the posterior margin nearly straight. The paracone is the main cusp. The paracone connects with a moderately low, straight ectoloph which is slightly broader anteriorly than posteriorly. A well-developed internal cingulum is present with a distinct style in the position of a protocone, as a smaller, less well-developed accessory style posterior to it on the lingual border of the tooth. The region of the hypocone is expanded into a distinct lip, but the hypocone cusp is absent. The cingulum is well developed on the anterolabial corner of the tooth, forming a prominent parastylar shelf, but the parastyle is absent. The labial cingulum is poorly developed.

M^1 is triangular with three main cusps (protocone, paracone, and metacone) and a small but distinct hypocone. Parastyle, mesostyle, and metastyle are prominent and connect with the paracone and metacone tc form a "W" pattern. The hypocone is round and joins the postprotocrista posterior to the protocone. A deep central basin is closed posteriorly by a narrow loph from the base of the metacone to the junction of the hypocone-postprotocrista. Identification of the cusp posterior to the protocone as the hypocone is not secure. This cusp appears as a functional hypocone; however, we cannot rule out the possibility that it is an expanded metaconule. A minute protoconule joins the preprotocrista lingual to the paracone in *Plionycteris*. Anterior and posterior cingula are well-developed. An internal cingulum is weakly developed.

DISCUSSION.—*Plionycteris* differs from soricid insectivores in having much weaker development of hypocone of P^4M^1 and in not having a distinct parastyle of P^4. *Plionycteris* has been compared with representatives of every Recent family of bats (as listed by Koopman and Jones, 1970) except the Myzopodidae and the Craseonycteridae (of Hill, 1974). The morphology of P^4M^1, indicates that *Plionycteris* should be included in the family Vespertilionidae, subfamily Vespertilioninae. The orientation of P^4 relative to M^1 of *Plionycteris* indicates that the premolars anterior to P^4 were of diminutive size, and suggests the muzzle was short. In form, the P^4M^1 of *Plionycteris* most closely resemble *Myotis*, *Lasionycteris*, and *Pipistrellus*. These genera are included in two different tribes (Koopman and Jones, *op. cit.*). *Plionycteris* is no more closely related to any of these three than to the others, although some species of *Pipistrellus* have a rather closed central basin in M^1 as in *Plionycteris*. The characters that distinguish *Plionycteris* from *Myotis*, *Lasionycteris*, and *Pipistrellus* are the expanded parastylar shelf and the straight pos-

terior margin of P^4, plus the closed central basin and small rounded but distinct hypocone on M^1.

Plionycteris of the Hemphillian is not a likely ancestor for *Myotis, Lasionycteris,* or *Pipistrellus.* It is too specialized in having the expanded parastylar shelf on P^4 and closed central basin on M^1.

Extinct genera of vespertilionid bats from North America are few in number. *Ancenycteris,* known by a lower jaw from the Barstovian (late Miocene) of Montana (Sutton and Genoways, 1974), and *Simonycteris* known from the Blancan (Pliocene) of Arizona (Stirton, 1931; Harrison, 1978) have been considered most closely related to *Eptesicus* or *Lasiurus. Anzanycteris,* known from the Blancan of southern California (White, 1969), is most closely related to *Antrozous. Oligomyotis, Miomyotis,* and *Suaptenos* are known from humeri only (Galbreath, 1962; Lawrence, 1943). Some indeterminate chiropteran specimens have been recovered from the Hemphillian Redington fauna of Arizona, geographically and temporally close to the Yepómera fauna. Robinson (*in* McKenna, Robinson, and Taylor, 1962) reported a lower jaw fragment from the Bridgerian (Eocene) of Wyoming that he considered a bat similar to *Eptesicus.*

Slaughter (1970) suggested the development of cingula in bats is related to the degree of insectivory. With the exception of the parastylar shelf, the cingula of *Plionycteris* are not well developed. In addition, compared to most other vespertilionids, the ectoloph of P^4 in *Plionycteris* is not particularly trenchant, and the teeth have a less sharply angular aspect. No definite conclusions on the diet of *Plionycteris* can be drawn from the morphology of P^4M^1.

Order Lagomorpha
Family Leporidae
Notolagus velox Wilson 1937
(Figure 4a-g)

MATERIAL.—Seventeen isolated cheek teeth, including two P^2 and three P_3.

RANGE.—UALP localities Y3 (CH-11) and Y39 (CH-15), Yepómera fauna, Chihuahua, Rancho El Ocote fauna, Guanajuato, and Wolf Ranch fauna, Arizona; late Hemphillian and Blancan land mammal age.

DISCUSSION.—Wilson (1937) described *Notolagus velox* and characterized it has having two anterior inflections in P^2. One specimen, IGCU 2729 (Figure 4b), has a shallow third anterior inflection medial to the two deep anterior inflection in P^2. The P_3 specimens have a very deep anterointernal inflection, which unites with the anterior external inflection in two of three specimens, thus isolating the anterior part of the tooth, as seen on the type of *N. velox* and described by Wilson (1937).

Order Rodentia
Family Sciuridae
Spermophilus species indeterminate
(Plate 1c-f)

MATERIAL.—New material of *Spermophilus* includes four upper and five lower isolated cheek teeth.

RANGE.—UALP localities Y3 (CH-11) and Y39 (CH-15), Yepómera fauna, Chihuahua; late Hemphillian land mammal age.

DISCUSSION.—Wilson (1949) recognized two species of *Spermophilus*, *S. pattersoni* and *S. matachicensis*, from Yepómera. In addition, he referred two specimens (LACM 3552 and 3553) to *Spermophilus* sp., which he considered may be specifically distinct from each other, and from *S. matachicensis*. *S. pattersoni* is characterized by large size; *S. matachicensis* is of moderate size, with moderately high crowned cheek teeth but low lophs and posterolophids (Black, 1963). The specimens recovered in screening are smaller than *S. pattersoni* and do not appear so high crowned as *S. matachicensis*.

Cheek teeth of squirrels are usually very conservative with subtle differences characterizing taxa. It is often difficult to distinguish individual from taxonomic variation in a small sample due to the subtle nature of cheek tooth differences. More, and associated, material is needed to resolve the identity of squirrels from the Yepómera fauna.

Repenning (1962) noted that, among other differences, the genus *Paenemarmota* differs from *Marmota* in possessing a metaloph on M^3. The material assigned to *Marmota mexicana* by Wilson (1937) has a metaloph on M^3 and was synonymized with *Paenemarmota barbouri* by Repenning (1962). No additional material of *Paenemarmota* was recovered by wet screening.

There is apparently at least one unnamed species of squirrel from Yepómera, in addition to *S. pattersoni*, *S. matachicensis*, and *Paenemarmota barbouri*.

MEASUREMENTS (in mm).—IGCU 2726 left P^4, length 2.30, width 2.58; IGCU 2727, left P^4, length 2.91, width 2.92; IGCU 2724, right M_x, length 2.18, width 2.63; IGCU 2725, right M_3, length 2.67, width 2.67.

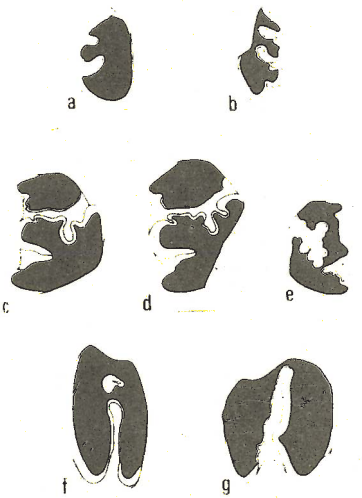

Figure 4.—*Notolagus velox* from Chihuahua faunas, occlusal views of cheek teeth. (a) left P^2 (IGCU 2730); (b) right P^2 (IGCU 1729); (c) left P_3 (IGCU 2733); (d) left P_3 (IGCU 2734); (e) right P_3 (IGCU 2728); (f) left M^x (IGCU 2731); (g) right M_x (IGCU 2732). Bars equal 1 mm.

Family Heteromyidae
Perognathus sp.

(Figure 5a; Plate 1h)

MATERIAL.—*Perognathus* is represented by an isolated lower molar, IGCU 2723, probably M_1.

RANGE.—*Perognathus* is widely distributed in western North America since the late Miocene. *Perognathus* sp. is known only from UALP locality Y39 (CH-15), Yepómera fauna, Chihuahua;. late Hemphillian land mammal age.

DESCRIPTION.—The tooth is mesolophodont with cusps distinct at their apices, but united below the apices into two transverse lophs. The occlusal outline is subrectangular, wider than long. The protoconid and metaconid are joined anteriorly. The protostylid is slightly smaller than the protoconid. The hypostylid is smaller than the entoconid, which is smaller than the hypoconid. The base of the enamel is slightly irregular, lowest posteriorly and higest anteriorly. There are two broad roots; one anterior, the other posterior.

MEASUREMENTS (in mm).—M_1 length 0.88, width 1.16.

DISCUSSION.—This specimen is similar in size and cusp position to M_1 of *Perognathus mclaughlini* from the Redington fauna, Arizona, Buis Ranch fauna, Oklahoma, and Saw Rock Canyon, Kansas. The M_1 is not adequate for species identification in Pliocene *Perognathus*.

Prodipodomys idahoensis

(Figure 5b-h; Plate 1g, i-l)

MATERIAL.—Ten isolated cheek teeth (one P^4, one M^1, two M^2, one M^3, one P_4, two $?M_2$, and two M_3).

RANGE.—UALP localities Y3 (CH-11), Y13 (CH-16), and Y39 (CH-15), Yepómera fauna, Chihuahua; Wolf Ranch fauna, Arizona; and Hagerman fauna, Idaho; late Hemphillian and early Blancan land mammal age.

DESCRIPTION.—Specimens from the Yepómera fauna assigned to this taxon are similar in size and height of crown. They are relatively high crowned, rooted, and usually with wide dentinal tracts which extend only a short distance from the base of the crown.

P^4: The protoloph has a prominent rounded protocone and a small labial accessory cuspule; the base of the protoloph is rounded, with a shallow, vertical groove at the union of the protoloph and metaloph. The protoloph and metaloph merge after moderate wear. The metaloph has three cusps, with the metacone and hypocone joined in early wear, and the hypostyle separate until moderate wear. The hypocone is slightly posterior relative to te metacone, and the hypostyle is anterolingual to the hypocone. A narrow posterior cingulum joins the hypostyle to the posterior margin of the hypocone. The base of the enamel is much lower on the protoloph, with broad dentinal tracts at the base of the metaloph on both the labial and lingual sides. A large and long root lies at the base of the protoloph; there are two small roots at the base of the metaloph.

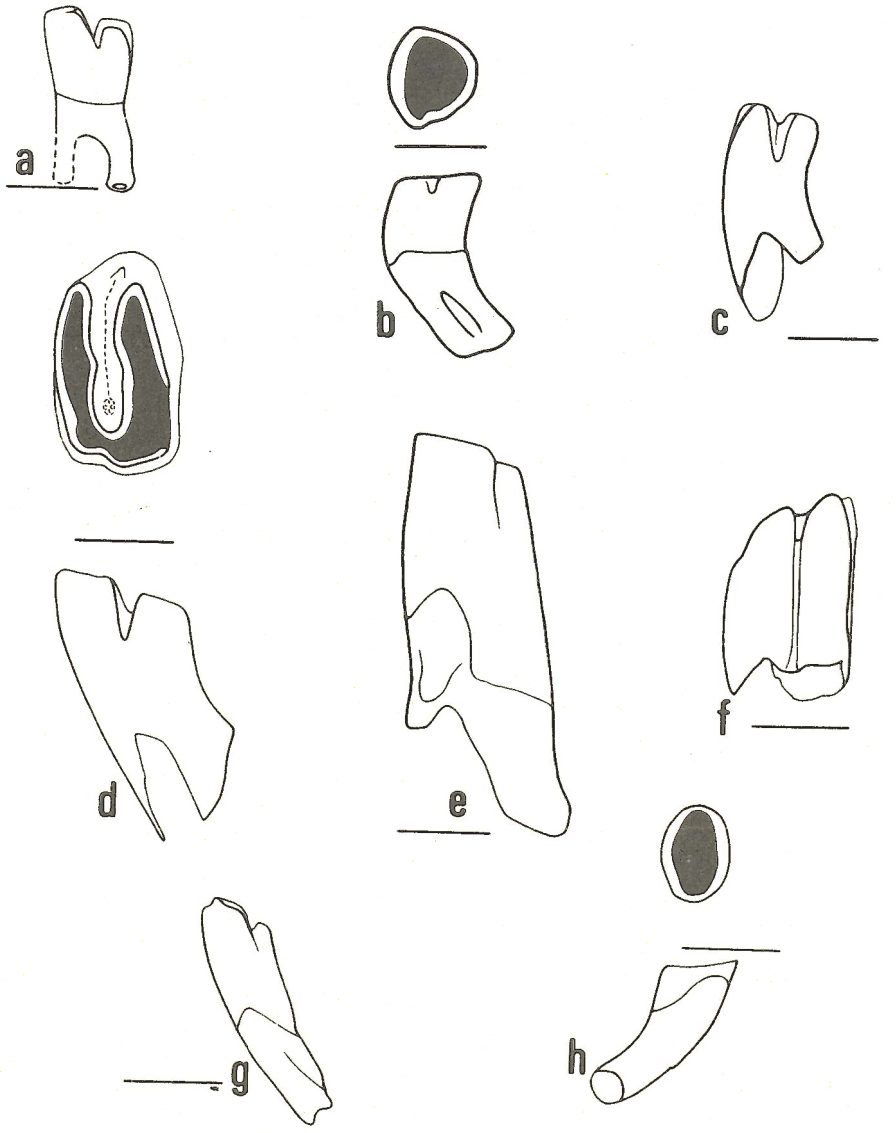

Figure 5.—Heteromyid rodents from Chihuahua faunas. (a) *Perognathus* sp. indet., left M_2 (IGCU 2723), labial view; (b through h) *Prodipodomys idahoensis:* (b) right M^3 (IGCU 2722), labial and occlusal views; (c) right M^2 (IGCU 2721), labial view; (d) right M^1 (IGCU 2718), labial and occlusal views; (e) right P^4 (IGCU 2719), lingual view; (f) right P_4 (IGCU 2715), labial view; (g) left M_2 (IGCU 2716), labial view; (h) ?right M_3 (IGCU 1717), labial and occlusal views. Bars equal 1 mm.

M^1: Wear on this tooth is moderate, and the base of the tooth is broken off. The protoloph is straight and wider than the curved metaloph. Cusps on both lophs are obliterated with wear. Lophs are united lingually with moderate wear, then labially with greater wear to enclose a deep central basin. A narrow and relatively high dentinal tract occurs on the labial side of the tooth.

M^2: One of these teeth is in early wear, the other is corroded by acid (postmortem). The straight protoloph has three cusps; the paracone is transversely elongate, the protostyle is rounded and slightly anterior to the protocone. The curved metaloph has three cusps and is shorter thant the protoloph. The metacone and hypostyle are transversely elongate. The narrow posterior cingulum curves around the posterior margin of the tooth from the metacone to the hypostyle, posterior to the hypocone. The protoloph and metaloph join lingually after moderate wear; they join labially at a later stage of wear, approximately when the shallow central basin is obliterated. Shalow, broad dentinal tracts occur at the base of the protoloph, on both the labial and lingual sides. Roots are separate distally.

M^3: This tooth is well worn, so that cusps and lophs are indistinct. The anterior margin is nearly straight; the posterior margin is rounded. The base of the enamel is slightly irregular, highest at the base of the protoloph (both labially and lingually) as incipient dentinal tracts. Roots are completely fused, with a shallow vertical groove posterolabially.

P_4: The protolophid has two cusps joined medially and a shallow anterior fold. The protoconid has a high, posterolingual cuspule that is removed in early wear. The metalophid has three cusps and is wider than the protolophid. It is joined to the protolophid by a broad central connection after moderate wear. Initial connection between the protolophid and metalophid is between the protoconid (lingual cusp of protolophid) and hypoconid (median cusp of metalophid). The labial groove between the protolophid and metalophid is deep and distinct to the base of the enamel. Lingual groove between lophids is shallow, becoming indistinct at the base of the enamel. The base of the enamel is irregular, highest at the lateral base of the metalophid, lowest posteriorly. Dentinal tracts are absent. Roots are not preserved.

M_2: The metalophid is straight, three cusped, with a transversely-oriented, subequal metaconid and protoconid, and a smaller protostylid. The anterior cingulum curves lingually from the protostylid and terminates anterior to and between the metaconid and protoconid. The hypolophid is two cusped (hypostylid is indistinct), shorter, and lower than the metalophid. Lophids join medially after moderate wear, forming an ephemeral H-pattern. Dentinal tracts are broad and shallow at the labial and lingual base of the metalophid. Roots are narrow, fused throughout their length, with a shallow posterolingual groove.

M_3: These teeth are well worn; cusps and lophids are indeterminate. The occlusal outline is oval, wider than long. Base of the enamel is much deeper posteriorly, slightly more shallow on the labial and lingual sides suggesting an incipient dentinal tract. Roots are completely fused, with a shallow, lingual (?) groove.

MEASUREMENTS (in mm)

	Number	*Length*	*Width*
P^4	1	1.66	1.70
M^1	1	0.92	1.81
M^2	2	0.96-1.00	1.44-1.47
		$\bar{x} = 0.98$	$\bar{x} = 1.46$
M^3	1	0.86	1.01
P_4	1	1.24	1.40
(?)M_2	2	0.76-0.92	1.08-1.20
		$\bar{x} = 0.84$	$\bar{x} = 1.14$
M_3	2	0.72-0.78	1.00-1.10
		$\bar{x} = 0.75$	$\bar{x} = 1.05$

DISCUSSION.—Specimens of *Prodipodomys idahoensis* from the Yepómera fauna are similar in size, cusp morphology, and development of dentinal tracts to *P. idahoensis* described from Blancan faunas at Wolf Ranch, Arizona (Harrison, 1978) and Hagerman, Idaho (Zakrzewski, 1969). *Prodipodomys rexroadensis* of the Blancan Rexroad fauna, Kansas (Hibbard, 1954) differs from *P. idahoensis* in being less hypsodont, and roots are less fused (Zakrzewski, 1969). *Perognathoides bidahochiensis* of the Hemphillian White Cone fauna, Arizona (Baskin, 1979), *Prodipodomys kansensis* of the Hemphillian Edson fauna, Kansas (Hibbard, 1939; Zakrzewski, 1970) and the Hemphillian Redington fauna, Arizona (Jacobs, 1977), and *Prodipodomys griggsorum* of the Rexroad fauna (Zakzewski, 1970) are all smaller and lower crowned than *P. idahoensis* of the Yepómera fauna. *Prodipodomys minor* of Blancan faunas at Benson and 111 Ranch, Arizona is smaller and higher crowned than *P. idahoensis.*

Prodipodomys sp.

An insolated and broken cheek tooth (IGCU 2718), identified as ?M^2, from locality Y35 (=CH-13), Concha fauna, represents a second species of *Prodipodomys,* Measurements of IGCU 2718 are: length = 1.32 (occlusal), 1.24 (midsection), width = 2.26. Size of this specimen is significantly greater than specimens of *P. idahoensis* from the Yepómera fauna.

Family Geomyidae

Pliogeomys carranzai, n. sp.

(Figure 6)

TYPE.—IGCU 2712, right P_4.

HYPODIGM.—The type, plus a worn and broken P_4, two lower molars (probably M_1) and an upper incisor fragment.

RANGE.—UALP locality Y39 (CH-15), Yepómera fauna, Chihuahua; late Hemphillian land mammal age.

DIAGNOSIS.—A very high crowned geomyid, with high and wide dentinal tracts. P_4 probably with two roots (base of tooth is broken, but is distinctly separated into an anterior and posterior half), the protolophid is relatively short and wide, with continuous enamel on the occlusal surface until moderate wear. Medial groove of upper incisor very shallow.

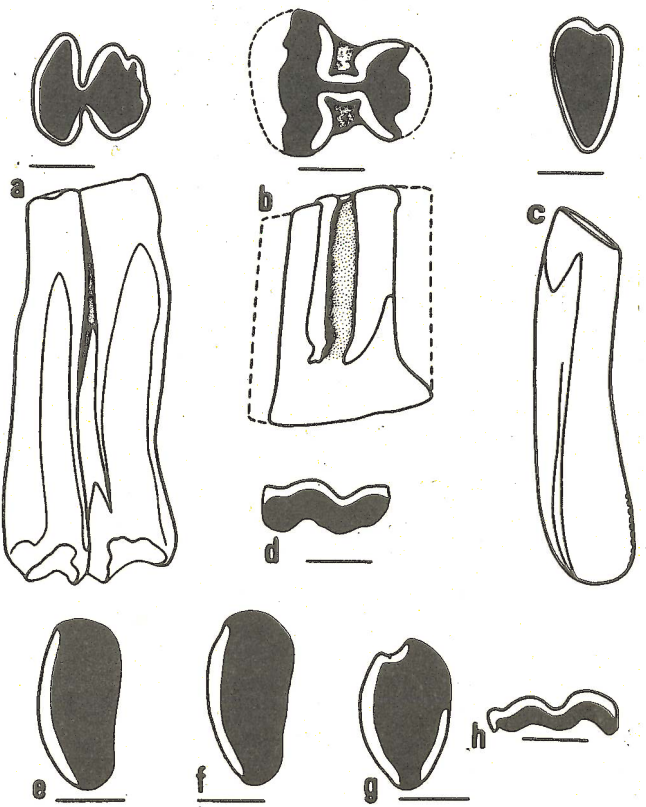

Figure 6.—Geomyid rodents from Chihuahua faunas. (a through d) *Pliogeomys carranzai*, n. sp.: (a) right P_4, TYPE, (IGCU 2712), labial and occlusal views; (b) ?right P_4 (IGCU 2713), labial and occlusal views; (c) right M_1 (IGCU 2711), lingual and occlusal views; (d) upper incisor fragment (IGCU 2714), cross section; (e through h) *Geomys minor;* (e) left M_1 (IGCU 2705), occlusal view; (f) left M_1 (IGCU 2706), occlusal view; (g) left M_3 (IGCU 2707), occlusal view; (h) upper incisor fragment (IGCU 2708), cross section. Bars equal 1 mm.

ETYMOLOGY.—Named for Sr. Gonzalo Carranza of Madera, Chihuahua, who provided lodging and assistance during our field work in Chihuahua.

DESCRIPTION.—The P_4 is very high crowned and steep-walled, longer at the base of the tooth, which appears divided into an anterior and posterior root, although roots are not preserved. The protolophid of the P_4 is rounded, narrower than the metalophid, and narrows slightly toward the occlusal surface. In occlusal view, there is a minor fold on the lingual side of the P_4, and smaller folds on the anterior side. Protolophid and metalophid of the type are closely appressed, without a parallel-sided, enamel-bounded lophid separating the principal lophids, as in modern *Geomys*. Cementum is absent from the type, but fills the lateral folds between the lophids on the worn P_4.

A slightly worn lower molar (IGCU 2711) has an unbroken enamel cap circling the occlusal surface; there is a slight lateral fold in the enamel cap. The other lower molar is well worn; it has a posterior enamel plate, and a vestige of enamel on the anteromedial part of the occlusal surface. Roots are not preserved on any of the specimens.

The incisor fragment of *Pliogeomys carranzai* has two grooves as in *Geomys;* however, the medial groove is very shallow, compared to development of the groove in both fossil and recent species of *Geomys*.

MEASUREMENTS (in mm)

	Length	*Width*
P_4 (type)	2.25	1.87
P_4	——	2.17
M_1 (slightly worn)	0.96	1.92
M_1 (deeply worn)	1.10	1.92

DISCUSSION.—*Pliogeomys carranzai* was compared with casts of *Pliogeomys buisi* of the Hemphillian Buis Ranch fauna, Oklahoma. *P. carranzai* is comparable in size to *P. buisi* (length P_4 = 2.25—2.75; width P_4 = 2.0—2.17), but is higher crowned (dentinal tracts wider and higher). Both *P. carranzai* and *P. buisi* are larger than *P. parvus* (length P_4 = 1.11—1.60; width P_4 = 0.81—0.93 in Zakrzewski, 1969, p. 8) of the Blancan Hagerman fauna, Idaho.

Parapliosaccomys oregonensis of the Hemphillian McKay Reservoir fauna, Oregon, is as high crowned as *P. carranzai*, but the protolophid on P_4 is longer and narrower in *P. oregonensis*.

Geomys minor

(Figure 7)

MATERIAL.—Fourteen isolated cheek teeth (four P^4, two M^1, one M^3, one P_4, three M_1, two M_2, and one M_3) and two incisor fragments.

RANGE.—UALP localities Y35 (CH-13) and Y40 (CH-17), Concha fauna, Chihuahua, and Benson fauna, Arizona; Blancan land mammal age.

DESCRIPTION.—Enamel is removed from the posterior occlusal surface after early wear on P^4 in modern species of *Geomys*. A vestige of enamel is retained on the posterior wall in two of the four P^4 specimens assigned to *Geomys minor* from Chihuahua. The

protoloph of P^4 specimens is narrower than the metaloph, and the anterior face of the protoloph is relatively flat in occlusal view. Protoloph and metaloph are not closely appressed, but are joined by a narrow medial loph. Dentinal tracts on P^4 are uniformly narrow. The upper molars have relatively wide dentinal tracts, and are distinguished from lower molars by having an anterior as well as a posterior enamel plate.

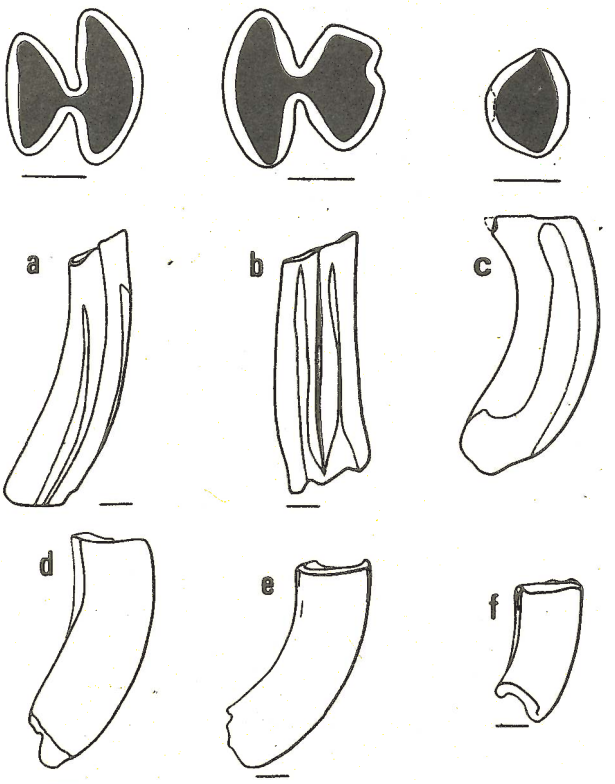

Figure 7.—*Geomys minor* from the Concha fauna, Chihuahua. (a) ?left P^4 (IGCU 2709), lingual and occlusal views; (b) ?right P_4 (IGCU 2710), labial and occlusal views; (c) right M^3 (IGCU 2704), lingual and occlusal views; (d) left M_1 (IGCU 2705), posterior view; (e) left M_1 (IGCU 2706), posterior view; (f) left M_3 (IGCU 2707), posterior view. Bars equal 1 mm.

P_4 has a continuous enamel cap on the occlusal surface until moderate wear. The protolophid is narrower than the metalophid, and may have a slight anterior fold; the anterior face of the protolophid is rounded, not flat. The lingual dentinal tracts on P_4 are narrower than the labial dentinal tracts. The protolophid and metalophid of P_4 are connected by a short, tapered loph, forming an indistinct "neck region" between

the lophids in occlusal view. M_1 and M_2 lack enamel on the anterior occlusal surface after early wear. M_3 has a vestige of enamel on the anterior occlusal surface after moderate wear, and a rather persistent fold in the posterolateral occlusal surface. Incisors of *G. minor* have two grooves, as in modern species of *Geomys*.

MEASUREMENTS (in mm)

	Number	*Length*	*Number*	*Width*
P^4	2	1.68-1.83 $\bar{x} = 1.76$	4	2.21-2.42 $\bar{x} = 2.28$
M^1	2	0.92-1.04 $\bar{x} = 0.98$	2	2.08-2.33 $\bar{x} = 2.21$
M^3	1	1.25	1	1.59
P_4	1	2.29	1	2.29
M_1	2	1.13-1.25 $x = 1.19$	3	2.21-2.48 $\bar{x} = 2.36$
M_2	1	1.18	2	2.42-2.48
M_3		1.22		2.09

DISCUSSION.—Specimens of *Geomys minor* of the Concha fauna are larger and higher crowned than *Pliogeomys carranzai* of the Yepómera fauna.

Family Cricetidae
Copemys, near *C. valensis*

(Figure 8a, b; Plate 2a, b)

MATERIAL.—Four isolated cheek teeth (one M^1, one M^2, and two M_1).

RANGE.—UALP localities Y3 (CH-11) and Y39 (CH-15), Yepómera, Chihuahua (*Copemys valensis* is recorded from Little Valley, McKay Reservoir, and Bartlett Mountain, Oregon); Hemphillian land mammal age.

DESCRIPTION.—*Copemys* near *C. valensis* is a relatively small, low-crowned cricetid with simple dental features. Cusps alternate in position, more so in lower molars than in upper molar. Cusps of upper molars slope anteriorly, with straight, vertical posterior walls; cusps of lower molars slope posteriorly, with straight, vertical anterior walls.

M^1: Occlusal outline of M^1 is relatively narrow anteriorly. The anterocone is relatively wide but single cusped, and asymmetrical with the lingual side tapering to a low, narrow transverse loph. The anterocone is joined posteriorly near the midline of the tooth by the anterior arm of the protocone. The protocone has a strong anterior arm, directed obliquely toward the anterocone, and a short, weak posterior arm that weakly joins the paracone. The paracone is transversely elongate, with a strong protoloph. The hypocone has a strong anterior arm, barely contacting the protoloph, and with a labial expansion anteriorly as an incipient (or vestigial) mesoloph. Posterior arm of the hypocone is short, joining the posterior cingulum medial to the midline of the tooth. The metacone is round until late wear, at which stage it joins the posterior cingulum. There is no metaloph. The mesoloph is short and sloping; it terminates well short of the

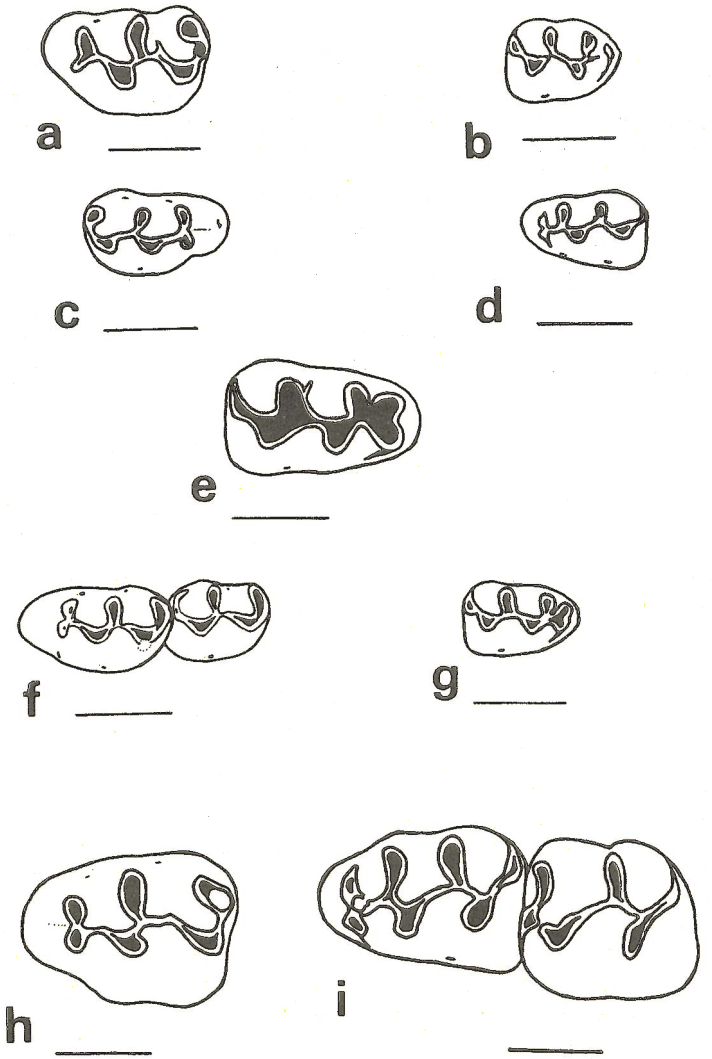

Figure 8.—Cricetid rodents from Chihuahua faunas, all in occlusal view. (a and b) *Copemys* near *C. valensis:* (a) left M^1 (IGCU 1195); (b) right M_1 (IGCU 1209); (c and d) *Calomys (Bensonomys) elachys*, n. sp.: (c) right M^1, TYPE (IGCU 1174); (d) left M_1 (IGCU 1178); (e) *Calomys (Bensonomys) baskini*, n. sp., right M_1, TYPE (IGCU 1224); (f and g) *Baiomys kolbi;* (f) left M^{1-2} (IGCU 1179); (g) right M_1 (IGCU 1201); (h) *Prosigmodon chihuahuensis*, left M^1 (IGCU 1232); (i) *Prosigmodon chihuahuensis*, n. sp., left M_{1-2}, TYPE IGCU 1238). Bars equal 1 mm.

labial border of the tooth. The posterior cingulum becomes broad with wear. The valley between the anterocone and paracone is partly closed by a low cuspule anterior to the paracone. Three distinct roots are present, plus a slight bulbous expansion below the paracone, suggesting an incipient accessory rootlet.

M^2: This specimen is in a late stage of wear. Cusps, lophs, and their connections appear as in M^1, except the protocone joins the anterior cingulum anteriorly. A long, narrow anterior cingulum connects the anterior arm of the protocone and the anterolabial base of the paracone. The valley between the paracone and metacone is partly closed by posterior elongation of the paracone. The valley between the protocone and hypocone is bridged by a low internal cingulum. Three distinct roots are present, with no suggestion of accessory rootlets.

M_1: Occlusal outline of M_1 tapers anteriorly to a symmetrical, rounded point near the midline of the tooth. The anteroconid is single cusped, short, and asymmetrical with the apex lingual to the midline, sloping gently labially as the low anterior cingulum. A low and narrow anterolophid is directed posteriorly from the anteroconid near the midline to its union with the protoconid and metalophid. The metaconid and entoconid are transversely elongate, merging with the metalophid and hypolophid. The protoconid has a short anterior arm that joins the metalophid and anterolophid, plus a long posterior arm that joins the hypolophid. The hypoconid joins the hypolophid anteriorly and the posterior cingulum posteriorly. There is no mesolophid. The posterior cingulum is expanded labial to the midline, forming an indistinct posteroconid. The valley between the anteroconid and metaconid is very narrow, partly closed by union of those cusps. The lingual valley are relatively narrow, V-shaped, and are slightly closed by a low cingulum joining the metaconid and entoconid, and by union of the posterior cingulum with the entoconid. The labial valleys are relatively narrow, with a gently rounded floor, and are partly closed by union of the anterior cingulum with the protoconid, and by a low labial cingulum joining the protoconid and hypoconid. Anterior and posterior roots are present, with no indication of accessory rootlets.

MEASUREMENTS (in mm).—M^1 length 1.68, width 1.02; M^2 length 1.08, width 0.98; M_1 length 1.10, width 0.80-0.82.

DISCUSSION.—Upper molars of *Copemys* near *C. valensis* from Yepómera are very similar to *Copemys valensis* (Shotwell) from Little Valey, Oregon. Cusps in *Copemys* near *C. valensis* are more sloping than those of *Copemys valensis* from Oregon. *Shotwell* (1967, p. 9) noted the mesoloph and mesolophid occur infrequently in *Copemys valensis* from Oregon. Lower molars of *Copemys* near *C. valensis* from Yepómera are distinctly smaller than those from Little Valley, Oregon; they are also similar to but smaller than those of *?Copemys vasquezi* from the Hemphillian Redington fauna of Arizona (Jacobs, 1977). *?Copemys vasquezi* has a bilobed anterocone on M^1. The *Copemys* from the Yepómera fauna may represent a new species that is closely related to *C. valensis* and *?C. vasquezi*, but the present sample is too small for specific diagnosis.

Calomys (Bensonomys)

Eligmodontia arizonae was named by J. W. Gidley (1922) for specimens of a small cricetid rodent collected from Blancan deposits in the San Pedro Valley near Benson, Arizona. Gazin (1942) reported additional specimens from the same beds, and erected

a new genus, *Bensonomys*, for the taxon named *Eligmodontia arizonae* by Gidley. Subsequently, Hibbard named three other species of *Bensonomys* (*B. eliasi, B. meadensis*, and *B. stirtoni*) from late Hemphillian and Blancan deposits in Kansas. *Bensonomys* has also been reported from Blancan and Irvingtonian faunas in Nebraska, Texas, and California.

Baskin (1978) reported Hemphillian rodents from the White Cone fauna in Arizona in which he named two new species of *Bensonomys*. Baskin thoroughly reviewed the history of *Bensonomys*, compared it with South American cricetids, and concluded *Calomys*, the South American vesper mouse (closely related to *Eligmodontia*), is generically inseparable from *Bensonomys*. He synonymized *Bensonomys* with *Calomys*, recognizing *Bensonomys* as a subgenus, and discussed its significance in a North American radiation of early sigmodontine cricetids.

Calomys (Bensonomys) is very near *Eligmodontia*, as suggested by Gidley and by Gazin, differing from that genus in lower height of crown, less reduction of M_3, and less expansion of the anterior masseteric crest. Numerous details of dental and mandibular morphology are shared by *Calomys (Bensonomys)* and other sigmodontine rodents. These similarities suggest a close phylogenetic relationship between *Calomys (Bensonomys)* and other sigmodontine rodents, rather than parallel evolution (Baskin, 1978).

Calomys (Bensonomys) elachys n. sp.

(Figure 8c, d; Plate 2e-h)

TYPE.—IGCU 1174, isolated right M^1 from UALP loc. Y35 (CH-13), Chihuahua.

HYPODIGM.—Type, plus eight isolated M^1, three isolated M^2, five isolated M_1, and three isolated M_2.

RANGE.—UALP localities Y3 (CH-11), Y39 (CH-15), and Y35 (CH-13), Yepómera and Concha faunas, Chihuahua; late Hemphillian and early Blancan land mammal ages.

DIAGNOSIS.—Small brachydont cricetid rodent with large unequally bilobed anterocone of M^1; anteroconid of M_1 relatively short and broad, slightly bilobed. Anterolingual valley of M_1 deep and narrow between anteroconid and metaconid. Size of *Baiomys kolbi*; differs from *Baiomys* in having a deeper anteromedian groove on M^1.

ETYMOLOGY.—*elachys*, Greek for small, alluding to the relative size of this species.

DESCRIPTION.—Small, low crowned cricetid rodent with a long, unequally bilobed anterocone on M^1, and a short, wide, slightly bilobed anteroconid on M_1.

M^1: Occlusal outline is oval, longer than wide, with rounded anterior and posterior margins. Greatest width is at the hypocone (six specimens) or the protocone (two specimens). The anterocone is wide, unequally bilobed with a deep anterior groove separating lobes of the anterocone. The labial lobe of the anterocone is higher, posterior, and larger at the base than the lingual lobe. The lingual lobe of the anterocone expands anteriorly, causing the anterolingual margin of the tooth to project slightly anteriorly in seven of eight specimens. A low transverse cingulum is located anterior to the deep anteromedian groove of the anterocone in four of eight specimens. Labial cusps (paracone and metacone) have straight, vertical posterior sides and long, sloping anterior sides. Lingual cusps (protocone and hypocone) have short, transversely-oriented posterior arms and long, anteriorly-oriented anterior arms. Valleys between the cusps are relatively

wide and are partially closed by a low cingulum, especially the labial valleys. A minute mesostyle is distinct on one of eight specimens (IGCU 1174). A short posterior cingulum, posterior to the metacone and lateral to the posterior arm of the hypocone, is distinct on only three of eight specimens; it is obliterated after early wear. Three prominent roots are present and a small "bump" or rootlet is present below the paracone in five of seven specimens.

M^2: Three isolated M^2 (IGCU 1184, 1186, 1205) are tentatively assigned to *C. elachys*. Occlusal outline is oval with a near-straight anterior margin and a rounded, narrow posterior margin.. Cusps and lophs are similar to M^1 except that the anterocone is absent and a broad, low anterior cingulum is present. Three well developed roots are present, accessory rootlets are unknown.

M_1: Occlusal outline is oval, with a narrow, gently rounded anterior margin and a relatively straight, broad posterior margin. The anteroconid is indistinctly bilobed, with a shallow vertical median groove separating the lobes of the anteroconid. Lobes of the anteroconid appear subequal and symmetrical, although the labial lobe is slightly lower. The protoconid, metaconid, hypoconid, and entoconid have straight, near-vertical anterior sides and slightly sloping posterior sides. The anterolophid (joining the protoconid and anteroconid) is short; it is double in one of five specimens (IGCU 1175). The metalophid is short and narrow, joining the anterior arm of the protoconid; the hypolophid ish short and wide, joining both the posterior arm of the protoconid and the anterior arm of the hypoconid. The posterior arm of the hypoconid is expanded near the midline of the tooth, forming a small cuspule (posteroconulid) lingual to the midline. The valleys are deep and relatively wide. Broad labial shelves and narrow lingual shelves are partially closed by stylar (or cingular) ridges. A slight ectostylid is present in three of five specimens; a minute mesostylid is present in one of five specimens (IGCU 1199). Two roots, anterior and posterior, are present, without accessory rootlets.

M_2: Three isolated M_2 (IGCU 1187, 1188, 1191) are assigned to *C. elachys* because of their similarity to *C. yazhi*, *C. gidleyi*, and modern species of *Calomys*. Occlusal outline is oval, longer than wide. Cusps, lophs, and roots are similar to those on M_1 except the anteroconid is absent. The anterior cingulum is relatively robust compared to specimens assigned to *Baiomys*. The posterior cingulum is also relatively long and robust; it tends to join the base of the entoconid, thereby closing the shallow posterolingual valley between the entoconid and posterior cingulum. The anterolingual valley between the metaconid and entoconid and the labial valley between the protoconid and hypoconid are also slightly closed by low cingula.

MEASUREMENTS (in mm)

	N	*X*	*S*	*V*	*Observed Range*
M^1 length	8	1.36	.093	6.84	1.25 - 1.53
M^1 width	8	0.85	.052	6.13	0.77 - 0.92
M^2 length	3	0.91	.042	4.64	0.89 - 0.99
M^2 width	3	0.81	.041	5.04	0.76 - 0.84
M_1 length	5	1.25	.039	3.12	1.20 - 1.31
M_1 width	5	0.80	.034	4.27	0.76 - 0.84
M_2 length	3	1.00	.084	8.37	0.95 - 1.10
M_2 width	3	0.81	.046	5.68	0.77 - 0.86

DISCUSSION.—*Calomys (Bensonomys) elachys* is most similar to *C. (Bensonomys) yazhi* and *C. (Bensonomys)* gidleyi from the White Cone fauna of Arizona (Baskin, 1978). Teeth of *C. elachys* are slightly higher crowned and narrower than in *C. yazhi*, and the anteromedian groove of the anterocone is deeper in *C. elachys* than in *C. yazhi*. M_1 of *C. elachys* is more slender, and the labial stylar shelf is better developed in *C. yazhi*. Teeth of *C. elachys* are slightly smaller and narrower than in *C. gidleyi*, and the lingual lobe of the anterocone is larger and more expanded toward the base of *C. elachys* than in *C. gidleyi*. M_1 of *C. elachys* is more slender than in *C. gidleyi*, and lobes of the anteroconid are more equal in *C. elachys* than in *C. gidleyi*.

All other described species of *C. (Bensonomys)* are larger and have other minor morphological differences from *C. elachys*. *C. elachys* is distinguished from *Baiomys kolbi* with great difficulty, suggesting a close phyletic relationship between these genera. *C. elachys* has a deeper cleft in the anterocone of M^1 and is slightly lower crowned than *B. kolbi*. In *Calomys* the anteroconid of M_1 is broadly separated from the metaconid and lobes of the anteroconid approach the size of the metaconid. In *Baiomys* the anteroconid of M_1 tends to be close to and smaller than the metaconid, with the lingual lobe of the anteroconid more prominent than the labial lobe.

Calomys (Bensonomys) baskini n. sp.

(Figure 8e; Plate 2i-o)

TYPE.—IGCU 1224, isolated right M_1 from UALP loc. Y35 (CH-13).

HYPODIGM.—Ten isolated cheek teeth including the type and a second M_1, four M_2, one M_3, one M^1, and two M^2.

RANGE.—UALP localities Y3 (CH-11), Y30 (CH-12), Y35 (CH-13), and Y39 (CH-15), Yepómera and Concha faunas, Chihuahua; late Hemphillian and early Blancan land mammal age.

DIAGNOSIS.—Small brachydont cricetid rodent with subequally bilobed anteroconid having a deep anteromedian groove on M_1 and unequally bilobed anterocone with a deep anteromedian groove on M^1. Tendency to retain a short mesolophid appressed to the base of the entoconid on M_{1-2}, and a "hint" of an ectolophid on M_1. Posterolabial valley of M_3 deep, extending more than halfway across the tooth. Size is comparable to that of *C. (Bensonomys) stirtoni* from Saw Rock Canyon; length on M_1 = 1.87-1.90 mm.

ETYMOLOGY.—*baskini*, patronym for Jon A. Baskin who identified and characterized North American Pliocene species assigned to *Bensonomys* as a subgenus of the South American rodent *Calomys*.

DESCRIPTION.—M^1: Represented by an unworn isolated right molar with an oval occlusal outline, longer than wide and narrow anteriorly. The anterocone is broad, strongly bilobed, and sloping anteriorly. Labial lobe of the anterocone is higher, larger, and posterior relative to the lingual lobe. A small transverse cingular shelf is present below the deep anterior groove of the anterocone. Labial cusps are placed slightly posterior relative to the lingual cusps. Posterior side of the cusps is vertical whereas the anterior side slopes gently. Lingual cusps have short, transversely-oriented posterior arms and long, anteriorly-oriented anterior arms. Valleys between the cusps are deep and relatively wide; they are partially closed by low cingula. The posterior arm of the hypocone joins

the metacone to form a high posterior tooth margin. The posterior cingulum is indistinct. A short spur at the posterior base of the metacone near the midline of the tooth is directed posteriorly. Roots are not preserved.

M^3: The occlusal outline is a rounded triangle. Three cusps (protocone, paracone, and hypocone) are prominent and join to enclose a central basin. A small anterior cingulum extends labially from the protocone to the anterior base of the paracone. There is no metacone. M^3 is three-rooted with no accessory rootlets.

M_1: Occlusal outline is an elongate oval, narrowing anteriorly to a broadly rounded anterior margin. Cusps are moderately robust, and valleys between cusps are wide. The anteroconid is wide, subequally bilobed, with a deep anteromedian groove that persists until late wear. The metaconid and entoconid are placed slightly anterior relative to the protoconid and hypoconid. A small, short mesolophid appressed to the anterior side of the entoconid is present on IGCU 1224 and indeterminate on IGCU 1225. The posterior arm of the protoconid is high and narrow, directed antero-posteriorly. A very subdued and short ectostylid is directed labially into the posterolabial valley from the wall of the anterior arm of the hypoconid. The posterior arm of the hypoconid is transversely elongate and forms a high posterior cingulum. The posterior cingulum thickens slightly in its medial portion. The labial side of the anteroconid tapers posteriorly as a narrow anterior cingulum which terminates at the anterior base of the protoconid. The anterolingual valley between the anteroconid and the metaconid is shallow and narrow; the posterolingual valley between the entonocid and posterior cingulum is deep and narrow. The posterolabial valley between the metaconid and entoconid is deep and broad. Lingual valleys are open; labial valleys are wider, flatter, and partially closed by low cingula. Two prominent roots are present; accessory rootlets are not seen.

M_2: Occlusal outline is a rounded rectangle, longer than wide. Four cusps (metaconid, protoconid, entoconid, and hypoconid) are subequal in size with lingual cusps placed slightly anterior relative to labial cusps. The posterior cingulum, an extension of the posterior arm of the hypoconid, is prominent with a distinct expansion at the midline of the tooth. An anterior cingulum tapers from a high point near the midline of the tooth, where it joins the anterior arm of the protoconid, to a low point near the anterolabial base of the protoconid. A short mesolophid, closely appressed to the anterior side of the entoconid, is distinct on two of four specimens. The anterolabial valley between the anterior cingulum and the protoconid, and the lingual valleys are narrow whereas the posterolabial valley between the protoconid and the hypoconid is wide. The valleys tend to be partially closed by a low cingulum although the anterolingual valley is open in one specimen (IGCU 1230) and both labial valleys are open in another specimen (IGCU 1228).

M_3: Occlusal outline is subtriangular with a relatively short and straight anterior side. Three cusps (protoconid, metaconid, and hypoconid) are prominent; a smaller but distinct entoconid is joined by the posterior arm of the protoconid on the labial side of the tooth. Metalophid is absent, hypolophid is short and narrow. Anterior cingulum joins the protoconid near the midline of the tooth by a very short, indistinct, anterolophid then continues to the lingual side of the tooth as the lingual cingulum. A small ectostylid is developed on the lingual cingulum between the protoconid and hypoconid. Posterior cingulum is a thick anterolabial extension of the posterior arm of the hypoconid that terminates near the base of the entoconid. Roots are not preserved.

MEASUREMENTS (in mm)

IGCU Number	*Locality*	*Element*	*Length*	*Width*	
1234	CH-11	RM^1	2.00	1.34	
1231	CH-13	LM^3	1.04	1.08	
——	CH-15	RM^3	1.08	1.10	
1224	CH-13	RM_1	1.90	1.14	TYPE
1225	CH-13	LM_1	1.87	1.18	
1227	CH-13	RM_2	1.43	1.26	
1228	CH-11	LM_2	1.24	1.22	
1229	CH-11	LM_2	1.32	1.16	
1230	CH-13	RM_2	1.44	1.20	
1211	CH-12	LM_3	1.22	1.05	

DISCUSSION.—*Calomys (Bensonomys) baskini* is most similar to *Calomys (Bensonomys) stirtoni* from the Saw Rock Canyon fauna of Kansas. *C. baskini* differs from *C. stirtoni* in having a slightly wide anteroconid, presence of a short mesolophid and hint of an ectolophid on M_1, and having the posterolabial valley of M_3 extending more than halfway across the tooth. Other known fossil and extant species of *Calomys* are smaller than *C. baskini*. *C. baskini* is lower crowned than all extant species of *Calomys*.

C. baskini is approximately the size of *Prosigmodon oroscoi* of the Yepómera and Concha faunas; it differs from *P. oroscoi* in being lower crowned with a deeper anteromedian groove on the anterocone and anteroconid, plus having a more medial junction of the anterocone and protocone on M^1. *C. baskini* is also similar to *Symmetrodontomys simplicidens* of the Rexroad fauna of Kansas. However, *S. simplicidens* is smaller, higher crowned, and has a deeper anteromedian groove and deeper anterolingual valley on M_1 than *C. baskini*. UMMP 4546, assigned to *S. simplicidens* by Hibbard (1941) has a short mesolophid appressed to the anterior base of the entoconid on M_1, similar to its development in *C. baskini*.

Calomys (Bensonomys) sp. indet.

(Plate 2p)

One isolated M_3 (IGCU 1192) is considered too large to represent *Calomys (Bensonomys) elachys* or *Baiomys kolbi*, and too small to represent *Calomys (Bensonomys) baskini*. It may represent a new species of *Calomys (Bensonomys)*, but species assignment is withheld until this taxon is better represented. Occlusal outline of the M_3 is longer than wide with a broadly rounded posterior margin. The protoconid and metaconid are subequal; the hypoconid is broad and slopes gently on the posterior side. A small, indistinct entoconid is located on the labial side of the tooth, posterior to the metaconid. The posterior arm of the protoconid joins the hypoconid, and the lingual wall between the metaconid and entoconid is low, forming a partly open lingual valley. The valley between the protoconid and hypoconid is deep and relatively straight with a low, narrow cingular shelf. Measurements (mm): IGCU 1192, left M_3 from locality CH-14, length 1.25, width 0.97.

Baiomys kolbi Hibbard 1952

(Figure 8f, g; Plate 3a-c)

TYPE.—UMMP 24846, a right dentary with incisor plus M_{1-3} from the Fox Canyon fauna, locality (UM-K1-47), Meade County, Kansas (Hibbard, 1952, p. 201).

REFERRED MATERIAL.—IGCU 1201, right dentary with incisor and M_1; three isolated M_1 (IGCU 1176, 1177, and 1200); five isolated M_2 (IGCU 1189, 1190, 1208, 1210, and unnumbered specimen); IGCU 1179, left maxilla fragment with M^{1-2}; six isolated M^1 (IGCU 1168, 1170, 1171, 1172, 1240, and 1241); and five isolated M^2 (IGCU 1181, 1182, 1183, 1185, and 1204).

RANGE.—Fox Canyon fauna, Kansas; Yepómera (locs. CH-11 and CH-15) and Concha faunas (loc. CH-13), Chihuahua; late Hemphillian and early Blancan land mammal ages.

These specimens are assigned to *Baiomys kolbi* because of their size (M_{1-3} alveolar length = 2.96 mm), very shallow anteromedian groove on M_1, and transversely narrow (width = 0.4 mm) incisor. *B. kolbi* was characterized (Hibbard, 1952, and Packard, 1960) only on the lower dentition. Upper dentition from Chihuahua is assigned to this taxon, so an amended diagnosis including characters of the upper dentition follows.

AMENDED DIAGNOSIS.—Small brachydont cricetid rodent with narrow incisor. Anteroconid of M_1 is relatively narrow, slightly bilobed, with lingual lobe higher and larger than labial lobe. Anteromedian groove separating lobes of the anteroconid is very shallow, obliterated after moderate wear. Anterolingual valley between anteroconid and metaconid is shallow and narrow. Anterocone of M^1 is relatively broad, subequally bilobed, with a shallow anteromedian groove separating lobes of the anterocone. Size is comparable to that of *B. rexroadi* (Rexroad fauna of Kansas) and *B. brachygnathus* (Curtis Ranch fauna of Arizona). *B. kolbi* differs from *B. rexroadi* in having a more shallow anteromedian groove on M_1; B. *kolbi* differs from *B. brachygnathus* in having a larger M_3. *B. kolbi* is larger than *B. minimus* (Benson fauna of Arizona), *B. sawrockensis* (Saw Rock Canyon fauna of Kansas), and *B. aquilonius* (Hagerman fauna of Idaho).

DESCRIPTION OF REFERRED MATERIAL.—The dentary is rather slender with a steep posterior surface of the diastema and the anterior termination of the masseteric crest is below the anterior half of M_1. Dorsal and ventral ridges of the masseteric crest are distinct, joining at the anterior margin of the masseteric crest. The mental foramen is located high on the side of the dentary, below the diastema and ventral relative to the anterior termination of the masseteric crest. The incisor is narrow (width = 0.4 mm) with enamel rounded on the lateral side. Length of the M_{1-3} alveoli is 2.96 mm.

M^1: Occlusal outline is oval, longer than wide, with rounded anterior and posterior margins. Greatest width is at the hypocone. The anterocone is relatively wide, subequally bilobed with labial lobe slightly higher and steeper than lingual lobe. Anterior groove between the lobes of the anterocone is relatively shallow, but is distinct. Lingual side of the anterocone slopes more gently to the base of the crown, and is thereby expanded anteriorly more than the labial side of the anterocone. Labial cusps (paracone and metacone) have straight, vertical posterior sides and long, sloping anterior sides. Lingual cusps (protocone and hypocone) have short, transversely-oriented posterior arms and long, anteriorly-oriented anterior arms. Valleys between the cusps are relatively wide and slightly closed by a low cingulum, especially the labial valleys. A minute mesostyle

closes the posterior labial valley in one of five specimens (IGCU 1179). A short, indistinct posterior cingulum is present in two of three specimens, posterior to the metacone and lateral to the posterior arm of the hypocone. Three prominent roots are present and small "bump" or rootlet is present below the paracone in three of five specimens.

M^2: Five isolated M^2 (IGCU 1181, 1182, 1183, 1185, and 1204) are assigned to *B. kolbi*, based on similarity to the associated M^2 on IGCU 1179. Occlusal outline is oval with a relatively broad, straight anterior margin and a narrow, rounded posterior margin. Cusps and lophs are similar to those of the M^1, except the anterocone is absent, and a long, labial anterior cingulum is present. The labial anterior cingulum is relatively high and joins the anterior paracone on the labial side of the tooth to enclose the anterolabial valley. The posterior labial valley is also partly closed by a labial cingulum. The lingual valley between the protocone and hypocone is slightly closed by a low lingual cingulum in five of six specimens. Three well developed roots are present, and on one specimen (IGCU 1185) the lingual root is bifurcated distally to form an incipient 4-rooted tooth.

M_1: Occlusal outline is oval, with a narrow, almost pointed anterior margin and a relatively straight, wide posterior margin. The anteroconid is small, narrow, indistinctly bilobed with the highest, most anterior projection slightly lingual to the midline of the tooth. The anteromedian groove is very shallow or absent. The anteroconid is placed close to the base of the metaconid. Protoconid, metaconid, hypoconid, and entoconid have straight, near vertical anterior sides, and slightly sloping posterior sides. A very short anterolophid joins the anteroconid and anterior arm of the protoconid. The metalophid and hypolophid are short, joining the anterior and posterior arms of the protoconid, respectively. The posterior arm of the hypoconid is expanded near the midline of the tooth, forming a small cuspule (posteroconulid) lingual to the midline. The anterolingual valley between the anteroconid and metaconid is shallow and narrow, other valleys are deep and wide. Broad labial stylar shelves are partially closed by the anterior cingulum and the ectostylid (= cingular ridge of Packard). The anterior lingual valley is partially closed in two of four specimens and the posterior lingual valley is partially closed by the posterior cingulum in one of four specimens. Two roots, anterior and posterior, are present without accessory rootlets.

M_2: Five isolated teeth (IGCU 1189, 1190, 1208, 1210, and unnumbered specimen) are assigned to *B. kolbi* because of similarity to specimens described by Hibbard from Fox Canyon. Occlusal outline is rounded, subrectangular, longer than wide. Cusps and lophs are as in M_1, except the anteroconid is absent. The labial anterior cingulum (anterolophid of Hibbard, 1952) is thin and close to the protoconid. The posterior cingulum terminates short of the lingual margin of the tooth, which causes the posterolingual valley to be open. Two roots, anterior and posterior, without accessory rootlets are present.

Discussion.—*Baiomys kolbi* was characterized by Packard (1960) as a relatively large (for *Baiomys*) species with a very shallow anteromedian groove on M_1. The only other known species of *Baiomys* with a shallow anteromedian groove are *B. rexroadi*, which is about 10 percent smaller (measurements of Packard, 1960), and *B. brachygnathus* which has a reduced M_2. *Baiomys intermedius* of the Tlalnepantla fauna of Mexico (Packard and Alvarez, 1965) is another large species of *Baiomys*, but *B. intermedius* has a deep anteromedian groove that distinguishes it from *B. kolbi*.

MEASUREMENTS (in mm)

	N	*X*	*S*	*V*	*Observed Range*
M^1 length	7	1.30	.086	6.62	1.16 - 1.39
M^1 width	7	0.80	.024	3.00	0.76 - 0.82
M^2 length	6	0.94	.045	4.77	0.88 - 1.00
M^2 width	6	0.81	.038	4.67	0.74 - 0.84
M_1 length	4	1.22	.053	4.36	1.16 - 1.27
M_1 width	4	0.81	.051	6.30	0.75 - 0.86
M_2 length	5	0.98	.083	8.43	0.88 - 1.08
M_2 width	5	0.80	.066	8.25	0.73 - 0.88

Prosigmodon Jacobs and Lindsay 1981

The type-species, *Prosigmodon oroscoi*, was named and diagnosed (for the genus) in an earlier publication (Jacobs and Lindsay, 1981). Diagnosis and comparisons for the genus are repeated below for comprehension and clarity in the complete taxonomic description of the two included species that follow.

Prosigmodon

TYPE-SPECIES.—*Prosigmodon oroscoi.*

INCLUDED SPECIES:—*P. oroscoi* and *P. chihuahuensis*, n. sp.

DIAGNOSIS.—A genus of cricetid rodent with rooted, moderately high crowned and moderately robust cheek teeth with accessory roots often developed, especially on M^1. The anterocone of M^1 is wide, weakly bilobed when unworn, and expanded anterolingually at the base. Posterior cingulum on M^1 is indistinct or absent. The anteroconid of M_1 is wide and strongly bilobed. The M^3 has a narrow anterior cingulum, and an indistinct or absent metacone; the median valley is deep, but the anterior and posterior valleys are shallow. The M^3 is not lophate. The dentary is moderately deep with a prominent masseteric crest, and a relatively dorsal mental foramen on the diastema, anterior to but lower than the M_1.

Comparisons.—Prosigmodon is most similar to *Calomys (Bensonomys)* and *Sigmodon*. It is distinct from *Calomys (Bensonomys)* in being more robust, higher crowned, and in having less strongly bilobed anterocone and anteroconid. The M^1 and M_1 of *Prosigmodon* are relatively shorter and wider than in *Calomys (Bensonomys)*. The masseteric crest of *Calomys (Bensonomys)* terminates high on the side of the dentary, well above the level of the mental foramen; the masseteric crest of *Prosigmodon* terminates at about the level of the mental foramen, as it does in fossil species of *Sigmodon*. *Prosigmodon* differs from *Sigmodon* in being less robust, slightly lower crowned, lophs are not as high and prominent, valleys are wider, and a slightly bilobed anterocone (M^1) and strongly bilobed anteroconid (M_1) is present. Union of the anterocone and protocone is more lingual, and cusps in the upper molars are not so posteriorly inclined in *Prosigmodon* as in *Sigmodon*.

The M^3 is lophate in *Sigmodon* and modern *Calomys*, with three lophs (anterior cingulum, paracone, and posterior cingulum) in *Sigmodon* and two lophs (paracone and posterior cingulum) in modern *Calomys*. *Calomys (Bensonomys)* and *Prosigmodon* have a cuspate M^3 with a distinct paracone, protocone, and hypocone, and with incipient development of lophs between the paracone and protocone, and between the posterior

cingulum and hypocone. The anterior cingulum of *Prosigmodon* is short *(P. oroscoi)* or narrow *(P. chihuahuensis)*, and does not form a strong loph. This, and the lingual union of protocone and anterocone in known species of *Prosigmodon* suggest they are not directly ancestral to fossil *Sigmodon*.

Accessory rootlets are developed in *Calomys, Prosigmodon, and Sigmodon;* they are less well developed in *Calomys,* and better developed in *Sigmodon,* relative to *Prosigmodon*. All lower teeth of *Prosigmodon* are two-rooted, without accessory rootlets. M_2 and M_3 of *Sigmodon medius* are three-rooted, resulting from bifurcation of the anterior root. All modern species of *Sigmodon* have three-rooted teeth with accessory rootlets, except that M_1 is two-rooted with two accessory rootlets. Accessory rootlets are never well developed on M^2.

Prosigmodon oroscoi Jacobs and Lindsay 1981

(Figure 8h, 9c, d; Plate 3d-g)

TYPE.—IGCU 1217, left M^1 from locality CH-15.

HYPODIGM.—Type and eleven isolated cheek teeth (four M^1, two M^2, two M^3, one M_1, and two M_2) plus a maxillary fragment with M^{1-2}.

RANGE.—UALP localities Y3 (CH-11), Y35 (CH-13), and Y39 (CH-15), Yepómera and Concha faunas, Chihuahua; late Hemphillian and early Blancan land mammal ages.

DIAGNOSIS.—Characters of the genus, plus smaller size, lower crowned, and less robust than *P. chihuahuensis.*

ETYMOLOGY.—*oroscoi*, named for Sr. Francisco Orosco, a rancher from the Yepómera area who worked for geologists from the California Institute of Technology when they collected fossils in that area, and guided us to many of the CIT localities.

DESCRIPTION.—In upper molars the posterior side of cusps is near vertical and the anterior side slopes anteriorly; in lower molars the anterior side of cusps is near vertical and the posterior side slopes posteriorly.

M^1: Occlusal outline is oval, with the width decreasing markedly anterior to the protocone. The anterocone is moderately wide, sloping anteriorly gently to the base which is expanded anterolingually. The anterocone is weakly bilobed, with a shallow anterior median groove removed by moderate wear. The anterior arms of both the protocone and hypocone are heavier and are oriented more anteroposteriorly than the posterior arm. The anterior arm of the protocone joins the anterocone lingual to the midline of the tooth. The paracone and metacone are offset slightly posteriorly relative to the protocone and hypocone, and are joined to those cusps by short transversely oriented metaloph and hypoloph, respectively. The posterior arm of the hypocone is high, forming the posterior wall of the tooth, and joining the metacone posteriorly with no separation as a posterior cingulum. Valleys between the cusps are relatively narrow; lingual valleys are open, labial valleys are partially closed by low cingula. Three prominent roots are present, with a small accessory rootlet variably developed beneath the paracone.

M^2: Occlusal outline is near quadrate with rounded corners. Cusps and lophs of M^2 are similar to those of M^1 except the anterocone is absent and a long, narrow anterior cingulum is present from the anterior midline of the tooth to its termination short of the anterolabial margin. Three prominent roots are present; accessory rootlets are not seen.

M^3: Occlusal outline is oval, with a slightly flattened anterior margin. The protocone and paracone are large, connected by a heavy medial, transverse loph, and by a narrow anterior cingulum, thereby forming a narrow, shallow anterior basin. The hypocone is rather broad, and rounded at the posterior margin of the tooth. A narrow; transversely-oriented loph connects the anterior portion of the hypocone and an indistinct metacone, enclosing a narrow, shallow, posterior basin. The hypocone and protocone are joined by a narrow loph that forms the lingual side of a deep medial basin. The labial side of the medial basin is closed by a high labial cingulum connecting the paracone and the indistinct metacone. Three well developed roots are present; accessory rootlets are not seen.

M_1: Represented by an isolated tooth with the anteroconid and half of the protoconid missing. Cusps are moderately robust and valleys between the cusps are wide. The posterior arm of the protoconid is broad, directed posterolingually to the base of the entoconid. The posterior arm of the hypoconid is directed transversely as the posterior cingulum.

M_2: Occlusal outline is subrectangular, longer than wide, with rounded corners. Cusps, lophs, and roots are as in M_1 except that an anteroconid is absent.

MEASUREMENTS (in mm)

	Number	*Mean*	*Observed Range*
M^1 length	6	1.93	1.80 - 2.08
M^1 width	6	1.37	1.23 - 1.48
M^2 length	3	1.43	1.36 - 1.52
M^2 width	3	1.37	1.28 - 1.44
M^3 length	2	1.14	1.12 - 1.16
M^3 width	2	1.18	1.16 - 1.20
M_1 width	1	1.33	
M_2 length	2	1.47	1.45 - 1.48
M_2 width	2	1.29	1.26 - 1.32
M_3 length	1	1.22	
M_3 width	1	1.05	

Prosigmodon chihuahuensis, n. sp.

(Figure 8i, 9a, b; Plate 3h-n)

TYPE.—IGCU 1238, left dentary fragment with M_{1-2}, from locality CH-15.

HYPODIGM.—Type and ten isolated cheek teeth (three M^1, two M^2, one M^3, one M_1 and three M_3).

RANGE.—UALP localities Y37 (CH-14), Y39 (CH-15), and Y40 (CH-17), Yepómera and Concha faunas, Chihuahua; late Hemphillian and early Blancan land mammal ages.

DIAGNOSIS.—Characters of the genus and large size. In addition to size, *P. chihuahuensis* differs from *P. oroscoi* in being more robust, higher crowned, the anterocone and anteroconid are more strongly bilobed, and an accessory rootlet is present on M^2.

ETYMOLOGY.—*chihuahuensis*, named for Chihuahua, and -ensis from the place of.

DESCRIPTION.—In upper molars the posterior side of cusps is near vertical and the anterior side slopes anteriorly; in lower molars the anterior side of cusps is near vertical and the posterior side slopes posteriorly.

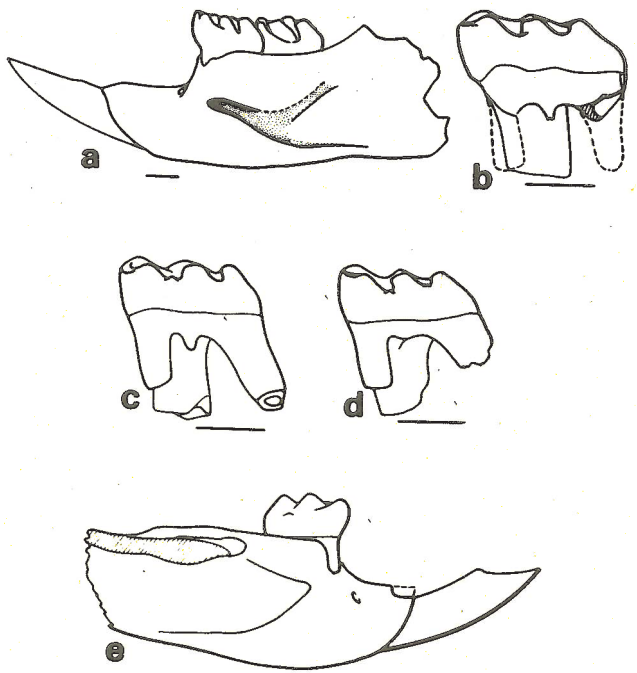

Figure 9.—Cricetine rodents from Chihuahua faunas, all labial views. (a) *Prosigmodon chihuahuensis,* n. sp., left dentary, TYPE (IGCU 1238); (b) *Prosigmodon chihuahuensis,* n. sp., left M^1 (IGCU 1232); (c) *Prosigmodon oroscoi,* left M^1, TYPE (IGCU 1217); (d) *Prosigmodon oroscoi,* left M^1 (IGCU 1214); (e) *Baiomys kolbi,* right dentary (IGCU 1201). Bars equal 1 mm.

M^1: Occlusal outline is oval, with width tapering anteriorly to a broadly rounded anterior margin. The anterocone is moderately wide, with the anterior surface sloping anteriorly to the base of the tooth which is expanded anterolingually. The anterocone is subequally bilobed, with an anterior median groove at the occlusal surface that extends well down toward the base of the crown. The anterior arms of the protocone and hypocone are oriented more antero-posteriorly than the posterior arms. The anterior arm of the protocone joins the anterocone lingual to the midline of the tooth. The paracone and metacone are displaced posteriorly relative to the protocone and hypocone, respectively. Short, transversely oriented protoloph and metaloph join the paracone-protocone and metacone-hypocone, respectively. The posterior arm of the hypocone is

high and joins the metacone at the posterior margin of the tooth. A posterior cingulum is not present. Valleys between the cusps are deep and relatively narrow; lingual valleys are open, labial valleys are partially closed by a low cingulum. Three prominent roots are present, in addition to a small rootlet beneath the paracone.

M^2: Occlusal outline is subquadrate, with rounded corners. Cusps and lophs are similar to those of M^1 except the anterocone is absent and a long, narrow anterior cingulum is present from the anterior midline of the tooth to its termination short of the labial margin. A short posterior cingulum is distinct in slightly worn specimens at the posterolabial corner of the tooth. Three prominent roots are present, plus a small rootlet between the two labial roots.

M^3: Occlusal outline is oval, with a slgihtly flattened anterior margin. The protocone and hypocone are large, the paracone is small, and the metacone is indistinct. A small, shallow anterior basin is formed by the anterior cingulum and a loph from the paracone to a longitudinal median loph that divides the central basin. The deep, double, central basin is partially closed labially by a low labial cingulum. A narrow, shallow posterior basin is formed between the hypocone and indistinct metacone. Roots are not preserved on the only specimen.

M_1: Occlusal outline is an elongate oval, narrowing anteriorly with a broadly rounded anterior margin. Cusps are moderately robust, and valleys between the cusps are relatively wide. The anteroconid is wide and subequally bilobed, with an anterior median groove that persists until late wear. The metaconid and entoconid are slightly anterior relative to the protoconid and hypoconid. The anterior arm of the protoconid and hypoconid is short and narrow compared to the posterior arm of those cusps. The posterior arm of the hypoconid is elongate and continuous with a high posterior cingulum. The posterior cingulum thickens medially but does not form a distinct cusp. A mesolophid is absent. The labial side of the anteroconid joins a narrow anterior cingulum which tapers posteriorly to the anterior base of the protoconid. The valley between the anteroconid and metaconid is slightly shallower than the other valleys. Lingual valleys are open, labial valleys are slightly closed by a low cingulum. Two prominent roots (anterior and posterior) are present.

M_2: Occlusal outline is a rectangle, longer than wide, with rounded corners. Cusps, lophs, and roots are as in M_1 except that the anteroconid is absent.

M_3: Occlusal outline is suboval to trapezoidal with a relatively straight anterior margin, narrowing posteriorly to a broadly rounded posterior margin. Protoconid, metaconid, and hypoconid are large, the entoconid is small (on IGCU 1237), becoming indistinct with wear (on IGCU 1215). A deep and narrow anterolingual valley is formed by union of the metaconid and entoconid with the anterior and posterior arms of the protoconid. A deep and narrow posterolabial valley is formed by union of the transversely oriented hypoconid with the entoconid. The anterolingual valley is closed after moderate wear by union of the anterior entoconid with the base of the metaconid; the labial valley is open until late wear. A minute anterior cingulum is present anterior to the protoconid. Two prominent roots are present; the anterior root is oriented transversely, narrowing medially with incipient separation into two rootlets; the posterior root is directed anterolingually from the posterolabial corner of the tooth.

Dentary: The dentary is moderately deep, with a prominent masseteric crest divided into an upper crest and a more prominent lower crest. The upper crest joins the

lower crest below the anterior portion of M_2 where the crest is most prominent. The posterior diastema is very steep from the base of the M_1 to the mental foramen. The anterior diastema is relatively flat, gently climbing upward from the position of the mental foramen toward the tip of the incisor. The coronoid process ascends from the horizontal ramus lateral to the M_3, and is separated from the M_3 by a gently rounded trough.

MEASUREMENTS (in mm)

IGCU Number	*Locality*	*Element*	*Length*	*Width*
1232	CH-15	LM^1	2.20	1.63
1233	CH-15	RM^1	2.17	——
1235	CH-15	RM^1	2.60	1.86
1218	CH-15	RM^2	1.68	1.76
1219	CH-15	RM^2	1.74	——
1236	CH-15	LM^3	1.40	1.56
1245	CH-17	RM_1	2.44	1.48
*1238	CH-15	LM_1	2.04	1.50
*1238	CH-15	LM_2	1.76	1.57
1239	CH-17	LM_3	1.68	1.52
1215	CH-14	RM_3	2.00	1.68
1237	CH-15	LM_3	1.80	1.60

* Type

DISCUSSION.—*Prosigmodon oroscoi* and *Prosigmodon chihuahuensis* are similar, differing primarily in greater size and greater tendency to develop accessory rootlets in *P. chihuahuensis*. Both species show the trend toward development of more robust lophs separated by narrow, deep valleys; again, this trend is better developed in *P. chihuahuensis*.

Pliophenacomys wilsoni, n. sp.

(Figures 10-13)

TYPE.—IGCU 1164, right dentary fragment with M_{1-2} from locality CH-13.

HYPODIGM.—Type and 99 isolated cheek teeth (twenty-three M^1, twenty M^2, fifteen M^3, thirteen M_1, fourteen M_2, and fourteen M_3).

RANGE.—UALP localities Y35 (CH-13) and Y40 (CH-17), Concha fauna, Chihuahua; early Blancan land mammal age.

DIAGNOSIS.—A small, rooted microtine rodent lacking cementum in the reentrant angles, with dentinal tracts weakly developed, labial reentrant angles more shallow than lingual reentrant angles in lower molars, and an enamel islet rarely present on M_1 and M^3.

ETYMOLOGY.—*wilsoni*, named for R. W. Wilson who studied and described the first small mammals from the Yepómera area.

DESCRIPTION.—Small microtine rodent having high crowned, prismatic cheek teeth with roots present and cementum lacking. Alternating triangles and dentine bridges

between anterior and posterior loops are generally slightly open (except in M^3) in occlusal view. In upper molars labial reentrants are approximately as deep as lingual reentrants; in lower molars labial reentrants are distinctly more shallow than lingual reentrants. In upper molars, base of the enamel is lowest anteriorly; in lower molars, base of the enamel is lowest posteriorly, except on M_2 in which the enamel is approximately as low anteriorly and posteriorly.

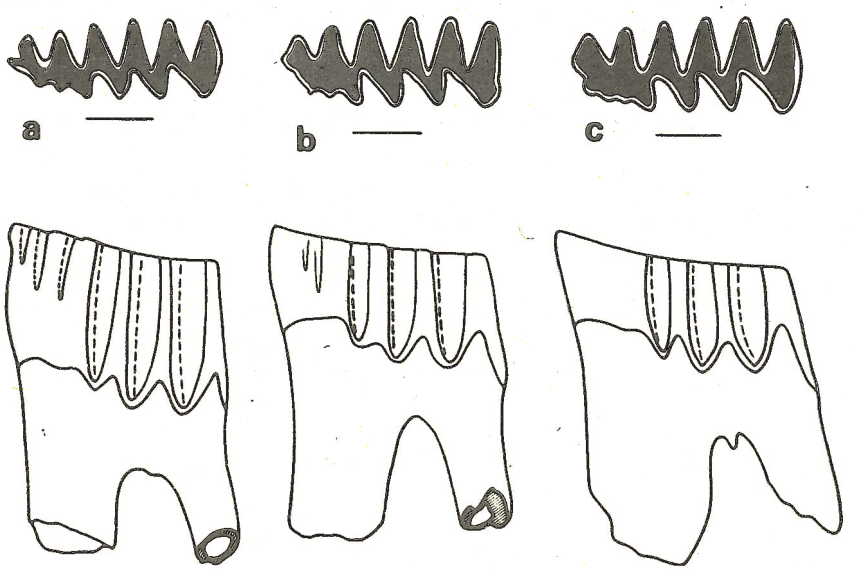

Figure 10.—*Pliophenacomys wilsoni* n. sp., from Chihuahua. (a) left M_1 (IGCU 1118), labial and occlusal views; (b) left M_1 (IGCU 1124), labial and occlusal views; (c) left M_1 (IGCU 1116), labial and occlusal views. Bars equal 1 mm.

M^1: Anterior upper molars have a simple anterior loop and four alternating triangles. Dentinal tracts are weakly developed, highest on the first alternating triangle, next highest and subequal on the third and fourth alternating triangles, lowest on the second alternating triangle, and incipiently developed on the anterior loop. Anterior face of the anterior loop has a slight median fold, best seen in anterior view. The fourth alternating triangle has a posterior median ridge that becomes broader near the base of the enamel. The "re-entrant pit" (a posterolingual depression at the base of the enamel) of Zakrzewski (1969, p. 21) is weakly developed. Three roots are present, the lingual root is small.

M^2: Central upper molars have a broad anterior loop with a median anterior expansion, and three alternating triangles. Dentinal tracts are weakly developed and subequal in height on the anterior loop and alternating triangles. The third alternating triangle has a posterior median ridge that becomes broader near the base of the enamel. The lingual root is located at the anterolingual corner of the tooth, below the lingual

side of the anterior loop. This results in one posterior and two anterior roots. The anterior roots are fused at their base, separate and diverging through half their length in 9 of 20 specimens; these roots do not appear to be completely fused in any of the M^2 specimens.

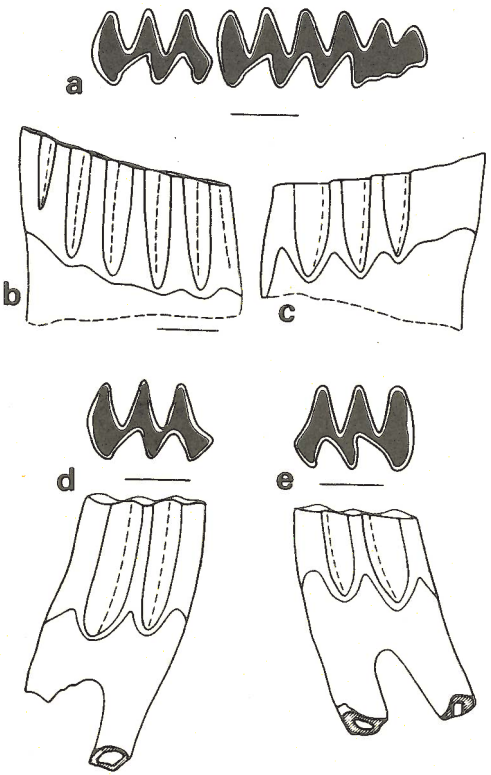

Figure 11.—*Pliophenacomys wilsoni*, n. sp., from Chihuahua. (a-c) right M_{1-2}, TYPE (IGCU 1164): (a) occlusal view; (b) lingual view; (c) labial view; (d) right M_2 (IGCU 1136), labial and occlusal views; (e) left M_2 (IGCU 1138), labial and occlusal views. Bars equal 1 mm.

M^3: The posterior upper molar has a broad anterior loop, small labial first and third alternating triangles, a large lingual second triangle, and a relatively long posterior loop with a lingual ridge that gets broader near the base of the enamed. The anterior loop —first alternating triangle and posterior loop— third alternating triangle dentinal bridges are broadly open. Labial reentrant angles (*a* and *b* of Zakrzewski, 1967, fig. 1B) are very shallow, especially the anterior (a) that never reaches the midline of the tooth and could be interpreted as a prism fold except that it is persistent to the base of the

enamel. Dentinal tracts are weakly developed, highest and subequal on the labial side of the anterior loop and the second alternating triangle. Anterior face of the anterior loop has a slight fold on the labial side. The posterior loop has a minute enamel islet where it joins the third alternating triangle in 1 of 14 specimens. Two roots, anterior and posterior, are present.

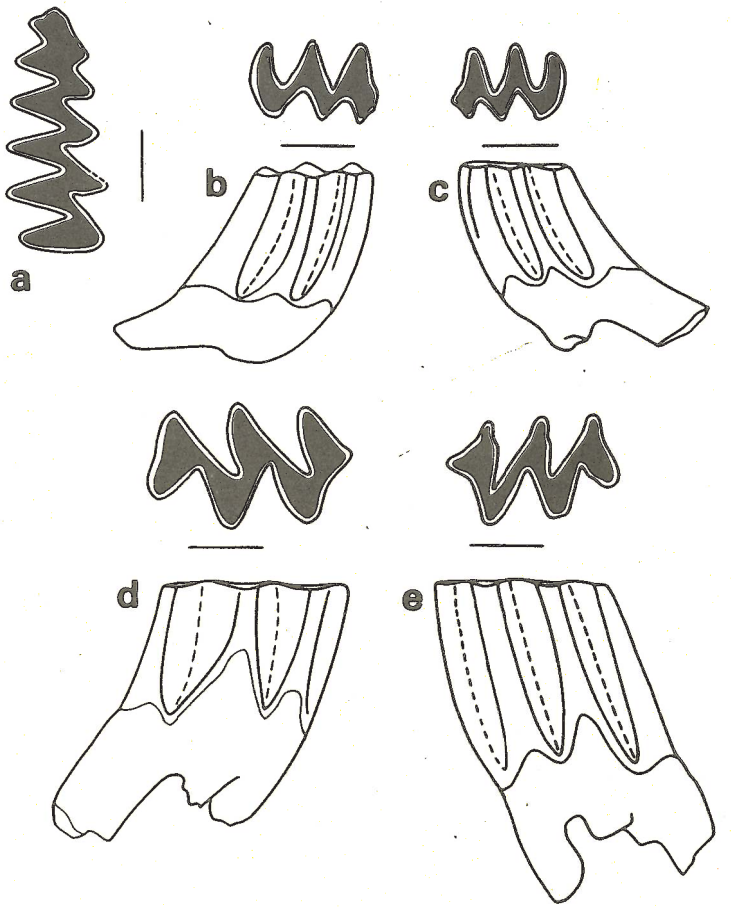

Figure 12.—*Pliophenacomys wilsoni*, n. sp., from Chihuahua. (a) right M^1 (IGCU 1115), occlusal view; (b) right M_3 (IGCU 1148), labial and occlusal views; (c) left M_3 (IGCU 1150), labial and occlusal views; (d) left M^1 (IGCU 1065), labial and occlusal views; (e) right M^1 (IGCU 1071), labial and occlusal views. Bars equal 1 mm.

M_1: The anterior lower molar has a broad posterior loop, five alternating triangles, and a long complex anterior loop. The anterior loop has a single, broad prism fold on the lingual side and shallow, multiple folds on the labial side. Folds on the anterior loop are not persistent to the base of the enamel. Dentinal tracts are weakly developed but persistent, highest on the labial side where they are subequal in height at the anterior and posterior loops, slightly lower on the labial alternating triangles. Two prominent roots are present, the anterior is very large; a small accessory rootlet is variably developed below the second alternating triangle.

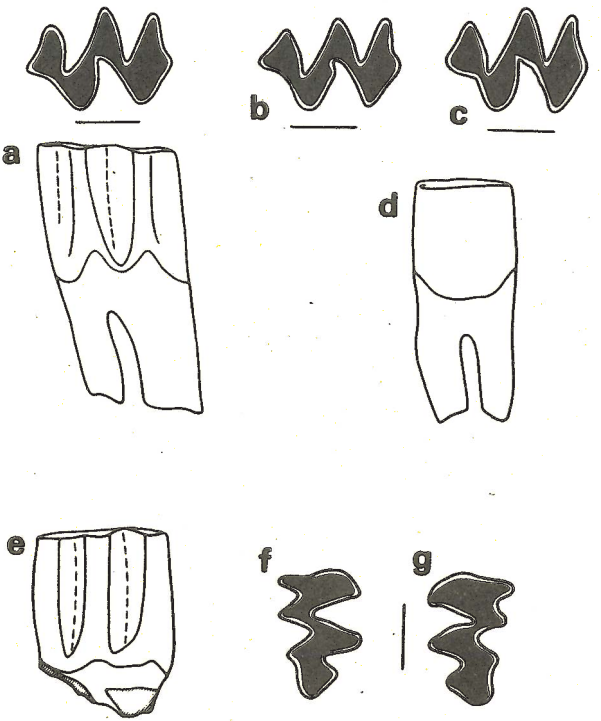

Figure 13.—*Pliophenacomys wilsoni*, n. sp., from Chihuahua. (a) right M^2 (IGCU 1099), lingual and occlusal views; (b) right M^2 (IGCU 1103), occlusal view; (c and d) right M^2 (IGCU 1162); (c) occlusal view; (d) anterior view; (e and f) right M^3 (IGCU 1106); (e) labial view; (f) occlusal view; (g) left M^3 (IGCU 1156), occlusal view. Bars equal 1 mm.

M_2: The central lower molar has a broad posterior loop and four alternating triangles. The fourth alternating triangle has an anterior ridge that broadens toward the base of the enamel. Dentinal tracts are higher labially than lingually, highest at the apex

of the fourth alternating triangle, decreasing in height slightly on the second alternating triangle and the labial posterior loop. Two prominent roots, anterior and posterior, are present; accessory rootlets are absent.

M_3: The posterior lower molar is similar to M_2, except the fourth alternating triangle is reduced, and the tooth is gently curved, with the roots directed posteriorly, more or less.

The dentary has a prominent masseteric crest that terminates anteriorly below the anterior portion of M_1. The mental foramen is anterior to the masseteric crest, on the dorso-lateral surface of the dentary, and only slightly visible from above.

MEASUREMENTS (in mm)

	Length					*Width*				
	N	*Mean SE*	*SD*	*V*	*OR*	*N*	*Mean SE*	*SD*	*V*	*OR*
M^1	19	2.46±.018	0.77	3.15	2.32-2.63	23	1.66±.014	.066	3.96	1.52-1.76
M^2	20	2.12±.013	.058	2.75	2.00-2.24	20	1.59±.017	.074	4.64	1.44-168
M^3	13	2.00±.014	.049	2.44	1.92-2.08	14	1.23±.015	.057	4.65	1.14-1.32
M_1	12	3.26±.036	.126	3.98	2.95-3.44	13	1.40±.018	.063	4.52	1.36-1.52
M_2	14	1.92±.016	.061	3.25	1.84-2.01	14	1.36±.016	.060	4.43	1.28-1.49
M_3	13	1.52±.021	.077	5.08	1.39-1.62	13	0.99±.015	.052	5.27	0.90-1.09
Height of dentine tract on posterior loop of M_1										
	11	0.57±.017	.057	9.9	0.45-0.64					

DISCUSSION.—*Pliophenacomys wilsoni* is most similar to *Pliophenacomys finneyi* of the Blancan Fox Canyon fauna of Kansas. *P. wilsoni* is larger (although their size ranges overlap), has a longer, more complex anterior loop, is slightly lower crowned (with lower dentinal tracts), and has labial reentrants more shallow in lower molars than in *P. finneyi*. Both *P. wilsoni* and *P. finneyi* have fusion of roots on M^2 less well developed than in *P. primaevus* of the Blancan Rexroad fauna of Kansas. *P. primaevus* appears to have labial reentrants more shallow than lingual reentrants in lower molars, as in *P. wilsoni*, but has higher dentinal tracts, and greater fusion of roots in M^2 than in *P. wilsoni*.

P. wilsoni differs from *Propliophenacomys parkeri* of Hemphillian deposits in Knox County, Nebraska (Martin, 1975, p. 105-107) in having more open alternating triangles, better development of dentinal tracts, and M^2 with three roots. Voorhies (1984) recently showed that *Propliophenacomys uptegrovensis* Martin 1975 is based on a buried partial skull of Recent *Phenacomys intermedius*.

The posterior upper molar (M^3) of microtine rodents is considered very important for phyletic interpretations. Hibbard and Zakrzewski (1972) noted the absence of an enamel islet on a large sample (452 right M^3) of *P. finneyi*. Chaline (1975) suggested the primitive M^3 of *Promimomys*, with a deep anterolingual reentrant could have given rise to several lineages, delineated by changes in M^3. Of these, the line leading to *Pliophenacomys* in North America and *Pliomys* in Eurasia is characterized by reduction (shallowing) of the anterolingual reentrant and loss of the enamel islet in M^3. *P. wilsoni* represents an early stage in that lineage, slightly more primitive than *P. finneyi* in which the enamel islet has been completely lost on M^3 (and M_1).

CONCLUSION

As noted by Ferrusquía (1978), the Yepómera fauna is the richest and best known Pliocene vertebrate fauna of Mexico. We report 10 taxa (shrew, bat, pocket mouse, kangaroo rat, primitive gopher, and six species of cricetid rodent) new to the Hemphillian Yepómera fauna. Nine taxa (shrew, rabbit, gopher, and six species of cricetid rodent) are reported from the superposed Concha fauna of Blancan age. Ferrusquía (1978) noted 22 mammal species (including four small mammals) in his review of the Yepómera fauna. We have added 13 small mammal taxa, including two new genera and eight new species, to the combined Yepómera and Concha faunas.

In addition to its diversity, the Yepómera fauna is significant because of its proximity to the Hemphillian/Blancan faunal boundary, the possible direct ancestry of Equus (*Dolichohippus*) from *Pliohippus mexicanus* (Lance, 1950), and radiation of sigmodont rodents. The absence of South American immigrants in the Yepómera and Concha faunas suggests the Panamanian land bridge between North and South Americas was not in use at the beginning of Blancan land mammal age. The presence of sigmodontine rodents in the Yepómera and Concha faunas, along with the absence of South American immigrants, point to a Pliocene radiation of sigmodontine rodents in North America prior to their dispersal and explosive radiation in South America. Similarly, absence of South American immigrants in the Yepómera and Concha faunas indicates the South American Chapadmalalan mammal age (characterized by the appearance of numerous immigrants from North America) should be later than the early Blancan Concha fauna of Chihuahua.

Marshall and coworkers (1979) reported the presence of sigmodontine rodents in Montehermosan age deposits of northern Argentina, older than Chapadmalalan age, and they postulated these sigmodontine rodents reached South America by waif dispersal prior to the wave of North American immigrants that entered South America via the Panamanian land bridge. We consider this hypothesis plausible, but emphasize the alleged waif dispersal of sigmodontine rodents was probably not significantly earlier than development of the Panamanian land bridge. Baskin (1978) reported the first appearance of sigmodontine rodents in northern Arizona less than 6.7 Ma ago. Sigmodontine rodents are not known from the slightly younger Redington fauna in southern Arizona (Jacobs, 1977). Marshall and coworkers (1979) placed the limits of Montehermosan land mammal age as 3 to 5 Ma ago, based on the radiometric and magnetostratigraphic correlations. The sigmodontine record from the southwestern United States and Mexico suggests an evolutionary change from *Calomys (Bensonomys)* to *Prosigmodon* to *Sigmodon* over a span of approximately 2 to 3 Ma. It does not support an explosive Central American radiation prior to the arrival of sigmodontine rodents into South America. As noted by

Marshall and coworkers (1979, p. 278), Reig reported four genera (three of which are extant) in the Chapadmalal Formation of South America. Sigmodontine rodent diversification in North America was part of an incompletely documented but apparently nonexplosive late Tertiary cricetid radiation. The sigmodontine radiation in South America occurred later than in North America, and was more rapid, literally explosive. There are now about nine genera and 45 species of sigmodontine rodents living in North America, and about 46 genera and 225 species of sigmodontine rodents living in South America. Radiation of sigmodontine rodents in South America is one of the most interesting and complex chapters in the evolution of mammals, but the roots of that radiation lie in the less explosive late Cenozoic diversification of North American cricetids.

Webb (1977, 1978) and Gregory (1971) have reviewed the history of savannas and savanna vertebrates in the New World and have discussed the trend throughout the Tertiary of climatic xerification and progressive development of savannas from forests and woodlands. According to Webb, the extensive savannas of North and South America were joined together by woodland savanna extensions when the Panamanian land bridge was formed, thus facilitating faunal exchange of savanna adapted vertebrates.

The late Hemphillian Yepómera and early Blancan Concha faunas in Mexico apparently predate the closing of the Panamanian land bridge because no South American elements appear in these faunas. The Yepómera fauna is a savanna fauna with three genera and five species of horse, an antilocaprid, a camel, a badger, and other taxa. The Concha fauna, while not as thoroughly sampled as the Yepómera fauna, is distinct from the Yepómera fauna in composition. A large horse, distinct from those in the Yepómera fauna, is present in the Concha fauna, but no other equids have been recovered. The Yepómera fauna gopher *Pliogeomys carranzai* is replaced by the higher crowned *Geomys minor* in the Concha fauna. Elements in the Concha fauna which are new invaders and apparently do not specifically replace taxa in the Yepómera fauna are the shrew *Notiosorex repenningi* and the microtine *Pliophenacomys wilsoni*. Five species of sigmodontine rodents and perhaps the rabbit *Notolagus velox* occur in both the Yepómera and Concha faunas. With the cricetids, *Copemys* occurs in the Yepómera fauna, but not the Concha fauna.

The Yepómera fauna is better represented than the Concha fauna, both in number of specimens and in number of sites. However, the record is adequate to indicate that (i) new taxa appear and (ii) the diversity of equids is reduced in the Concha fauna. These faunal differences may reflect, in part, a change in sedimentation as sites yielding the Yepómera fauna are mainly from silts while sites yielding the Concha fauna are from diatomites. Differences in the Yepómera and Concha faunas may also reflect, in part, a

climatic change. The presence of diatomites and the vole *Pliophenacomys wilsoni* may suggest wetter conditions for the Concha fauna. The sigmodontine rodents in the Yepómera fauna persist into the Concha fauna, apparently enhanced by change in climatic conditions between the two faunas.

Webb (1977) suggested that savanna habitats persisted longer around the Gulf of Mexico and into the Mexican Plateau, and the tendency toward dessication was countered by summer rains during Hemphillian time. His suggestion was based on faunal similarity between the Yepómera fauna of Mexico and Bone Valley fauna of Forida. He (Webb, 1978) noted that the most progressive steppe— and desert—adapted species did not participate in the great American interchange. He suggested further that woodland savanna and thorn forest habitats that are best represented in seasonally arid environments formed the principal avenue for the Great American interchange. It seems likely that environmental conditions changed between the Yepómera and Concha faunas, with wetter habitats developed during the early Blancan, and this change probably enchanced the great American interchange.

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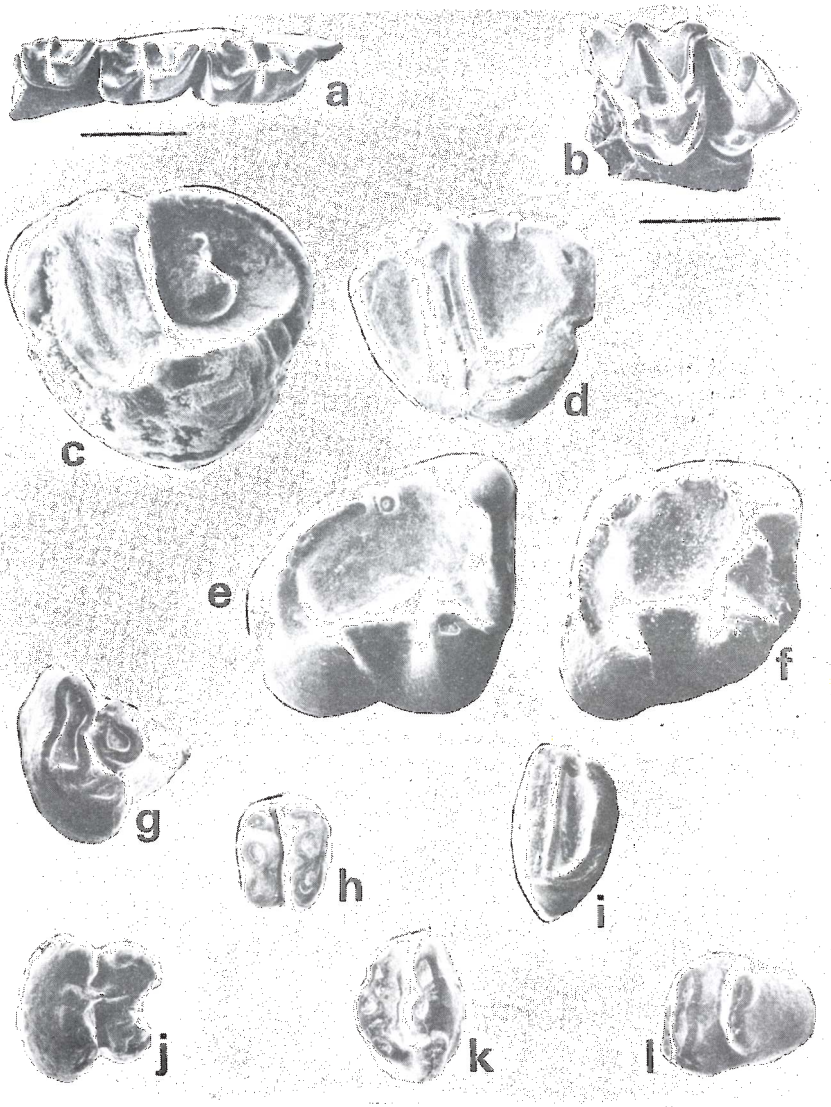
PLATES 1-3

PLATE 1

NOTIOSOREX, PLIONYCTERIS, SPERMOPHILUS, PEROGNATHUS AND *PRODIPODOMYS*

Bars equal 1 mm; "b" through "l" are the same scale

a. *Notiosorex repenningi* n. sp., IGCU 2736, TYPE, right dentary with M_{1-3}.
b. *Plionycteris trusselli* n. gen. and n. sp., IGCU 1165, TYPE, right P^4-M^1.
c. *Spermophilus* sp. indet., IGCU 2727, left P^4.
d. *Spermophilus* sp. indet., IGCU 2726, left P^4.
e. *Spermophilus* sp. indet., IGCU 2725, right M_3.
f. *Spermophilus* sp. indet., IGCU 2724, right M_2.
g. *Prodipodomys idahoensis*, IGCU 2719, right P^4.
h. *Perognathus* sp., IGCU 2723, left M_2.
i. *Prodipodomys idahoensis*, IGCU 2720, left M^1.
j. *Prodipodomys idahoensis*, IGCU 2715, right P_4.
k. *Prodipodomys idahoensis*, IGCU 2721, right M^2.
l. *Prodipodomys idahoensis*, IGCU 2716, left M_2.



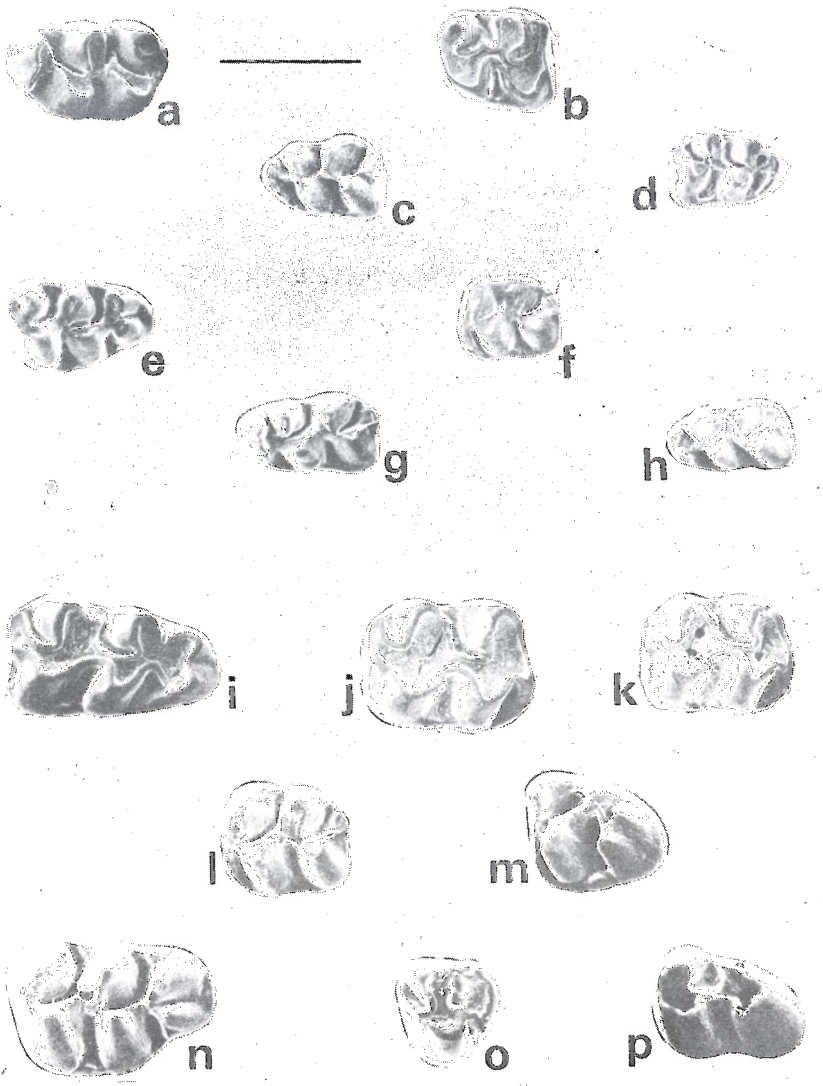
NOTIOSOREX, PLIONYCTERIS, SPERMOPHILUS, PEROGNATHUS AND *PRODIPODOMYS*

PLATE 2

COPEMYS AND *CALOMYS*

Bar equals 1 mm

a. *Copemys* near *C. valensis*, IGCU 1195, left M^1.
b. *Copemys* near *C. valensis*, IGCU 1206, right M^2.
c. *Copemys* near *C. valensis*, IGCU 1242, left M_1.
d. *Copemys* near *C. valensis*, IGCU 1209, right M_1.
e. *Calomys (Bensonomys) elachys* n. sp., IGCU 1174, TYPE, right M^1.
f. *Calomys (Bensonomys) elachys* n. sp., IGCU 1187, left M_2.
g. *Calomys (Bensonomys) elachys* n. sp., IGCU 1178, left M_1.
h. *Calomys (Bensonomys) elachys* n. sp., IGCU 1199, left M_1.
i. *Calomys (Bensonomys) baskini* n. sp., IGCU 1224, TYPE, right M_1.
j. *Calomys (Bensonomys) baskini* n. sp., IGCU 1227, right M_2.
k. *Calomys (Bensonomys) baskini* n. sp., IGCU 1230 right M_2.
l. *Calomys (Bensonomys) baskini* n. sp., IGCU 1228, left M_2.
m. *Calomys (Bensonomys) baskini* n. sp., IGCU 1211, left M_3.
n. *Calomys (Bensonomys) baskini* n. sp., IGCU 1234, right M^1.
o. *Calomys (Bensonomys) baskini n.* sp., IGCU 1231, left M^3.
p. *Calomys (Bensonomys)* sp. indet., IGCU 1192, left M_3.



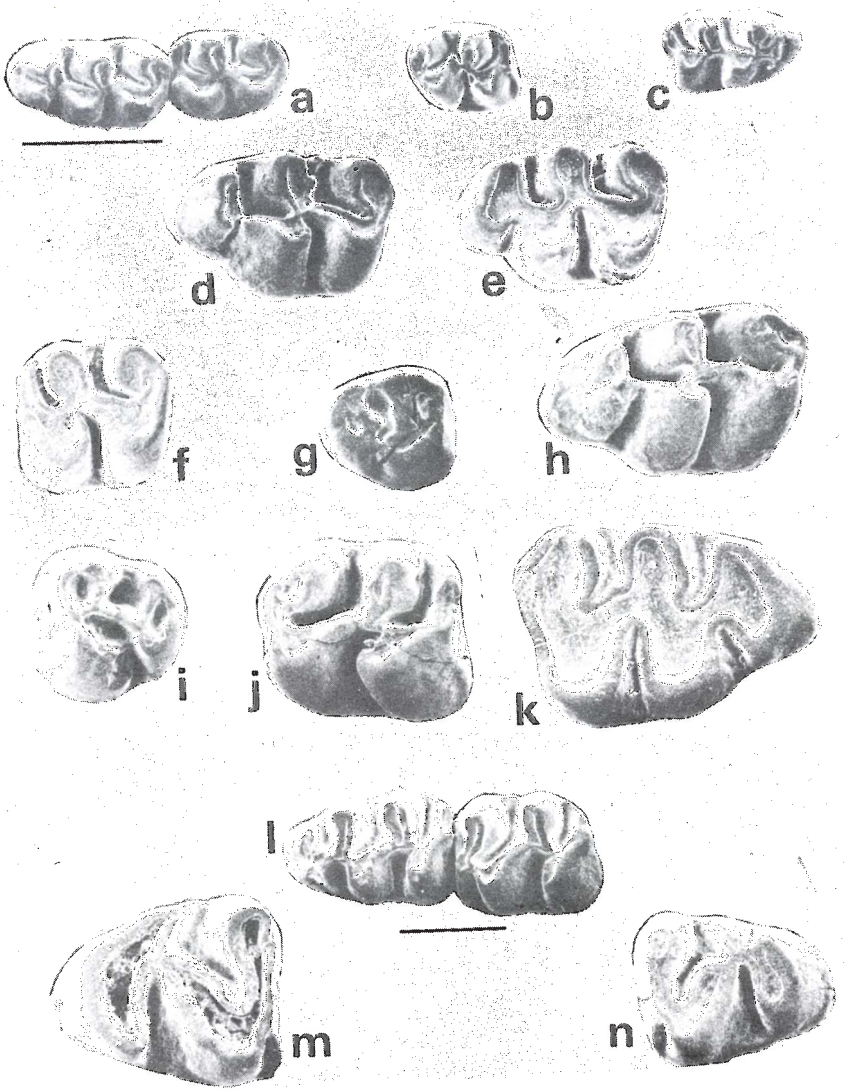
COPEMYS AND *CALOMYS*

PLATE 3

BAIOMYS AND *PROSIGMODON*

Bars equal 1 mm; "a" through "k", "m" and "n" are to the same scale

a. *Baiomys kolbi*, IGCU 1179, left M^{1-2}.
b. *Baiomys kolbi*, IGCU 1181, right M^2.
c. *Baiomys kolbi*, IGCU 1201, right M_1.
d. *Prosigmodon oroscoi*, IGCU 1217, TYPE, left M^1.
e. *Prosigmodon oroscoi*, IGCU 1213, left M^1.
f. *Prosigmodon oroscoi*, IGCU 1222, right M^2.
g. *Prosigmodon oroscoi*, IGCU 1180, right M^3.
h. *Prosigmodon chihuahuensis* n. sp., IGCU 1232, left M^1.
i. *Prosigmodon chihuahuensis* n. sp., IGCU 1236, left M^3.
j. *Prosigmodon chihuahuensis* n. sp., IGCU 1218, right M^2.
k. *Prosigmodon chihuahuensis* n. sp., IGCU 1235, right M^1.
l. *Prosigmodon chihuahuenesis* n. sp., IGCU 1238, TYPE, left M_{1-2}.
m. *Prosigmodon chihuahuensis* n. sp., IGCU 1215, right M_3.
n. *Prosigmodon chihuahuensis* n. sp., IGCU 1237, left M_3.



BAIOMYS AND *PROSIGMODON*

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