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BY

CLAUDE W. HIBBARD, RICHARD J. ZAKRZEWSKI,
RALPH E. ESHELMAN, GORDON EDMUND,
CLAYTON D. GRIGGS, AND CAROLINE GRIGGS

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ANN ARBOR

PROLOGUE

This paper represents the last major project undertaken by the late Claude W. Hibbard. He had examined most of the material and had begun to write the systematic descriptions for most of the small mammals and a few of the large ones. After his death Mrs. Hibbard provided us with his notes and other data, and the specimens were borrowed from the University of Michigan. Gordon Edmund worked up the giant armadillo, Ralph Eshelman worked up the data for the large mammals, and Rick Zakrzewski did the same for the small ones and collated the manuscript. We have tried to maintain Hibbie's original ideas and statements. The only differences, other than minor editing, involve segments of the paper for which we had no original data such as descriptions of *Pitymys, Perognathus* and the large mammals with the exception of the peccary. We hope that the finished product does him justice.

R.J.Z.

R.E.E.

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MAMMALS FROM THE KANOPOLIS LOCAL FAUNA, PLEISTOCENE (YARMOUTH) OF ELLSWORTH COUNTY, KANSAS

By

Claude W. Hibbard[1], Richard J. Zakrzewski[2],
Ralph E. Eshelman[3], Gordon Edmund[4],
Clayton D. Griggs[5], and Caroline Griggs[5]

Abstract.– Thirty-four species of mammals (three insectivores, two edentates, fourteen rodents, five carnivores, two proboscideans, one rabbit, three perissodactyls, and four artiodactyls) are reported from the Kanopolis local fauna. Eighteen of the taxa are extinct. Eleven of the taxa (two insectivores, five rodents, three carnivores, and the rabbit) can be assigned to extant species. Each of the eleven taxa represent the earliest occurrence of these species in Kansas, and in four cases (*Perognathus hispidus, Reithrodontomys humulis, Neotoma floridana*, and *Microtus pennsylvanicus*) they are the earliest record for that taxon in North America.

The environmental implications of the mammals suggest that a number of habitats were present close to the depositional site. These include the presence of a permanent stream, a marshy stream-border area, and an extensive riparian or gallery forest which graded into a savannah and grassland away from the stream. More effective moisture than at present is also indicated.

The sediments in which the fossils were found are part of a high terrace along the Smoky Hill River valley and have been mapped as Kansan (second glacial stage). However, the paleoclimatological and biogeographical implications of the mammals suggest a warm, moist interglacial stage. The stratigraphic evidence and the stage of evolution of the mammals suggest a Yarmouth (second interglacial stage) age for the Kanopolis local fauna.

INTRODUCTION

In the spring of 1969, the Griggs' discovered the remains of fossil vertebrates in an abandoned gravel pit at the north end of the town of Kanopolis, Ellsworth County, Kansas. They reported their finds to Hibbard and he visited the site in the summer of 1969. The Griggs' had found the remains of a tapir and when the short visit to the pit resulted in the discovery of a scute belonging to a giant armadillo, it was decided that a full-scale effort at washing the fossiliferous sediments should be attempted.

[1] Late of the University of Michigan, Museum of Paleontology, Ann Arbor
[2] Fort Hays State University, Sternberg Memorial Museum, Hays, Kansas
[3] Calvert Marine Museum, Solomons, Maryland
[4] Royal Ontario Museum, Canada
[5] 808 Ash, McPherson, Kansas

The summers of 1970 and 1971 were spent washing matrix (see Hibbard, 1949 for method) from this site by Hibbard and his field crews, composed primarily of students from Fort Hays State University. Numerous remains of invertebrates and vertebrates were obtained. Additional remains were recovered by the Griggs' in the winter of 1971 and by Zakrzewski and T. L. McMullen in the spring of 1972.

The mammalian remains form the basis for this report. The pelecypods (Miller, 1976), fish (Neff, 1975), and the herpetofauna (Holman, 1972) have been published, and the ostracods have been identified (E. D. Gutentag, pers. comm.). Preston (in ms.) has added a turtle to the fauna and the gastropods are being studied at Kent State University by B. B. Miller and T. Kay. No pollen was recovered (S. R. Hall, pers. comm.). The faunal list as presently known is given in Table 1.

TABLE 1 – Taxa of the Kanopolis local fauna

PELECYPODA

Tritogonia verrucosa (Rafinesque)
Arcidens confragosus (Say)
Ligumia subrostrata (Say)
Anodonta grandis (Say)
Uniomerus tetralasmus (Say)
Carunculina parva (Barnes)
Quadrula quadrula (Rafinesque)
cf. *Q. pustulosa* (Lea)
cf. *Lampsilis anodontoides* (Lea)
Pisidium casertanum (Poli)
P. compressum (Prime)
Sphaerium lacustrae (Müller)
S. transversum (Say)
S. striatinum (Lamarck)

OSTRACODA

Candona acuta Hoff
C. patzcuaro Tressler
C. caudata Kaufmann
C. crogmaniana Turner
C. lactea Baird
C. cf. *C. shawneensis* Staplin
Cypridopsis vidua O. F. Müller
Cyclopypris ampla Furtos
Ilyocypris bradyi Sars
I. gibba Ramdohr
Limnocythere cf. *L. sharpei* Staplin

Class OSTEICHTHYES

Order SEMIONOTIFORMES

Family **Lepisosteidae**

Lepisosteus osseus (Linnaeus)

Order CYPRINIFORMES

Family **Cyprinidae**

Pimephales promelas Rafinesque
Notropis cf. *N. rubellus* (Agassiz)
Notropis sp.

Nocomis cf. *N. biguttata* (Kirtland)
Campostoma sp.
Gen. et sp. unident.
Cyprinidae indet.

Family **Catostomidae**

Ictiobus niger (Rafinesque)

Order SILURIFORMES

Family **Ictaluridae**

Ictalurus melas (Rafinesque)
I. punctatus (Rafinesque)
Noturus (*Rabida*) cf. *N. furiosus* species group
Incertae sedis
Ictaluridae indet.

Order PERCIFORMES

Family **Centrarchidae**

Micropterus salmoides (Lacepede)
Lepomis cyanellus Rafinesque
L. cf. *L. humulis* (Girard)
L. megalotis Cope
Incertae sedis
Centrarchidae indet.

Class AMPHIBIA

Order SALIENTIA

Family **Hylidae**

Acris crepitans Baird
Hyla versicolor LeConte

Family **Ranidae**

Rana catesbeiana Shaw
R. pipiens Schreber

Class REPTILIA

Order CHELONIA

Family **Kinosternidae**

Sternotherus odoratus (Latreille)

Family **Trionychidae**

Trionyx spinifer (LeSueur)

Family **Chelydridae**

Chelydra serpentina (Linnaeus)

Family **Emydidae**

Graptemys geographica (LeSueur)
Chrysemys cf. *C. concinna* (LeConte)
C. scripta (Schoepff)

Family **Testudinidae**

Geochelone sp.

Order SAURIA

Family **Anguidae**

Ophiosaurus attenuatus Baird

Family **Scincidae**

Eumeces nr. *E. fasciatus* (Linnaeus)

Order SERPENTES

Family **Colubridae**

Regina grahami Baird and Girard
Natrix sipedon (Linnaeus)
Thamnophis nr. *T. sirtalis* or *T. proximus*
Natricinae indet.
Heterodon sp.
Coluber sp. or *Masticophis* sp.
Pituophis melanoleucus sayi (Schlegel)
Colubrinae indet.

Family **Crotalidae**

Sistrurus catenatus (Rafinesque)

Class MAMMALIA

Order INSECTIVORA

Family **Soricidae**

Blarina sp.
Cryptotis parva (Say)

Family **Talpidae**

Scalopus aquaticus (Linnaeus)

Order EDENTATA

Family **Mylodontidae**

Paramylodon harlani (Owen)

Family **Dasypodidae**

Holmesina septentrionalis (Leidy)

Order RODENTIA

Family **Sciuridae**

Cynomys (*Leucocrossuromys*) sp.

Family **Geomyidae**

Geomys bursarius (Shaw)
Thomomys sp.

Family **Heteromyidae**

Perognathus hispidus Baird

Family **Castoridae**

Castoroides cf. *C. ohioensis* Foster

Family **Cricetidae**

Reithrodontomys humulis (Audubon and Bachman)
Peromyscus cf. *P. cragini* Hibbard

P. cf. *P. progressus* Hibbard
Neotoma cf. *N. floridana* (Ord)

Family **Arvicolidae**

Neofiber leonardi Hibbard
Ondatra nebrascensis (Hollister)
Pitymys llanensis (Hibbard)
Microtus pennsylvanicus (Ord)

Family **Zapodidae**

Zapus sandersi Hibbard

Order CARNIVORA

Family **Canidae**

Vulpes sp.

Family **Procyonidae**

Procyon lotor (Linnaeus)

Family **Mustelidae**

Mephitis cf. *M. mephitis* (Schreber)
Lutra canadensis (Schreber)

Family **Felidae**

Smilodon sp.

Order PROBOSCIDEA

Family Indet.

gomphothere or mastodon

Family **Elephantidae**

Mammuthus cf. *M. columbi* (Falconer)

Order LAGOMORPHA

Family **Leporidae**

Sylvilagus floridanus (Allen)

Order PERISSODACTYLA

Family **Equidae**

Equus niobrarensis Hay
E. sp.

Family **Tapiridae**

Tapirus veroensis Sellards

Order ARTIODACTYLA

Family **Tayassuidae**

Mylohyus nasutus (Leidy)

Family **Camelidae**

Camelops sp.
Hemiauchenia cf. *H. seymourensis* (Hibbard and Dalquest)

Family **Cervidae**

Odocoileus sp.

GEOLOGY

The fossils were obtained from alluvial fill deposits in an abandoned sand and gravel pit in the SW¼, NE¼, Sec. 25, T.15S., R.8W., Ellsworth County, Kansas, at an elevation of 1,570 feet. These deposits form part of a high terrace along the Smoky Hill River. They are 6 miles east of the Wilson Valley complex formed by the ancestral upper Saline River when it was tributary to the Smoky Hill from pre-Nebraskan? to early Illinoian time (Bayne and Fent, 1963). More recently, Bayne *et al.* (1971) mapped the deposits at this locality as Kansan in age. Although the contained fauna indicates more humid conditions than at present, warmer winters are also indicated and so an interglacial rather than a glacial stage is suggested. The climatic implication and the stage of evolution of the contained taxa indicates a Yarmouth age for the deposit.

SYSTEMATIC PALEONTOLOGY

Order INSECTIVORA Bowdich, 1821

Family *Soricidae* Gray, 1821

Blarina sp.

Geologic range.– Pleistocene (?Nebraskan) to Recent.

Habitat.– Prefers a habitat with grass cover near water.

Material.– UM 61000, left dentary with incisor, 2 unicuspids, and M_1-M_3; UM 60612, left dentary with incisor, M_1-M_3; UM 60415, right dentary with incisor, M_1-M_3; UM 60412, left M^1.

Remarks.– The three dentaries are in three different ontogenetic stages. The youngest specimen (UM 60612) has a length of 8.6 mm from the tip of the incisor to the posterior edge of M_3. UM 60415 is a slightly older adult and UM 61000 is an old adult. The same parameter on these dentaries measures 9.0 mm. The length of M_1-M_3 in UM 60612 is 4.8 mm, whereas UM 60415 and UM 61000 measure 5.0 and 5.1 mm, respectively.

The left M^1 (UM 60412) represents a young adult and is larger than the M^1 (UM 44591) from the late Illinoian Mt. Scott local fauna (UM-K4-53), Meade County, Kansas. The M^1 from the Kanopolis local fauna also has a heavier posterolingual cingulum, extending from the hypocone along the posterior border of the tooth, than is found in either Recent *Blarina* or the specimens from the Mt. Scott assigned to "*B. brevicauda carolinensis*" (Bachman) by Hibbard (1963).

If the specimens from the Kanopolis local fauna represent a single species from one population then a new taxon might be warranted. However, more and better material is needed before a judgment can be made. The dentaries from the Kanopolis local fauna are the size of *B. carolinensis* and possess a reduced digastric tubercle (Gaughran, 1954). This tubercle is well developed in Recent *B. brevicauda* (Say). The coronoid process is the same width (anteroposterior) as that of extant *B. carolinensis* from southeastern Kansas. The width of the fossil M_1-M_3 is narrower than in recent specimens. The characteristics of the dentaries and the size of M^1 suggests that more than one species of *Blarina* are present in the Kanopolis local fauna. In addition, a dentary (UM 61263) recovered from a Cudahy local fauna equivalent (UM-K3-71) on the Big Springs Ranch, Meade County, Kansas, is similar to the Kanopolis specimens, with the exception that the external cingulum on the teeth is heavier. These specimens support the suggestion of Genoways and Choate (1972) that the *B. brevicauda* and *B. carolinensis* stocks were separated by late Kansan time.

Cryptotis parva (Say) 1823

Geologic range.— Pleistocene (Kansan) to Recent.
Habitat.— Prefers grasslands on well-drained uplands.
Material.— UM 60613, left dentary with M_1-M_3.
Remarks.— The anteroposterior length of M_1-M_3 is 3.5 mm. This specimen appears to be intermediate in nature between those of the Vera local fauna from the Kansan of Texas (Hibbard and Dalquest, 1966) and the Mt. Scott local fauna (Hibbard, 1963).

Family ***Talpidae*** Gray, 1825

Scalopus aquaticus (Linnaeus) 1758

Geologic range.— Pleistocene (Nebraskan) to Recent.
Habitat.— Prefers sandy, well-drained soils on the flood plain.
Material.— UM 60413, left M^1, left M^2, left M^3; UM 60422, left humerus; UM 60999, 2 right humeri, right ulna, left ulna.
Remarks.— At least two individuals of the eastern mole are present in the local fauna. The humeri fall within the size range of *S. a. machrinoides* Jackson. This taxon is extant in the Kanopolis area.

Order EDENTATA Cuvier, 1798

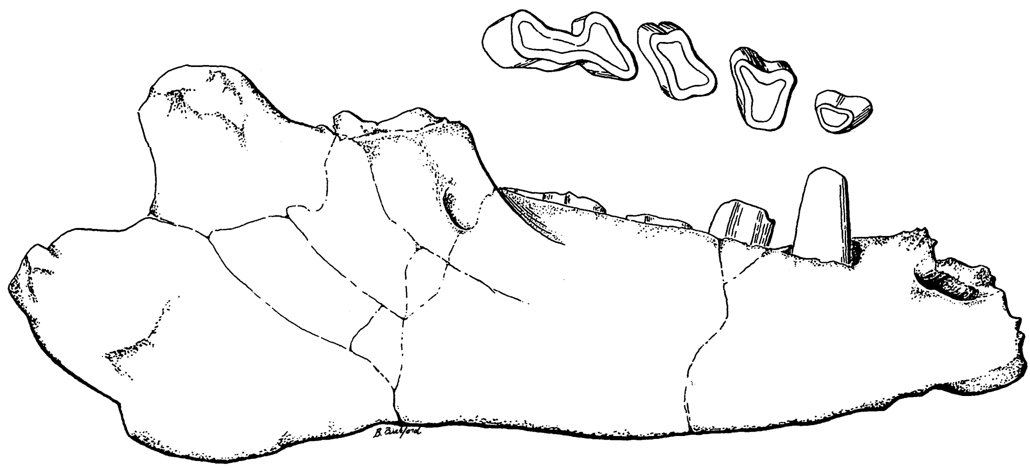
Family ***Mylodonidae*** Ameghino, 1898

Paramylodon harlani (Owen) 1840

(Text-fig. 1)

Mylodon harlani Owen, 1840, The Zoology of the Voyage of H.M.S. Beagle, etc., Part 1, Fossil Mammalia, p. 68.
Mylodon harlani Owen, 1840, Stock, 1925, Carnegie Inst. Washington Pub. 331, p. 120.
Paramylodon nebrascensis Brown, 1903, Bull. Amer. Mus. Nat. Hist., vol. 29, p. 569-583.
Mylodon harlani tenuiceps Stock, 1917, Univ. Calif. Pub., Bull. Dept. Geol. Soc., vol. 10, p. 171-173.
Mylodon garmani Allan, 1913, Harward Coll., Mem. Mus. Comp. Zool., vol. 40, no. 7, p. 319-346.
Mylodon harlani Stock, 1925, Carnegie Inst. Washington Pub. 331, p. 112-200.

Geologic range.— ? Pliocene to Pleistocene (Wisconsin).
Habitat.— Probably preferred browsing in relatively sheltered forested regions.
Material.— UM 60384, partial cranium, 2 isolated upper teeth, right and left dentaries; UM 60963, fragment of tooth.
Remarks.— UM 60384 represents a young individual as shown by the unfused sutures on the cranium and the tapering nature of the teeth from crown to root. The cranium is too fragmentary for any measurements, but the following ones were made on the dentaries: length (measured from the anterior end of the symphysis to the posterior end of the condyle) estimated at about 275 mm; depth of ramus (measured between the third and fourth tooth perpendicular to the ventral margin of the dentary) 54.4 mm; and maximum predental width estimated at about 84 mm. That these measurements are all less than those reported by Lundelius (1972) for similar parameters in *Paramylodon harlani* from the late Pleistocene Ingelside local fauna of Texas is probably due to the immaturity of the specimen.



TEXT-FIG. 1 – Edentate from the Kanopolis local fauna. *Paramylodon harlani*, UM 60384, right dentary with 4 teeth, labial and occlusal views, x ½.

The teeth are similar to those described by Lundelius (1972) from the Ingelside. However, the development of the external bulge posterior to the tight constriction on the fourth lower tooth (text-fig. 1) is more like the configuration found on the specimens from the Rock Creek local fauna (Kansan of Texas) rather than the Ingelside. The total length versus length of the anterior lobe of the fourth inferior tooth falls well below the data points for *P. harlani* on the scatter diagram constructed by Lundelius (1972). This feature is probably a result of the ontogenetic stage of the Kanopolis specimen. Only one species of *Paramylodon, P. harlani*, is recognized in North America (Lull, 1915; Lundelius, 1972).

Family *Dasypodidae* Bonaparte, 1838

Holmesina septentrionalis (Leidy)

(Text-figs. 2 and 3)

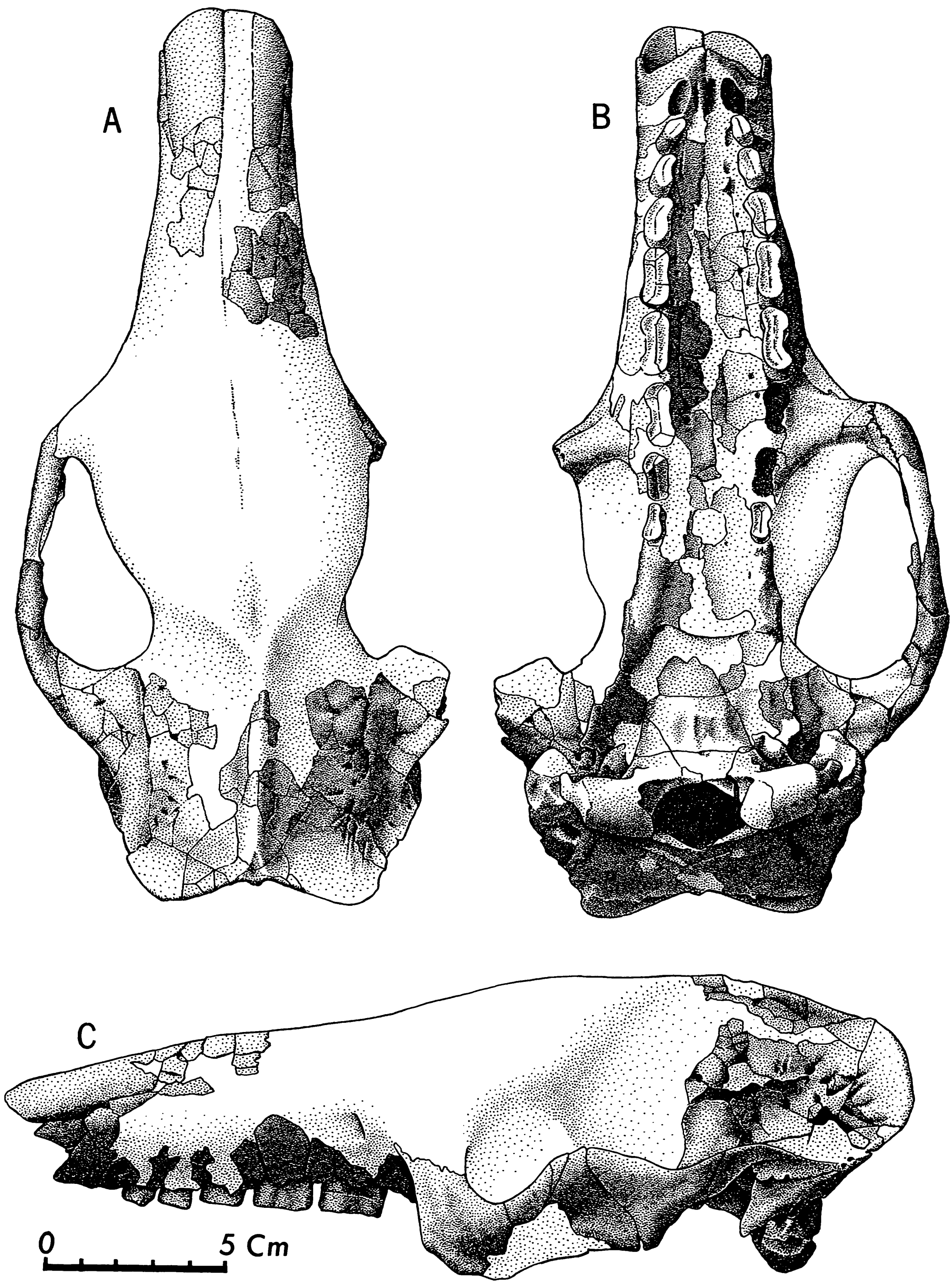
Glyptodon septentrionalis Leidy, 1889, Proc. Acad. Nat. Sci. Philadelphia, p. 97.
Chlamydotherium humboldtii Leidy (not Lund, 1838), 1889, Trans. Wagner Free Inst. Sci., vol. 2, p. 24-25.
Chlamytherium humboldtii Hay (not Lund, 1839), 1902, U.S. Geol. Survey Bull. 179, p. 581-582.
Chlamytherium septentrionalis (Leidy). Sellards, 1915, Amer. Jour. Sci., 4th ser., vol. 40, p. 139-145.
Holmesina septentrionalis (Leidy). Simpson, 1930, Amer. Mus. Novitates 442, p. 1-9.
Chlamytherium septentrionale (Leidy, 1889). James, 1957, Jour. Paleont., vol. 31, p. 796-808.

Geologic range.– Pleistocene (Kansan to Wisconsin).

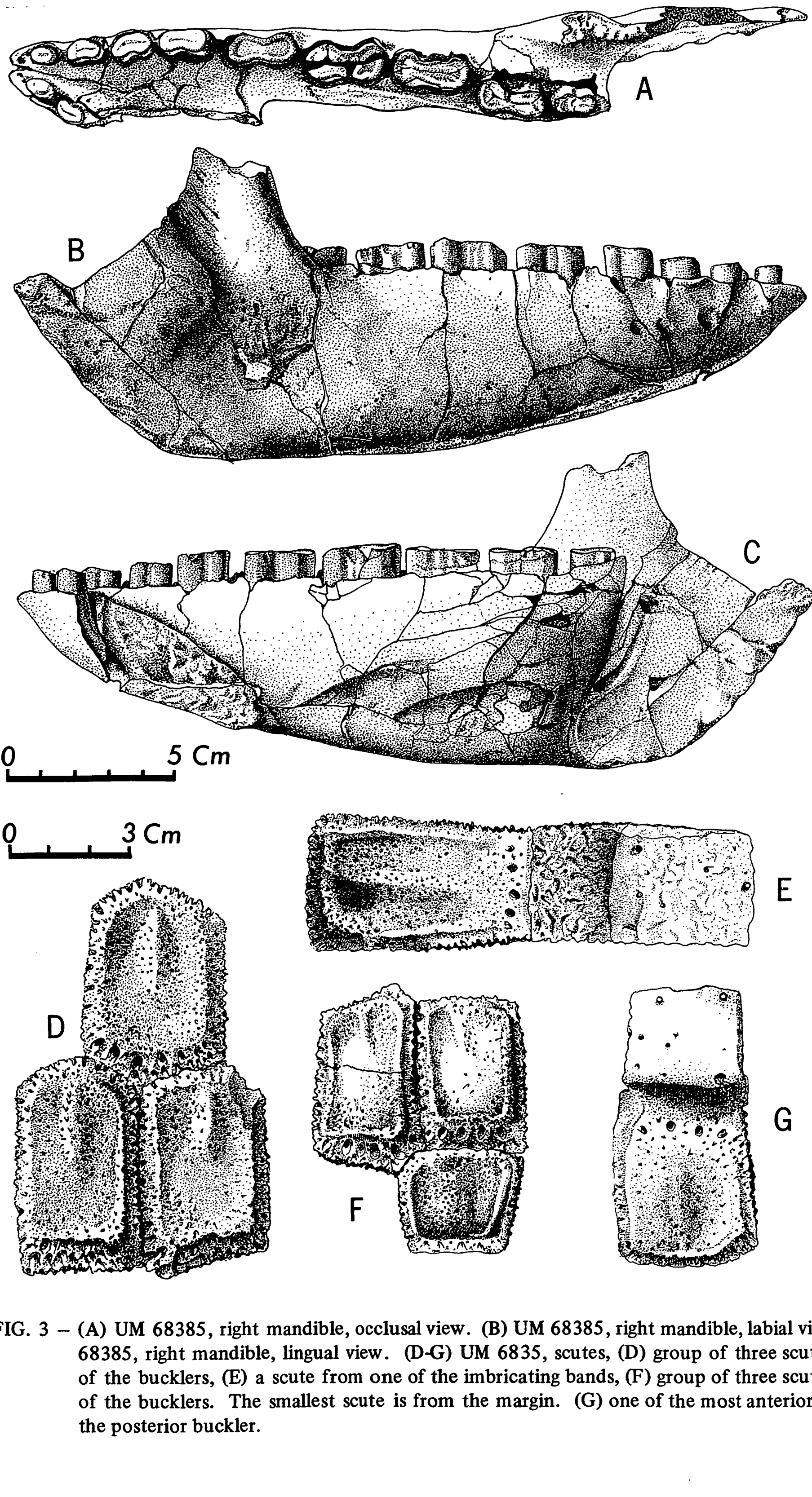
Habitat.– Probably preferred grassland habitat on upland.

Material.– UM 60385, partial skull, left and right mandible and 210 various scutes; UM 60347, scute; UM 60349, scute.

Remarks.– Hibbard had begun work on the description of the giant armadillo, and had prepared a bibliography, distribution list, and some drawings. The present description is a preliminary report, with a fuller description to be included in a review of the group currently being written by Edmund. Essentially, the specimen is typical of the giant armadillos common in the southeastern U.S. during the late Pleistocene, generally given the name *Chlamytherium* or *Holmesina*.



TEXT-FIG. 2 – (A) UM 6835, skull, dorsal view. (B) UM 68385, skull, ventral view. (C) UM 68385, skull, left lateral view.



TEXT-FIG. 3 – (A) UM 68385, right mandible, occlusal view. (B) UM 68385, right mandible, labial view. (C) UM 68385, right mandible, lingual view. (D-G) UM 6835, scutes, (D) group of three scutes from one of the bucklers, (E) a scute from one of the imbricating bands, (F) group of three scutes from one of the bucklers. The smallest scute is from the margin. (G) one of the most anterior scutes from the posterior buckler.

All of the bones appear to belong to a single individual. The bone is well preserved but severely fragmented. Painstaking restoration has produced the best single example of a skull and associated mandible of this sub-family from North America. While much of the upper surface of the skull is missing, the nasal, occipital, palatal and basicranial areas are in excellent condition. The mandibles lack only the condyles and coronoids, while the upper and lower dentitions are well preserved. Several scutes from diagnostic regions of the carapace are associated. Because of the relative completeness of the specimen and its discovery so far north of its previously known range, it merits special comment.

Numerous specimens of a giant armadillo have been found over much of the southern U.S.A., from Texas to Florida. Usually they lack precise stratigraphic information, but all of the larger individuals belong to the Irvingtonian or Rancholabrean land mammal stages. Robertson (1976) described *Kraglievichia floridanus* from a Blancan locality in Florida, and suggested that later forms could have descended from it. Unpublished data by Edmund confirms this. Several series of comparable bones from a number of sites throughout the Pleistocene can be studied. The lineage is relatively conservative, with the change through time being mainly an increase in size and a progessive "molarization" of the anterior teeth. The ornamentation of the scutes remains constant. Preliminary analysis of measurements shows a relatively rapid increase in size from the Blancan to the Irvingtonian and a smaller increase from Irvingtonian to Rancholabrean. In the absence of an absolute time scale these data indicate only a general trend. In fact, several pampatheres associated with Irvingtonian faunas fall well within the ranges of size and morphological variability of Rancholabrean specimens. Thus, at our present state of knowledge, it is impossible to assign a pampathere specimen to any specific part of the later Pleistocene with any degree of confidence.

Edmund considers *Holmesina septentrionalis* as the correct name for the Kanopolis pampathere. Leidy (1889A) gave the name *Glyptodon septentrionalis* to a collection of scutes from Florida, although he later (1889B) considered that they probably belonged "to the same species as the *Chlamydotherium humboldtii* of South America." Sellards (1915) described a mandible and some scutes from Florida under the name *Chlamytherium septentrionalis*, thus recognizing the Floridian species as distinct from the Brazilian. Cahn (1922) accepted the same spelling of the generic name, which in fact was a result of a *lapsis kalmi* of Lund, the shorter name being generally accepted by most workers despite Lund's subsequent objections (Paula Couto, 1954). The genus *Holmesina* was proposed to include the North American species by Simpson (1930), who believed it "to be totally distinct from *Chlamytherium humboldtii.*"

Whether or not it is morphologically distinct, the generic name *Chlamytherium* is inappropriate for two reasons. It had been proposed (as *Chlamydotherium*) for an Uruguyan glyptodont by Bronn early in 1838 (Paula Couto, 1954) and is therefore unavailable. Secondly, there is good evidence that the Late Pleistocene species *septentrionalis* evolved in North America (probably in Florida), from *Kraglievichia floridanus* or some near relative. Thus we cannot accept a South American generic name for it, unless we postulate that certain South American species were also derived from the Floridian Blancan ancestor, which is unlikely.

Robertson (1976: 135-142) reviewed the problems of taxonomy in this group. Edmund agrees that any current classification of the pampatheres is open to question, but for the reasons stated above prefers *Holmesina septentrionalis* as the valid name for the common large, late Pleistocene North American forms. They would thus belong to the sub-family Pampatheriinae, family Dasypodidae (Hoffstetter, 1953).

The Kanopolis specimen is exceptionally important because of its fine preservation and extreme northerly and inland occurrence. Measurements and a full description will be forthcoming in a paper by Edmund on the pampatheres of North America. The specimen clearly belongs with the main line of evolution of pampatheres in eastern North America, and is distinct in at least two features (scute ornamentation and anterior dentition) from the other phyletic line of pampatheres from Texas and Mexico, which is represented by only a few specimens. (Unpublished data, Edmund).

Order RODENTIA Bowdich, 1821

Family *Sciuridae* Gray, 1821

Cynomys (*Leucocrossuromys*) sp.

Geologic range.— Pleistocene (?Nebraskan) to Recent.
Habitat.— Burrows into well-drained soil.
Material.— UM 60414, left M_3.
Remarks.— The tooth belongs to a young adult in the white-tailed praire dog group. The greatest anteroposterior length is 4.8 mm. The tip of the paraconid is missing. The re-entrant valley between the hypoconid and protoconid, on the labial side, is more open than in Recent specimens of all species assigned to the subgenus *Leucocrossuromys*.

Family *Geomyidae* Gill, 1872

Geomys bursarius (Shaw) 1800

Geologic range.— Pleistocene (?Kansan) to Recent.
Habitat.— Burrows into deep, friable soils generally on flood plains.
Material.— UM 60621, left dentary with I, P_4-M_2; UM 60423, 2 partial palatines and edentulous maxillaries, 7 P^4s, 4 P_4s, M^3, 3 isolated molars.
Remarks.— The dentary of this specimen is similar to those of *G. bursarius* found in the Recent of Kansas. The chief difference is that the temporal pit between the alveolus of M_3 and the ascending ramus is not as deep as in Recent specimens of the same size. The occlusal length of P_4-M_2 is 5.2 mm.

Thomomys sp.

(Text-fig. 4B)

Geologic range.— Pliocene to Recent.
Habitat.— Burrows into thin, well-drained soils generally on uplands.
Material.— UM 60848, right P_4.
Remarks.— This specimen is similar to one (UM 42317) reported from the Cudahy local fauna by Paulson (1961) in that there is a groove in the enamel on the lingual side of the anterior loph (text-fig. 4B). Stephens (1960) reported that two of ten *Thomomys* from the Doby Spring local fauna (Illinoian of Oklahoma) had a similar lingual groove.

No *Thomomys* has been reported previously from an interglacial stage in Kansas or Oklahoma. The sympatric occurrence of two genera of pocket gophers during glacial stages is thought to result from the eastward shift of montane populations of *Thomomys* as alpine glaciers developed in the Rockies. The specimens of *Thomomys* and the white-tailed prairie dog (which also has an extant distribution to the west of the Great Plains) in the Kanopolis local fauna might represent individuals from relict populations of these taxa; another interpretation is that, because of the increased humidity (suggested by other elements in the fauna) during this time, these taxa could exist on the Plains, whereas post-glacial dessication prevents their living in the Plains region at present.

Family *Heteromyidae* Allen and Chapman, 1893

Perognathus hispidus Baird, 1858

Geologic range.— Pleistocene (Yarmouth) to Recent.

Habitat.— Prefers grassland habitat on the upland surface.

Material.— UM 60411, partial left dentary with P_4, partial right dentary with P_4-M_2.

Remarks.— These two specimens are similar in all parameters to Recent specimens assigned to *P. hispidus* in the Museum of the High Plains. The left dentary represents a young adult. The P_4 measures 0.76 mm in occlusal length and 0.80 mm in width. The other specimen represents an adult individual. The teeth are badly eroded and the M_2 is incomplete. An estimate of the P_4-M_3 alveolar length is 4.86 mm. These specimens represent the earliest fossil record of *P. hispidus*.

Family *Castoridae* Gray, 1821

Castoroides cf. *C. ohioensis* Foster, 1833

Geologic range.— Pleistocene (Kansan to Wisconsin).

Habitat.— The fossil record indicates that the giant beavers lived in marshes, bogs, around lakes, and along large rivers.

Material.— UM 60358, fragment of left maxillary with M^3; UM 60362, tip of right upper incisor.

Remarks.— The M^3 has a width of 11.6 mm and a height of 47.5 mm. The occlusal length cannot be determined as the specimen is damaged. The transverse width of the incisor is 23.4 mm. The anterior posterior width is 21.5 mm.

Stirton (1965) states "the tail (of *Castoroides*) was relatively not as wide as in *Castor*. The gouge-shaped incisors, their long projection beyond the alveolar borders and other features in the cranium of *C. ohioensis* do not support the idea that the giant beaver felled large trees.***There is no evidence that it built dams." We agree with Stirton on the above remarks concerning *Castoroides*.

Pilleri (1961) studied and figured the brain cast of *Castoroides* and the brain of *Castor canadensis*. The brain of *Castoroides* is more primitive than that of *Castor*. It is also proportionately smaller in *Castoroides* when the relative body sizes of the two beavers are compared. *Castor* simply "out beavered" *Castoroides* and built its own environment as early as the Hagerman local fauna (Blancan of Idaho), where evidence of beaver dams and ponds exist. Stirton (1965) states "Eventual reduction and disappearance of most of its preferred environment in the late Pleistocene probably was influential in its extinction." *Castoroides* was taken with *Neofiber* in the Rezabek local fauna (Yarmouth of Kansas) (Hibbard, 1943) as well as the Kanopolis local fauna. *Neofiber* is certainly an indicator of swamp and marsh habitats. With the disappearance of these large and widespread habitats because of uplift of the Plains region and entrenchment of our modern streams, *Castoroides* was doomed to extinction.

Family *Cricetidae* Rochebrune, 1883

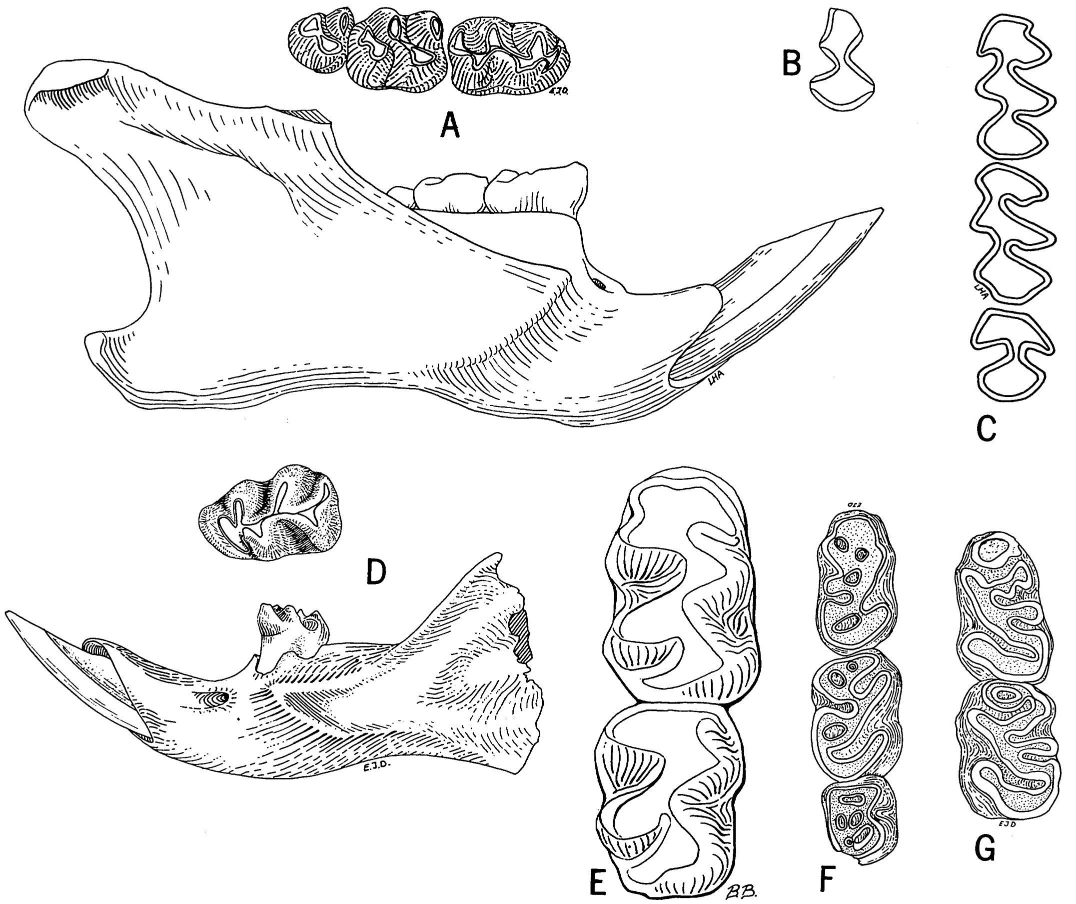
Reithrodontomys humulis (Audubon and Bachman) 1841

(Text-fig. 4A)

Geologic range.— Pleistocene (Yarmouth) to Recent.

Habitat.— Prefers a grassland habitat.

Material.— UM 60408, right dentary with I, M_1-M_3.



TEXT-FIG. 4 – Rodents from the Kanopolis local fauna. (A) *Reithrodontomys humulis*, UM 60408, right dentary with M_1-M_3, labial view, x 10, occlusal view, x 12.5. (B) *Thomomys* sp., UM 60848, RP_4, occlusal view, x 6. (C) *Neotoma* cf. *N. floridana*, UM 60388 and UM 61001, composite RM_1-M_3, occlusal view, x 6. (D) *Peromyscus* cf. *P. cragini*, UM 60407, left dentary with M_1, labial view, x 6, occlusal view, x 12.5. (E) *Peromyscus* cf. *P. progressus*, UM 60409, RM_1-M_2, occlusal view, x 20. (F-G) *Zapus sandersi*, (F) UM 60406, RM_1-M_3, (G) UM 60405, LM_1-M_2, occlusal view, x 12.5.

Remarks.– This specimen (text-fig. 4A) represents a young adult and the earliest occurrence of the eastern harvest mouse in the fossil record. The occlusal length of M_1-M_3 is 2.78 mm. The occlusal lengths of the individual teeth are: M_1 = 1.25 mm; M_2 = 0.99 mm; M_3 = 0.60 mm. The fossil dentary has the mental foramen situated a little more dorsally than in Recent specimens.

A strong labial cingulum (labial ridge of Hooper, 1952; shelf of Paulson, 1961) extends from the anteroconid along the labial side of M_1 to the anterior base of the hypoconid. The cingulum is slightly enlarged to form a small cusplet which joins the base of the protoconid. The cingulum is higher anterior to the protoconid than it is posteriorly.

The M_2 has a well-developed cingulum anterolabial to the protoconid. Eighty-nine specimens of Recent *R. humulis* were examined and only three specimens (UMMZ 83941, 115759, 85847) had labial cingula that approached those of the fossil M_1 and M_2. UMMZ 85847 has the best developed cingulum on the M_2s and one is also present on the M_3. In the other Recent specimens the labial cingulum joins the base of the protoconid and does not extend posteriorly as a distinct entity.

Hibbard (1963, fig. 4G) referred to a distinct shelf that occurred on a right M_2 (UM 43947) from the Mt. Scott local fauna. This tooth is longer and wider than the M_2 of the jaw assigned to *R. humulis*. One Recent specimen (UMMZ 66940) of *R. montanus* (Baird) has an M_2 similar to UM 43947. If more specimens of the two fossil forms become available, they may show that distinct races are represented.

No upper molars of *Reithrodontomys* were recovered from the Kanopolis local fauna. All fossil and Recent M^1s of *R. megalotis* (Baird) and *R. montanus* that were examined have four roots. The fourth root is reduced and located medially on the labial side. All previous specimens of fossil *Reithrodontomys* M^1s reported from Kansas have four roots.

Peromyscus cf. *P. cragini* Hibbard, 1944

(Text-fig. 4D)

Geologic range.– Pliocene to Pleistocene (Yarmouth).

Habitat.– Unknown but, as relationship is suggested to *P. maniculatus* (McMullen, in press), it might be similar to that taxon.

Material.– UM 60407, left dentary with I, M_1.

Remarks.– The specimen represents a young adult. The occlusal length of the M_1 is 1.3 mm. The tooth is not as hypsodont as the M_1 of *P. maniculatus* (Wagner). No stylids or lophids are present and the anteroconid does not have an anteromedian groove (text-fig. 4D). The labial and lingual re-entrant valleys are wider and extend well down on the crown of the tooth. The diastemal region is narrower than that of *P. maniculatus* and *P. polionotus* (Wagner) but wider than that of *P. cragini* (UM 38346 and UM 38347) from the Cudahy local fauna. In most characteristics the specimen is closest to *P. cragini*.

Peromyscus cf. *P. progressus* Hibbard, 1960

(Text-fig. 4E)

Geologic range.– Pleistocene (Yarmouth to Sangamon).

Habitat.– Unknown but, as relationship is suggested to *P. leucopus* (Hibbard and Taylor, 1960), it might be similar to that taxon.

Material.– UM 60409, right dentary with M_1-M_2; UM 60410, left dentary with I, M_1, edentulous left dentary; UM 60620, left M_1.

Remarks.– The above specimens compare favorably with those assigned to *P. progressus* from the Cragin Quarry local fauna (Sangamon of Kansas). UM 60409, the right dentary with M_1-M_2, represents an old adult (text-fig. 4E). The occlusal length of the M_1-M_2 is 2.7 mm. A small ectostylid is present on both teeth.

The other dentary that has a tooth (UM 60410) is a young adult. The occlusal length of M_1 is 1.45 mm and it has a small mesolophid which comes off the base of the entoconid.

The isolated M_1 (UM 60620) represents a young adult, also. Its occlusal length is 1.5 mm. The M_1 has a small mesolophid and mesostylid, and an anterior groove on the anteroconid.

Neotoma cf. *N. floridana* (Ord) 1818

(Text-fig. 4C)

Geologic range.– Pleistocene (Yarmouth) to Recent.

TABLE 2 – Measurements (in mm) of various parameters in the crania of *Neofiber*.

	N. leonardi	*N. alleni*	
Parameter	UM 61005	MHP 3567	MHP 3568
Length of molar row	11.5	11.8	11.6
Palatal	23.8	23.2	25.0
Palitar	21.5	20.9	22.5
Diastema	13.8	12.6	13.7
Palatal bridge	8.1	9.5	10.1
Least interorbital breadth	4.1	4.6	4.9
Width of rostrum	7.6	8.3	8.3

Habitat.– Prefers habitat of rock outcrops on upland surface.

Material.– UM 60388, right M^1, right M^2, 2 right M^3s, left M^1, left M^3, 3 right M_1s, 3 right M_2s, 4 left M_1s, left M_2; UM 61001, part of left dentary with I and M_3.

Remarks.– The teeth are slightly smaller than those of *N. f. osagensis* Blair which is extant in the area. The M_3 has the bilophate pattern (text-fig. 4C) found in the subgenus *Neotoma* rather than the S-shaped pattern found in the subgenus *Hodomys* and in most of the extinct species of the genus *Neotoma*.

Family *Arvicolidae* Gray, 1821

Neofiber leonardi Hibbard, 1943

(Text-fig. 5A)

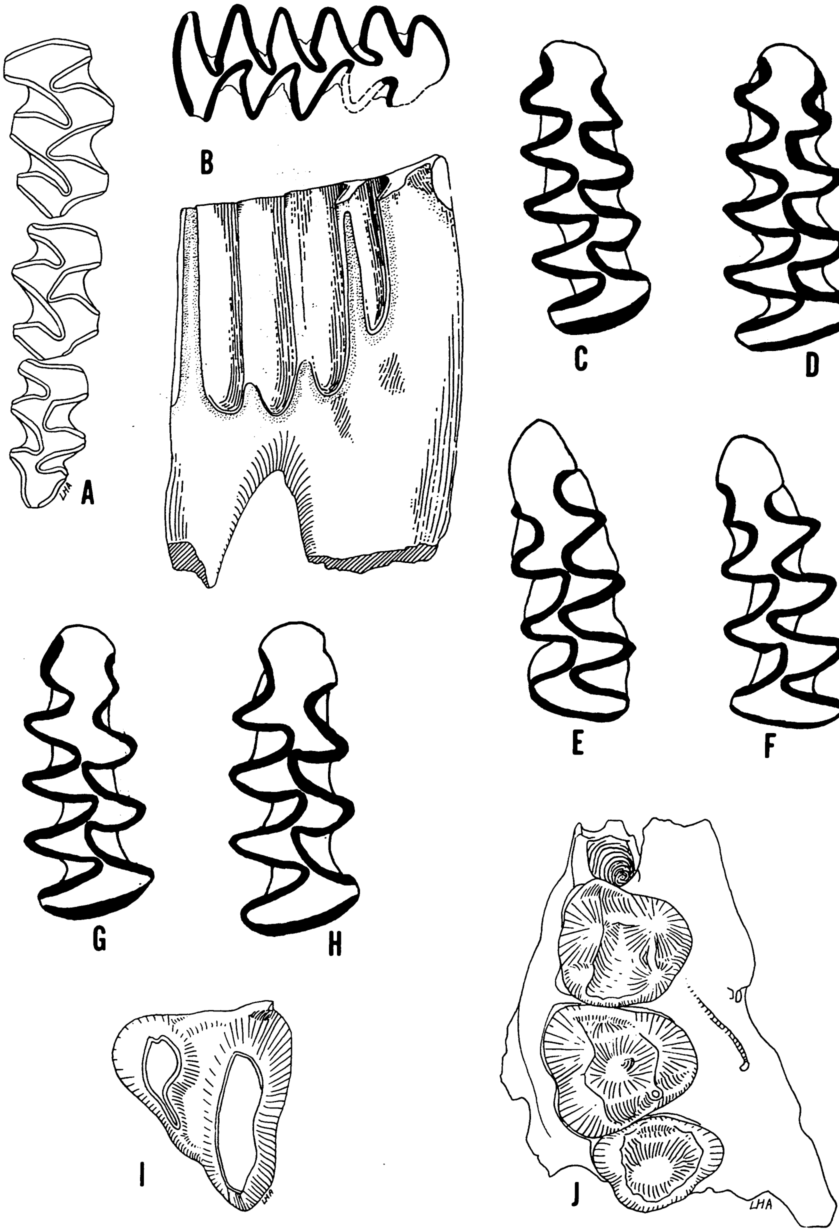
Geologic range.– Pleistocene (Kansan to Yarmouth).

Habitat.– Probably preferred marshy environment.

Material.– UM 61005, partial cranium with frontal (disassociated), premaxillary and maxillaries with both I and M^1-M^3 present; UM 61002, right maxillary with M^1-M^3; UM 61068, partial right dentary with I, M_1-M_3; UM 61004, partial left dentary with I, M_1-M_2; UM 61003, partial left dentary with M_1-M_2; UM 60390, partial right dentary with M_1-M_2; UM 60391, left M^1, right M^3, left M^1; UM 60392, left M^1, right M^1, right M^2, right M^3, 2 left M^3s, 3 right M_1s, 2 left M_2s, left M_3, 3 right M_3s.

Emended diagnosis.– *Neofiber leonardi* is slightly larger than the Recent round-tailed water rat, *N. alleni* True. The external re-entrant angles are broader and more anteriorly directed. The alternating triangles are slightly more compressed anteroposteriorly, with more angular apices. The mental foramen is closer to the M_1 than in *N. alleni*. The incisor extends slightly above the dental foramen crowding the foramen anteriorly from the posterior border of the ascending ramus (see Meade, 1952, Pl. 1 and MU 6794).

Remarks.– Measurements of seven parameters were taken from the partial cranium (UM 61005) of *Neofiber leonardi* using the definitions of Hershkovitz (1962) and are listed in Table 2. UM 61005 represents a young adult and in most of the parameters it is slightly smaller than extant *N. alleni* in the Museum of the High Plains. UM 61005 is exceptionally narrow in the interorbital region, but



TEXT-FIG. 5 – Rodents and carnivores. (A) *Neofiber leonardi*, UM 61002, RM^1-M^3, occlusal view, x 6. (B) *Ondatra nebrascensis*, UM 60622, RM$_1$, labial and occlusal views, x 6. (C-G) *Pitymys*, (C) *P. pinetorum*, MHP 630, (D) *P. ochrogaster*, MHP 4712, (E) *P. llanensis*, KU 6626, holotype, (F) *P. llanensis*, UM 60393, (G) ? *P.* sp., KU 7384-1, (C-D, G) RM$_1$, (E-F) LM$_1$ occlusal view, x 12.5. (H) ? *Allophaiomys* sp., KU 7384-2, occlusal view, x 12.5. (I) *Mephitis* cf. *M. mephitis*, UM 60614, LP^4, occlusal view, x 4. (J) *Procyon lotor*, UM 60983, partial right maxillary with P^4-M^2, occlusal view, x 2.

this narrowness might be a reflection of the damaged condition rather than the true nature of the specimen. The diastema in the fossil specimen is slightly longer than in the extant forms measured. The third triangle on the right M^3 is closed off from the posterior loop, a condition shown by Birkenholz (1972, fig. 2) to be characteristic of immature and young adult individuals; but the third triangle on the left M^3 opens slightly into the posterior loop.

The occlusal length of the M^1-M^3 in the right maxillary (UM 61002) is 10.25 mm. In this specimen the third triangle opens broadly into the posterior loop (text-fig. 5A).

The posterior part of all the dentaries are missing. The occlusal length of six M_1s range in size from 4.45 to 5.30 mm, with a mean of 5.03 mm. The shortest M_1 has an enamel ridge on the anterior loop similar to those described by Hibbard and Zakrzewski (1967) and Zakrzewski (1969) for the genera *Ophiomys* and *Cosomys*. It appears that this specimen represents a very young individual. If this specimen is discounted the mean of the remaining specimens is 5.20 mm. In young individuals the loops and triangles are very slightly open, but as the animal becomes older there is a tendency for them to become closed.

Birkenholz (1963) suggests that *Neofiber* might be separated ecologically from *Ondatra* if the two species existed sympatrically. There is no reason to doubt this suggestion and this separation probably existed when the two taxa lived sympatrically in the Port Kennedy Cave (Yarmouth of Pennsylvania), Rezabek, and Kanopolis local faunas. However, it appears that *Ondatra* and *Neofiber* occurred sympatrically only at the edges of their geographical ranges. *Neofiber* is considered to have developed as a southern form in warm, broad, marsh-land areas. *Ondatra* probably developed to the north of the range of *Neofiber*. It is interesting to note, for example, that no remains of *Ondatra* were recovered with the large sample of *Neofiber leonardi* taken with the Slaton local fauna from Lubbock County, Texas (Dalquest, 1967). It appears that the habitat of *Neofiber* was widespread in the middle Pleistocene. Its range retracted as its habitat was destroyed by late Pleistocene stream incision and less effective rainfall.

Ondatra nebrascencis (Hollister) 1911

(Text-fig. 5B)

Ondatra annectens (Brown); Hibbard and Dalquest, 1973, p. 273.

Geologic range.– Pleistocene (Kansan to Illinoian).

Habitat.– Probably very similar to the extant muskrat, which prefers marshes, ponds, lakes, and streams.

Material.– UM 60622, right M_1; UM 60623, right M_3 and 2 M^1s.

Remarks.– The muskrat, with only four isolated teeth found, is relatively rare in the fauna when compared to the round-tailed water rat. The right M_1 (UM 60622) represents a young adult and has an occlusal length of 6.0 mm (text-fig. 5B). The tooth is larger than those of *Ondatra annectens* (Brown) from the Cudahy local fauna and has slightly higher dentine tracts. The tooth is not as large nor are the dentine tracts as well developed as those of *O. zibethicus* (Linnaeus) from the Mt. Scott local fauna. UM 60622 is like the M_1s assigned to *O. nebrascencis* by Semken (1966) from the Kentuck (Kansan of Kansas) and Sandahl (Illinoian of Kansas) local faunas. The right M^1 (UM 60623) has an occlusal length of 3.9 mm and possesses an anterior cingulum (see Zakrzewski, 1969, text-fig. 7c). In other characteristics, it is like the right M^1 (KU 6678) from the Rezabek local fauna.

Pitymys llanensis (Hibbard) 1944

(Text-fig. 5E-F)

Microtus (Pedomys) llanensis Hibbard, 1944, p. 729-730.
Microtus (Pedomys) llanensis Hibbard; Hibbard, 1952, p. 10 (in part ?).

TABLE 3 – Length of M_1s (in mm) in *Pitymys.*

Taxa	N	O.R.	$\bar{X}$	S.D.	S.E.
P. llanensis	12	2.61 – 2.92	2.74	0.14	0.05
P. ochrogaster	12	2.89 – 3.26	3.09	0.12	0.04
P. pinetorum	29	2.55 – 3.41	3.00	0.20	0.04

N = number, O.R. = observed range, $\bar{X}$ = mean, S.D. = standard deviation, S.E. = standard error of mean.

Pedomys llanensis Hibbard; Paulson, 1961, p. 148-149.
Microtus (Pedomys) llanensis Hibbard; Semken, 1966, p. 157 (in part ?).

Geologic range.– Pleistocene (Kansan to Yarmouth).

Habitat.– Probably preferred grassland habitat on upland.

Material.– UM 60403, partial palate and maxillary with left M^1-M^3; UM 60397, partial palate and maxillary with left M^1-M^2; UM 60396, partial maxillary with left M^1, partial maxillary with right M^1; UM 60617, right dentary with M^1-M^3; UM 60998, 60393, 60399, 60619, 60400, left dentaries with M_1-M_2; UM 60618, 60424, 60395, right dentaries with M_1-M_2; UM 60398, right dentary with M_1; UM 60988, 16 left M^1s; UM 60989, 15 left M^2s; UM 60991, 2 left M^3s; UM 60984, 17 right M^1s; UM 60985, 8 right M^2s; UM 60987, 4 right M^3s; UM 60402, 14 left M_1s; UM 60993, 8 left M_2s; UM 60995, 2 left M_3s; UM 60401, 19 right M_1s; UM 60389, 5 right M_2s; UM 60996, 3 right M_3s.

Emended diagnosis.– *Pitymys llanensis* is characterized by its M_1 which consists of a posterior loop, three closed alternating triangles, and a set of mostly confluent fourth and fifth alternating triangles that open broadly into an anterior loop. The anterior loop varies from a relatively simple knob to one that can be modified by an additional internal and external re-entrant angle.

The teeth of *Pitymys llanensis* are generally shorter than those of either *P. pinetorum* (LeConte) (text-fig. 5C) or *P. ochrogaster* (Wagner) (text-fig. 5D). *P. llanensis* is narrower than *P. ochrogaster* and its fourth and fifth alternating triangles open more broadly into the anterior loop than in *P. pinetorum.*

Remarks.– A left dentary (UM 60393) with M_1-M_2 (text-fig. 5F) from the Kanopolis local fauna compares favorably with the holotype of *Pitymys llanensis* (KU 6626) from the Cudahy local fauna (text-fig. 5E).

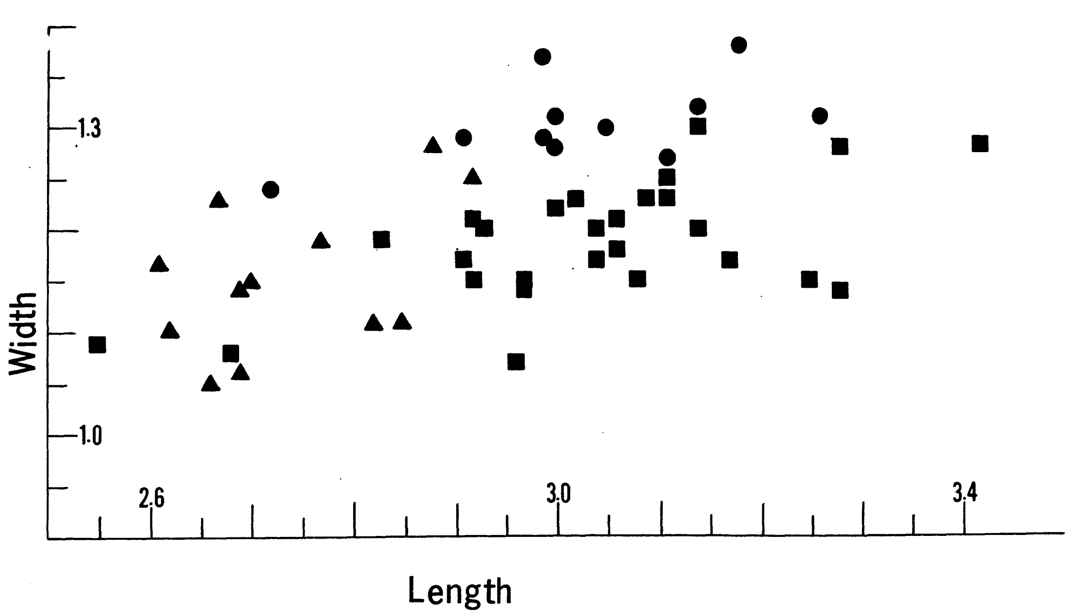
Parameters of the M_1 (greatest length, greatest width, and the width of the opening, or isthmus, between the fourth and fifth alternating triangles and the anterior loop) were measured on *Pitymys llanensis, P.pinetorum,* and *P. ochrogaster* using a Gaertner measuring microscope. The data obtained are plotted in graphical form in text-figures 6 and 7. These data demonstrate that three species are recognizable. As mentioned in the diagnosis, *P. llanensis* is shorter than the other two taxa (Table 3). *P. llanensis* and *P. pinetorum* are narrower than *P. ochrogaster*; while *P. llanensis* and *P. ochrogaster* have a broader isthmus than *P. pinetorum*. Similar data for the extant taxa had been obtained earlier by Johnson (1972).

The variation observed in the parameters used in this study plus the variation seen in parameters suggested by others to distinguish the taxa [relative thickness of enamel, van der Meulen (pers. comm. to Semken); shape of M_3, Johnson (1972) and Hager (1974)] suggests that *Pitymys pinetorum* and *P. ochrogaster* are congeneric. Therefore, the opinion of Ellerman and Morrison-Scott (1951) that all voles with three closed triangles be synonymized under *Pitymys* is followed here. Martin (1974) also synonymizes *Pedomys* with *Pitymys* but retains some of the other genera, such as *Neodon* Hodgson and *Phaiomys* Blyth which Ellerman and Morrison-Scott synonymize.

In another recent paper, Martin (1975) reports the presence of the extinct genus *Allophaiomys* Kormos from the Java local fauna (Kansan of South Dakota) and the Kentuck local fauna. *Allophaiomys* is distinguished by its M_1 which has a posterior loop, three closed triangles and a moderately simple anterior loop. However, these criteria do not distinguish this genus from the extant European genus *Phaiomys* (Martin, 1975). M_1s in a similar stage of evolution are also known from the Wathena local fauna of Kansas, the local fauna associated with the type Sappa formation of Nebraska, the Fyllan Cave local fauna of Texas [in which they were reported as either *Microtus* or *Pedomys llanensis* by Einsohn (1971) and Zakrzewski (1975)], and the Cumberland Cave local fauna of Maryland (J. E. Guilday, pers. comm.). These local faunas are thought to be Kansan in age.

In the Kentuck local fauna, there are M_1s which are in the *Allophaiomys* stage of evolution (text-fig. 5H). There are also M_1s which approach the *Pitymys llanensis* stage of evolution (text-fig. 5G). It has not been possible to determine with satisfaction whether two taxa are present or whether we have a variable population where the change from a three-triangled form to a five-triangled form is beginning to take place. Van der Meulen (1973), when considering what seems to be a similar amount of variation in a European population of voles, places all the individuals into *Allophaiomys*. Whatever the resolution of the above problem, it seems reasonable to support the suggestion of Chaline (1966) that the *Pitymys* stage of evolution was reached through an *Allophaiomys* stage.

A number of questions then arise: Does the presence of an arvicoline at an *Allophaiomys* stage of evolution represent a migration from Eurasia as suggested by Martin (1975)? Could the taxon have evolved here (there are a number of primitive North American taxa whose evolutionary relationships are not well understood that might have served as an ancestral stock)? Was the *Pitymys* generic grade reached independently on the two continents (much as Martin (1970) has suggested for species of *Sigmodon* in Kansas and Arizona)? Does it represent a separate migration, or could we be looking at some kind of parallelism?



TEXT-FIG. 6 – Scatter diagram of length vs. width of M_1 (in mm) in *Pitymys*. Circles represent *P. ochrogaster*, squares = *P. pinetorum*, and triangles = *P. llanensis*.

Microtus pennsylvanicus (Ord) 1815

Geologic range.— Pleistocene (Yarmouth) to Recent.

Habitat.— Prefers grassland habitat.

Material.— UM 60615, 2 right M_1s; UM 60616, 2 left M_1s; UM 60992, 2 right M_2s; UM 60994, 2 left M_2s; UM 60990, 2 left M^2s; UM 60986, 2 right M^3s.

Remarks.— The best preserved left (UM 60616) and right (UM 60615) M_1 have occlusal lengths of 2.8 mm and five closed alternating triangles. Davis (1975) has demonstrated that geographic clines in both the length of the lower first molar and number of closed alternating triangles exist in extant populations of *Microtus pennsylvanicus*. While the populations with a higher percentage of five-triangled individuals are on the edges of the modern range of *M. pennsylvanicus*, the number of triangles during Yarmouth time more likely reflects the stage of evolution of the taxon rather than biogeographic variation. Even in post-Yarmouth local faunas on the Great Plains, very few *M. pennsylvanicus* having M_1s with more than five alternating triangles are found (McMullen, in press).

Family *Zapodidae* Coues, 1835

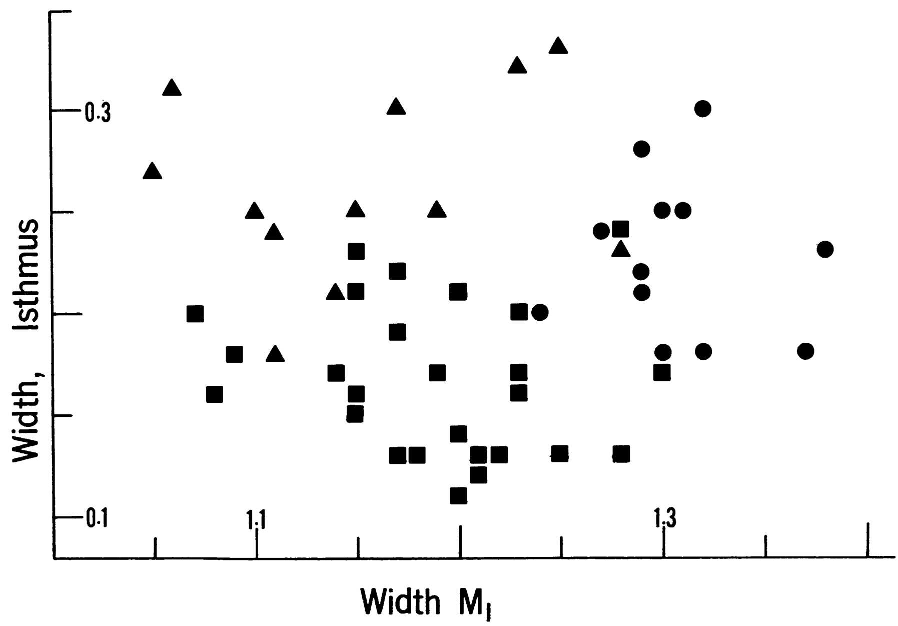
Zapus sandersi Hibbard, 1956

(Text-fig. 4F-G)

Geologic range.— Pliocene to Pleistocene (Yarmouth).

Habitat.— Probably similar to extant *Zapus* which prefers low meadows, but can be present in any nearby moist habitat.

Material.— UM 60404, partial left dentary with I, M_1-M_2; UM 60405, partial left dentary with M_1-M_2; UM 60406, partial right dentary with I, M_1-M_3.



TEXT-FIG. 7 – Scatter diagram of width of M_1 vs. width of isthmus between fourth and fifth alternating triangles and anterior loop (in mm). See text-figure 6 for legend.

Remarks.– The occlusal pattern of the molars from the Kanopolis local fauna more closely resemble that of *Zapus sandersi sandersi* from the Cudahy local fauna than they do *Z. hudsonicus transitionalis* Klingener (1963) from the Mt. Scott local fauna. Likewise, the teeth from Kanopolis have lower crowns than those of extant *Z. hudsonicus* (Zimmerman) in comparable stages of wear.

The right dentary (UM 60406) represents an old adult. The greatest occlusal length of M_1-M_3 is 3.43 mm. In addition to lower crowned teeth, its prehypoconid fold (text-fig. 4F) is not as deep as in *Z. hudsonicus*.

The left dentary (UM 60405) represents an adult. The occlusal length of M_1 is 1.63 mm and the width is 0.91 mm. The postentoconid fold is closed (text-fig. 4G). The occlusal length of M_2 is 1.42 mm and the width is 0.99 mm. The M_2 is wider than that measured in *Z. hudsonicus*. The re-entrant formed by the prehypoconid fold is broader on these teeth than on the teeth from the Cudahy local fauna. There is a pit at the base of the re-entrant on the M_2.

The left dentary (UM 60404) represents an old adult. The occlusal length of the M_2 is 1.35 mm and the width is 0.99 mm. The postentoconid fold is closed on these teeth as well.

Order CARNIVORA Bowdich, 1821

Family *Canidae* Gray, 1821

Vulpes sp.

Geologic range.– Pliocene to Recent.
Habitat.– Prefers riparian woodland.
Material.– UM 60976, proximal half of a right humerus.
Remarks.– The humerus corresponds in size with those of the red fox, *Vulpes vulpes* Pocock.

Family *Procyonidae* Bonaparte, 1850

Procyon lotor (Linnaeus) 1758

(Text-fig. 5J)

Geologic range.– Pleistocene (?Kansan) to Recent.
Habitat.– Prefers forested regions, especially along streams and near lakes.
Material.– UM 60983, part of right maxillary with P^4-M^2.
Remarks.– The specimen (text-fig. 5J) represents a young adult raccoon just slightly larger than a young adult male (UMMZ 89686) from Lee County, Alabama. The greatest length of P^4-M^2 is 21.6 mm. The greatest width of the crown of M^1 is 9.5 mm.

Arata and Hutchinson (1964) measured a number of Pleistocene and Recent raccoons. They showed that a cline existed in the extant forms, with the largest specimens in the north and the smallest in the south. Somewhat similar data were obtained by Wright and Lundelius (1963). If similar clines existed during the Pleistocene a raccoon the size of one from Alabama could be expected in the Kanopolis local fauna and could be used as biogeographic evidence to support an interglacial age for the local fauna.

Family *Mustelidae* Swainson, 1835

Mephitis cf. *M. mephitis* (Schreber) 1776

(Text-fig. 5I)

Geologic range.– Pleistocene (?Kansan) to Recent.

Habitat.– Prefers a mixture of woods, brush land, and grassland near water.

Material.– UM 60614, left P^4.

Remarks.– The tooth (text-fig. 5I) belongs to a small, adult striped skunk. The greatest length is 7.0 mm. The length of the carnassial blade (paracone-metacone) is 5.5 mm. The greatest width (5.7 mm) is across the base of the paracone and protocone. Remains of *Mephitis* from the Pleistocene of the Great Plains are rare. This is the earliest unquestioned record of this genus in Kansas.

Lutra canadensis (Schreber) 1776

Geologic range.– Pleistocene (?Kansan) to Recent.

Habitat.– Lives along streams and lakes.

Material.– UM 60977, part of a right squamosal.

Remarks.– The width of the glenoid fossa is 23.2 mm. This is slightly longer than the width observed in Recent otter skulls. The greatest width (22.6 mm) was found in an old male (UMMZ 840929) from Michigan. Because of its size the fossil specimen is thought to be the squamosal of an old male. If it is a female a new species is represented.

Family *Felidae* Gray, 1821

Smilodon sp.

Geologic range.– Pleistocene (?Kansan to Wisconsin).

Habitat.– It has been assumed that *Smilodon* preyed upon thick-skinned, slow-moving herbivores in the fauna.

Material.– UM 60373, proximal end of left femur, with the head, part of the neck, and most of the greater trochanter missing.

Remarks.– The digital fossa (trochanteric fossa) is 16 mm in width. A specimen of *Smilodon californicus* Bovard (UM 48647) has a width of 25.5 mm. Meade (1961) states, "the digital fossa (of *Dinobastis serus* Cope) is even larger than in *Smilodon* and the distal end is continuous to the lesser trochanter through a shallow, curving depression." It appears that the fragment of the femur belongs to a species of saber-tooth cat smaller than *S. californicus*.

Order PROBOSCIDEA Illiger, 1811

Family Indet.

Material.– UM 60967, fragment of enamel.

Remarks.– The fragment of massive rather than platy enamel suggests the presence of a gomphothere or a mastodon in the fauna.

Family *Elephantidae* Gray, 1821

Mammuthus cf. *M. columbi* (Falconer) 1857

Elephas columbi Falconer, 1857, Quart. Jour. Geol. Soc. London, vol. 12, p. 307-360.
Paralephas columbi (Falconer). Osborn, 1942, Proboscidea, vol. 2, Amer. Mus. Nat. Hist., p. 1071.
Mammuthus columbi (Falconer). Hibbard, 1955, Univ. Michigan. Contr. Mus. Pal., vol. 12, no. 10, p. 96.

Geologic range.– Pleistocene (Kansan to Wisconsin).
Habitat.– Does not appear to be restricted to any particular habitat (Lundelius, 1972).
Material.– UM 60351, partial lower molar; UM 60072 and 60360, partial epiphyses of an illium.
Remarks.– This partial tooth is 8 cm long. There are five plates within this distance suggesting a plate number of 6.3 per 10 cm. The thickness of the enamel ranges from 1.8 to 2.9 mm, which is similar to measurements obtained by Aguirre (1969) on *M. columbi*. This specimen also resembles *M. columbi* in having a relatively narrow grinder with a thin outer cement coating (Osborn, 1942). The epiphysial fragments are tentatively assigned to this taxon.

Order LAGOMORPHA Brandt, 1855

Family *Leporidae* Gray, 1821

Sylvilagus floridanus (Allen) 1894

Geologic range.– Pleistocene (?Kansan) to Recent.
Habitat.– Prefers forested and/or brushy regions.
Material.– UM 60417, partial left dentary with P_4-M_2; UM 60418, partial right dentary with I, P_3-M_1; UM 60419, partial left dentary with ½ of P_4, M_1-M_3; UM 61006, partial right dentary with P_3-P_4; UM 60978, partial, edentulous right dentary; UM 60416, left P^2; UM 60624, right P_3; UM 60420, partial right dentary with P_4, 2 partial portions of dentaries, 3 upper incisors, left P^2, 15 isolated upper teeth, right DP_4, left P_4?, 5 isolated lower teeth, 5 right M_3s, 4 left M_3s; UM 60421, proximal ends of a humerus and femur, distal end of tibia, metatarsal; UM 60841, portion of a pelvis, proximal end of ulna, distal ends of a tibia and humerus; UM 60361, distal end of tibia.
Remarks.– The fragmentary remains of the cottontail rabbit represent a minimum number of five individuals based on a count of M_3s. The rabbit is larger than *Sylvilagus audubonii neomexicanus* Nelson, which is extant in southwestern Kansas, and smaller than *S. aquaticus* Bachman, which is extant in extreme southeastern Kansas.

The occlusal pattern of the teeth is similar to that of *Sylvilagus floridanus* (Allen) and the partial right dentaries (UM 60418 and 61006), the P_3 (UM 60624), and the P^2 (UM 60416) are all the size of *S. floridanus*. The limb bones vary in size between *S. f. alacer* (Bangs) and *S. f. mearnsi* (Allen). The latter taxon is extant in the area (Hall, 1955).

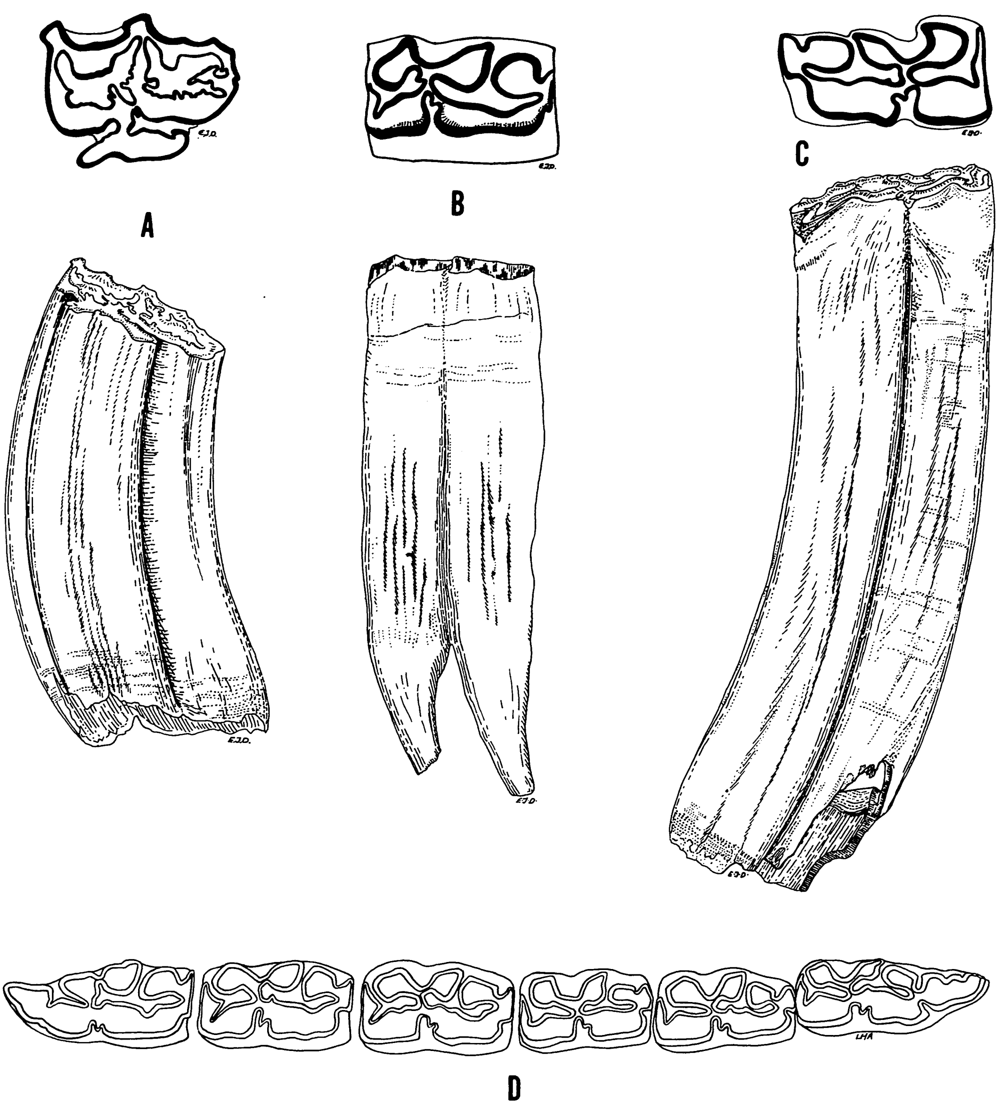
Order PERISSODACTYLA Owen, 1848

Family *Equidae* Gray, 1821

Equus niobrarensis Hay, 1913

(Text-fig. 8)

Equus niobrasensis Hay, 1913, Proc. U.S. Nat. Mus., vol. 44, p. 569-594.
Equus hatcheri Hay. Savage, 1951, Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 28, no. 10, p. 215-314.
Equus niobrarensis Hay. Dalquest, 1967, Southwestern Naturalist, vol. 12, no. 1, p. 1-30.



TEXT-FIG. 8 – *Equus niobrarensis* from the Kanopolis local fauna. (A) UM 60382, LM^3, lingual and occlusal views, (B) UM 60383, LP_4, (C) UM 60371, RM_2, labial and occlusal views, x 1. (D) UM 60847, LP_2-M_3, occlusal view, x ¾.

Geologic range.– Pleistocene (Kansan-Illinoian).

Habitat.– Preferred grassland regions.

Material.– UM 60847, left and right dentaries with I_1-M_3; UM 60848, fragment of left dentary with P_2-P_3, M_1-M_3; UM 60369, left P_2, right P_4, left and right M_3; UM 60352, ?right M_1; UM 60972, left DP_3 and DP_4, right P_2, 2 left P_3s, 2 right P_3s, right and left P_4, left M_3; UM 60981, right M_1; UM 60383, left P_4; UM 60371, right M_2; UM 60980, right P^4 and M^3; UM 60382, left M^3; UM 60370, left M^1; UM 60973, 2 left M^2s, fragment of right $M^?$; UM 60346, right $DP^?$, 2 left $P^?$, right P^4, 2 left M^3s; UM 60980, 3 I's; UM 60368 and 60971, proximal ends of scapulae; UM 60968, patella; UM 60969, distal end of nasal; UM 60970, right tarsal.

TABLE 4 – Measurements (in mm) of lower teeth of *Equus niobrarensis*.

	UM 60847			UM 60846		
Tooth	Length	Width	M–ML	Length	Width	M–ML
P_2	33.4	16.9	15.2	29.8	17.8	15.4
P_3	27.2	18.0	16.4	27.5	18.5	15.8
P_4	26.6	17.9	15.4	–	–	–
M_1	24.1	17.0	14.3	23.8	19.2	14.3
M_2	25.0	15.8	13.4	24.2	18.3	13.9
M_3	33.7	15.0	13.2	33.9	15.8	13.9

M–ML = Metaconid – metastylid length.

Remarks.– Aside from the slightly smaller size, the teeth assigned to the above taxon (text-fig. 8) from the Kanopolis local fauna are practically identical to the type of *Equus niobrarensis* (USNM 4999). Minor differences in the enamel occur with wear and between individuals. The I_3s in the Kanopolis dentaries do not have a fundibular cusp. The cheek teeth of the associated dentaries (UM 60847) possess plicaballinids (text-fig. 8D), but they are absent from the cheek teeth of the remaining dentary (UM 60848). The mandibular proportions and dimensions compare closely with the type.

Savage (1951) suggests that *E. niobrarensis* and *E. hatcheri* Hay are synonymous with *E. scotti* Gidley, although post-cranial comparisons might show different body proportions. Another interpretation is that *E. scotti* might represent the large end of a size chronocline with *E. niobrarensis*, but the exact relationships have yet to be resolved.

The Kanopolis material can be excluded from the subgenera *Equus* and *Dolichohippus* based on the character of the ectoflexid in the lower molars, and from *Amerhippus* by the presence of cups in I_1-I_2 (Skinner, in Skinner and Hibbard *et al.*, 1972). The lack of cups in I_3, although possibly a useful character for specific separation, is not applicable for subgeneric separation (Skinner, in Skinner and Hibbard *et al.*, 1972). We question the usefulness of the shape of the linguaflexid (valley between the metaconid and metastylid) in differentiating subgenera and species of horses as discussed by McGrew (1944), Hibbard (1953), and Dalquest (1967). This character appears to be variable even within a single specimen [for example, see type of *E. niobrarensis* (USNM 4999)].

Measurements of various parameters of the teeth from the Kanopolis local fauna are given in Table 4. No metapodials were recovered. The post-cranial elements listed above are tentatively assigned to this taxon.

Equus (*Equus* or *Dolichohippus*) sp.

Geologic range.– Pliocene to Recent.

Habitat.– Prefers grassland regions.

Material.– UM 67670, left M_1, right $M_?$.

Remarks.– The isolated molars are distinguishable from the hemionid and asinid groups by the presence of antero-isthmuses and post-isthmuses as demonstrated by Skinner (Skinner and Hibbard, 1972). The teeth are smaller than equivalent ones in *Equus simplicidens* (Cope).

TABLE 5 – Measurements and observed ranges of the size of selected teeth of *Tapirus*.

Tooth	Kanopolis	Crankshaft[1]	Seminole[2]	Florida[3]	Texas
P^2L	21.5[4]	20.0	18.5 – 20.8	18.7 – 21.1	19.8 – 20.5[3]
P^2AW	21.8	23.4	19.3 – 22.9	19.6 – 23.2	21.1 – 23.9
P^2PW	20.5	15.0	21.0 – 25.5	22.8 – 25.8	22.4 – 25.9
M_1L	20.1[5]	28.7	21.7 – 25.0	20.0 – 26.9	22.7 – 24.2[6]
M_1AW	20.6	19.9	17.6 – 19.3	17.0 – 22.0	18.9 – 19.9
M_1PW	19.6	19.2	16.1 – 18.9	15.9 – 20.0	17.5 – 18.8
M_2L	25.3	26.3	22.6 – 26.6	22.5 – 29.0	24.3 – 26.5
M_2AW	21.4	21.8	18.9 – 19.7	18.4 – 23.4	20.6 – 21.6
M_2PW	22.2	21.3	18.0 – 19.7	17.8 – 22.8	19.2 – 19.6
M_3L	26.6	–	25.7 – 28.3	25.4 – 32.2	26.7
M_3AW	21.3	–	19.5 – 20.5	19.0 – 23.1	–
M_3PW	19.5	–	17.4 – 18.6	17.0 – 21.7	17.5

L = Length, AW = Anterior width, PW = Posterior width, [1] = from Parmalee, *et al* (1969), [2] = from Simpson (1945), [3] = from Lundelius and Slaughter (1976), [4] = UM 60367, [5] = UM 60348, [6] = from Lundelius (1972).

Family *Tapiridae* Burnett, 1830

Tapirus veroensis Sellards, 1918

Tapirus veroensis Sellards, 1918, Florida State Geol. Survey, 10th and 11th Ann. Repts., p. 57-70.
Tapirus veroensis Sellards, var. *excellsus* Lundelius and Slaughter, 1976, Royal Ont. Mus., Misc. Pub. p. 226-240.

Geologic range.– Pleistocene (Yarmouth to Wisconsin).

Habitat.– Preferred forested regions with abundant soft vegetation.

Material.– UM 60348, partial left dentary with P_4 and fragments of M_1-M_3, partial right dentary with M_2 and fragment of M_3; UM 60345, partial right dentary with M_2 and fragment of M_3; UM 60367, right P^2.

Remarks.– The left dentary (UM 60348) is from an adult as shown by the wear on the M_3. The cheek teeth fall into the *Tapirus terrestris-veroensis* complex on the basis of the occlusal pattern. Simpson (1945) indicates that teeth in this complex are inseparable except on the basis of relative sizes and proportions.

Among the teeth from the Kanopolis local fauna, the widths of the lower molars (Table 5) fall within or above the range for specimens previously assigned to *T. excelsus* Simpson (Parmalee *et al.*, 1969; Lundelius, 1972). On the other hand the lengths fall not only within the range for that species, but also within the range for specimens assigned to *T. veroensis* (Simpson, 1945). The only exception is the M_1, which appears to be one of the shortest teeth yet measured for the extinct species, being smaller or equal to M_1s of *T. veroensis* (Eshelman and Ray, in press). The isolated P^2 (UM 60367) is among the longest ones measured for this complex. The anterior width is about average, but the posterior width is among the narrowest (Table 5).

Lundelius and Slaughter (1976) suggest that *T. excelsus* is a growth stage of *T. veroensis* and that the larger specimens eventually may be regarded as a subspecies, *T. v. excelsus*. The variation observed among the specimens from the Kanopolis local fauna tends to support their view.

It is interesting that remains of tapirs recorded from the Great Plains in local faunas of pre-Yarmouth age [Gilliland of Texas (Hibbard and Dalquest, 1966); Donnelly Ranch of Colorado (Hager, 1974); and the Hudspeth of Texas (Strain, 1966)] have been assigned to the slightly larger species *Tapirus copei* Simpson. The presence of *T. veroensis* in the Kanopolis suggests either replacement of the larger *T. copei* by the former taxon or niche partitioning on the part of the tapirs during this time. The above records for *T. copei* are to the south and west of Kanopolis, and the premolars of this taxon are more molariform than those of *T. veroensis*; perhaps *T. copei* preferred more open country and selected somewhat more fibrous material for food. As an example, Janis (1976) suggests that the rapid molarization of the premolars in the early equids reflects their selection of the more fibrous parts of the plant as part of their evolutionary strategy. Perhaps the increased humidity and forested situation suggested by the other taxa in the Kanopolis local fauna favored the presence of *T. veroensis*. The advanced molarization of the premolars of *T. copei* probably excludes it as an ancestor to *T. veroensis*.

Order ARTIODACTYLA Owen, 1848

Family *Tayassuidae* Palmer, 1897

Mylohyus nasutus (Leidy) 1868

Dicotyles nasutus Leidy, 1868, Proc. Acad. Nat. Sci. Phil., p. 230-231.
Dicotyles pennsylvanicus Leidy, 1889, Amm. Rep. Geol. Survey Penn., p. 8.
Mylohyus nasutus (Leidy), Cope, 1889, Amm. Nat., vol. 23, p. 134-135.
Mylohyus pennsylvanicus (Leidy). Gidley, 1920, Proc. U.S. Nat. Mus., vol. 57, p. 674.
Mylohyus browni Gidley, 1920, Proc. U.S. Nat. Mus., vol. 57, p. 675-676.
Mylohyus nasutus (Leidy). Lundelius, 1960, Bull. Texas Me. Mus., vol. 1, p. 30.

Geologic range.— Pleistocene (?Kansan to Wisconsin).

Habitat.— Associated with forested regions (Lundelius, 1960) and warm environment.

Material.— UM 60982, fragment of right maxillary with P^4-M^1 and alveoli for P^3; UM 60979, right astragalus.

Remarks.— The length of P^4-M^1 is 28.0 mm. This measurement falls within the expected range of variation for an old adult of *M. nasutus* (Ray, 1967). Both the P^3 and P^4 have four roots as do the premolars of the *Mylohyus* (UM 44763) described by Semken and Griggs (1965). In addition, both P^4s have a small fifth root that comes off the posterior lingual edge of the anterolingual root. *Platygonus* has only one lingual root on its premolars. No comparison with the early Pleistocene peccary, *M. floridanus* Kinsey (1974), could be made as no upper teeth of this taxon are known so far.

The astragalus has a length of 45.0 mm and is larger than those of *Platygonus compressus* LeConte reported by Eshelman *et al.* (1973) and *Mylohyus nasutus* by Lundelius (1960). These finds constitute the second report of the long-nosed peccary from Kansas, the other being from the Sandahl local fauna from McPherson County (Semken and Griggs, 1965).

Family *Camelidae* Gray, 1821

Camelops sp.

Geologic range.— Pliocene to Pleistocene (Wisconsin).

TABLE 6 – Measurements (in mm) of upper teeth of llamas.

	Hemiauchena			*Paleolama*	
Tooth	Kanopolis	Blanco[1]	Florida[2]	Ingelside[3]	Florida[2]
P^3L	17.5	–	15.0	13.2 – 14.0	13.0 – 14.5
P^3GW	10.4	–	9.0	11.9 – 12.0	9.0 – 9.5
P^4L	20.8	–	16.0 – 19.0	15.1 – 16.2	14.5 – 17.5
P^4GW	18.5	–	16.5	14.9 – 17.0	14.5 – 17.0
M^1L	27.5	29.4	20.0 – 23.0	22.1	18.5 – 24.5
M^1AW	21.6	21.0	20.0 – 21.5	20.0 – 20.1	18.0 – 21.5
M^1PW	21.0	–	–	20.6 – 20.9	–
M^2L	29.7	32.2	24.5 – 27.5	24.1 – 25.9	17.5 – 22.5
M^2AW	21.9	20.0	20.0 – 22.0	22.3 – 23.6	18.5 – 23.0
M^2PW	21.6	–	–	21.0 – 21.6	–
M^3L	27.8	–	25.0 – 28.0	24.3 – 28.3	21.0 – 26.0
M^3AW	21.8	–	20.5 – 21.5	21.9 – 25.0	18.5 – 22.5
M^3PW	19.9	–	–	18.9 – 20.8	–

L = Length, GW = Greatest width (where only one width measurement is given it is equal to greatest width), AW = Anterior width, PW = Posterior width, [1] = from Meade (1945), [2] = from Webb (1974), [3] = from Lundelius (1972).

Habitat.– Preferred open grasslands for grazing but could have browsed occasionally (Webb, 1965).

Material.– UM 60365, fragment of $M_?$; UM 60366, proximal and distal fragment of metapodial III; UM 60845, distal end of right femur; UM 60962, 2 I's; UM 60975, epiphysis of phalange.

Remarks.– The femur (UM 60845) measures 95.7 mm across the condyles and 37.7 mm across the patellar surface. The fragment of metapodial III (UM 60366) measures 39.4 mm transversly and 41.7 mm anteroposteriorly. All of these measurements are below the observed range given by Webb (1965) for the same parameters in *Camelops hesternus* (Leidy) from Rancho La Brea. These data suggest that the Kanopolis specimens are referrable to one of the smaller species of the genus *Camelops*, either *C. sulcatus* (Cope) or *C. minidokae* (Hay). This suggestion is further supported by the fact that the fragment of the lower molar (UM 60365) has a width of 21.4 mm, which agrees with the measurements given by Dalquest (1967) for *C. sulcatus* from the Slaton local fauna.

Lundelius (1972) discusses the characteristics of the small species of *Camelops* and suggests the probability of a third species, as yet unnamed, based on his data from the Ingelside local fauna. Assignment of the Kanopolis material will have to await the recovery of more diagnostic and complete material.

Hemiauchenia cf. *H. seymourensis* (Hibbard and Dalquest) 1962

Tanupolama seymourensis Hibbard and Dalquest, 1962, Michigan Acad. Sci. Arts, Letters, 47: 83-99.
Hemianchenia seymourensis (Hibbard and Dalquest). Webb, 1974. *Pleistocene Mammals of Florida*, p. 170-213.

Geologic range.– Pleistocene (Kansan to Yarmouth).

Habitat.– Probably preferred open grasslands because of cursorial adaptations of limbs (Webb, 1974).

Material.– UM 60843, partial left maxillary with P^3-M^3; UM 60844, partial associated dentaries with both canines and left $P_?$.

Remarks.– The measurements (Table 6) of the teeth associated with the maxillary (UM 60843) are significantly greater than those of *Paleolama mirifica* (Simpson) from the Ingelside local fauna (Lundelius, 1972) and from Florida (Webb, 1974). The lengths of the teeth are slightly smaller than corresponding teeth in *Hemiauchenia blancoensis* Meade (1945) from the Blanco local fauna (Pliocene of Texas). No upper teeth have been previously assigned to *H. seymourensis*, but based on lower teeth it is about the same size as *H. blancoensis* (Hibbard and Dalquest, 1962). *H. macrocephala* (Cope) from Rock Creek is smaller than *H. blancoensis* and *H. seymourensis* (Webb, 1974). Because *H. blancoensis* is more primitive than *H. seymourensis*, the Kanopolis material is tentatively referred to the latter taxon because of its advanced nature and comparable size.

Family *Cervidae* Gray, 1821

Odocoileus sp.

Geologic range.– Pliocene to Recent.

Habitat.– Prefers marginal habitat between forest and grassland.

Material.– UM 60350, metapodial; UM 60363, distal end of radius; UM 60364, fragment of phalange; UM 60964, phalange; UM 60965, 2 fragments of an antler; UM 60966, ungual.

Remarks.– Because none of the material is diagnostic, no attempt was made to assign it to a species.

PALEOECOLOGY

The environmental preferences of the mammals in the Kanopolis local fauna as deduced by comparison with extant taxa suggest that a number of habitats were present close to the depositional site. These include a permanent stream, marshy stream-border areas, and an extensive gallery forest which graded into a savannah and grassland away from the stream. The forest occurred primarily on the flood plain, the savannah was primarily restricted to the slopes, whereas the grasslands were primarily confined to the well-drained upland. Part of the upland overlooking the valley might have consisted of rock outcrop covered by thin soils. Similar habitats are suggested by the herpetofauna (Holman, 1972). The largest fish fauna from the Pleistocene of the Great Plains (Neff, 1975) also indicates the presence of a large permanent, low gradient stream as do the ostracodes (Gutentag, pers. comm.) and the pelecypods (Miller, 1976).

In addition to the fish (see Table 1) almost half (6 of 14) of the herpetofauna that are indicative of a preferred environment indicate a permanent stream community. Characteristic mammalian inhabitants of this community would include the otter, *Lutra*, and the muskrat, *Ondatra*.

A marshy stream-border area is indicated by six members of the herpetofauna (3 frogs and 3 snakes). Mammalian members of this community would include the giant beaver, *Castoroides*, the round-tailed water rat, *Neofiber*, and the short-tailed shrew, *Blarina*.

Preferring the gallery forest would be taxa such as the raccoon, *Procyon*, which would also be a frequent visitor to the stream, the long-nosed peccary, *Mylohyus*, the ground sloth, *Paramylodon*, the tapir, *Tapirus*, and the fox, *Vulpes*. Found in various areas on the flood plain would be the gopher, *Geomys*, and the meadow vole, *Microtus*. As the forest graded into the savannah, or more grassy regions we might expect to find the white-footed mice, *Peromyscus*, the harvest mouse, *Reithrodontomys*, the vole, *Pitymys*, the jumping mouse, *Zapus*, the rabbit, *Sylvilagus*, the skunk, *Mephitis*, and the deer, *Odocoileus*.

On the well-drained upland covered primarily by grass with sparse amounts of brush, one might expect to find the prairie dog, *Cynomys*, the pocket mouse, *Perognathus*, the mammoth, the horses, and perhaps the camelids. The gopher, *Thomomys*, and the wood rat, *Neotoma*, might be found in the area of rock outcrops.

When the area of sympatry for the vertebrates with extant representatives is determined, all classes show a distribution primarily to the east of the fossil locality. This fact suggests that if there was not an overall increase in the amount of moisture that fell, then that which did was more effective than it is now. The presence of the eastern harvest mouse, the round-tailed water rat, the ground sloth, the tapir, and the giant armadillo would suggest that winters were not so cold as they are now.

The white-tailed prairie dog and the gopher, *Thomomys*, seem anomolous in the fauna. Perhaps these taxa represent relicts from the previous glacial stage, or the increased humidity in the area prevented the amount of dessication that we witness today. These two taxa were then able to live under the more equable conditions that must have existed.

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