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VERTEBRATE FOSSILS FROM LATE CENOZOIC DEPOSITS
OF CENTRAL KANSAS

By CLAUDE W. HIBBARD



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ABSTRACT

The paper reports on fossil mammals found in beds of McPherson County, central Kansas, interpreted as middle Pliocene and middle Pleistocene in age. The Pliocene deposits (Delmore) have yielded mastodon, horse, and rhinoceros remains. The middle Pleistocene (McPherson) beds contain a much more varied mammalian fauna, in which rodents, horse, and elephant remains are most prominent.

1. Curator of Fossil Vertebrates, University of Michigan, Museum of Paleontology. This report was written in 1945-46 in a cooperative study with the State Geological Survey of Kansas and the United States Geological Survey (WILLIAMS & LOHMAN, 1949).

INTRODUCTION

For the past fifty years the term "Equus beds" has been used in the literature for the fossiliferous deposits of gravel, sand, clay, silt and volcanic ash in the area surrounding McPherson, Kansas. Pleistocene age was assumed for these deposits, and both O. P. HAY (1925, p. 244) and OSBORN (1936, p. 373) assigned them to the Aftonian interglacial stage. Relatively few vertebrate fossils have been taken from this area. FRYE & HIBBARD (1941) have published a more complete history of the early paleontological work in this area, with references to the early literature.

STANLEY W. LOHMAN, JOHN C. FRYE, CHARLES C. WILLIAMS, and CLAUDE W. HIBBARD collected fossils while studying exposures in McPherson County in the fall of 1943. WILLIAMS and HIBBARD made further collections in the area in the spring and sum-

mer of 1944, and WILLIAMS, MANUEL MALDONADO-KOERDELL, and HIBBARD spent October 12-19 of the same year removing approximately one ton of matrix to the University of Kansas Museum of Natural History for further study. More specimens were recovered on July 10, 1945, by GLEN C. RINKER, RICHARD RINKER, RUSSELL CAMP, and HIBBARD. We are greatly indebted to R. E. MOHLER, McPherson College; EMIL O. DEERE, Bethany College, Lindsborg; H. ERNEST CROW, Friends University, Wichita; and W. A. VER WIEBE, University of Wichita, for the privilege of studying additional collections of vertebrate fossils from this area and for permission to publish upon them. The collections of fossils mentioned above form the basis of this report.

The drawings were made by MARY FRANCES NEIDIG and ILLA MAE JUNOD.

VERTEBRATE FOSSILS FROM THE DELMORE FORMATION

The vertebrate fossils reported by FRYE & HIBBARD (1941) as having been taken from the "Emma Creek formation," were collected in part from the Delmore formation and in part from the younger McPherson formation.

On the basis of the horses, which have been examined by R. A. STIRTON, University of California, the fossils from the Delmore are of the same age as vertebrates taken from Pliocene deposits near Higgins, Texas, and are either latest Clarendonian or earliest Hemphillian (WOOD *et al.*, 1941). Following is a systematic account of the vertebrate fossils collected from the Delmore formation (WILLIAMS & LOHMAN, 1949, p. 57).

Amebelodon cf. *fricki* BARBOUR

Amebelodon fricki BARBOUR, 1927, Nebraska State Museum, Bull. 13, vol. 1, pp. 131-134.

The lower jaws and vertebrae (No. 19, McPherson College Museum) of a shovel-tusked mastodon, reported by R. E. MOHLER (1938), were taken from approximately the middle of sec. 31, T. 18 S., R. 1 W., on the Richard Ganson farm, northwest of Canton, Kansas.

A right M³, KUMNH (Kansas University Museum of Natural History) no. 6893 was found by T. H. KINKERMAN in a sand pit on his farm near the center of sec. 30, T. 18 S., R. 1 W. The tooth has an over-all length of 217 mm. and a greatest width of 87.5 mm. (across the third ridge from the anterior end of the tooth). The tooth consists of five well-developed ridges and a prominent heel or sixth ridge. The trefoil pattern is developed on the inner crests of the transverse ridges and is present also on the third and fourth outer crests. The first and second crests are so much worn that their patterns

are no longer present, but it is evident that a trefoil pattern existed on the second outer crest. The tooth would have possessed, in part, a double trefoil pattern.

Tetralophodon elegans (HAY)

Gomphotherium elegans HAY, 1917, Univ. Texas, Bull. 71, pp. 21-22.

Anancus mirificus HAY, 1924, Carnegie Inst. Wash., no. 322a, p. 16.

Tetralophodon elegans OSBORN, 1936, *Proboscidea*, Am. Mus. Press, vol. 1, pp. 372-373.

The only specimen of this form known to date is the type, a lower left third molar, USNM (United States National Museum) no. 8253. HAY (1917) gave the type locality as sec. 34, T. 19 S., R. 3 W., McPherson County, Kansas, and described the specimen as having been taken at a depth of 35 feet in a sand pit. The sand pit occurs in the northwest quarter of the section.

Examination of the type fails to reveal any character permitting separation of it from the corresponding tooth of *Amebelodon*. OSBORN considered the presence of double trefoils in the type molar, the size of the specimen, and the number of ridges as diagnostic of *Tetralophodon*. He (OSBORN, 1936, p. 333) gave as one of the characters of the subfamily Amebelodontinae the presence of brachyodont grinding teeth having single trefoils, yet (p. 335) indicated that large molars having double trefoils are characteristic of *Amebelodon*. Apparently the only reliable character for distinction of the two genera is development of the lower tusks. The specimen of *Amebelodon* taken from this area is larger than usual (BARBOUR & HIBBARD, 1941, p. 43). In the University of Kansas collection are both upper and lower teeth identified as *Ame-*

belodon with 5½ or 6 ridges having double trefoil patterns. *Tetralophodon elegans* (HAY) probably should be assigned to *Amebelodon*.

The sand pit has not been worked for years and is slumped and covered by vegetation; hence the material from which the tooth was taken cannot be studied, but the exposed upper part of the deposit appears to belong to the McPherson formation.

Mastodon, genus indet.

A mastodon tooth (KUMNH no. 7557) was taken from a sand and gravel pit at the middle of the NW¼ sec. 26, T. 21 S., R. 2 W. in about 1924 by E. P. SCHOWALTER, who has kindly donated it to the University of Kansas. The tooth is a second molar.

Neohipparion cf. *eurystyle* (COPE)

Figure 1, A-D

Equus eurystylus COPE, 1893, Texas Geol. Survey 4th Ann. Rept., pp. 43-46.
Neohipparion eurystyle MATTHEW, 1909, U. S. Geol. Survey, Bull. 361, p. 117.

A number of isolated horse teeth were found weathered out of the Delmore formation. Some are referred to the above form. Upper molars (KUMNH nos. 6871, 6874, 6875, 6915) were taken in the NE¼ sec. 31, T. 18 S., R. 1 W. Also referred to the *N. eurystyle* group are eight lower molars (KUMNH nos. 6917, 6918, 6921) from the W½ sec. 31, T. 18 S., R. 1 W. A number of these teeth were found by LESTER PHILLIS, of Canton, Kansas.

Nannippus sp.

Figures 2; 14, C

Belonging to this genus are two toe bones (KUMNH nos. 6870, 6876), a lower molar (KUMNH no. 6872), and an upper molar (KUMNH no. 6869), which were taken from the sand pit of T. H. KINKERMAN in the SE¼ sec. 30, T. 18 S., R. 1 W.

A lower molar (KUMNH no. 7039) of *Nannippus* sp. (Fig. 2) was taken on July 7, 1945, from a sand and gravel pit at the middle of the NW¼ sec. 26, T. 21 S., R. 2 W. This gravel pit is now used for the city dump of Moundridge. The characters of the tooth are not so advanced as those of the teeth of *Nannippus phlegon* (HAY). The material from which this tooth was taken resembles the older McPherson deposits, but the age of the beds is uncertain.

Pliohippus sp.

Figure 3

An upper molar (KUMNH no. 6914) of a *Pliohippus* was taken from the bank of a pit silo in the SE¼ sec. 9, T. 19 S., R. 1 W.

It is impossible to know definitely which species of horses inhabited the area during the part of late Cenozoic time represented by this deposit until more complete specimens are found.

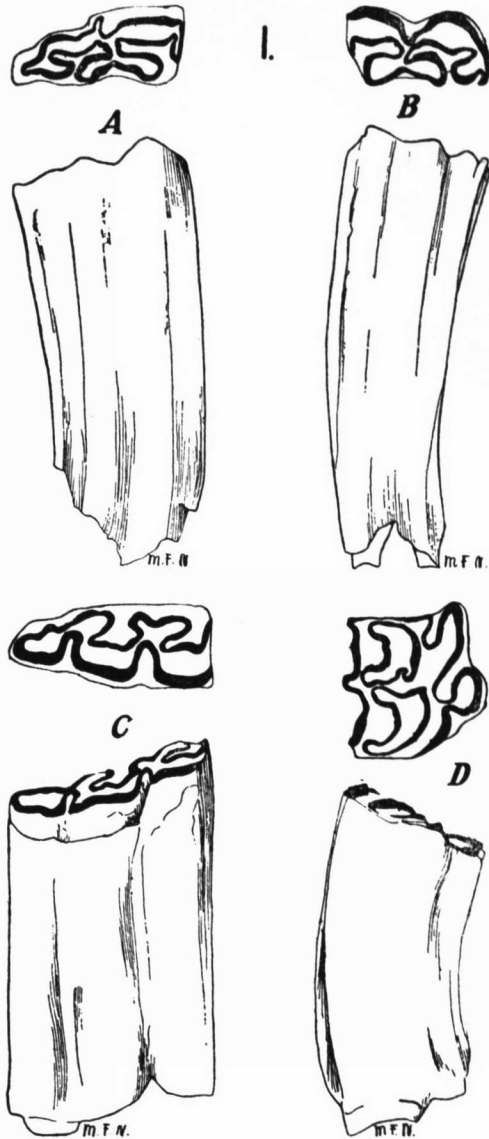


FIGURE 1.—*Neohipparion* cf. *eurystyle* (COPE), KUMNH specimens. (A) Left M₃ no. 6917a; (B) right molar, no. 6918; (C) right M₃ (lateral and occlusal views), no. 6917; (D) left molar (lateral and occlusal views), no. 6915. All figures are × 1.

Teleoceras cf. *fossiger* (COPE)

Figure 4

Aphelops fossiger COPE, 1878, U. S. Geol. Geog. Survey Terr., Bull., p. 382.
Teleoceras fossiger OSBORN, 1898, Am. Mus. Nat. Hist., Bull., vol. 10, p. 521.

A tibia-fibula (KUMNH no. 6877) of a short-legged rhinoceros probably referable to *T. fossiger* was found in the road ditch at the northeast corner of NE¼ sec. 34, T. 18 S., R. 2 W.

VERTEBRATE FOSSILS FROM THE MCPHERSON FORMATION

All Pleistocene deposits in the McPherson area are included in the McPherson formation, and in this area no upper Pliocene deposits have been recognized. The upper part of the Emma Creek was referred by FRYE & HIBBARD (1941, pp. 277-278) to the upper Pliocene because of the remains of *Equus (Plesippus)* cf. *simplicidens* COPE, but this assignment of age is dubious because this horse not only occurs in deposits of Blancan age but also in beds of younger age (Meade formation). Other reasons for considering these deposits as a part of the McPherson formation have been discussed by WILLIAMS & LOHMAN (1949, p. 59).

Near the base of the McPherson formation, scattered deposits of volcanic ash occur. No productive fossil zone has been found below the ash, as is present in Meade, Clark and Lincoln Counties, Kansas. We think this ash is equivalent to the Pearlette ash.

UDDEN (1891, pp. 340-345) discussed the presence of volcanic ash in the McPherson area and was able to view a number of localities where the ash was in contact with the underlying beds. Because of slumping and erosion since that time, we were unable to locate these exposures. UDDEN's interpretation of the age of the volcanic ash was based on its topographic position.

The following remains of horse were taken below the ash: a lower molar (KUMNH no. 6929) of *Equus*, taken on May 13, 1944, by WILLIAMS and HIBBARD from the blue-gray silt below the volcanic ash near the middle of the E½ sec. 28, T. 18 S., R. 5 W.; a radius referred to *Equus (Plesippus)* cf. *simplicidens* COPE, collected by FRYE in 1939 from the blue-gray clay, in the SE¼ sec. 11, T. 18 S., R. 3 W.

Near the east line of the section in the northeast corner of the NE¼ sec. 14, T. 18 S., R. 3 W., is an extensive deposit of volcanic ash up to 4 feet in thickness, underlain by a blue-gray clay. A more recent Pleistocene channel of local origin cuts into or through this deposit. The channel was filled in Pleistocene time and is now dissected by the ditch along the east side of the road in the NW¼ sec. 13, T. 18 S., R. 3 W. This local deposit contains abundant vertebrate remains which seem to represent two distinct Pleistocene ages. Some of the fossils, which occur in a zone containing abraded pebbles of caliche, are judged to have been reworked from an older Pleistocene deposit. This local mixture of vertebrates is designated as the Kentucky assemblage, because the deposit containing the fossils crops out along a small tributary of Kentucky Creek.

KENTUCK ASSEMBLAGE

CLASS PISCES

Small vertebrae of fish, pectoral spines of catfish and spines of the dorsal fin of sunfish were recovered from the matrix.

CLASS AMPHIBIA

Remains of salamanders, frogs and toads were taken.

CLASS REPTILIA

Vertebrae of snakes are numerous in the deposit, and a few fragments of a turtle were found.

CLASS AVES

Two fragmentary bones of birds were found.

CLASS MAMMALIA

ORDER INSECTIVORA, FAMILY SORICIDAE

A fragmentary ramus (KUMNH no. 7344), with the roots of M_1 - M_3 present, of a small shrew of the genus *Sorex* was found.

ORDER CARNIVORA, FAMILY CANIDAE

An axis (KUMNH no. 7341) of a large wolf, probably *Aenocyon*, was taken from the top of the exposure. The bone is of the same light gray color as the caliche rubble with which it was found. The antero-posterior diameter of the axis from the tip of the dens to the posterior face of the centrum is 65.9 mm. The greatest width across the anterior articular faces of the axis is 36.9 mm.

ORDER CARNIVORA, FAMILY FELIDAE

Felis sp.

A left M_1 (KUMNH no. 7349) of a medium-sized cat was found. The antero-posterior diameter is 17 mm. The tooth is the size of the M_1 of *Felis lacustris* GAZIN, but the carnassial notch is completely closed, and a well-developed cingulum is present along the postero-labial margin of the tooth.

ORDER RODENTIA, FAMILY SCIURIDAE

Citellus sp.

Isolated teeth of the ground squirrel were found. To judge from their size, at least two kinds of squirrels are represented, a small squirrel and another twice as large.

ORDER RODENTIA, FAMILY GEOMYIDAE

Geomys sp.

Figure 5

A number of isolated incisors, premolars, molars, and parts of eight rami of the pocket gopher were taken. In one specimen (KUMNH no. 7346), the antero-posterior diameter of P_4-M_1 is 4.1 mm.

ORDER RODENTIA, FAMILY HETEROMYIDAE

Perognathus hispidus BAIRD

Figure 7

Perognathus hispidus BAIRD, 1857, Mammals North America, p. 421.

A left ramus with P_4-M_3 of a pocket mouse (KUMNH no. 7427), recovered from the deposit, is in-

distinguishable from the subspecies of *Perognathus hispidus* now living in Kansas. The antero-posterior diameter of P_4-M_3 is 4.15 mm.

ORDER RODENTIA, FAMILY CRICETIDAE

Peromyscus sp.

Figure 6

In the collection is the anterior part of a right ramus bearing M_1 of a *Peromyscus* (KUMNH no. 7385). The first lower molar differs from that of the type of *Peromyscus cragini* HIBBARD in that the anterior part of the tooth has a well-developed anterior groove. Also, anteriorly the tooth is wider. An accessory cusplet (mesostylid of GOLDMAN, 1918, p. 11) is present between the metaconid and entoconid. The antero-posterior diameter of M_1 is 1.5 mm. The greatest width of the tooth is 0.9 mm.

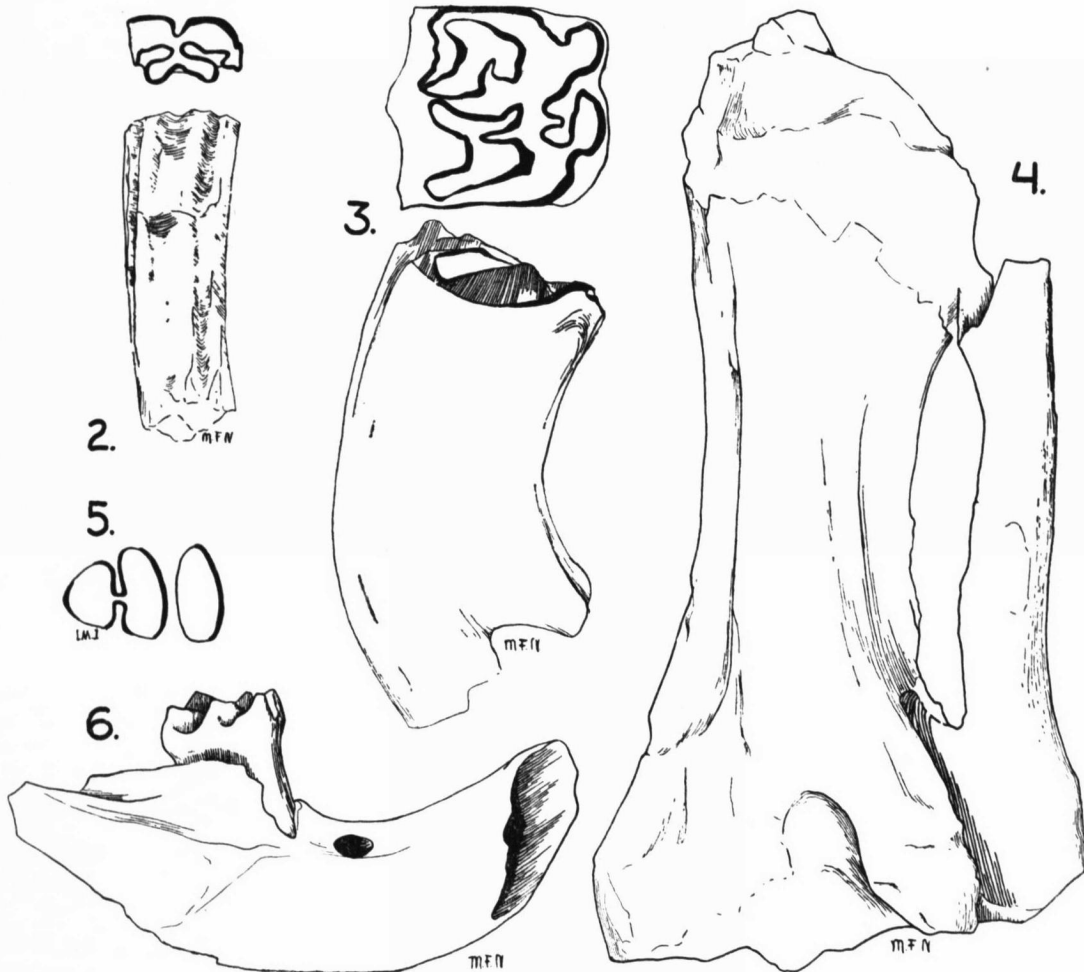


FIGURE 2.—*Nannippus* sp. Right molar, lingual and occlusal views, $\times 1$; KUMNH no. 7039.
 FIGURE 3.—*Pliohippus* sp. Upper left molar, lateral and occlusal views, $\times 1$; KUMNH no. 6914.
 FIGURE 4.—*Teleoceras* cf. *fossiger* (COPE). Tibia-fibula, $\times 0.5$; KUMNH no. 6877.
 FIGURE 5.—*Geomys* sp. Left P_4-M_1 , occlusal view, $\times 5$; KUMNH no. 7346.
 FIGURE 6.—*Peromyscus* sp. Part of right ramus and M_1 , labial view, $\times 10$; KUMNH no. 7385.

Sigmodon cf. hispidus SAY & ORD

Figure 8

Sigmodon hispidus SAY & ORD, 1825, Jour. Acad. Nat. Sci., Phila., vol. 4, pt. 2, p. 354.

Part of a right ramus (KUMNH no. 7361) with M_1 - M_3 of a cotton-rat, slightly smaller than *Sigmodon hispidus texianus* (AUDUBON & BACHMAN),

was found on October 19, 1944. The internal and external re-entrant angles of the molar teeth are wider than in the recent subspecies of *Sigmodon* occurring in Kansas, and relative to their length antero-posteriorly the teeth are narrower. Number 7361 is larger than *Sigmodon hilli* HIBBARD which is known from the Pleistocene of Kansas.

Judging from the wear of the molar teeth, the

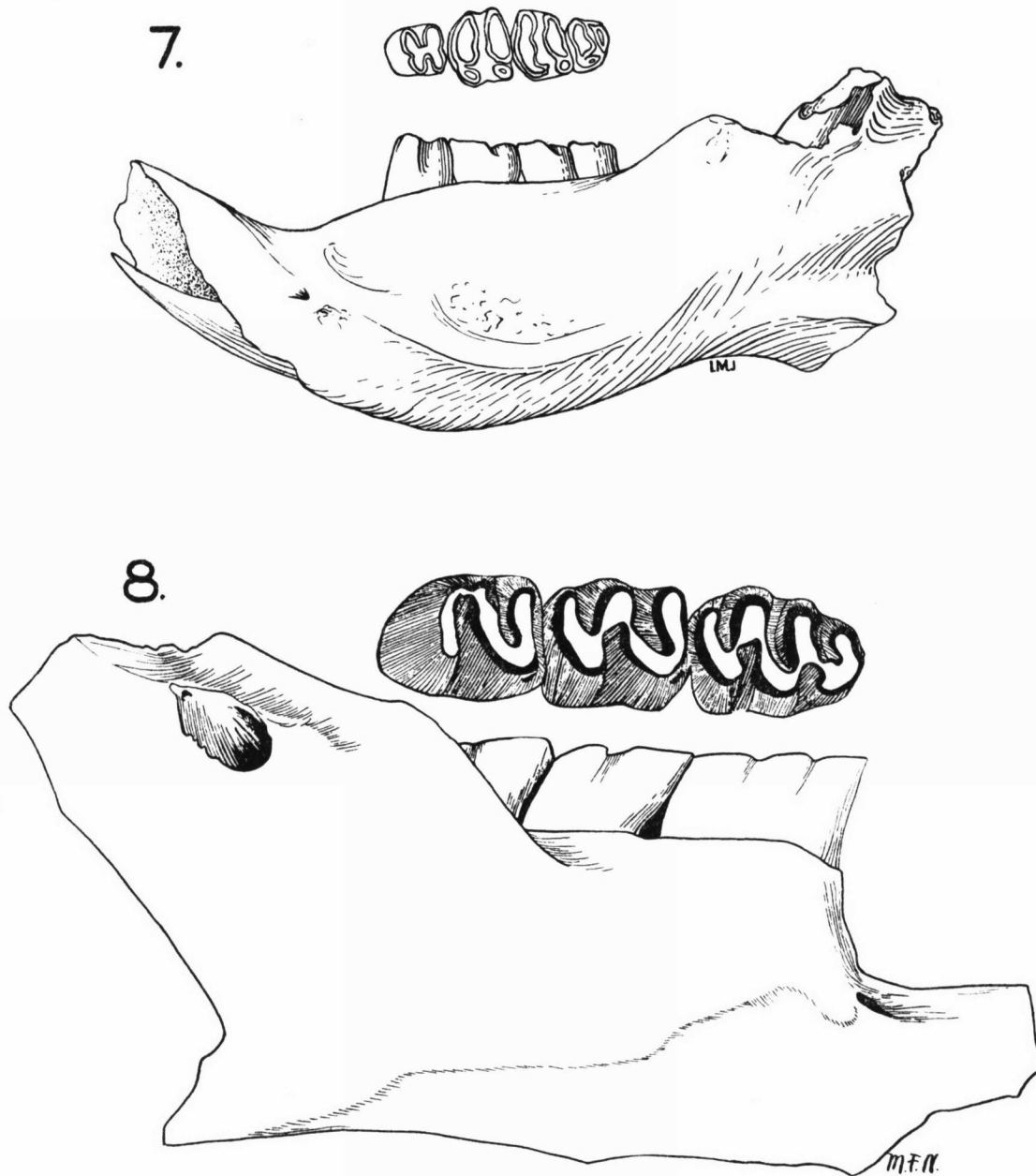


FIGURE 7.—*Perognathus hispidus* BAIRD. Left ramus, with P_4 - M_3 , labial and occlusal views, $\times 8$; KUMNH no. 7427.

FIGURE 8.—*Sigmodon cf. hispidus* SAY & ORD. Right ramus, labial and occlusal views, $\times 8$; KUMNH no. 7361.

right ramus is that of a young adult. In crown view, the anterior loop of M_1 is connected to the remainder of the tooth by a tract of dentine. The internal and external re-entrant angles separating most of the anterior loop from the posterior part of the tooth are deep and broad, and the valleys are not compressed as in recent subspecies of *Sigmodon hispidus*. The first internal fold anterior to the posterior loop lies perpendicular to the antero-posterior axis of the tooth. The third fold or second internal fold lies more nearly perpendicular to the antero-posterior axis of the tooth than it does in specimens of *S. hispidus* examined. The second internal fold in *S. hispidus* was oblique to the axis of the tooth, with the fold directed posteriorly.

Enamel pits are present on the labial side of the anterior loop of M_2 and M_3 . The crowns of the teeth have not worn down to the level of these enamel pits.

The internal part of the anterior loop of M_2 does not extend lingually as far as the internal enamel loop. Therefore, both the anterior and posterior loops of M_2 lie slightly labially to the internal enamel fold. The lingual part of the anterior fold of M_3 does not extend as far lingually as the rest of the tooth. The posterior loop of M_3 is narrower and more compressed than the posterior loops observed in specimens of *Sigmodon hispidus*. The valleys between both the external and internal re-entrant angles are broader and deeper than those examined in the subspecies of *S. hispidus*.

A groove lies between the alveolar border and the anterior margin of the coronoid process. This groove was not observed in recent forms. The mental foramen is situated anterior and slightly lingual to the anterior root of M_1 .

The antero-posterior diameter of the M_1 - M_3 series is 6.5 mm. The antero-posterior diameter of the cheek-tooth series of the type of *Sigmodon intermedius* HIBBARD (KUMNH no. 3887) from the Rexroad faunule of Meade County, Kansas, is 5.5 mm. The antero-posterior diameter of M_1 - M_3 of the type of *S. hilli* HIBBARD (KUMNH no. 5431) from the Borchers faunule of Meade County, Kansas, is only 5.25 mm. The isolated ramus (KUMNH no. 7361) of a young adult is referred to *S. hispidus*, to which it shows the closest relationship.

Neotoma or Parahodomys sp.

Four isolated molars (No. 7359) were recovered from the deposit. Two of the teeth are similar to the teeth of *Parahodomys* obtained from the Borchers deposit in Meade County, Kansas.

Synaptomys (Mictomys) kansasensis HIBBARD, n. sp.

Figure 9, A-D

Holotype.—KUMNH no. 7425, part of right ramus bearing incisor, M_1 - M_3 , taken by HIBBARD and party, July 10, 1945. Paratypes, KUMNH no.

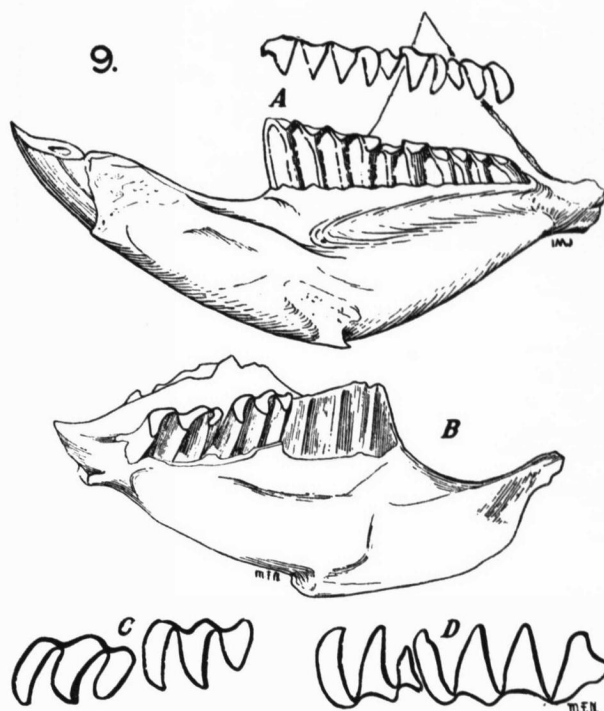


FIGURE 9.—*Synaptomys (Mictomys) kansasensis* HIBBARD, n. sp., KUMNH specimens. (A) Holotype, right ramus, lingual and occlusal views, no. 7425, $\times 4.9$. (B) Lingual view of left ramus, with M_2 - M_3 , no. 7365, $\times 4.9$. (C) Left M_2 - M_3 , occlusal view, no. 7365, $\times 8.2$. (D) Right M_1 and M_2 , occlusal view, no. 7370, $\times 8.2$.

7365, part of left ramus bearing M_2 and M_3 ; no. 7366, nearly complete right ramus without teeth; no. 7378, right ramus bearing M_1 and M_2 ; no. 7369, right ramus bearing M_1 , M_2 , and part of M_3 ; no. 7370, right ramus bearing M_1 and M_2 ; no. 7374, part of left ramus bearing M_1 ; no. 7375, part of left ramus bearing M_1 ; no. 7376, part of left ramus bearing M_1 and M_2 . These paratypes were collected on July 9, 1944, by WILLIAMS and HIBBARD and on October 19, 1944, by WILLIAMS, MALDONADO, and HIBBARD.

Geologic age and type locality.—Pleistocene, McPherson County, Kansas, NW $\frac{1}{4}$ sec. 13, T. 18 S., R. 3 W.

Diagnosis.—A member of the subgenus *Mictomys* having the size of *Synaptomys (Mictomys) borealis sphagnicola* PREBLE. Lower incisor extends in a well-rounded capsular process to posterior edge of M_3 ; lower molars have a greater transverse width than in *S. b. sphagnicola*; ramus between alveolar border of M_2 and M_3 and coronoid process not pitted along labial side of M_3 , as in *S. borealis*. A shallow pit is present labial to posterior loop of M_3 ; the pit "drops off" vertically immediately posterior to M_3 , as in *S. cooperi gossii* (Coues).

Description of holotype.—A part of the coronoid process, the tip of the ascending ramus, and the

angle are missing. The ramus is heavier than that of *Synaptomys borealis*, and the masseteric ridge is better developed and extends farther posteriorly. The ventral surface of the ramus is broad and the flattened part extends farther posteriorly than in *S. cooperi*. The dental pattern has completely closed triangles, and is typical of that of *Mictomys* except that, in proportion to their antero-posterior diameter, the molars are wider than in recent forms of *Mictomys*.

The mental foramen is situated as in *Synaptomys borealis*. A distinguishing character of the specimen is the well-developed capsular process of the incisor, which is rounded and extends to the posterior edge of M_3 , a condition not observed in *S. borealis*, whose capsular process generally ends at the posterior edge of M_2 , although in a few forms it was observed to end at the edge of the anterior loop of M_3 . Also, the labial and lingual sides of M_3 are not covered by a thin layer of bone, as in *S. borealis*, because the capsular process on the lingual side covers this side of M_3 and no pit is developed on the labial side of M_3 . The antero-posterior diameter of M_1 - M_3 , measured at the alveolar border, is 6.6 mm.

Discussion.—The characters of the paratypes are the same as those of the type. No variant tooth patterns were observed. Thirty-five right lower first molars and many other teeth were recovered. The alveolar length of M_1 - M_3 of specimen KUMNH no. 7365 is 6.75 mm., of no. 7366, 6.7 mm., and of no. 7369, 6.8 mm.

Synaptomys (Mictomys) kansasensis is distinct from *S. (M.) borealis* reported by HIBBARD (1944, pp. 726-727) from the Cudahy fauna, in which specimens are slightly smaller than *S. kansasensis* and the capsular process of the incisor extends only to the anterior edge of M_3 .

In many respects the ramus of *Synaptomys kansasensis* resembles that of *S. cooperi* instead of that of *S. borealis* in that the ramus is heavier, flatter, and broader ventrally than in *S. borealis*. A well-developed and rounded capsular process extends posteriorly to the posterior edge of M_3 although not beyond M_3 as in *S. cooperi*; and the development of the ramus between M_2 and M_3 , and the coronoid process, resembles that of *S. cooperi*, although the ramus is not so deeply grooved or pierced by so many foramina between M_2 - M_3 and the ascending process.

Synaptomys (Mictomys) kansasensis appears to be more specialized than *S. borealis* in the development of the elongated incisor and its capsular process.

Microtus (Pedomys) llanensis HIBBARD

Figure 10

Microtus llanensis HIBBARD, 1944, Geol. Soc. America, Bull., vol. 55, pp. 729-730, fig. 12.

Three right rami (KUMNH nos. 7380, 7381, 7382)

all bearing M_1 - M_2 , a left ramus (no. 7351) bearing M_1 - M_2 , and 28 right first lower molars are referred to the above species. They differ from the type of *M. llanensis* in that the dentition has a slightly greater transverse width. The lesser breadth of the type, however, appears to be due to weathering. Also, M_1 of the type has a narrower anterior loop although it is nearly identical with the anterior loop of M_1 of no. 7380. The pit opposite M_3 appears deeper in these specimens than in that of the type. The one character that separates the type and the above specimens from recent species of *Pedomys* and *Pitymys* is the development of the anterior loop of M_1 , which is simple and continuous with the fourth and fifth confluent triangles. In the recent specimens of *Pedomys*, anterior to the fourth and fifth triangles, there are rudimentary sixth and seventh triangles which open into the anterior loop. There is no evidence of a sixth and seventh triangle in the fossil specimens. The antero-posterior diameters of M_1 and M_2 of the four fossil specimens are as follows: no. 7380, 4.8 mm.; no. 7382, 5.15 mm.; no. 7381, 4.7 mm.; and no. 7351, 4.4 mm.

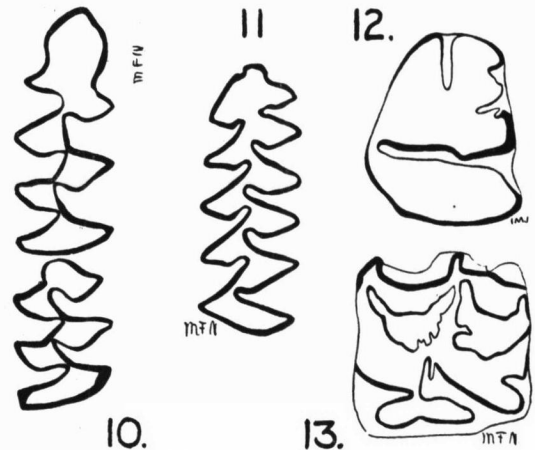


FIGURE 10.—*Microtus (Pedomys) llanensis* HIBBARD. Right M_1 - M_2 , occlusal view, $\times 10$, KUMNH no. 7382.

FIGURE 11.—*Ondatra kansasensis* HIBBARD. Left M_1 , occlusal view, $\times 6$, KUMNH no. 7350.

FIGURE 12.—*Lepus cf. americanus* ERKLEBEN. Right P_3 , occlusal view, $\times 6$, KUMNH no. 7348.

FIGURE 13.—*Equus cf. francisci* HAY. Upper left molar, occlusal view, $\times 1$, McPherson College no. 7.

Ondatra kansasensis HIBBARD

Figure 11

Ondatra kansasensis HIBBARD, 1944, Geol. Soc. America, Bull., vol. 55, pp. 732-734, fig. 14.

Four isolated teeth (KUMNH no. 7350) of a small muskrat from the deposit are referred to *Ondatra kansasensis*. One of the teeth, a left M_1 of an adult specimen, has an antero-posterior diameter of 5.9 mm. compared with 5.4 mm. for the type of *O. kansasensis*.

ORDER LAGOMORPHA, FAMILY LEPORIDAE

Lepus cf. *americanus* ERXLBEN

Figure 12

Lepus americanus ERXLBEN, 1777, Syst. Regni. Anim., vol. 1, p. 330.

Among the fossils recovered are four teeth (KU MNH no. 7348) of a hare. A right P₃ is referred to *Lepus americanus*. The general shape of the tooth is the same as that of the varying hare or snowshoe rabbit. The enamel of the posterior external re-entrant angle is smooth and not crenulated as in *L. californicus* GRAY, nor is the anterior part of the tooth narrow as in *L. townsendii campanius* HOLLISTER. The tooth has an antero-posterior diameter of 3.7 mm. and a transverse width of 3.0 mm.

ORDER PROBOSCIDEA

Fragments of a mastodon tooth were recovered from the caliche rubble.

ORDER PERISSODACTYLA, FAMILY EQUIDAE

Equus sp.

Part of a lower tooth (KUMNH no. 7342) of a large horse was associated with the fragments of the mastodon tooth.

ORDER ARTIODACTYLA, FAMILY CAMELIDAE

A calcaneum of a camel as large as *Gigantocamelus* BARBOUR & SHULTZ was taken from the deposit.

DISCUSSION OF THE KENTUCK ASSEMBLAGE

The Kentucky assemblage of vertebrates cannot be correlated with any known Pleistocene fauna or faunule from Kansas.

The occurrence of *Perognathus hispidus*, and

especially of *Sigmodon* cf. *hispidus*, with large numbers of *Mictomys* at once raises a question as to probability of the mixing of fossils of two different Pleistocene ages. The rami of *Sigmodon* and *Perognathus* exhibit a different type of fossilization than those of *Synaptomys* and *Microtus*. The former two are light gray and paler than the latter two kinds. *Mictomys* previously has been found only below the Pearlette ash in Kansas, in association with a glacial fauna, whereas, above the ash in the Borchers faunule of Meade County, abundant remains of *Sigmodon hilli*, a species not so advanced as *Sigmodon* cf. *hispidus*, have been collected. *S. hilli* was found associated with numerous forms which apparently lived in that area during an interglacial age.

Therefore, it seems that the local stream deposit from which the specimens were taken is younger than the Borchers deposit and that a number of the forms recovered were reworked from a local older fossil-bearing deposit. Possibly the older Pleistocene bed into which this channel is cut may have been the source of some of the fossils, for example the *Mictomys*. Cretaceous shark teeth, reworked from nearby Cretaceous beds, were associated with these Pleistocene forms.

Mictomys probably occurred in Kansas during more than one glacial age. It is doubtful, however, that *Sigmodon* and *Mictomys* lived in the same environment. If they did live together, one or both of these genera possessed a greater tolerance to varying climatic conditions than they are known to have at present.

It must be remembered that in any region the change from a glacial fauna to an interglacial fauna and *vice versa* is gradual. During this gradual shifting of ranges there would be found, to some extent, intermingling of some glacial and interglacial forms. At present not enough is known of past climatic conditions in given areas or of the faunas to plot the ranges of Pleistocene species.

ADDITIONAL VERTEBRATES FROM THE McPHERSON FORMATION

ORDER EDENTATA

Megalonyx leidy LINDAHL

Megalonyx leidy LINDAHL, 1892, Am. Philos. Soc., Trans., vol. 17, pp. 1-10.

The type specimen is in the Bethany College Museum at Lindsborg, Kansas. The exact gravel pit from which it was taken is not known, but from the evidence gathered from the records, early settlers, and field observations, it is probable that the skull came from the old abandoned sand and gravel pit in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 18 S., R. 4 W. on the east side of a tributary to Sharps Creek. This is the only sand and gravel pit observed in the southwest corner of Harper Township that is overlain by a

rather extensive silt containing mollusks, and which fits the description and location of the type locality. No other remains of this sloth have been recognized from these deposits.

Paramylodon cf. *harlani* OWEN

Myiodon harlani OWEN, 1840, Zoology, Voyage H. M. S. Beagle, pt. 1, p. 68.

Paramylodon harlani KRAGLIEVICH, 1928, Physis, vol. 9, p. 196.

A caudal vertebra (McPherson College Museum, no. 50), taken December 29, 1924, from the Hammann gravel pit in NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 18 S., R. 4 W., was referred by H. H. NININGER (1928) to the above species.

ORDER CARNIVORA

Smilodon sp.

In the McPherson College Museum (no. 9) is the base of a skull of a saber-tooth cat which was taken from the above gravel pit.

ORDER PROBOSCIDEA

Mammut americanus (KERR)

Elephas americanus KERR, 1792, Anim. Kingdom, p. 116.
Mammut ohioiticum BLUMENBACH, 1799, Naturgeschichte, 6th ed., p. 698.

Mammut americanum HAY, 1902, U. S. Geol. Survey Bull. 179, p. 708.

A right M_3 (KUMNH no. 4929) of the American mastodon was taken by H. W. WINN in 1938 from a sand and gravel pit in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 12, T. 18 S., R. 5 W. The molar has an over-all length of 187.0 mm. The greatest width is across the second loph from the anterior end, which is 96.2 mm. The border of the tooth is smooth and not rugose. A molar of a Columbian mammoth taken from this pit was examined.

Mammuthus columbi (FALCONER)

Elephas (Eueleph.) Columbi FALCONER, 1857, Quart. Jour. Geol. Soc. London, vol. 13, table opposite p. 319.

Mammuthus columbi HOPWOOD, 1935, Pal. Sinica, ser. C, vol. 9, fasc. 3, pp. 11, 97.

In the McPherson College Museum are an upper molar (no. 65), a part of a tusk (no. 27) of the Columbian mammoth taken from the gravel pit in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 18 S., R. 4 W., and a tusk (no. 29) from center of west side of the W $\frac{1}{2}$ sec. 15, T. 18 S., R. 5 W. In the Bethany College Museum is a tooth (no. 871) that was taken from a sand pit near Marquette, Kansas.

Mammuthus cf. imperator (LEIDY)

Elephas imperator LEIDY, 1858, Acad. Nat. Sci. Phila., Proc., vol. 10, p. 10.

Mammuthus imperator SIMPSON, 1945, Am. Mus. Nat. Hist., Bull., vol. 85, p. 134.

Two lower third molars (McPherson College Museum, no. 48), which were taken 1 $\frac{1}{2}$ miles south of McPherson, and a tooth (Bethany College Museum, no. 896), which was taken approximately 10 miles west of Lindsborg, Kansas, are referred to the above form.

No specimens of the hairy mammoth were observed in the above collections from this area.

ORDER PERISSODACTYLA

Equus cf. francisci HAY

Figure 13

Equus francisci HAY, 1915, U. S. Nat. Mus., Proc., vol. 48, p. 566.

In the collection of vertebrate fossils at McPherson College is an upper left molar (no. 7) of a small horse collected from the Hammann gravel pit in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 18 S., R. 4 W. This appears to be the tooth reported by HARNLY (1934, p. 151) as *Equus leidy*.

This tooth is referred to *Equus francisci*. The greater width than length of the crown indicates that the tooth is probably the first upper molar.

Measurement of molar in millimeters

Height of tooth.....	50.4
Length of crown.....	22.5
Width of crown from enamel borders.....	23.7
Length of protocone.....	12.8

Equus scotti GIDLEY

Figure 14, B

Equus scotti GIDLEY, 1900, Am. Mus. Nat. Hist., Bull., vol. 13, art. 13, p. 111.

A left maxillary lacking M^3 (KUMNH no. 6878) of a young horse was collected on November 12, 1943, by WILLIAMS from near the base of a gravel pit in the SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 16, T. 18 S., R. 4 W., McPherson County, Kansas.

The dentition of this specimen compares well with that of *Equus scotti* from Rock Creek, Brisco County, Texas, except that the protocone is considerably longer and possesses a definite re-entrant angle along the lingual side. Because the specimen is from a young horse, the difference in the development of the protocone is probably only age difference and probably is within the range of individual variation.

This is one of the largest horses taken from the Pleistocene of Kansas. The crown of P^4 has not been worn down to its maximum size.

Measurements of teeth in millimeters (KUMNH no. 6878)

Length of premolar series.....	112.0
P^2 enamel length of crown.....	46.1
enamel width of crown (approximately).....	27.5
protocone.....	12.2
P^3 enamel length of crown.....	35.2
enamel width of crown.....	32.1
protocone.....	20.4
P^4 enamel length of crown.....	31.0
enamel width of crown.....	28.3
protocone.....	19.2
M^1 length of tooth.....	102.0
enamel length of crown.....	32.0
enamel width of crown.....	31.0
protocone.....	19.2
M^2 length of tooth.....	101.0
enamel length of crown.....	33.6
enamel width of crown.....	28.0
protocone.....	20.8

An upper molar (KUMNH no. 3197), which is referred to the above form, was taken in 1927 by GEORGE TEMPLIN from a gravel pit near Lindsborg, Kansas.

Equus niobrarensis HAY

Figure 14, A

Equus niobrarensis HAY, 1913, U. S. Nat. Mus., Proc., vol. 44, no. 1969, p. 576.

A study of the horse material from the McPherson formation has failed to reveal any upper molars that could be identified with those of *Equus complicatus* LEIDY. Because the types of the majority of species of Pleistocene horses have been based upon isolated upper molars or parts of the upper dentition, and because associated upper and lower dentitions have not been collected from these type localities, one hesitates to assign lower dentitions to any described species.

Most of the horse teeth collected from the McPherson formation pertain to medium-sized horses. The first medium-sized horse to be described from the Pleistocene of the High Plains was *Equus excelsus* LEIDY (1858) from Nebraska. Later, HAY described *Equus niobrarensis* (1913) and *Equus hatcheri* (1915), both species having been taken near Hay Springs, Nebraska. At present it seems that these three described species of horses are closely related if not identical. The only difference we can find in the study of the remains of the medium-sized horse from Kansas is that some teeth are simpler in pattern than other teeth showing the same degree of wear. Whether these two types of teeth belong to two species is not known, as this difference may result from individual variation.

In the McPherson College collection there is a right lower jaw (no. 42) from the Hammann sand and gravel pit, NW¼ SW¼ sec. 31, T. 18 S., R. 4 W., which has a tooth pattern almost identical with that of the type of *Equus niobrarensis* HAY (USNM no. 4999). The other isolated upper and lower teeth of the medium-sized horse from the McPherson formation also correspond in tooth pattern to *Equus niobrarensis*, and for that reason this material is assigned to *E. niobrarensis*.

Measurements in millimeters of *Equus niobrarensis* HAY

	McPherson specimen (no. 42)	Type, USNM no. 4999 (measurements after HAY)
Length of premolar-molar series,	181.0	180.0
Length of premolar series.....	95.0	94.0
Length of molar series.....	86.0	84.0
P ₂ length of crown.....	36.0	35.0
width of crown.....	17.3	15.0
P ₃ length of crown.....	30.6	28.0
width of crown.....	18.0	16.0
P ₄ length of crown.....	30.6	30.0
width of crown.....	18.3	16.0
M ₁ length of crown.....	28.0	27.5
width of crown.....	16.3	14.0
M ₂ length of crown.....	28.2	27.0
width of crown.....	16.7	13.5
M ₃ length of crown.....	30.8	30.0
width of crown.....	12.6	13.0

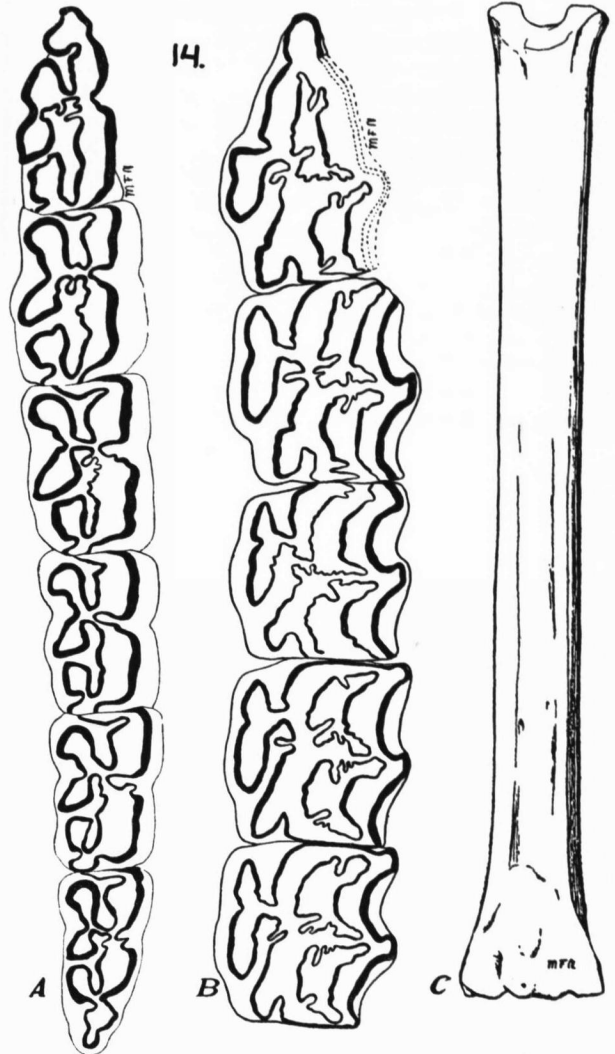


FIGURE 14.—Fossil horse remains from McPherson County, Kansas. (A) *Equus niobrarensis* HAY. Right ramus, P₂-M₃, occlusal view, McPherson College no. 42, × 0.8. (B) *Equus scotti* GIDLEY. Left maxillary, P₂-M₂, occlusal view, KUMNH no. 6878, × 0.8. (C) *Nannippus* sp. Metapodial, KUMNH no. 6870, × 0.8. Size approximate.

A right lower and a left upper molar (KUMNH no. 6685) of this horse were taken by C. R. THACH from a gravel pit at the northwest corner of sec. 5, T. 24 S., R. 3 W.

Fragmentary remains of a camel (McPherson College Museum no. 52), were found with the other fossils in the Hammann pit.

There are three sand and gravel pits on the Lewis W. Hammann farm, and they were carefully studied in trying to locate the type locality of *Megalonyx leidy* LINDAHL. The material in all three pits is of the same age and is part of the same stream deposit; the pits occur in the S¼ of sec. 31, in Harper

Township. The pit in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 18 S., R. 4 W., from which the fossils in the McPherson College Museum were taken, is on the west side of a tributary to Sharps Creek and was the last of the three pits to be opened and worked. The pit in the NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 31, T. 18 S., R. 4 W., is immediately north of an old cemetery. Fragments of horse teeth were observed here but there is no record of specimens having been taken from this pit.

There is an old abandoned pit in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 31, T. 18 S., R. 4 W., on the east side of the tributary of Sharps Creek and just southwest of the cemetery. Immediately south of this pit across the section line in sec. 6, T. 19 S., R. 4 W., is an old pit known as the Bighorn sand and gravel pit. No fossils were taken from this pit.

Discussion.—The sand and gravel deposits in S $\frac{1}{2}$ sec. 31, T. 18 S., R. 4 W. were traced to the Smoky Hill River and westward to Ellsworth County where

they were observed to be comparable to those of the intermediate terrace reported by FRYE, LEONARD, & HIBBARD (1943). In a road cut along the north side of the NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 16, T. 17 S., R. 5 W., is a deposit of sand and gravel of the intermediate terrace containing blocks of reworked volcanic ash (WILLIAMS & LOHMAN, 1949, p. 61, pl. 15B), which is also evidence that the sand and gravel deposits of this age are younger than the volcanic ash. From a study of the ash in McPherson County we find no reason for doubting it to be the same age as Cragin's Pearlette ash in Meade County. Without question, some of the ash in McPherson County has been involved in the formation of sinks, which would account for dipping beds, as well as for beds of lower elevation and the reworking of the original ash deposits. We observed no ash deposit in the McPherson area that we consider as a later fall or of younger deposition, unless it was reworked.

VERTEBRATES FROM THE ALLUVIUM

Bison bison remains have been observed in the alluvium along the streams.

In about 1932, BERNARD LAUTERBACH pumped a human skull (KUMNH no. 7479) from a depth of 20 feet from a sand pit north of Mount Hope, on the south bank of the Arkansas River, in the SW $\frac{1}{4}$ NW $\frac{1}{4}$

sec. 9, T. 25 S., R. 3 W., Sedgwick County, Kansas. Mr. LAUTERBACH donated the skull to the University of Kansas Museum of Natural History. The skull has been loaned for study to H. L. SHAPIRO, Curator of Physical Anthropology at the American Museum.

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