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UPPER PLIOCENE VERTEBRATES FROM KEEFE CANYON, MEADE COUNTY, KANSAS

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ABSTRACT

A late Pliocene artesian spring basin in Meade County, Kansas, was a trap for animals that came to the spring for water. They were either trapped by quicksand or became mired in the bog area around the edge of the spring. Some of the larger mammals that inhabited the region at the time the Rexroad fauna lived were recovered from this deposit. The following forms new to the Rexroad fauna were recovered from the Keefe Canyon deposit: ?*Megalonyx* sp.; *Dipoides rexroadensis* sp. nov.; *Martes foxi* sp. nov.; *Platygonus bicalcaratus* Cope; *Gigantocamelus spatulus* (Cope); *Pliauchenia cochrani* sp. nov.; and *Tanupolama blancoensis* Meade.

INTRODUCTION AND ACKNOWLEDGMENTS

The Rexroad fauna of Meade County, Kansas, is one of the better known late Cenozoic faunas of the High Plains region. To date, most of the forms recovered have been smaller animals. Previously only fragmentary evidence was at hand to indicate the presence of some of the larger mammals that were associated with the smaller forms.

In the fall of 1943, while Thad McLaughlin, Henry Firner, Elmer S. Riggs, and Claude W. Hibbard were searching the Guy Fox pasture for possible vertebrate remains, Riggs discovered a bone deposit which consisted chiefly of the remains of large mammals. The fossil deposit was found in Keefe Canyon, SW$\frac{1}{4}$ SW$\frac{1}{4}$ sec. 34, T.34 S., R. 30 W., Meade County, Kansas. The deposit was opened and worked during September and October. It was worked in 1944 from July 21 to September 20 by Hibbard, Riggs, and Dick Rinker. In 1945 the deposit was worked from July 23 to August 25 by Hibbard, Riggs, Rinker, Russell Camp, Manuel Maldonado, Dr. W. J. Baumgartner, and Dr. G. C. Rinker.

The specimens recovered were prepared for study by E. S. Riggs. The larger specimens were figured and checked under his direction and drawings were made by John Conard Hansen and Virginia L. Cassell. Drawings of the small forms were made by Frances Neidig and W. C. Sherman.

The deposit containing the fossils in Keefe Canyon was an old artesian spring basin. The present stream dissected the deposit and at least one-half of it and the overflow area of the basin had been removed by erosion (Pl. 1, fig. 1). At the time the spring was active, the area was apparently rather flat. Whether the underlying sands and gravels of the Rexroad formation formed the aquifer is not known.

At the Keefe Canyon quarry the vertical tube allowing the escape of the artesian water was approximately 30 inches in diameter and was developed in the underlying silt beds. The tube contained very fine sand, dominantly flour sand. The opening of the tube expanded broadly into the basin created by the flow. Concavities occurred in the walls of the silt near the mouth of the tube. Coarse sands, many small bone fragments, and horse teeth were lodged in these. This material had been churned by the artesian waters to become highly polished, and some were badly broken. Sometimes as much as half a gallon of fine bone fragments, mixed with highly polished enamel fragments of teeth, were encountered with some coarse sand. When a pocket like the one described above was encountered there was certain to be one or two horse teeth in it that had acted as millstones in breaking down the more fragile material. It was from the pockets of coarse sand and ground bone that the jaws and teeth of the small vertebrates were recovered.

The floor of the basin consisted of fine white flour sand overlying reddish silt. The maximum thickness of the sand was approximately 3 feet, rapidly thinning laterally to the edge of the basin. The part excavated was approximately a half circle with a 16-foot diameter. The sand tube of the spring was only 2 feet from the present stream bank. It may be estimated that about one-half of the deposit had been destroyed by erosion. The bone deposit was a conglomeration of disassociated, churned, broken, polished, and ground fragments matted with the complete material recovered (Pl. 2, figs. 1, 2). Parts of at least 2 mastodons, 21 giant camels, 15 smaller camels, numerous peccaries, a number of zebras, a giant dog, and a sloth were

FIGURE 1. QUARRY TO THE EXTREME LEFT
Meade Gravels near top of canyon wall.

FIGURE 2. BONE DEPOSIT AT BASE OF QUARRY
Note thickening of caliche to the left.

KEEFE CANYON, MEADE COUNTY, KANSAS

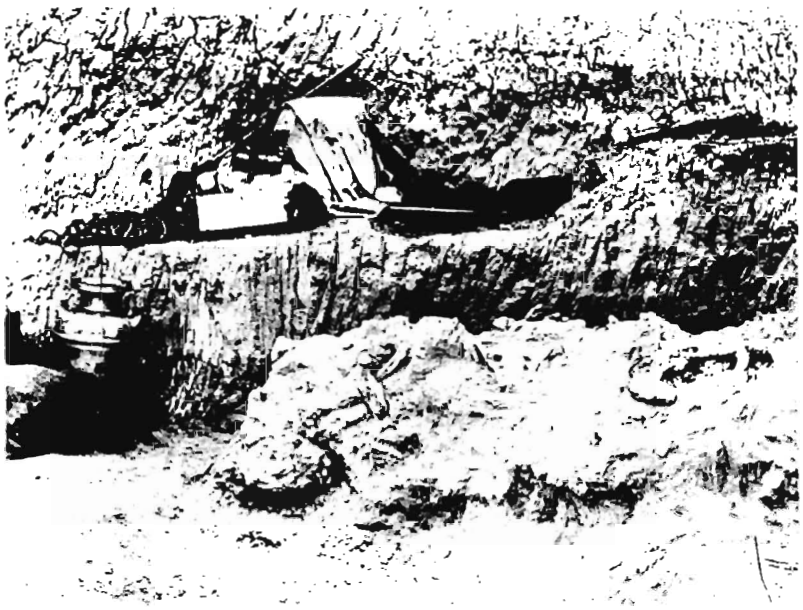


FIGURE 1. FLOUR SAND FROM ARTESIAN SPRING CONTAINING FOSSILS

FIGURE 2. CLOSE-UP VIEW OF A CHURNED MASS OF BONES

KEEFE CANYON QUARRY, MEADE COUNTY, KANSAS

found besides the fragmentary remains of birds and smaller mammals. Only 2 large pebbles were found in the deposit. The bones and the large teeth acted as grinding agents in the churning sand and water. The flour sand was covered by a layer of clay from 1 to 3 inches in thickness, blue gray to green gray. The clay thinned laterally into the sandy silt. Above the band of nearly pure clay was a zone of silty clay grading upward into a reddish sandy silt containing caliche. At the edge of the basin, reworked silty clay was mixed with many bone fragments and some plant material. The area around the artesian spring appears to have been a great deal like the bog areas around the present artesian springs along Crooked Creek Valley. Obviously the animals were mired in the bog or quicksand when they came to the pool for water. Around the edge of the spring skeletons were trampled and broken over a long period of time by animals which either watered there or became mired themselves. There was evidence that the bones along the edge of the basin were exposed to weathering, which probably helped to fracture them since they were not deeply buried. The bones recovered from the flour sand are white; all material in the silt and clay proper are reddish brown to dark brown as though they were stained under bog conditions. No lignite seams occurred in the deposit.

The spring was apparently destroyed by the deposition of silt and fine sand which occurs above it throughout the general region. The massive caliche horizon in the Rexroad occurs approximately 6 feet above the top of the quicksand. Above the spring proper only caliche nodules were found, to a depth of 1 foot, but 50 yards upstream the caliche forms a massive bed slightly more than 2 feet thick. A distinctive caliche zone occurs in the region above the fossil-bearing horizon (Pl. 1, fig. 2). The widespread massive hard white caliche of bed 5 apparently developed under rather stable conditions. The climate was probably semi-arid and the caliche was deposited near the surface, as a primary deposit which may have later been altered, added to, or removed by solution; at least its origin is different from that of the caliche nodules and vertical stringers observed in the silt deposits.

The top of another old artesian spring had been removed by erosion in sec. 22, T. 33 S., R. 29 W., Meade County, and the sand tube which allowed the exit of water was excavated in 1936 and followed to the depth of 10 feet. Many fossil teeth were recovered from the sand. A more recently abandoned artesian spring is the Cragin quarry of late Pleistocene age, SW$\frac{1}{4}$ sec. 17, T. 32 S., R. 28 W., on the Big Springs ranch, Meade County. A few yards northeast of the Cragin quarry and in the bottom of the valley is an artesian spring which flows approximately 800 gallons a minute. The evidence indicates that this spring flowed during part of the late Pleistocene at the level and locality of Cragin quarry but has later shifted because of the down-cutting of Crooked Creek and its tributaries.

Acknowledgment is made to the Geological Society of America for a grant from the Penrose Bequest, used to help defray the expense of the drawings; also, to E. Raymond Hall of the University of Kansas Museum of Natural History for permission to Hibbard to finish the report of the study after leaving the University of Kansas. We are indebted to Thad McLaughlin for his generous and untiring help and to the members of our field parties who contributed greatly in the removal of the fossil vertebrates from the Keefe Canyon quarry. Through the generosity and kindness of the following, who co-operated in every way possible during the war years we were able to complete the excavation in Keefe Canyon: the Kansas State Fish and Game

Commission, who permitted us to use their dwelling quarters; Mr. Guy Fox, owner of the land in Keefe Canyon, and numerous friends in Meade County. We are further indebted to Bryan Patterson, Chicago Natural History Museum; G. G. Simpson, American Museum of Natural History; and W. H. Burt, University of Michigan, Museum of Zoology, for permission to use specimens under their care for comparative study.

REXROAD FORMATION

GENERAL CONSIDERATIONS

H. T. U. Smith (1940, p. 95) named the Rexroad formation from exposures along tributaries of Crooked Creek on the Rexroad ranch, sec. 22, T. 33 S., R. 29 W., Meade County, Kansas. The beds at the type locality consist of gray to reddish silt containing stringers of caliche, buff sandy silt, and a few thin seams of lignite. Due to Hibbard's error in considering that *Equus* (*Plesippus*) *simplicidens* Cope and *Nannippus phlegon* (Hay) were confined only to deposits of Upper Pliocene, and to the fact that the Meade gravels as described by Cragin (1896, p. 53) were not restudied, the Meade gravels were included at the type locality of the Rexroad formation as the uppermost bed of the formation.

Frye and Hibbard (1941, p. 407) removed by definition the overlying basal Meade gravels from the Rexroad formation and assigned the upper Pliocene beds named by Smith the "Rexroad formation" to the Rexroad member of the Ogallala formation of Kansas. This was done chiefly to expedite the mapping and the report on the ground water of the region. Frye and Hibbard were unable to recognize the base of the formation at that time. The summers of 1942 to 1945 inclusive and a part of 1947 have been spent in that region studying deposits of the Rexroad formation. In the summer of 1943, McLaughlin and Hibbard recognized the base of the Rexroad formation in Meade and Seward counties.

For a review of the Rexroad problem and the recognition of the Rexroad as a distinct formation one is referred to McLaughlin (1946, p. 33, 113) and Byrne and McLaughlin (1948, p. 31, 34, 73).

Except for the flat-lying Rexroad beds in Wolf Canyon, the exposed beds have been involved in secondary regional sinking and dip either toward the Cimarron Valley or Crooked Creek Valley. The beds in Keefe Canyon dip toward the Cimarron Valley and disappear beneath the valley floor.

MEASURED SECTION

Section of the Rexroad and Meade formations, Keefe Canyon, Sec. 3, T. 35 S., R. 30 W., and SW ¼ Sec. 34, T. 34 S., R. 30 W.

(Measured by McLaughlin and Hibbard)

Bed No.	Description	Thickness (feet)
13.	Topsoil	
	Pleistocene	
	Meade formation	
12.	Silt, fine sandy, reddish	3.0
11.	Silt, fine sandy, tan to pinkish, with stringers of caliche near top	24.5
10.	Clay, reddish brown	3.0
9.	Silt, fine sandy, brownish buff	5.75
8.	Sand and gravel, coarse, locally cemented with calcium carbonate	33.0
	Disconformity	

Bed No.	Description	Thickness (feet)
Pliocene		
	Rexroad formation	
7.	Silt, fine sandy, reddish buff; grading upward into buff; contains stringers of caliche near the top	24.5
6.	Silt, fine sandy, reddish buff to tan grading to gray near top with zones of caliche.	13.0
5.	Caliche, thin zone, in places massive	2.0
4.	(Local within bed 3) Clay, blue-gray, containing white flour sand pockets (Keefe Canyon quarry, Locality 22)	3.0
3.	Silt, fine sandy, reddish buff, lenses of clay, bog-stained, light brown to blue gray, 12.5 feet above the base is a 3-foot zone with gastropods	23.5
2.	Interval covered.	
1.	Sand, fine to medium, micaceous, light yellow to rusty, cemented, alternating with clay and silt. Base not exposed	25.0

DRILLED SECTION

Because of the good exposure of beds in Keefe Canyon and the fact that these beds could be correlated with test hole samples, a drilling rig was set at the head of the canyon on the flat upland and test hole no. 17 was drilled (Byrne and McLaughlin, 1948, p. 117–118).

Log of test hole 17 in the SE¼ NE¼ Sec. 33, T. 34 S., R. 30 W., Meade County, Kansas

Drilled by the State Geological Survey, 1944. Surface altitude, 2655 feet. (Authority, Samples studied by Oscar S. Fent and Thad G. McLaughlin.)

Description	Thickness (feet)	Depth (feet)
Soil, silty, tan	4.5	4.5
Pleistocene		
Meade formation		
Silt, light gray to light brown, contains caliche and fine to coarse sand	23.5	28
Silt, light buff, and caliche, buff; sandy	5	33
Silt, clayey, light brown	4	37
Sand, coarse to fine, and gravel, medium to fine	3	40
Gravel, coarse, to sand, fine	15	55
Silt, light gray, contains caliche	3	58
Sand, coarse, to gravel, coarse, contains caliche	12	70
Pliocene		
Rexroad formation		
Silt, white and light buff, contains caliche and fine to coarse sand	25	95
Silt, clayey, light brown and white	15	110
Silt, clayey, gray brown to light brown, contains sand and fine gravel	10	120
Gravel, fine to medium, sand, and silt, light brown and white; contains caliche	7	127
Silt, clayey, dull yellow and light blue-gray	12	139
Sand, coarse to fine, and gravel, medium to fine; contains a little silt, greenish-gray and buff	61	200
Sand, coarse to fine, and gravel, fine	30	230
Sand, coarse to fine, and silt, light greenish-gray	22	252

Description	Thickness (feet)	Depth (feet)
Laverne formation		
Silt, soft, light gray to light tan, contains fine to medium sand	8	260
Silt, clayey, light gray, light buff, and light blue gray	20	280
Clay, thin-bedded, blue gray, contains fine sand	20	300
Clay, light blue gray	20	320
Clay, silty, blocky, dull greenish-gray	6	326
Silt and clay, brittle, gray	4	330
Silt and clay; gray and blue gray; contains very fine sand	23	353
Silt, green, contains fine to very fine sand	7	360
Clay, silty, light green gray and blue gray	10	370
Clay, soft, light gray	50	420
Clay, soft, light gray, contains thin beds of caliche and a little sand	25	445
Sand, coarse to fine, and gravel, fine	47	492
Clay, silty, white to pink buff	5	497
Sand, coarse to fine, contains white and buff silt	23	520
Sand, coarse to fine, and gravel, fine	80	600
Sand, coarse to fine, and gravel, fine; in part cemented; contains light buff and pink silt in lower part	14	614
Permian (red beds)		
Shale, silty, dull red	11	625

VERTEBRATE FOSSILS FROM THE KEEFE CANYON DEPOSIT

The Keefe Canyon deposit, SW¼ SW¼ sec. 34, T. 34 S., R. 30 W., Meade County, Kansas, is known as University of Kansas Museum of Natural History, Locality 22. The fossil remains included in this study are chiefly those of mammals and represent a part of the Rexroad fauna of Meade County, equivalent in age to the Blanco fauna of Texas.

Class REPTILIA
Order TESTUDINATA
Family TESTUDINIDAE
Testudo riggsi Hibbard

Testudo riggsi HIBBARD, 1944, Univ. Kans. Sci. Bull., vol. 30, pt. 1, no. 7, p. 72, Fig. 1.

This small land turtle was reported by Hibbard in 1944, as having been taken from deposits of middle Pliocene age. Later studies in 1944, 1945, and 1947, proved that the upper part of the Saw Rock Canyon section, from which the turtle remains were taken, belongs in the Rexroad formation. The beds of the Rexroad formation were traced northwestward on the north side of the Cimarron Valley from Locality 22, sec. 34, T. 34 S., R. 30 W., to SW¼ sec. 20, T. 34 S., R. 30 W. At this locality, an exposure of part of the Rexroad formation is overlain by the basal Meade sands and gravels. Three specimens of *Testudo riggsi*, nos. 7404, 7405, and 7406, taken from this bed of red sandy silt agree with the holotype and paratype, as well as with fragments recovered in Keefe Canyon quarry.

The sandy silt exposure from which the 3 specimens of *Testudo* were taken is the same horizon as the one just southwest across the Cimarron River from which the type was taken.

Class MAMMALIA
Order INSECTIVORA
Family SORICIDAE
?Sorex sp.
(Fig. 1J)

Two rami, nos. 7011 and 7012, of a shrew slightly larger than *Sorex taylori* Hibbard were recovered from the Keefe Canyon quarry.

Family TALPIDAE
Hesperoscalops rexroadi Hibbard
(Fig. 2B)

Hesperoscalops rexroadi HIBBARD, 1941, Am. Mid. Nat., vol. 26, no. 2, p. 337.

This mole has been known only from rather fragmentary skeletal elements from the Rexroad deposits. A single tooth, no. 7691, a left M_1 or M_2 was recovered from the spring deposit in Keefe Canyon. The tooth has an overall anteroposterior diameter of 2.8 mm. The characters of the tooth are the same as those of the type specimen from Loc. 2a, Meade County, Kansas.

Order EDENTATA
Family MEGALONYCHIDAE
?Megalonyx sp.
(Pl. 5, fig. 7)

A rather small sloth phalanx, no. 7547, was recovered from the mass of camel bones, the first remains of a sloth taken from the Rexroad formation. Sloth remains reported from deposits of Blancan age are not too numerous and at present are known only from fragmentary material. The unity of the Blanco fauna of Texas and the Rexroad fauna of Kansas indicates that the above toe bone probably belonged to *Megalonyx* described by Cope from the Blanco beds.

Measurements (mm.) of phalanx, no. 7547

Greatest overall length	59.3
Depth of distal end	31.5
Width of distal end	23.0
Depth of proximal end	36.0

Order RODENTIA
Family GEOMYIDAE
Geomys quinni McGrew

Geomys quinni MCGREW, 1944, Field Mus. Nat. Hist., geol. ser., vol. 9, no. 2, p. 49–52.

A part of a left ramus, no. 6996, bearing P_4, and the anterior part of a skull, no. 6995, with incisors, right and left P^4 and M^1, of this gopher were recovered. The diastema between the incisors and P^4 in specimen no. 6995 is 11.4 mm long. For a discussion of this gopher in other Rexroad deposits *see* Franzen (1947).

Family CASTORIDAE
Dipoides rexroadensis sp. nov.
(Fig. 1G)

HOLOTYPE: No. 7693, Kans. Univ. Mus. Nat. Hist. left upper molar, $?M^1$. Collected by Hibbard and party, 1944.

HORIZON AND TYPE LOCALITY: Upper Pliocene, Rexroad formation, Keefe Canyon, SW¼ SW¼ sec. 34, T. 34 S., R. 30 W., Meade County, Kansas, Loc. 22, Rexroad fauna.

DESCRIPTION OF TYPE: Left upper molar apparently an M^1. Hypsodont tooth with an S-pattern and the base of the tooth entirely open. Anteroposterior length of the occlusal surface is 6.5 mm. Greatest width of the occlusal surface is 5.5 mm, which is the posterior part of the tooth. Tooth narrows anteriorly. Mesostria and hypostria (see Stirton, 1935, for terminology) extend to base of tooth and are open. They are filled with cement. Tooth is not enlarged at base and is

that of an adult animal. Overall length is 12.3 mm. *Dipoides rexroadensis* is considerably larger than *Dipoides stirtoni* Wilson known from Pliocene lake beds of Malheur County, Oregon, and *Dipoides williamsi* Stirton from middle Pliocene, taken at White Cone, Hopi County, Arizona. *D. rexroadensis* approaches the size of *Procastoroides lanei* (Hibbard), specimen no. 4577, more nearly than *Dipoides*. It is distinguished from *Procastoroides lanei* with which it was found by its smaller size and the more triangular shape of the occlusal surface of the tooth (Hibbard, 1941, p. 280, 309, Pl. 2, fig. 1).

Procastoroides lanei (Hibbard)

Procastoroides sweeti BARBOUR AND SCHULTZ, 1937, Am. Mus. Novitates, no. 942, p. 6.
Eocastoroides lanei HIBBARD, 1938, Kans. Acad. Sci., Tr., vol. 40, p. 244.

Seven larger isolated beaver teeth referred to the above form were found associated with the tooth of *Dipoides rexroadensis*. Tooth no. 6847, a LM_2, has an anteroposterior occlusal length of 10.0 mm, and the greatest width of the occlusal surface is 7.0 mm. Hibbard (1941, p. 279–281) discusses the large amount of variation observed in the beavers from this region. It should be pointed out again that the type of *Eocastoroides lanei* Hibbard and the right maxillary, no. 4577, from Meade County, Loc. 1, NW¼ SE¼ sec. 15, T. 33 S., R. 29 W., Meade County, Kansas, were not taken from the Rexroad formation as was first thought, but from the Meade formation just above the basal Meade sands and gravels overlying the Rexroad formation in this area.

Family CRICETIDAE

Symmetrodontomys simplicidens Hibbard

Symmetrodontomys simplicidens HIBBARD, 1941, Am. Mid. Nat., vol. 26, no. 2, p. 354.

Five lower jaws of this mouse were recovered by sifting the sand removed from the quarry. Nos. 7003, 7007, and 7008 are left rami, each possessing M_1–M_2. Nos. 7005 and 7006 are right rami, each with M_1–M_2. The characters of the jaws and teeth are the same as those of the type from Meade County, Kansas, Loc. 3, sec. 22, T. 33 S., R. 29 W.

Parahodomys quadriplicatus Hibbard
(Fig. 2C)

Parahodomys quadriplicatus HIBBARD, 1941, Am. Mid. Nat., vol. 26, no. 2, p. 356.

Only isolated teeth of this pack rat were recovered. Figure 2C is that of a left M^1.

Ogmodontomys poaphagus Hibbard
(Fig. 1K)

Ogmodontomys poaphagus HIBBARD, 1941, Am. Mid. Nat., vol. 26, no. 2, p. 362.

A number of isolated teeth, 4 rami, and parts of 2 maxillaries of this vole were taken. A right ramus, no. 6988, contains M_1–M_3. Crown length of tooth row is 8.2 mm. A left ramus, no. 6987, Fig. 1K, is that of an old adult. A left maxillary, no. 6992, contains M^1 and M^2. Anteroposterior length of the 2 teeth along the occlusal surface is 5.0 mm. Specimens agree with type and paratypes from Loc. 3, Meade County, Kansas.

Order CARNIVORA
Family MUSTELIDAE
Martes foxi sp. nov.
(Fig. 2D)

HOLOTYPE: No. 7001, Kans. Univ. Mus. Nat. Hist. fragment of right ramus, bearing M_2, collected summer of 1944, by Dick Rinker.

HORIZON AND TYPE LOCALITY: Upper Pliocene, Rexroad formation, Keefe Canyon, Meade County, Kansas, SW¼ SW¼ sec. 34, T. 34 S., R. 30 W.; Loc. 22.

DIAGNOSIS: Smallest of the known fossil *Martes*, approximately the size of a female "Western Marten", *Martes caurina caurina* (Merriam), but distinguished by more pronounced angle of jaw and more oblong M_2 in contrast to the more circular M_2 in recent forms of *Martes*.

DESCRIPTION OF HOLOTYPE: Smallest known fossil species of *Martes*. Tooth is that of an adult animal. Greatest diameter of M_2 is 3.15 mm, least diameter is 2.4 mm.

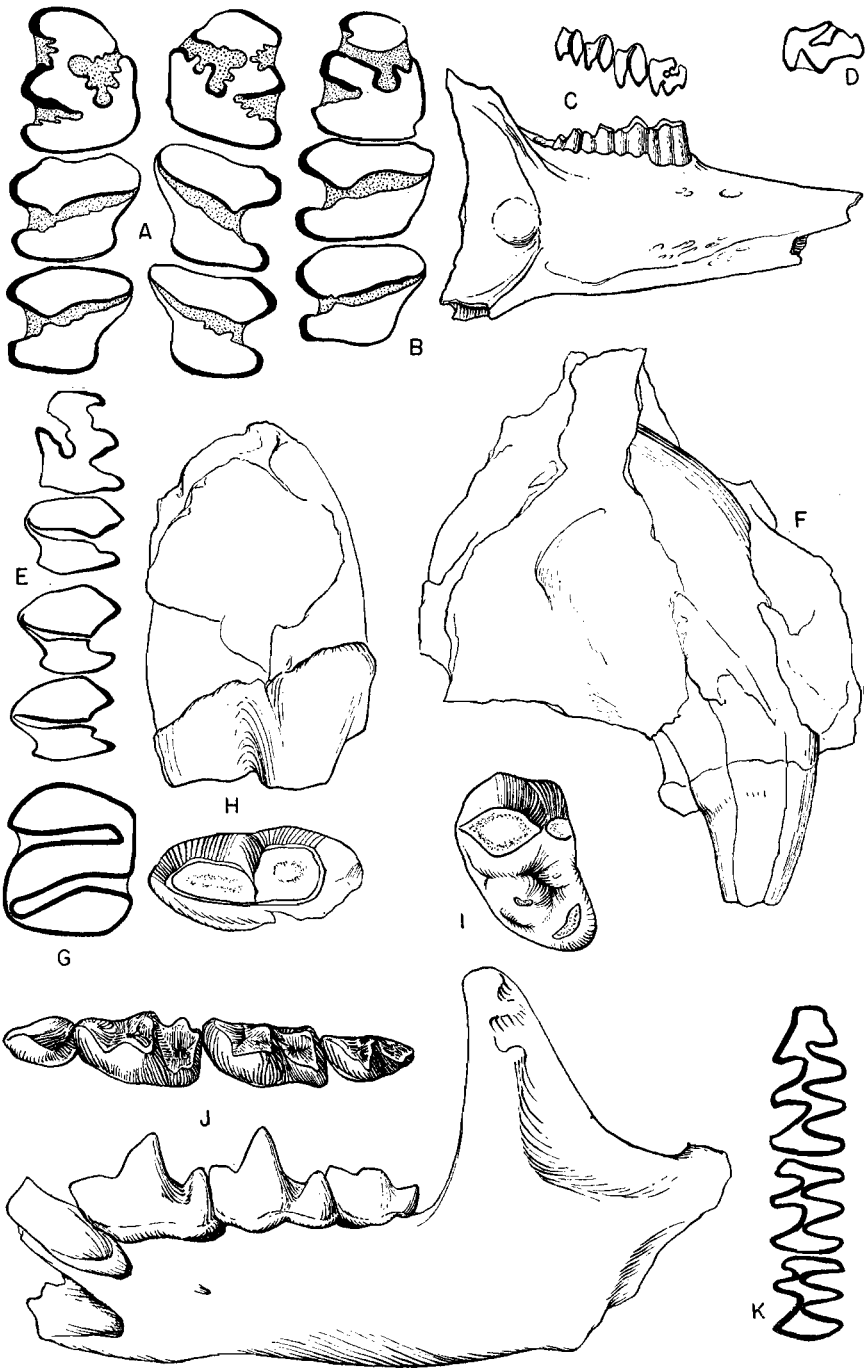


FIGURE 1.—*Upper Pliocene mammals*

(A) *Notolagus velox* Wilson. Paratype, CIT2134, left and right $P_3 - M_1$. Occlusal view. ×6. (B) *Notolagus velox*. Paratype, CIT2135, left $P_3 - M_1$. Occlusal view. ×6. (C) *Notolagus lepusculus* (Hibbard). KU6998, right ramus, $P_3 - M_2$. Labial and occlusal views. ×2. (D) *Notolagus lepusculus*. KU7000, RP_3, immature. Occlusal view. ×6. (E) *Notolagus lepusculus*. KU6999, $RP_3 - M_2$. Occlusal view. ×6. (F) *Borophagus diversidens* Cope. KU7266, part of right maxillary with canine and P^2. Lateral view. ×1. (G) *Dipoides rexroadensis* sp. nov. Holotype, KU7693, $?LM^1$. Occlusal view. ×2. (H) *Borophagus diversidens* Cope. KU7266, RP^4. Labial and occlusal views. ×1. (I) *Borophagus diversidens*. KU7266, LM^1. Occlusal view. ×1. (J) *Sorex*? sp. KU7012, left ramus, $P_4 - M_3$. Labial and occlusal views. ×10. (K) *Ogmodontomys poaphagus* Hibbard. KU6987, left $M_1 - M_3$. Occlusal view. ×6.

Ramus typical of genus *Martes*. Masseteric crest is more pronounced than in Recent forms. Angle has a well-developed groove on its dorsal surface. Subcondylar notch corresponds in size and shape to notch in *Martes caurina*. This species is named for Mr. Guy Fox on whose land was located the quarry from which this specimen was taken.

Measurements (mm.) of holotype of *Martes foxi* sp. nov.

Width of ramus below M_2	3.0
Depth of ramus below M_2	8.5
Length from posterior edge of alveolus of M_2 to posterior border of condyle, measured on lingual side	14.8
Distance from anterior border of inferior dental foramen to posterior border of alveolus of M_2	5.7
Distance from anterior border of inferior dental foramen to anterior edge of condyle	5.8
Width of condyle	9.0
Maximum depth of condyle	2.65
Height of subcondylar notch	3.2

Brachyprotoma breviramus Hibbard

Brachyprotoma breviramus HIBBARD, 1941, Am. Mid. Nat., vol. 26, no. 2, p. 340.

A left lower carnassial, no. 7015, of this mustelid was recovered from fine sand. Anteroposterior diameter of tooth is 6.0 mm; width across posterior border of talonid is 2.5 mm.

Taxidea cf. *taxus* (Schreber)

A left M_1, no. 7694, well worn, of a badger was recovered, and is referred to the badger living in the region.

Family CANIDAE

Canis lepophagus Johnston

Canis lepophagus JOHNSTON, 1938, Am. Jour. Sci., vol. 35, p. 385.

A left lower carnassial, no. 7692, of this small coyote was recovered that has an anteroposterior diameter of 18.0 mm.

Borophagus diversidens Cope

(Fig. 1F, H, I)

Borophagus diversidens COPE, 1892, Am. Nat., vol. 26, no. 312, p. 1028.

A part of the skull of this large bone-eating dog was recovered from among the mass of camel bones. The material consists of the right maxillary, in part, and a left M^1 and M^2, no. 7266. There is no evidence of P^1. P^2 is reduced, apparently single rooted, crowded lingually and anteriorly by P^3 so that it is situated along lingual side of canine. P^3 is two rooted. Lingual root of P^4 is missing. M^2 is reduced and single rooted.

Measurements (mm.) of specimen no. 7266.

Upper canine, anteroposterior length at alveolus	17.5
Upper canine, transverse width at alveolus	13.6
P^2, anteroposterior length	7.5
P^2, transverse width	5.6
P^3, (tooth missing)—alveolar length	17.0
P^4, anteroposterior length of crown	21.4
P^4, greatest anteroposterior length of tooth	30.0
M^1, anteroposterior length	16.2
M^1, transverse width	25.4
M^2, anteroposterior length	18.0
M^2, transverse width	7.8

Order PROBOSCIDEA

Family GOMPHOTHERIIDAE

Stegomastodon successor (Cope)

Mastodon successor COPE, 1892, Acad. Nat. Sci. Philadelphia, Pr., vol. 44, p. 227.
Stegomastodon successor COPE, OSBORN, 1936, Proboscidea, vol. 1, p. 671.

From the bog deposit at Loc. 3, sec. 22, T. 33 S., R. 29 W., Meade County, Kansas, 4 of the upper and lower teeth, in occlusion, of a young short-jawed mastodon, no. 4640 were recovered.

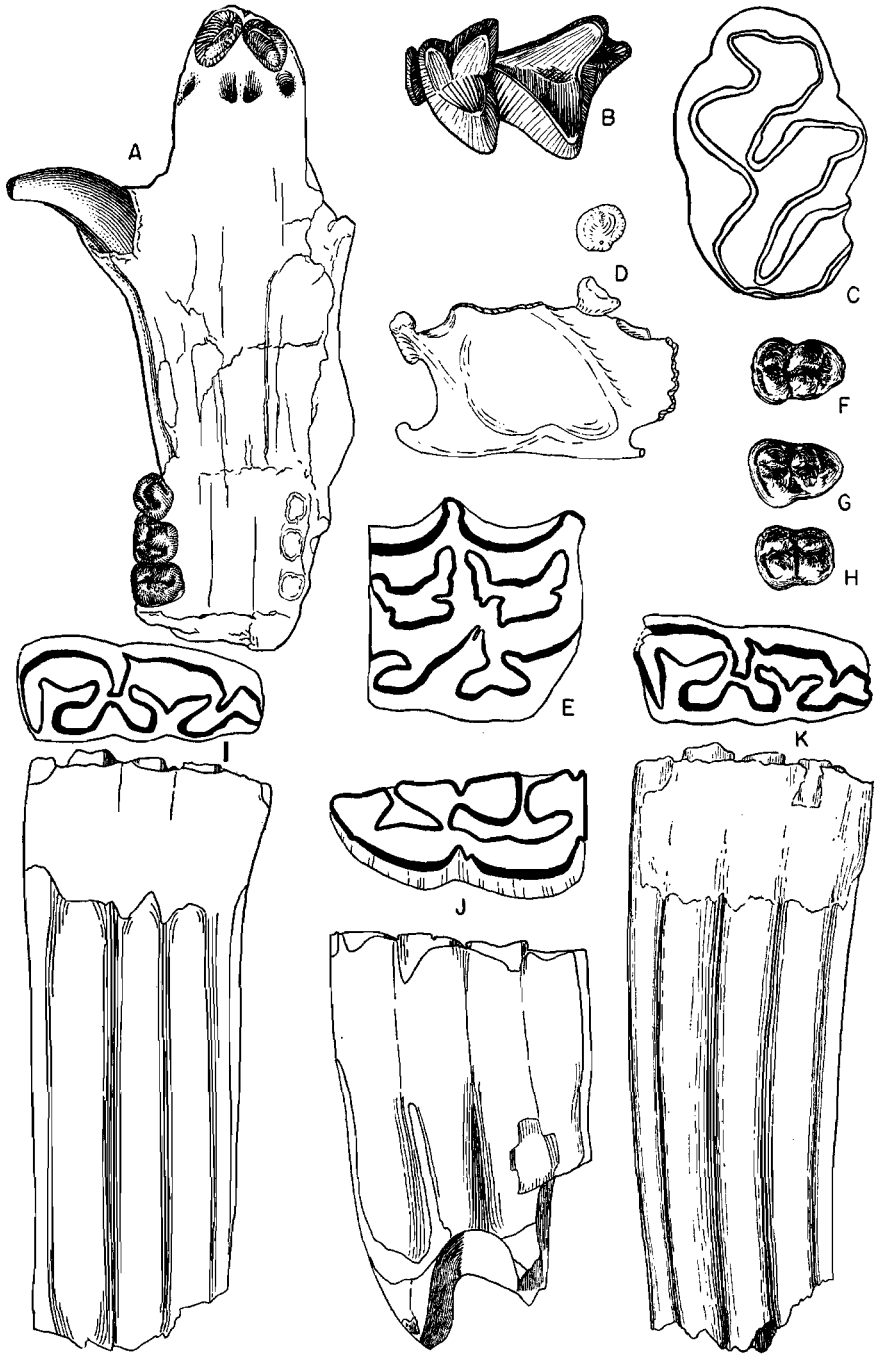


FIGURE 2.—*Upper Pliocene mammals*

(A) *Platygonus bicalcaratus* Cope. KU7274, part of premaxillary and maxillary region of skull. Anteropalatal view. ×½. (B) *Hesperoscalops rexroadi* Hibbard. KU7691, LM_1 or M_2. Occlusal view. ×10. (C) *Parahodomys quadriplicatus* Hibbard. KU7695, LM^1. Occlusal view. ×10. (D) *Martes foxi*, sp. nov. Holotype, KU7001, part of right ramus with M_2. Labial and occlusal views. ×2. (E) *Equus* (*Hippotigris*) *simplicidens* Cope. KU6819, right upper molar. Occlusal view. ×1. (F) *Platygonus bicalcaratus* Cope. KU7696, RM^3. Occlusal view. ×½. (G) *Platygonus bicalcaratus*. KU7697, LM^3. Occlusal view. ×½. (H) *Platygonus bicalcaratus*. KU6972, LM^3. Occlusal view. ×½. (I) *Equus* (*Hippotigris*) *simplicidens* Cope. KU7045, right lower molar. Labial and occlusal views. ×1. (J) *Equus* (*H.*) *simplicidens*. KU7044, LP_2. Labial and occlusal views. ×1. (K) *Equus* (*H.*) *simplicidens*. KU7045a, right lower molar. Labial and occlusal views. ×1.

These teeth are different from the short-jawed mastodon, *Stegomastodon mirificus* (Leidy) taken from the overlying basal Meade sands and gravels. The teeth of *S. successor* are shorter, consist of a fewer number of ridges, and the trefoils are less complicated.

Right M_3, no. 4640, consists of the anterior cingulum and 5½ ridge-crests. The greatest anteroposterior length of the tooth is 209.0 mm. The greatest width, across the second (anterior) loph, is 80.0 mm.

Right M^3, no. 4640, has the anterior cingulum missing. It consists of 5½ ridge-crests. Greatest width of this tooth is 85.0 mm., across the anterior loph.

Left M^3, no. 4640, consists of the anterior cingulum and 5½ ridge-crests. Anteroposterior length is 193.0 mm. The side of the first loph is broken.

The lower third molars of an adult specimen of *Stegomastodon mirificus*, no. 24314, University of Michigan, from the Meade sands and gravels possess the following characters. Anterior cingulum has been worn from both teeth. RM_3 consists of 7½ ridge-crests. Greatest width, 93.0 mm., is across fourth loph. Anteroposterior length is 221.0 mm. LM_3 consists of 7 ridge crests. The posterior one-half crest is united with the seventh loph. Overall length of tooth is 215.0 mm. Its greatest width is 91.0 mm, which is across fourth loph. Teeth of *S. mirificus* have a rectangular appearance in contrast to the elongated triangular appearance of the lower third molars of *S. successor*.

Family MAMMUTIDAE

Mammut (Pliomastodon) adamsi (Hibbard)

(Pl. 4, fig. 4)

Pliomastodon adamsi HIBBARD, 1944, Kans. Univ., Sci. Bull., vol. 30. pt. 1, no. 10, p. 109.

Specimens of this mastodon recovered from the spring basin are those of young individuals. The material had been badly churned and was broken and disassociated. Specimen no. 7267 is part of right ramus containing M_1–M_3. M_3 has not erupted. M_1 consists of 3 lophs and a posterior cingulum. Greatest anteroposterior length of tooth is 80.0 mm. Greatest width is 54.0 mm, across middle loph. M_2 consists of 3 lophs and a posterior cingulum. Greatest anteroposterior length of tooth is 113.0 mm. Greatest width is 68.0 mm, across posterior loph. A LM_1, no. 7268, has an overall length of 76.8 mm, and a width of 55.0 mm, across middle loph. A palate, no. 6983, was recovered with both right and left M^1 and M^2. It is not certain that it belongs to the above described lower teeth since fragmentary remains indicated that there was more than one individual in the deposit. Both molars consist of 3 lophs, teeth are those of a young animal.

Measurements (mm.) of specimen no. 6983

LM^1, anteroposterior diameter	81.0
RM^1, anteroposterior diameter	81.5
LM^1, transverse diameter across second loph	56.8
RM^1, transverse diameter across second loph	55.0
LM^2, anteroposterior diameter	110.0
RM^2, anteroposterior diameter	112.0
LM^2, transverse diameter across posterior loph	68.0
RM^2, transverse diameter across posterior loph	68.5

The teeth are not as large as those of the type, though the type was an older individual with M^2 worn nearly to base. Also, from the tusk associated with the type it appears that the individual was a male. The type of *Pliomastodon adamsi* was taken from near the head of Saw Rock Canyon, Seward County, Kansas. Since description of the type, it has been observed that the remains of the mastodon were taken from typical beds of the Rexroad formation, which occurs above the horizon where the invertebrates, *Osteoborus progressus* and *Dipoides* were recovered in the same exposure.

Tusks encountered with the above specimens were all very small. If they belonged with the maxillaries they would indicate that the maxillaries were those of a female. The difference in the size of M^2 between the young individual and the type is considered to be due to age, or to both age and sex.

Presence of the mastodons in these deposits is further evidence of a much more wooded condition along the streams during Rexroad time than now.

Order LAGOMORPHA

Family LEPORIDAE

Notolagus lepusculus (Hibbard)

(Figs. 1C, D, E)

Notolagus velox WILSON, 1937, S. Calif. Acad. Sci., Bull., vol. 36, pt. 3, p. 98.
Dicea lepuscula HIBBARD, 1938, Am. Mid. Nat., vol. 21, no. 2, p. 509.

Three lower jaws of this small rabbit were recovered from the spring deposit. Pattern and size of teeth correspond with those of the type of *Notolagus lepusculus*. No. 6998 is a right ramus of a young adult rabbit bearing P_3–M_2. Crown length of teeth is 8.8 mm. Depth of ramus below M_3 is 9.8 mm. No. 6999 is part of a right ramus bearing P_3–M_2, of a younger individual. The teeth have a crown length of 7.9 mm. No. 7000, another right ramus bearing only P_2–P_4, is that of an immature individual (Fig. 1D). The crown of P_3 is rather elongated. The internal re-entrant angle of P_3 is not bifurcated as in the type or as in specimens of *Notolagus velox* Wilson (Figs. 1A, B). Size and the uncrenulated internal re-entrant angles of the lower molariform teeth distinguish *N. lepusculus* from *N. velox*.

We are greatly indebted to Chester Stock of the California Institute of Technology for the opportunity to study the specimens of *Notolagus velox* and for permission to figure the drawings of them for comparison.

Order PERISSODACTYLA

Family EQUIDAE

Equus (*Hippotigris*) *simplicidens* Cope

(Figs. 2E, I, J, K)

Equus simplicidens COPE, 1892, Am. Philos. Soc., Pr., vol. 30, p. 124.
Plesippus simplicidens (COPE) MATTHEW, 1924, Am. Mus. Novitates, no. 131, p. 2.
Hippotigris simplicidens (COPE) MCGREW, 1944, Field Mus. Nat. Hist., geol. ser., vol. 9, no. 2, p. 55.

Forty isolated teeth of the above horse were recovered. Most were taken from the vertical sand tube which allowed the upward escape of the water. Many of them were badly abraded. Two upper teeth, nos. 7540 and 7541, greatly resemble those teeth of *Pliohippus* and do not appear as advanced as the teeth of *E. simplicidens* which were recovered from the overlying basal Meade sands and gravels. M^3, no. 7540, is 46.4 mm long; anteroposterior length of crown is 25.7 mm, and transverse width is 23.4 mm. Protocone has an anteroposterior length of 10.7 mm.

The other molar, no. 7541, is a LM^1 or LM^2. Hypocone of this tooth is as large as protocone.

The only associated series of teeth, DP_2–DP_4, was recovered in part of a ramus, no. 6980. Anteroposterior crown length of the series is 99.8 mm.

On the lower teeth, especially in the younger specimens, the metaconid and metastylid are round and internally convex, separated by a sharp V-shaped valley as in other specimens of *E. simplicidens*. The above characters were stressed by McGrew (1944) as characters of the African zebra (*Hippotigris*).

No remains of the little horse *Nannippus phlegon* (Hay) were found. It is interesting to note that the remains of this horse are more abundant in the base of the overlying Meade formation than in the Rexroad formation.

Order ARTIODACTYLA

Family TAYASSUIDAE

Platygonus bicalcaratus Cope

(Figs. 2A, F, G, H; 3A)

Platygonus bicalcaratus COPE, 1893, Texas Geol. Survey, 4th Ann. Rept., 1892, p. 68.
Platygonus texanus GIDLEY, 1903, Am. Mus. Nat. Hist., Bull., vol. 19, art. 16, p. 478.

Isolated teeth of *Platygonus* have not been uncommon in the Rexroad deposits. Complete dentitions have not been found that would allow a determination of the species present. At Locality 22, numerous remains of *Platygonus* were recovered. They varied from the premaxillaries of either embryonic or very young peccaries containing the unerupted tooth buds to the dentition of old individuals. One can group the teeth into 3 lots: those with the characters of *Platygonus bicalcaratus*

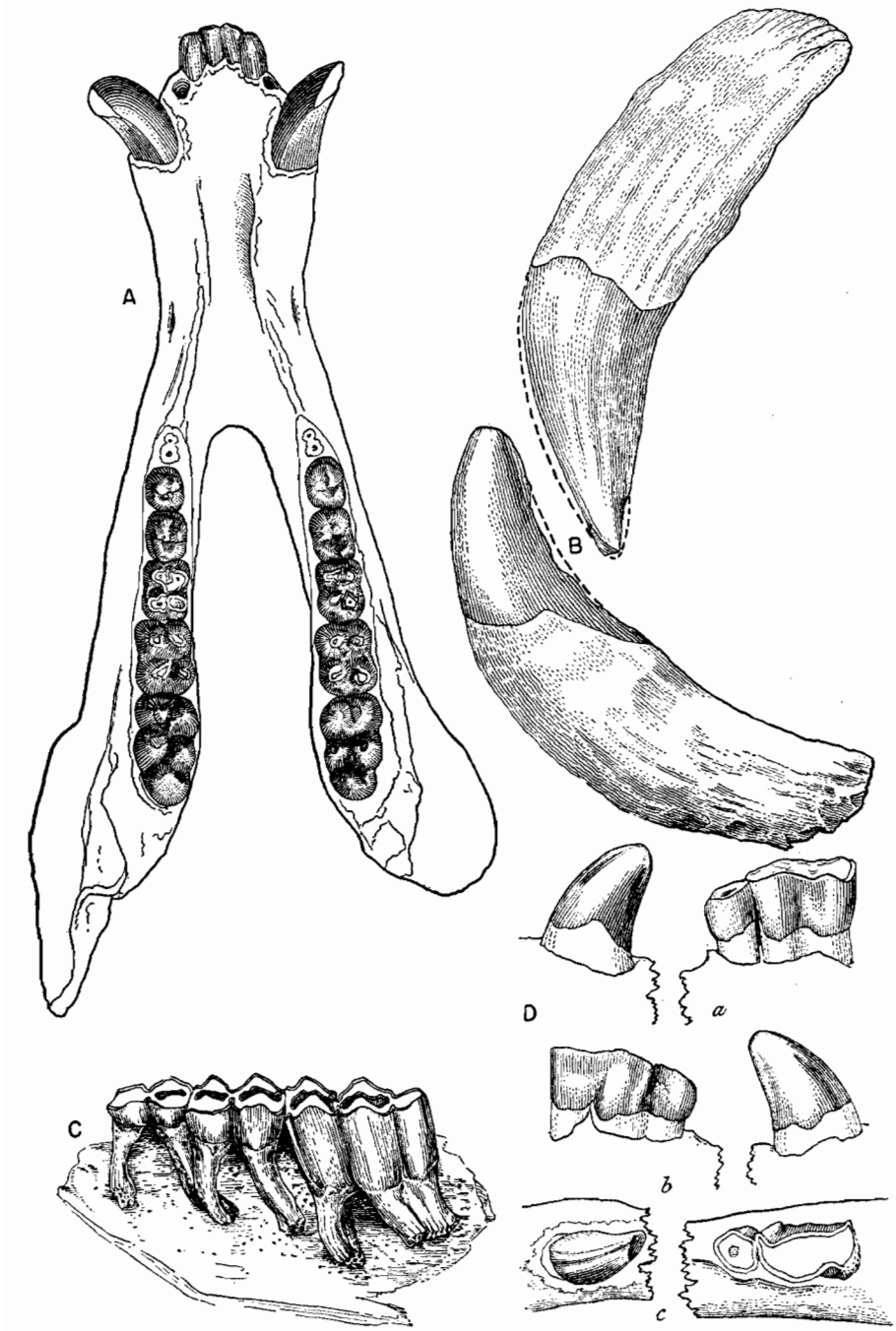


FIGURE 3.—*Upper Pliocene mammals*

(A) *Platygonus bicalcaratus* Cope. KU7273, rami with dentition. Dorsal views. ×½. (B) *Gigantocamelus spatulus* (Cope). KU7209, upper and lower canines of male. Labial view. ×½. (C) *Tanupolama blancoensis* Meade. KU7143, left $M_1 - M_2$. Labial view. ×½. (D) *Gigantocamelus spatulus* (Cope). KU7160, P_1, P_2 and P_4. a, labial view. b, lingual view. c, occlusal view. All ×½.

Cope, those with characters of *Platygonus texanus* Gidley, and those with characters intermediate between these two species. Cope, in his description of *P. bicalcaratus* had only a part of a superior canine, a lower canine, and what he considered to be part of the last inferior molar. All will agree that Cope had before him a part of a peccary premolar or molar. Gazin (1938) points out that the fragment of the tooth studied by Cope is probably an incomplete P_3 or P_4 rather than M_3. Gidley (1903) had 2 palates of a peccary from the Blanco which varied slightly in size and character of teeth. Because of the complete lack of a posterior heel on M^3, he referred this specimen to *P. bicalcaratus* and described the other specimen, a palate with upper dentition in which M^3 possessed a posterior heel as *P. texanus*. Meade (1945) has referred lower dentitions to both *P. bicalcaratus* and *texanus*. The lower dentitions referred to *P. texanus* were so disposed of in general because M_3 possessed a rather well-developed heel. The lower teeth referred by Meade to *P. bicalcaratus* do not include any last molars. He definitely states that M_3 is unknown and that the tooth should have a less well-developed posterior heel than M_3 in *P. texanus*, since the heel of M^3 is lacking in *P. bicalcaratus*.

TABLE 1.—*Measurements of upper dentitions of* Platygonus bicalcaratus *Cope*

	Specimens no.			
	7274	7535	6972	7536
	millimeters			
Diastema, I to C	25.4	—	—	—
C, anteroposterior length	21.0	—	—	—
C, transverse width	11.5	—	—	—
Diastema, C to P^2	58.3	—	—	—
Alveolar length P^2–P^4	36.4	33.7	—	—
P^2, anteroposterior length	11.8	9.5	—	10.2
P^2, transverse width	11.0	7.5	—	9.9
P^3, anteroposterior length	11.8	11.8	—	10.8
P^3, transverse width	12.3	9.8	—	12.4
P^4, anteroposterior length	14.0	14.0	—	11.6
P^4, transverse width	13.7	11.8	—	13.2
M^1, anteroposterior length	—	16.1	—	14.1
M^1, transverse width	—	12.5	—	12.6
M^2, anteroposterior length	—	—	18.0	18.4
M^2, transverse width	—	—	15.0	16.5
M^3, anteroposterior length	—	—	21.0	21.5
M^3, transverse width	—	—	17.4	16.5

The characters used by Gidley to separate the 2 species of *Platygonus* from the Blanco beds of Texas and the supposedly valid characters discussed by Meade to disinguish the 2 species, are here considered, after the study of our material, to be only differences of individual variation. One would not expect to find 2 forms of peccaries occupying the same region without diverse habitats. With diverse habitats one form would be more apt to be fossilized than the other, or at least there would be more fossils of one form in a given deposit than the other. At present the specimens are about equally divided numerically in the deposits from which they have been taken.

In the material recovered are: a right maxillary, no. 7535, with P^2 and M^2; posterior part of a palate, no. 6972, with RM^2—M^3, and LM^3; another right maxillary, no. 7563, with P^2—M^3; anterior part of skull, no. 7274, with 2 incisors, right canine, and RP^2—P^4; palate , no. 7536, with RP^2—M^3, and LM^2—M^3; complete right and left rami, no. 7273, lacking I_3 and P_2; right ramus, no. 7272, with P_3—M_3; nos. 6976, 7531, 7532, and 7533, rami of immature individuals, 3 of which contain DP_4.

Palate, no. 6972, with RM^2—M^3, and LM^3, possesses teeth typical in pattern to the upper teeth referred by Gidley to *P. bicalcaratus*. In contrast, is palate no. 7536, with RP^2—M^3, and LM^2—

M^3 in which RM^1 has a typical tapir pattern, a character Gidley assigns to *P. bicalcaratus*, though M^3 possesses a well-developed heel. The extreme development of the groad heel on RM^3 is seen in specimen, no. 7696, Fig. 2F. An intermediate tooth is seen in Fig. 2G, a LM^3, in which the heel is reduced and the oblique ridge from the inner cusp is less prominent and is intermediate between the connection with the heel and the cingulum which approaches the condition in palate no. 6972. The upper premolar and molar series are variable in tooth characters. In regard to the lower jaws where M_3 was present there was no reduced heel. All of the unworn teeth possessed high anterior and posterior crests which were completely divided by cross valleys.

TABLE 2.—*Measurements of lower dentitons of* Platygonus bicalcaratus *Cope*

	Specimens no.			
	7273	7272	6976	7532
	millimeters			
Distance from tip of I to posterior border of M_3	215.0	—	—	—
Diastema between C–P_2	70.0	—	—	—
Alveolar length of P_2–P_4	35.0	33.0	—	—
Alveolar length of P_2–M_3	101.0	95.0	—	—
Alveolar length of M_1–M_3	65.0	60.0	—	58.8
P_2, anteroposterior length	—	—	—	—
P_2, transverse width	—	—	—	—
P_3, anteroposterior length	11.6	11.0	D 10.5	—
P_3, transverse width	10.0	8.7	5.7	—
P_4, anteroposterior length	13.0	12.2	D 19.5	13.0
P_4, transverse width	12.2	10.6	9.5	12.5
M_1, anteroposterior length	16.0	15.4	—	14.8
M_1, transverse width	12.2	—	—	11.5
M_2, anteroposterior length	19.5	18.7	—	18.2
M_2, transverse width	15.5	14.0	—	15.4
M_3, anteroposterior length	27.5	25.8	—	26.5
M_3, transverse width	17.8	14.9	—	17.0

D, milk tooth.

Gigantocamelus spatulus (Cope)

(Pl. 3; Pl. 4, figs. 1, 5, 6; Pl. 5, fig. 6; Figs. 3B, D; 4;5; 6; 7; 8A, B, C; 9)

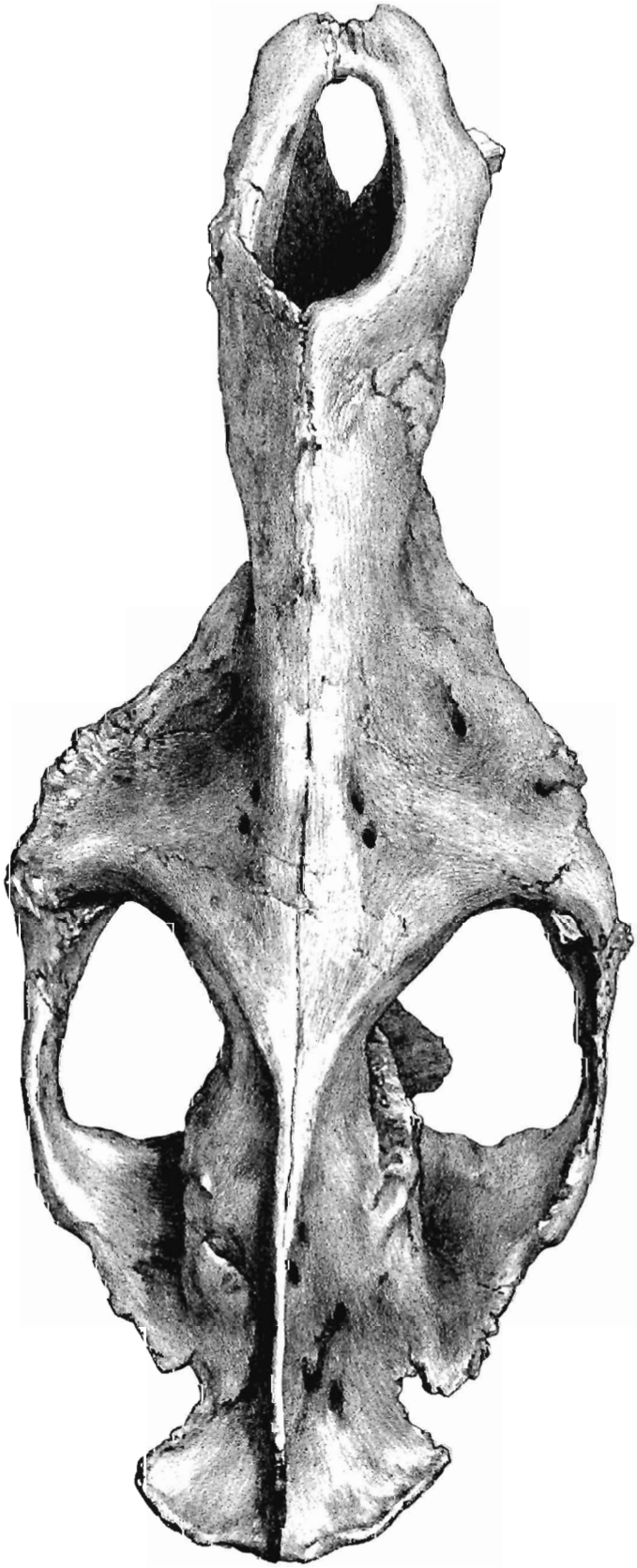
Pliauchenia spatula COPE, 1893, Texas Geol. Survey, 4th Ann. Rept., 1892, p. 70, Pl. 21, figs. 1 and 2.

Pliauchenia (*Megatylopus*) *spatula* COPE, MATTHEW AND COOK, 1909, Am. Mus. Nat. Hist., Bull., vol. 26, p. 396.

Gigantocamelus fricki BARBOUR AND SCHULTZ, 1939, Univ. Nebr. St. Mus., Bull., vol. 2, no. 2, p. 20, Figs. 5–10.

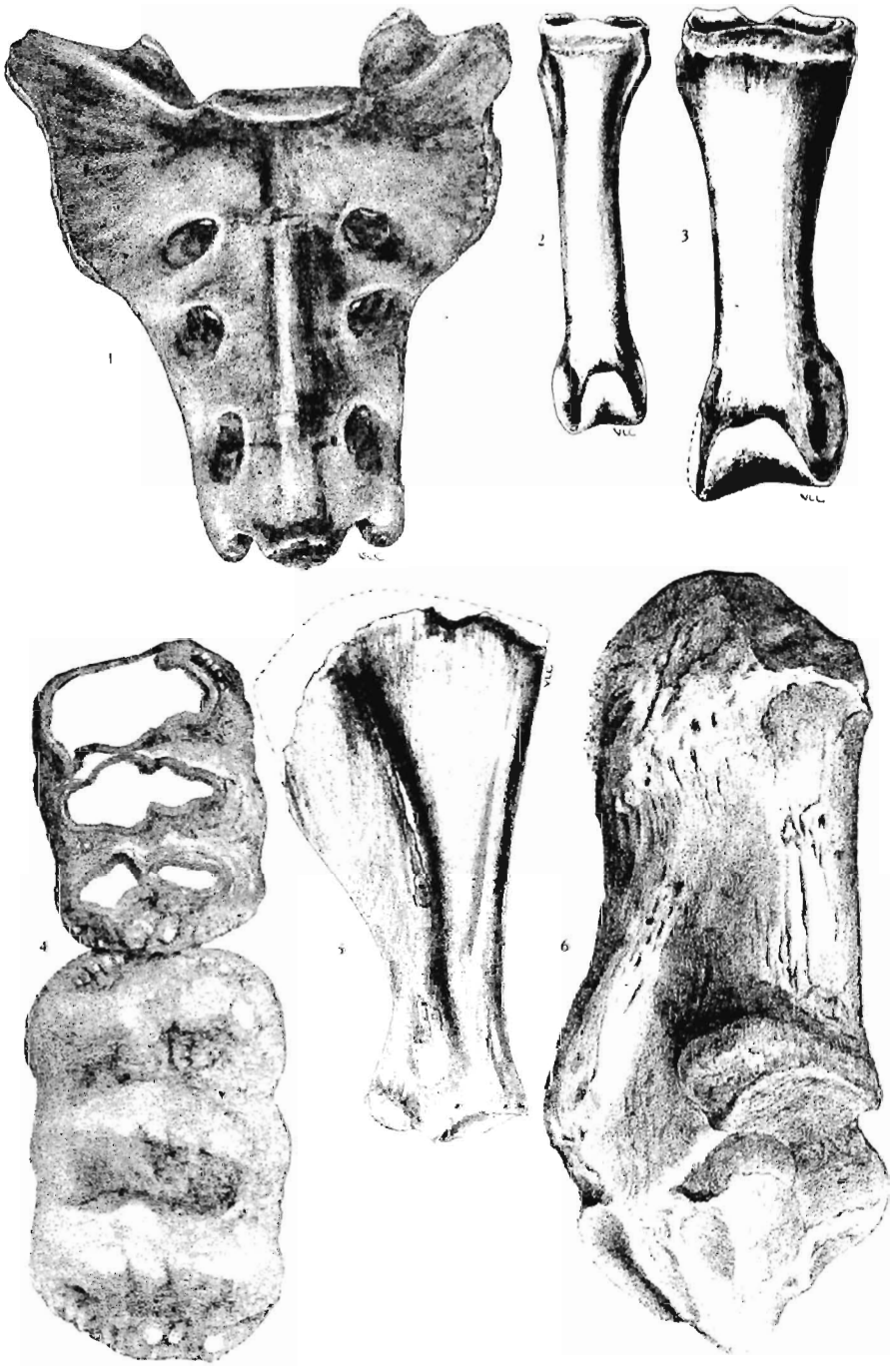
Gigantocamelus spatula (COPE), MEADE, 1945, Univ. Texas, Pub. 4401, p. 531, pls. 53 and 54.

A large male skull, no. 6943, (Table 3, Pl. 3), is slightly crushed and distorted to the right ventral side. The skull has a narrow sagittal crest, an occipital crest that projects well over the condyles, a small brain cavity, and lacks the depression between the orbits which is present on the skull of *Camelus*. Dorsal surface of orbital region is more convex than that surface observed in *Lama*. The infraorbital foramen, situated above P^4 is small in comparison to that of *Camelus*. Temporal fossa has an anteroposterior length of 140.0 mm. Anterior border of posterior narial aperture is situated at posterior edge of M^3. Maxillary is excluded from nasal opening. Premaxillary broadly joins the nasal. From posterior border of external nares to tip of supraoccipital crest is 702.0 mm. There is no evidence of a facial fossa between the maxillary and frontal as observed in *Lama* and *Camelus*. P^1 is more caniform than P_1 and not as recurved.



SKULL OF GIGANTOCAMELUS SPATULUS (COPE)

Skull of old male, KU6943, slightly crushed anteriorly. Dorsal view. X¼.



TEETH OF MASTODON AND SKELETAL ELEMENTS OF CAMELS

The skull, no. 6944, (Fig. 4A) is that of a young male. P^3 is well-developed with ends of the crescent turned inwardly toward center of tooth. On lingual side of M^1 and M^2, at the re-entrant angle, there is a very slender cylindrical-shaped style which arises from base of tooth and extends along side of tooth as far as triturating surface and is worn away to that level. It is not attached to

TABLE 3.—*Skull measurements of* Gigantocamelus spatulus *(Cope)*

	No. 6943 ♂	No. 4644 ♂	No. 7167 ♀
	millimeters		
Length, maximum (including supraoccipital crest and premaxillae)	870.0	—	—
Condylo-basal length (condyles to anterior of premaxillae)	795.0	—	—
Width maximum, at orbits	355.0	—	—
Length, tip of premaxillary to anterior base of P^3	287.0	—	245.0
Length of dental series (C–M^3 inclusive, alveolar)	421.0	—	359.0
Length, P^3–M^3 inclusive, alveolar	194.0	214.0	167.0
Length of P^3–P^4 inclusive, alveolar	92.0	57.0	54.0
Length of M^1–M^3 inclusive, alveolar	140.0	152.0	125.0
Diastema, P^1–P^3	130.0	—	102.0
Diastema between C–P^1	38.0	—	61.0
Greatest anteroposterior length of canine at alveolus	39.0	40.0	19.0
Height of canine from alveolus	37.0	—	35.0
Height of P^1 from alveolar border	—	23.0	13.0
P^1 greatest anteroposterior length	23.0	21.0	11.0
greatest transverse width	18.0	—	8.0
P^3 greatest anteroposterior length	—	31.0	27.0
greatest transverse width	—	20.0	17.0
P^4 greatest anteroposterior length	—	36.0	32.0
greatest transverse width	—	25.0	25.0
M^1 greatest anteroposterior length	—	45.0	32.0
greatest transverse width	—	34.0	36.0
M^2 greatest anteroposterior length	49.0	63.0	46.0
greatest transverse width	46.0	39.0	40.0
M^3 greatest anteroposterior length	60.0	65.0	38.0
greatest transverse width	42.0	35.0	40.0

lobe of tooth. (Fig. 4B). A few of these cylindrical-shaped stlyes were recovered from the matrix; they had become detached from the parent molars. This style is therefore to be considered only as a sporadic development.

Skull, no. 7167, (Fig. 4C) is that of a female. Skull is crushed laterally and part posterior to M^3 is missing. It is much lighter than that of the males (Table 3), measures 240.0 mm from tip of premaxillary to anterior borders of P^3; while the same part measures 290.0 mm on the skull of the old male, no. 6943. Anterior border of posterior narial aperture ends, as in no. 6943, just posterior to

PLATE 4.—TEETH OF MASTODON AND SKELETAL ELEMENTS OF CAMELS

Figure

1. *Gigantocamelus spatulus* (Cope). KU7647, sacrum. Ventral view. $\times\frac{1}{4}$.
2. *Tanupolama blancoensis* Meade. KU7149, phalange. Anterior view. $\times\frac{1}{2}$.
3. *Pliauchenia cochrani* sp. nov. KU7184, anterior phalange. Anterior view. $\times\frac{1}{2}$.
4. *Mammut* (*Pliomastodon*) *adamsi* (Hibbard). KU6983, LM^1 and M^2. Occlusal view. $\times\frac{1}{2}$.
5. *Gigantocamelus spatulus* (Cope). KU7166, scapula. Lateral view. $\times\frac{1}{5}$.
6. *Gigantocamelus spatulus*. KU7165, calcaneum. Medial view. $\times\frac{1}{2}$.

M^3. I^3 is known only from the alveolus. Canines and P^1 are greatly reduced in comparison to those of the males.

Skull, no. 7159, (Fig. 6A) female, lacks anterior part of skull in front of P^3, and left zygomatic arch. The basisphenoid is not damaged and presents a noticeable contrast to that of *Camelus*. It is high and its ventral surface ends in a decidedly sharp ridge which extends forward beyond the pterygoid processes. Anterior border of posterior narial aperture ends at midline of first lobe of M^3. The palate is not crushed. Distance between RM^3 and LM^3 taken between the centers of the posterior lobes is 92.0 mm; distance between RP^3 and LP^3 is 55.0 mm. Narrowest constriction of rostrum of skull is 46.5 mm, in comparison to 66.0 mm in the male, no. 6943. Infraorbital foramen is situated above P^4. Greatest vertical diameter of foramen is 21.0 mm, compared to 20.0 mm in a

TABLE 4.—*Jaw measurements of* Gigantocamelus spatulus *(Cope)*

	No. 6945 ♂	No. 6947 ♂	No. 7160 ♂	No. 6946 ♂	No. 7161 ♀	No. 7200 ♂
	millimeters					
Length, maximum, including incisors	—	—	—	673.0	—	—
Length from posterior of condyle to anterior of canine	646.0	—	—	632.0	—	—
Depth of ramus below anterior edge of M_3	103.0	104.0	97.0	84.0	91.0[a]	85.0
Depth of ramus, midway, between C and P_3	68.0	71.0	63.0	52.0	59.0	—
Length of dental series (C-M_3 inclusive, alveolar)	447.0	—	418.0	448.0	401.0	—
Length, alveolar, of premolar series including P_1	368.0	—	350.0	358.0	—	—
Length, alveolar, P_3–M_3	217.0	—	205.0	213.0	198.0	212.0
Length, alveolar, P_3–P_4	58.0	50.0	39.0	51.0	51.0	50.0
Length, alveolar, M_1–M_3	161.0	—	163.0	163.0	161.0	163.0
Diastema, C–P_1	54.0	58.0	30.0	60.0	—	—
Distance from C to P_3	205.0	175.0	172.0	195.0	176.0	—
Distance, P_1–P_3	139.0	105.0	121.0	121.0	—	104.0
Height of ascending ramus	360.0[a]	—	317.0[a]	300.0[a]	—	—
Depth of ramus below anterior end of M_1	108.0	98.0	87.0	75.0	78.0	79.0
Height of canine above alveolar border	45.0	51.0	—	64.0	30.0	—
Anteroposterior length of canine at alveolar border	34.0	37.0	—	33.0	20.0	—
Trans. width of canine at alveolar border	25.0	26.0	—	24.0	13.0	—
Distance from P_3 to anterior edge of I_3	—	249.0	—	284.0	—	—
Width of incisor series	—	112.0	—	110.0	—	—
Width between canines at alveolar border	—	82.0	—	61.0	—	—
Width across tips of canines (outside)	134.0	170.0	—	—	—	—

[a] Approximate.

recent skull of *Camelus*, no. 13513KU. In *Camelus*, the foramen is situated above anterior edge of M^1. The orbit of skull No. 7159, is round with a vertical height of 74.0 mm, and transverse diameter of 73.0 mm. Dorsal process of jugal extends posteriorly onto surface of squamosal for 32.0 mm. Ventral extension of jugal extends 87.0 mm, along ventral surface of squamosal. Characters of the dentition are the same as in the male, no. 6943. There is a small supraorbital notch in both the males and females, not as deep as in *Camelus* nor constricted at the anterior border as in *Camelus*. Meade (1945, p. 531) reports, "a large vacuity located just above and anterior to the orbit." No vacuity occurs, in this region, in the skulls here described. The bone is thinner in this area and the reported vacuity may be due to the breaking of the bone, or, if ever present in these skulls, it was very small and closed due to slight lateral crushing.

A number of isolated upper canines were recovered (Fig. 3B). The type of wear on these teeth differs with each tooth. No. 7525, a left upper canine with an overall length of 135.0 mm, the greatest anteroposterior width, 43.0 mm, and a transverse width of 36.0 mm, has all of the enamel

removed on the anterointernal surface where it came in contact with the lower canine. Upper canine, no. 7209, with an overall length of 124.0 mm, greatest anteroposterior width of 45.0 mm, and a transverse width of 34.0 mm, still possesses a 14.0 mm enamel band at its narrowest point.

TABLE 5.—*Skeletal measurements of* Gigantocamelus spatulus (*Cope*)

Radia-ulnae	No. 6951	No. 7203	No. 7168	No. 7510
	millimeters			
Length, maximum	825.0	760.0[a]	—	—
Greatest width at sigmoid notch	137.0	135.0	134.0	—
Greatest width at distal end	129.0	—	133.0	134.0
Length, articular, proximal end to sigmoid crest	705.0	—	713.0	646.0
Greatest articular width, distal end	114.0	—	115.0	117.0
Metacarpals	**No. 7518**	**No. 7682**		
Length, maximum	448.0	455.0		
Width, proximal end	103.0	106.0		
Width, distal end	136.0	140.0		
Metatarsals	**No. 6952**	**No. 7162**	**No. 7683**	**No. 7206**
Length, maximum	—	435.0	—	431.0[a]
Length of front side	420.0	415.0	375.0	420.0
Proximal width, maximum	95.0	88.0	91.0	89.0
Distal width, maximum	122.0	120.0	114.0	—
Tibia	**No. 6953**			
Greatest overall length	634.0			
Proximal width, maximum	187.0			
Distal width, maximum	120.0			
Calcanei	**No. 7199**	**No. 7515**	**No. 7165**	
Greatest overall length	213.0	203.0	210.0	

[a] Approximate.

LOWER JAWS: a pair of lower jaws, no. 6945, (Fig. 5B) of a male without the incisors, RP_1, RP_3, and LP_3; male , no. 6947, (Fig. 8A) lower jaws without posterior part, broken just posterior to second lobe of RM_3, and just anterior to LP_3; male, no. 7160, lower jaws lacking incisors and canines, and the right ramus missing posterior to RP_3; no. 7200, complete right ramus of male; no. 6946, (Fig. 9C) complete lower jaws of a male, with tip of right canine missing; right and left rami of female, no. 7161, (Fig. 5A) lacking posterior part back of M_3, were found with skulls of Nos. 6943, 6944, 7159 and 7167.

Tips of the lower incisors in young animals are broad, thin, and spatulate. Crowns wear down rather rapidly. Occlusal surface wears to an elongated oval, becoming nearly circular with further wear. Many times the tooth is worn down below the enamel surface.

In all specimens except one, lower canines were worn on their posterior face where they came in contact with upper canines. In specimen no. 6945, lower canines are worn on their anterior face. Canines of males flare outward while those of females are greatly reduced and remain in line with incisors. Symphysis of lower jaws of males extends posteriorly to alveolus of P_1. In specimen no. 6947, symphysis extends 52.0 mm, posterior to P_1

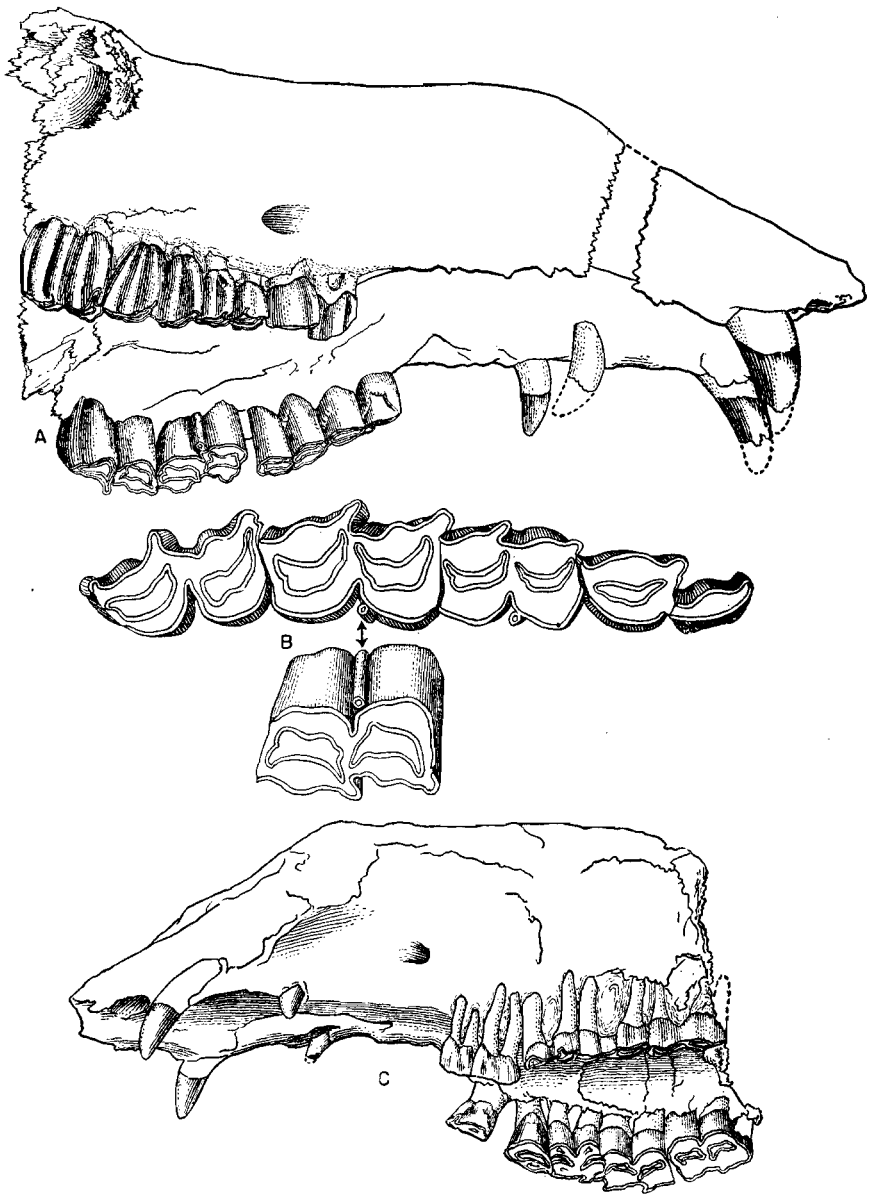


FIGURE 4.—Gigantocamelus spatulus (*Cope*)

(A) Anterior part of skull, male, KU6944. Lateral view. Approximate ×¼. (B) $RP^3 - M^3$ showing styles, of the above skull, KU6944. Occlusal view. Approximately ×½. (C) Anterior part of skull, female, KU7167. Lateral view. Approximately ×¼.

P_1, lacking in females, in the males is recurved with anterior and posterior enamel ridges.

P_2 is absent in both males and females.

P_3 is noticeably variable. In specimen no. 7160, a male, (Fig. 3D) it is single rooted and peg-shaped. An isolated single-rooted, peg-shaped P_3, no. 7233, was found which has an anteroposterior

crown length of 11.9 mm. This tooth is flattened on its posterior surface where it rested against P_4. Transverse width of its crown is 9.5 mm.

P_4 is molariform.

Anterior parts of M_1 and M_2 resemble anterior parts of M_1 and M_2 of *Tanupolama*.

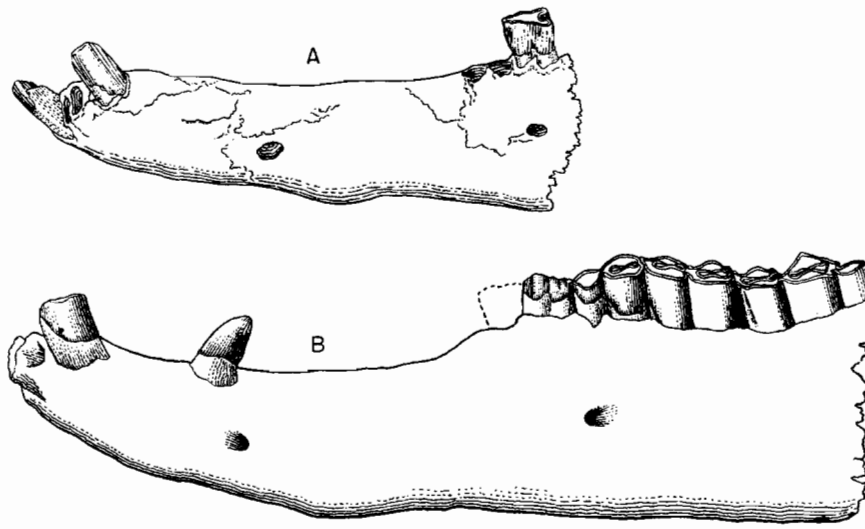


FIGURE 5.—Gigantocamelus spatulus *Cope*

(A) Female, KU7161, anterior part of left ramus. Note reduced canine and lack of P_1. Labial view. ×½. (B) Male, KU6945, anterior part of left ramus. Note well-developed P_1. Labial view. ×½

M_3 consists of 3 lobes (Figs. 6D, E; 9A, B). Posterior lobe of M_3 resembles that of *Tanupolama* since it is deflected labially and is not in line with first and second lobes along lingual side of tooth. The third, or posterior lobe, is set off from second lobe by re-entrant angles on both lingual and labial sides. Re-entrant angles are still present in old, worn, short-crowned teeth. In young teeth, third lobe approaches the condition observed in *Camelops* in that it is deflected lingually and is nearly in line with lingual edge of first and second lobes of M_3.

LIMB BONES: Massive, although for size of skull and vertebrae they are short compared to the limb bones of *Tanupolama*, (Table 5). No femurs and only fragmentary parts of pelvis and scapula were recovered.

Only a few complete vertebrae were recovered. The sacrum consists of 4 vertebrae (Pl. 4, fig. 1). Greatest overall length of sacrum, no. 7647, measured along centra is 222.0 mm; sacrum, no. 7681, 235.0 mm; sacrum, no. 7519, 221.0 mm.

A number of long thoracic vertebrae were encountered in the quarry. Whether these belong with *Gigantocamelus* or *Pliauchenia* is unknown. Centra and dorsal spines appear heavy enough for the large camel. Thoracic vertebra, no. 7169, (Fig. 7B) has an overall height of 785.0 mm; greatest anteroposterior width of dorsal spine, 68.0 mm; depth of centrum from neural canal, 78.0 mm. No measurements were given by Barbour and Schultz (1939) in regard to the vertebrae of their composite mount or other associated material. If these thoracic vertebrae belong to *Gigantocamelus*, as it appears, the camel was decidedly hump-backed and stood higher at the shoulders than has been shown in reconstructions of *Gigantocamelus*.

The astragalus is known from 10 or more specimens and the calcaneum from 6 or more specimens (Pl. 4, fig. 6). These are uniform and do not show individual variation.

Phalanges numerous in deposit and show considerable variation in size. A few second phalanges were found and these are rather broad, which may indicate development of a greater pad than in *Camelops*.

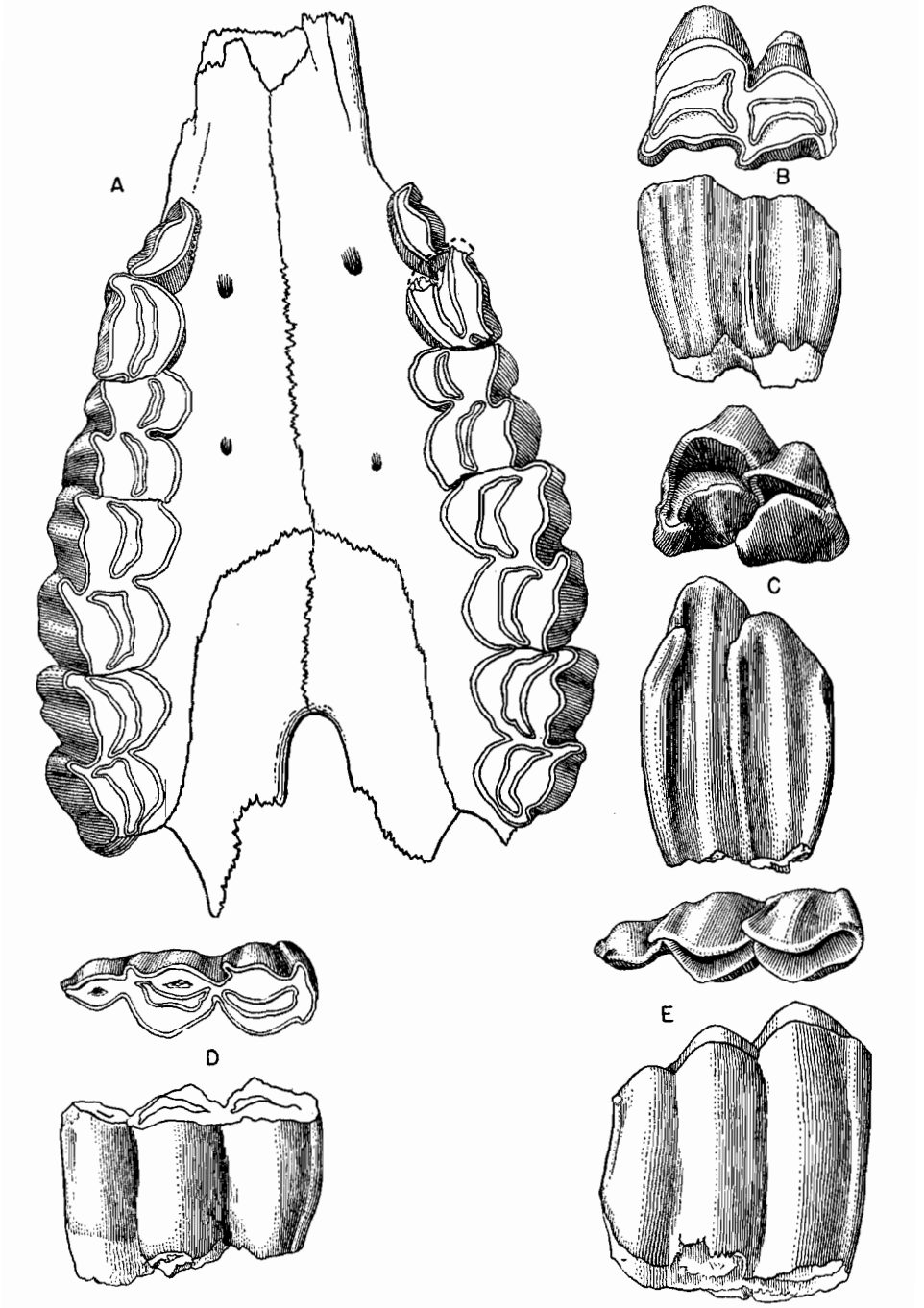


FIGURE 6.—Gigantocamelus spatulus (*Cope*)

(A) Anterior part of skull, female, KU7167. Ventral view. ×½. (B) RM^3, KU7171, worn. Occlusal and labial views. ×½. (C) RM^3, KU6938, unworn. Occlusal and labial views. ×½. (D) RM_2 KU7687, worn. Occlusal and labial views. ×½. (E) RM_4, KU7684, unworn. Occlusal and labial views. ×½.

FIGURE 7.—Gigantocamelus spatulus (*Cope*)

(A) Ulna-radius, KU6951. Front view. ×¼. (B) Dorsal vertebra, KU7169. Lateral view. ×¼. (C) Metatarsal, KU7162. Front view. ×¼.

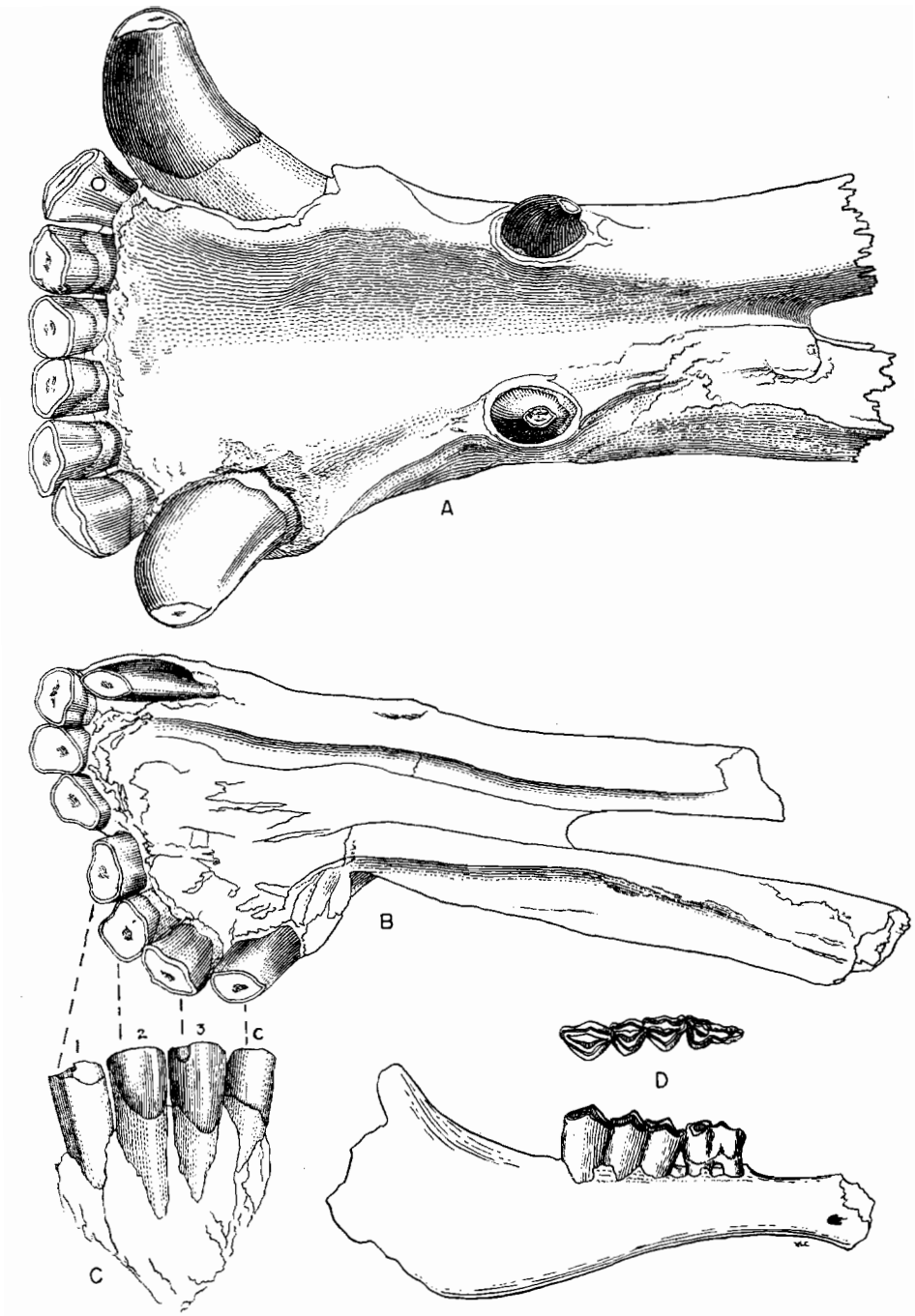


FIGURE 8.—Gigantocamelus *and* Tanupolama

(A) *Gigantocamelus spatulus* (Cope). KU6947, anterior part of lower jaws, male. Dorsal view. Approximately ×½. (B) *Gigantocamelus spatulus*. KU7201, anterior part of lower jaws, female. Dorsal view. Approximately ×½. (C) *Gigantocamelus spatulus*. KU7201, left $I_1 - C$. Anterolateral view. Approximately ×½. (D) *Tanupolama blancoensis* Meade. KU7500, right ramus, DP_3, DP_4. Labial and occlusal views. Approximately ×½.

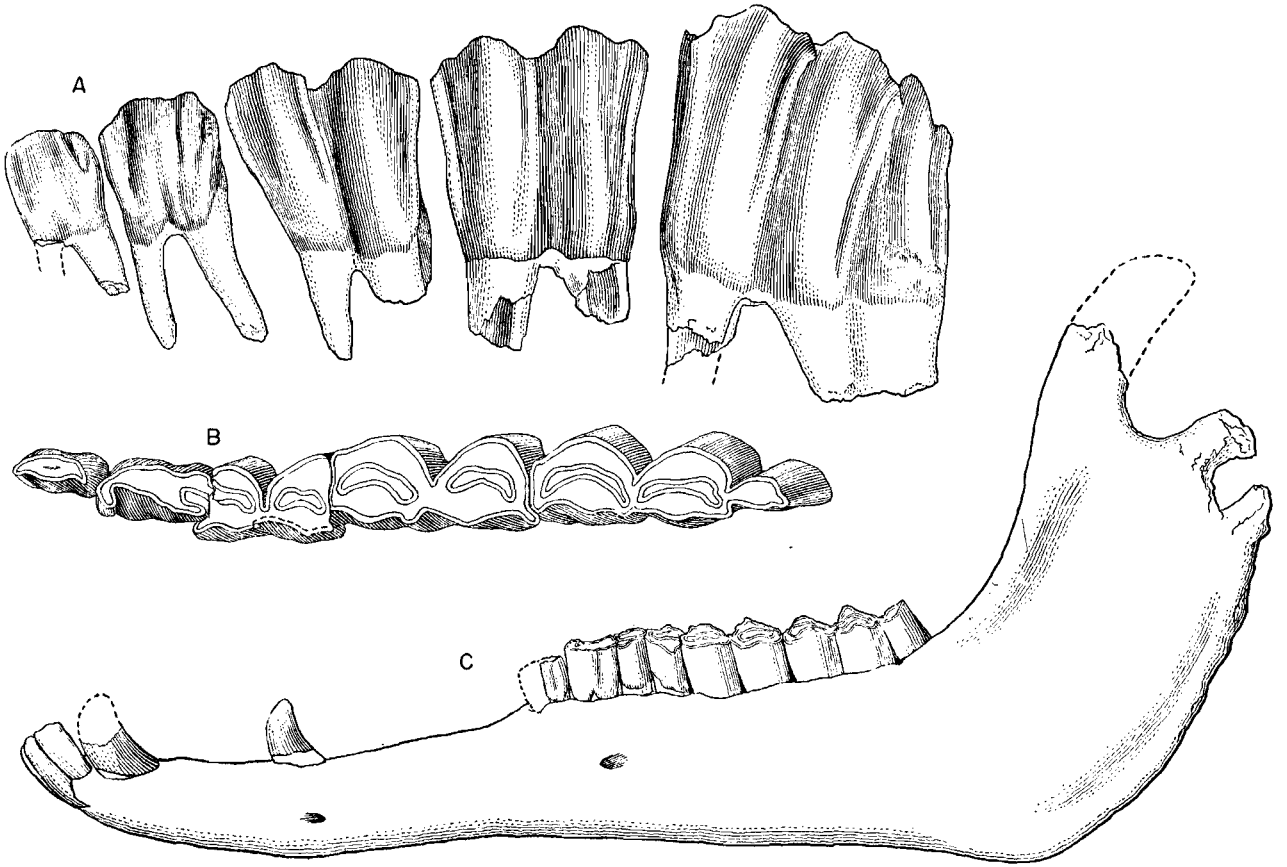


FIGURE 9.—Gigantocamelus spatulus (*Cope*)

(A) A composite series of unworn teeth, $RP_3 - M_3$. Lingual view. ×½. (B) $RP_3 - M_3$, KU6946. Labial view. ×½. (C) Left ramus, KU6946. Labial view. ×¼.

DISCUSSION: Parts of at least 21 individuals of *Gigantocamelus spatulus* were recovered, based on the count of right M_3. Many individual skeletal elements are lacking. In most cases the material confirms the findings of Cope, Barbour and Schultz, and Meade. The following information has been acquired from the study of the material in regard to the great camel; (1) in the deposit studied, the remains of males outnumber females 2 to 1; (2) there is considerable sexual dimorphism—the males are larger, with more heavily developed skulls and teeth, especially the canines. The upper canines have only a slight outward flare and the lower canines have a decided outward flare. P^1 and P^3 are well-developed in the male and caniform, while in the female P^1 and P^3 are caniform but reduced. The dental formula as given by Barbour and Schultz for the genus is that of the male, $I\frac{0-1}{3}$, $C\frac{1}{1}$, $P\frac{3}{3}$, $M\frac{3}{3}$. The female definitely lacks P_1, at least in the specimens examined, and has greatly reduced canines (Figs. 5A, 8B). The anterior parts of the lower jaws, no. 7201, a female, have canines with an anteroposterior width of 18.0 mm; and a transverse width of 10.0 mm. The spatulate-shape of the incisors is of short duration in both sexes. They soon wear to an oval grinding surface becoming nearly round in old age.

If the thoracic vertebrae which were recovered with the long dorsal spines are those of *Gigantocamelus*, the camel was decidedly hump-backed.

Gigantocamelus is considered distinct from *Megatylopus* Matthew and Cook because of the absence of the lachrymal vacuities and because the anterior border of the posterior narial aperture does not extend forward as in *Megatylopus gigas* Matthew and Cook.

Pliauchenia cochrani sp. nov.

(Figs. 10A, B, C)

HOLOTYPE: No. 7643, left ramus bearing vestigial P_1, alveolus of P_2, and P_4 — M_3; no. 7644, right ramus bearing vestigial P_1, P_3 — M_2; and M_3, no. 7180. All 3 specimens belong to the same individual, an adult animal.

HORIZON AND TYPE LOCALITY: Upper Pliocene, Rexroad formation, Keefe Canyon, SW¼ SW¼ sec. 34, T. 34 S., R. 30 W., Meade County, Kansas, Locality 22, Rexroad fauna.

DESCRIPTION OF TYPE: A camel the size of *Camelops sulcatus* Cope having a well-developed P_3, which is two rooted, and a vestigial P_1. Distinguished from *Tanupolama* by absence of anterior stylar processes on M_1, M_2, and M_3. M_3 is typical of *Camelops* in structure.

Measurements (mm) of holotype

	Left	Right
P_3, occlusal length	—	18.5
P_3, greatest width	—	10.0
P_4, occlusal length	23.1	21.8
P_4, greatest width	15.5	15.0
M_1, occlusal length	32.7	32.6
M_1, greatest width	23.8	24.0
M_2, occlusal length	39.2	39.8
M_2, greatest width	25.2	26.3
M_3, occlusal length	52.3	52.0
M_3, greatest width	24.3	21.7
Alveolar length, M_1–M_3, left ramus		119.5
Occlusal length P_3–M_3, right ramus		159.6
Alveolar length P_3–M_3, right ramus		166.2
Diastema from anterior edge P_1 to P_3, right ramus		66.2
Depth of right ramus (inside) below P_4		62.2
Depth of right ramus (inside) below M_1		73.2
Depth of left ramus (inside) below M_3		80.7
Distance from posterior edge of the mental foramen to the anterior edge of P_3, right ramus		62.5
Distance from posterior edge of the mental foramen to the anterior edge of P_4, left ramus		89.2

In the type, M_1 is deeply worn. M_3 has 2 roots, a well-developed root under first lobe with a large fused tripartite root supporting second and third lobes. Internal ridges on M_2 and M_3 are more strongly developed than in any specimens of *Camelops* examined. If jaws were not broken at posterior border of the symphysis, there would be no indication that P_1 exists. It is a well-developed tooth, but lacks at least 7.0 mm of penetrating surface of ramus. In right ramus, P_1 is well exposed, and situated at anterior border of mental foramen. It has an overall height of 31.2 mm, height of enamel crown is 15.8 mm, with an anteroposterior width of 14.5 mm. It is caniform and curves posteriorly. The specimen may be that of a female and the tooth may be found to be well-developed in the males.

Four isolated lower third molars, nos. 6967a and b, 7179, and 7181, are those of immature or young adult animals since the third lobe is set off at the occlusal surface from the inner surface of the other 2 lobes; also the third lobe at the occlusal surface appears oblique to the long axis of the tooth. In these specimens, with wear, the third lobe of these teeth would not appear set off from the second lobe, or oblique to the axis of the tooth, but would be flush and continuous with the inner surface of the 2 anterior lobes of M_3, as in the type.

This species is named for Mr. Henry Cochran of Meade, Kansas, who has contributed to the success of our work in that region during the past 12 years.

This species has been assigned to *Pliauchenia* because of well-developed P_3, and absence of P_2. The absence of P_1 is a sexual character in some forms of camels. This species definitely possesses characters of *Camelops* and may be intermediate between *Pliauchenia* and *Camelops*. Length of the tooth row indicates that this species is not large enough to belong to the form from the Blanco referred to *Camelops* cf. *kansanus* by Meade. When these camels are better known they may be found to be conspecific and the differences to be only sexual and individual. It appears without doubt that the specimens from the Blanco referred by Meade to the American Museum specimen, no. 20085, are limb bones of the same animal as the dentitions he referred to *Camelops* cf. *kansanus* Leidy.

Tanupolama blancoensis Meade
(Figs. 3C; 8D; 11A, B; Pl. 4, fig 2; Pl. 5, figs. 2, 3, 4, 5)

Tanupolama blancoensis MEADE, 1945, Univ. Texas, Pub. no. 4401, p. 535–536, Pl. 55.
Leptotylopus percelsus MEADE, *nomen nudum*, 1945, Univ. Texas, Pub. no. 4401, p. 538.

Associated with the remains of *Gigantocamelus spatulus* and *Pliauchenia cochrani* in the Keefe Canyon quarry, a few jaws, teeth, and bones of the skeleton of a smaller, llama-like camel were found.

Tanupolama blancoensis is distinguished from *Tanupolama stevensi* (Merriam and Stock); *Tanupolama mirifica* Simpson; and *Tanupolama americana* Wortman by its larger size, slightly stronger mandible, and two-rooted P_3, which is reduced to a narrow blade-like crown. *Tanupolama longurio* Hay is a larger animal if the anterior first phalange measured and figured by Hay (1921) belongs to the type of *T. longurio*. Previously described forms of *Tanupolama* were taken from younger deposits. Scattered remains of *Tanupolama* are common in Pleistocene deposits of this area of the High Plains, though the material is not sufficient to make an adequate comparison with *T. blancoensis*.

It was unfortunate that Meade (1945) was not familiar with Matthew's use of the name *Leptotylopus* (Elias, 1931, p. 161, after Matthew, *Leptotylopus* sp. *nomen nudum*) and was unable to see the specimen to which he assigned the name *Leptotylopus percelsus*.

We are greatly indebted to G. G. Simpson for having the specimen A.M. no. 20085, prepared, and for making it available for our examination. The specimen is a large young male of *Tanupolama blancoensis* Meade. It was a surface find and badly weathered and broken. Anteroexternal style is developed on $M_1 - M_3$. Diastema between C and P_1 is 17.0 mm. Diastema between P_1 and P_3 is 45.0 mm. P_3 is strongly developed. Overall length of $P_3 - M_3$ is 123.0 mm. Restored length of left metacarpal is 465.0 mm, and of right metacarpal, 457.0 mm. Length of a right proximal phalange is 127.0 mm, and of a left proximal phalange, 130.0 mm. Right metatarsal length is 428.0 mm, and length of a posterior proximal phalange is 113.0 mm. Restored overall length of right

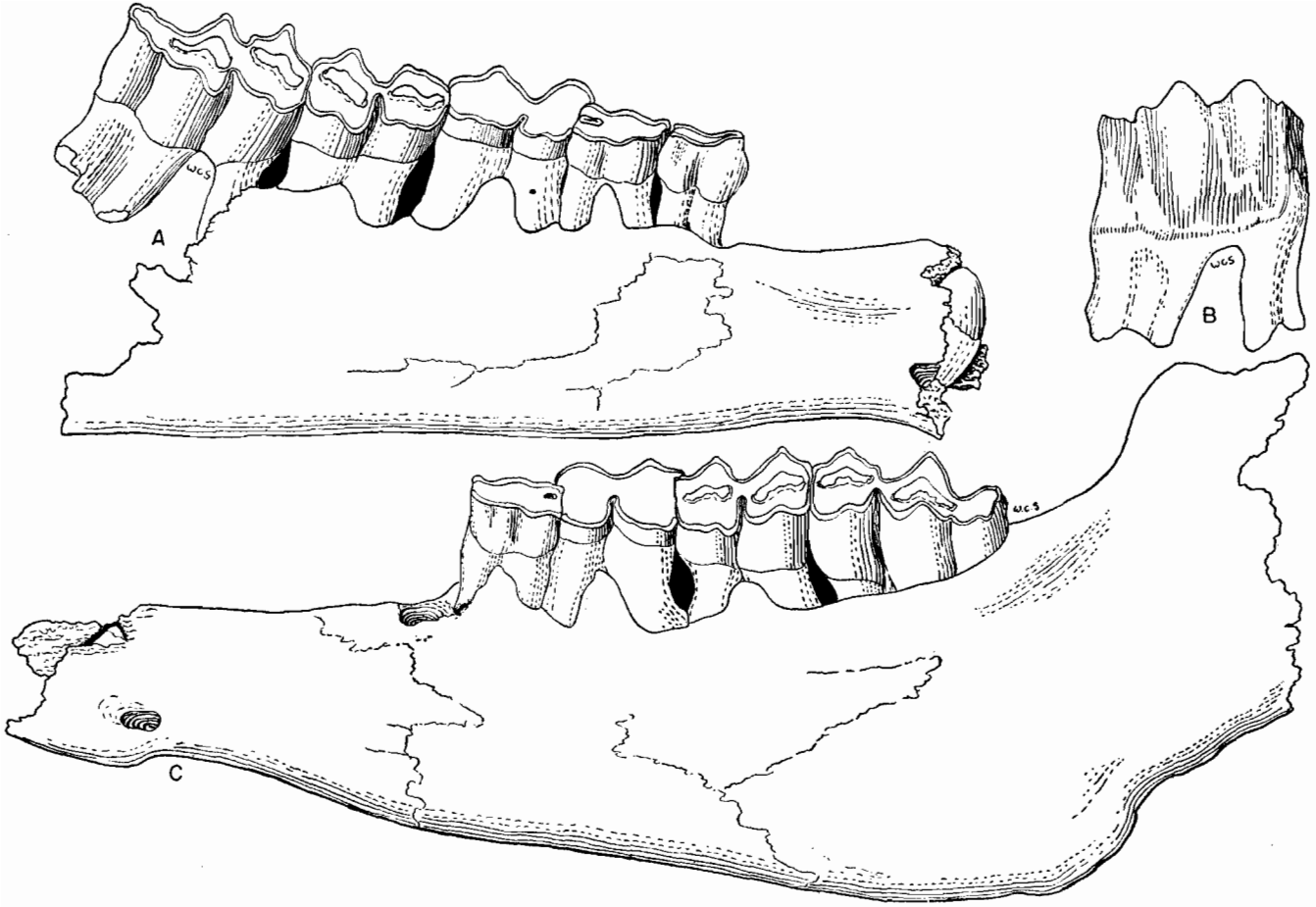


FIGURE 10.—Pliauchenia cochrani *sp. nov.*

(A) Right ramus, P_1, P_3— M_3, holotype KU7644. Labial view. ×½. (B) Left M_3, KU7181. Lingual view. ×½. (C) Left ramus, P_1, P_4 — M_3, holotype, KU7643. Labial view. ×½.

tibia fibula is 530.0 mm; left is 505.0 mm long. Skeletal elements referred by Meade (1945, p. 538) to this form do not belong to *Tanupolama blancoensis* but are considered as belonging to *Camelops* or *Pliauchenia*.

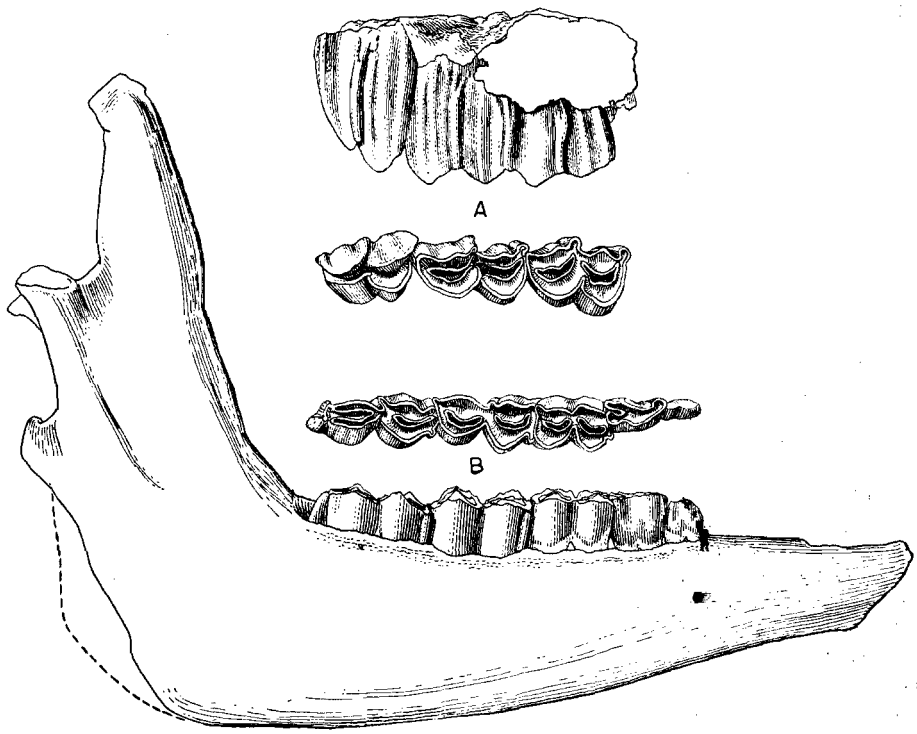


FIGURE 11.—Tanupolama blancoensis *Meade*

(A) $RM^1 - M^3$, KU7141. Labial and occlusal views. ×½. (B) Right ramus, $P_3 - M_3$, KU6962. Labial and occlusal views. ×½.

The specimens of *Tanupolama* recovered in Keefe Canyon possess the following characters:

P_4 has a narrow crown, and a deep cleft in posterior margin in young specimens. With wear, cleft is reduced to a rounded pit.

M_1 in early stage of wear possesses an anteroexternal style which disappears with wear.

M_2 has a well-developed anteroexternal and anterointernal style.

M_3 has a more strongly developed anterior style than M_2. Third lobe of M_3, in an unworn tooth (Fig. 11B), has form of an elongated cone with its apex closely applied to posterior surface of second lobe and its base extending downward and supported by a distinct third root. As this lobe is worn down at triturating surface, crown of lobe becomes more and more conspicuously a part of the tooth (Fig. 3C). This increase in prominence of the third lobe increases anteroposterior diameter of that tooth as well as molar series. Meade (1945, p. 535) states that the , "anterior lobes of M_1 and M_2 are but slightly wider basally than the posterior lobes"; width of anterior and posterior lobes of M_1 and M_2 depend upon stage of wear. In specimen no. 6962, posterior lobe of M_1 is wider than anterior lobe of M_1 while anterior lobe of M_2 is wider than posterior lobe of M_2. In specimen no. 7183, lobes of M_1 are equal, though anterior lobe of M_2 is wider than posterior lobes of M_2. Specimen no. 7493 has well-worn teeth; and posterior lobe of M_1 is wider than anterior lobe; this condition also exists in M_2.

All of the molars develop long roots. There is no trace of a second premolar in any of the 3 man-

dibles preserved. The mandibular condyle is saddle-shaped at articular surface; the angle is not inflected as is common in Recent *Lama*.

Specimen no. 7500 is the ramus of an immature animal (Fig. 8D) with DP_3 and DP_4. DP_3 has an anteroposterior length of 16.5 mm, its greatest width is 7.0 mm . DP_4 has an anteroposterior length of 33.7 mm, and a width of 11.8 mm. Distance of DP_3 from mental foramen is 28.0 mm.

Three maxillaries were recovered with molar series, all of young animals with unworn M^3. Specimen no. 7141 is a right maxillary with $M^1 - M^3$, anteroposterior length of molar series is 80.0 mm, while that of specimen no. 7144, a left maxillary, is 83.0 mm.

STRUCTURE OF THE FORE LEG: Length of humerus of *T. blancoensis* is nearer to length of *Camelus* than to that of Recent *Lama*. Humerus of *T. blancoensis* (Pl. 5, fig. 5) is approximately nine-tenths as long by axial measurement as humerus of *Camelus*. Shaft is somewhat straighter than in either *Camelus* or *Lama*. Deltoid crest does not terminate in a definite process. Pronator ridge is not marked by a rugose line. External condyle, like that in the llama, has a deep pit for ligamentary insertion, but has no tuberosity. Proximal end of bone has been modified slightly by abrasion of mesial surface, but does not appear essentially different in porportions from that of *Lama*.

A well-preserved ulna-radius, no. 7491, (Plate 5, fig. 4) as well as several incomplete specimens, gives the essential characters of that bone. Length of radial element between articular facets is practically the same as that of the museum specimen, no. 13513KU, of the dromedary. By this measurement, the radius is one-tenth longer in proportion to length of humerus than in the specimen of *Camelus*, but it is much more slender. Greatest width at distal end is 63.0 mm. Olecranon is broad and flat and apparently shorter in proportion to length of shaft than that of the llama; though epiphysial portion of olecranon is missing from specimen, overall length is 550.0 mm. Ulnar element is almost as completely co-ossified at distal end as that of the llama. Interosseous foramen has a more elevated position, and foramen at proximal end has a similar position to that of the llama. Superior margin of the olecranon is straight rather than concave as in the llama.

Carpus offers few variations from that of Recent *Lama*. Unciform presents an angular surface to the trapezoid and is notched into the latter. Lunar has a more elongate posteroproximal facet.

The metacarpal has a length and slenderness comparable to that of the ulna-radius. Overall length is 422.0 mm in specimen no. 7498, and 430.0 mm in specimen no. 7497 (Pl. 5, fig. 3). It is more than one-sixth longer than same bone in the dromedary. The 2 elements are firmly co-ossified in shaft. Distal end is narrow and is deeply cleft at median line. The leg as mounted stands 1422.0 mm high.

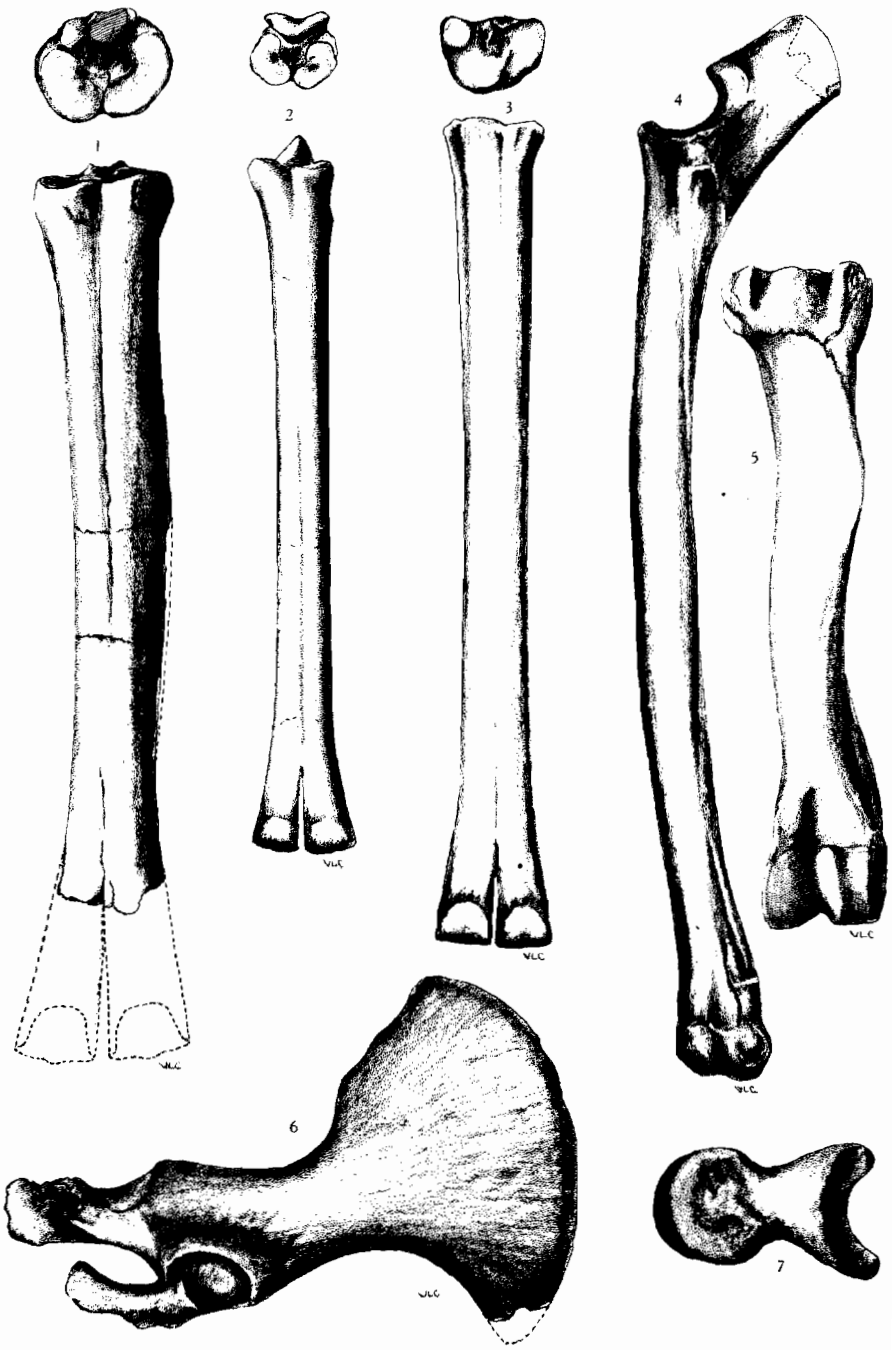
Of the phalanges, 10 entire specimens are preserved. The first phalanges are long and slender and are consistent with length of leg bones and great stature of animal indicated by assembled fore leg. First phalanges preserved vary from 84.0 to 108.0 mm long. Shafts are straight and slender, ligamentary and muscular attachments are lightly but clearly marked. Distinction between phalanges of fore and hind foot rests chiefly upon length of muscular attachments at proximal end, those of hind foot are larger. Only 2 second phalanges are preserved. One of these measures 42.0 mm in its axial length.

A single metatarsal, no. 7499, (Pl. 5, fig. 2) was recovered which has an overall length of 371.0 mm, a width of 45.0 mm at proximal end, and 55.0 mm greatest width at distal end.

PLATE 5.—SKELETAL PARTS OF CAMELS AND GROUND SLOTH

Figure

1. *Pliauchenia cochrani* sp. nov. KU7646, left metatarsal. Anterior view. $\times\frac{1}{4}$.
2. *Tanupolama blancoensis* Meade. KU7499, metatarsal. Anterior view. $\times\frac{1}{4}$.
3. *Tanupolama blancoensis*. KU7497, left metacarpal. Anterior view. $\times\frac{1}{4}$.
4. *Tanupolama blancoensis*. KU7491, left ulna-radius. Lateral view. $\times\frac{1}{4}$.
5. *Tanupolama blancoensis*. KU7645, left humerus. Anterior view. $\times\frac{1}{4}$.
6. *Gigantocamelus spatulus* (Cope). KU7648, right side of pelvis. Lateral view. $\times\frac{1}{8}$.
7. *?Megalonyx* sp. KU7547, phalanx. Lateral view, $\times\frac{1}{2}$.



SKELETAL PARTS OF CAMELS AND GROUND SLOTH

SUMMARY

The vertebrates recovered from the Keefe Canyon quarry in many cases duplicated forms previously known from the Rexroad fauna. From this study 10 species have been added to the mammalian fauna of the Rexroad. Eight of the species have been taken from the Keefe Canyon quarry. The Rexroad fauna is now the most completely known fauna from a given horizon of the High Plains. Among the known mammals, 10 genera and 31 species are confined to the upper Pliocene. For reference to the invertebrates see Baker (1938), Hibbard (1941) and Franzen and Leonard (1947). Taylor (1941; 1942) described the reptiles and the frogs and toads. Wetmore (1944) reported upon the bird remains from the Rexroad formation. The following mammals are now known:

Mammalia
- Insectivora
  - *Sorex taylori* Hibbard
  - *Sorex?* sp.
  - *Hesperoscalops rexroadi* Hibbard
- Chiroptera
  - genus?
- Edentata
  - *Megalonyx?* sp.
- Rodentia
  - *Paenemarmota barbouri* Hibbard and Schultz
  - *Citellus howelli* Hibbard
  - *Citellus rexroadensis* Hibbard
  - *Geomys quinni McGrew*
  - *Liomys centralis* Hibbard
  - *Perognathus gidleyi* Hibbard
  - *Dipoides rexroadensis* Hibbard and Riggs
  - *Procastoroides lanei* (Hibbard)
  - *Onychomys gidleyi* Hibbard
  - *Symmetrodontomys simplicidens* Hibbard
  - *Bensonomys arizonae* (Gidley)
  - *Peromyscus kansasensis* Hibbard
  - *Baiomys rexroadi* Hibbard
  - *Sigmodon intermedius* Hibbard
  - *Parahodomys quadriplicatus* Hibbard
  - *Ogmodontomys poaphagus* Hibbard
- Carnivora
  - *Canis lepophagus* Johnston
  - *Canis* sp.
  - *Borophagus diversidens* Cope
  - *Procyon rexroadens* Hibbard
  - *Trigonictis kansasensis* Hibbard
  - *Martes foxi* Hibbard aed Riggs
  - *Spilogale rexroadi* Hibbard
  - *Brachyprotoma breviramus* Hibbard
  - *Taxidea taxus* (Schreber)
  - *Felis lacustris* Gazin
  - *Panthera* sp.
  - *Machairodus* or *Ailuraena* sp.
- Proboscidea
  - *Stegomastodon successor* (Cope)
  - *Mammut* (*Pliomastodon*) *adamsi* (Hibbard)
- Lagomorpha
  - *Pratilepus kansasensis* Hibbard
  - *Notolagus lepusculus* (Hibbard)
  - *Hypolagus regalis* Hibbard
  - *Nekrolagus progressus* (Hibbard)
- Perissodactyla
  - *Equus* (*Hippotigris*) *simplicidens* Cope
  - *Nannippus phlegon* (Hay)
- Artiodactyla
  - *Platygonus bicalcaratus* Cope
  - *Gigantocamelus spatulus* (Cope)
  - *Pliauchenia cochrani* Hibbard and Riggs
  - *Tanupolama blancoensis* Meade
  - Cervid (genus?)
  - Antilocaprid (genus?)

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