PAPERS OF THE MICHIGAN ACADEMY OF SCIENCE, ARTS, AND LETTERS
VOL. LII, 1967 (1966 MEETING)

GEOLOGY

NEW RODENTS FROM THE LATE CENOZOIC OF KANSAS

CLAUDE W. HIBBARD
The University of Michigan

PAPERS OF THE MICHIGAN ACADEMY OF SCIENCE, ARTS, AND LETTERS
VOL. LII, 1967 (1966 MEETING)

GEOLOGY

NEW RODENTS FROM THE LATE CENOZOIC OF KANSAS

CLAUDE W. HIBBARD
The University of Michigan

DURING the past 30 years a large series of isolated teeth and jaws of various rodents has been recovered from Pliocene and Pleistocene deposits in the Meade Basin in southwestern Kansas.

Careful collecting from different stratigraphic levels in these late Cenozoic deposits has produced the largest number of successive faunas known for a given geographical locality in the world.

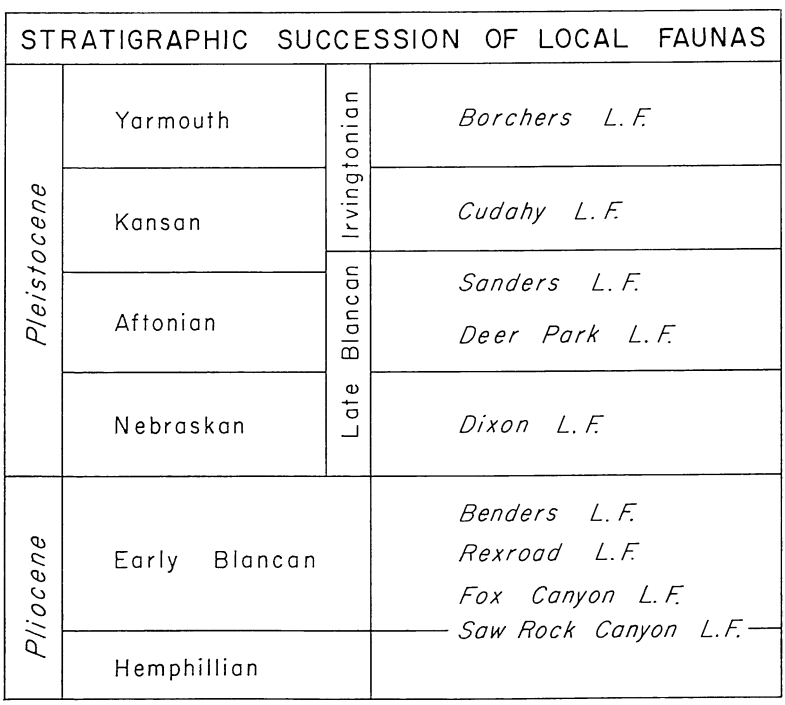

FIG. 1. Stratigraphic sequence of late Pliocene and early Pleistocene local faunas in western Kansas.

This series of specimens allows a better understanding of the individual and age variation within the different populations. The present study includes only the pocket gophers from the Pliocene Rexroad formation and the packrats from the Rexroad and the Pleistocene Crooked Creek formations. It has been found that in the past certain fossils have been incorrectly assigned to certain genera and species. Hibbard (1950) was unable to account for the difference between the fauna from the Fox Canyon locality (UM-Kl-47) in the Rexroad formation and the fauna from KU Loc. 3 of the Rexroad local fauna. At that time the local fauna from both localities was considered as part of the Rexroad local fauna, and the difference between the localities was considered to reflect environmental differences between the two areas. A detailed study of various members of the fauna from the two localities shows that the fauna from the Fox Canyon locality is older than the vertebrates from the Rexroad local fauna from Loc. 3. It appears that considerable time separates the two faunas.

Fossils are described from the Saw Rock Canyon, Fox Canyon, Rexroad and Borchers local faunas. Their stratigraphic positions are shown in Fig. 1.

Catalogue numbers not otherwise identified are those of the University of Michigan Museum of Paleontology (UMMP). Names of other collections are abbreviated as follows: KU, Kansas University Museum of Natural History; UCMP, University of California Museum of Paleontology; UMMZ, University of Michigan Museum of Zoology; and USNM, United States National Museum.

SYSTEMATIC DISCUSSION
CLASS MAMMALIA
ORDER RODENTIA

Family Geomyidae

Geomys (Nerterogeomys) smithi sp. nov.

(Fig. 2C)

Nerterogeomys cf. *minor* Hibbard 1950.

Holotype.—UMMP 25095, part of a right lower jaw with incisor and P_4-M_3 (Fig. 2C). Collected by Claude W. Hibbard and party in the summer of 1947.

Paratypes—Parts of two right lower jaws, Nos. 28258 with P_4-M_2, and 28265 with P_4-M_2 from Loc. UM-K1-47, Meade County, Kansas were collected by Claude W. Hibbard and party in the summer of 1951.

Horizon and type locality.—Upper Pliocene, Rexroad formation, Fox Canyon local fauna, Loc. UM-K1-47, in SW$\frac{1}{4}$ NE$\frac{1}{4}$ Sec. 35, T. 34 S., R. 30 W., Meade County, Kansas.

Diagnosis.—A pocket gopher larger than *Geomys adamsi.* The temporal pit between M_3 and the lingual side of the ascending ramus is deep, but not as deep as in Recent species of the same size. The mental foramen is just below the anterior extremity of the masseteric crest or more posteriorly placed as in *Nerterogeomys persimilis* (Hay), Fig. 2D.

Description of holotype.—The right lower jaw (No. 25095) is that of an adult gopher. The back part of the jaw is broken posterior to M_3 and the temporal pit. The jaw in comparison to *Geomys adamsi* is more massive. The diastemal region is more robust than that of the holotype of *Nerterogeomys? minor* (Gidley). The diastemal length from the anterior edge of P_4 to the center of the incisor is 6.0 mm. Its greatest width across the alveolus of the incisor is 3.9 mm. The masseteric crest is large and the anterior part of the jaw is much like that of *G. arenarius brevirostris* Hall. The diastemal length in the holotype of *N.? minor,* USNM 10498, is 5.4 and the greatest width is 3.5 mm.

The occlusal length of P_4-M_3 is 6.9 and of P_4-M_2, 5.9 mm. The occlusal length of P_4-M_2 of the holotype of *N.? minor* is 5.0 mm. The greatest width of the occlusal surface of P_4 is 2.1 mm; M_1 is 2.4. The same measurements of P_4 of the holotype of *N.? minor* are 1.9 and 2.0 mm.

The pattern of P_4 lacks the lingual dentine tract on the anteroloph. It is not visible on the lingual side. This is considered as a variable character. The dentine tract on the lingual side of the posteroloph is very narrow. M_1-M_3 have typical *Geomys* patterns. The pit labial to M_3 is as deeply developed, or deeper, than that of the holotype of *Nerterogeomys? minor.* The holotype of *N.? minor* has both the M_3 and part of the border of the pit missing (Fig. 2D).

This species is named for Harry Smith, former superintendent of Meade County State Park, who was most cooperative with us in our work.

Description of paratypes.—The right lower jaw, No. 28265, is that of an immature individual. The lingual and labial dentine tracts have not worn through on the anteroloph. The P_4 would have worn to a typical *Geomys* pattern. The mental foramen is situated as in the holotype of *G. smithi*. The occlusal length of P_4-M_3 is 5.6 mm. The temporal pit labial to M_3 is not as deep as in the adult holotype.

Specimen No. 28258 is that of an adult, but not as old as the holotype. M_3 and the posterior part of the lower jaw are lacking. The occlusal length of P_4-M_2 is 5.0 mm. The mental foramen is more posteriorly placed under the masseteric crest. The temporal pit labial to M_3 is as deep as in the holotype.

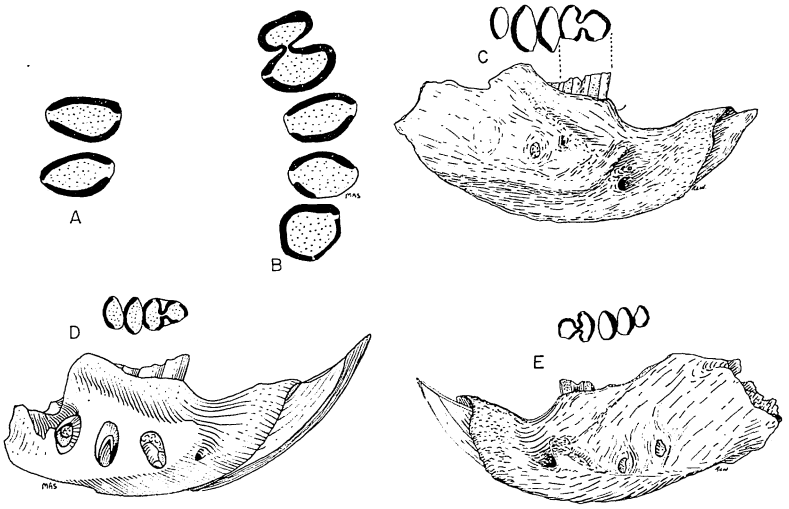

FIG. 2. A and B, *Nerterogeomys persimilis* (Hay), genotype, USNM 10492, occlusal view of right M^1 and M^2, left P^4-M^3. × 8. C, *Geomys* (*N.*) *smithi* sp. nov. holotype, UMMP 25095, right lower jaw with M_1-M_3. Labial and occlusal views. × 3. D, *Geomys* (*N.*) *minor* Gidley, holotype, USNM 10494, part of right lower jaw with P_4-M_2. Labial and occlusal views. × 3. E, *G.* (*N.*) *minor*, UMMP 29156, part of left jaw with P_4-M_3. Labial and occlusal views. × 3.

Remarks.—The enamel pattern of the genotype of *Nerterogeomys persimilis* (Hay) is based on an immature LP^4 pattern (Fig. 2A and B). The left P^4 has only the lingual dentine tract of the posteroloph worn through to the occlusal surface. The lingual den-

tine tract of the anteroloph is 0.3 mm below the occlusal surface. The labial dentine tract of the anteroloph is 1.1 mm below the occlusal surface, while the posterolabial dentine tract is also 1.1 mm below the occlusal surface. The dentine tracts of some of the earlier gophers did not extend as high on the side of the teeth as in some species such as *Geomys adamsi* and *G. jacobi*. A good example of a Pleistocene gopher that retains a closed enamel pattern on P_4 in young adult specimens is *G.* (*Parageomys*) *tobinensis* Hibbard from the Cudahy fauna of late Kansan age.

The genus *Nerterogeomys* Gazin (1942) is considered to be of subgeneric rank for those species of *Geomys* that have the mental foramen ventral to the extremity of the masseteric crest.

Geomys (*Nerterogeomys*) *minor* Gidley

(FIG. 2E)

Nerterogeomys minor Hibbard 1950, p. 171.

Fragmentary remains of this small gopher are common at Loc. 3. Most of the specimens are isolated teeth. A good lower jaw (UMMP 29156) with incisor, and P_4-M_3 of an adult individual (Fig. 2E) was recovered in the summer of 1951. It represents a pocket gopher the size of *Geomys adamsi* but is distinguishable by the mental foramen being situated below the anterior extremity of the masseteric crest and by a better developed pit between M_3 and the lingual side of the ascending ramus.

Following is a comparison with the holotype of *Geomys minor*, USNM 10494. Measurements of specimen UMMP 29156 will be given first and then will be followed by those of the holotype. The width of the incisor is 1.9 and 2.1 mm. The length of the diastema is 5.0 and 5.4 mm. The occlusal length of P_4-M_3 is 5.0 and of P_4-M_2 in the holotype is 5.0 mm. The occlusal width of M_1 is 1.7 and 2.0 mm.

In the University of Michigan collection there are 46 LP_4s (No. 53923) and 50 RP_4s (No. 53924) considered to belong to this small gopher from Loc. 3. There is also part of a right lower jaw (No. 53919) with P_4-M_2 from Loc. 3 that is like the left lower jaw No. 29156. The occlusal length of P_4-M_2 is 4.0 mm. Part of a right lower jaw with P_4 (No. 45490) from Loc. 2A and part of a left lower jaw (No. 53922) with P_4 and M_1 have the mental foramen situated as in the other specimens.

The small gopher from the Rexroad local fauna assigned to *Geomys* (*Nerterogeomys*) *minor* appears to belong to smaller gophers than the holotype of *G.* (*N.*) *minor*, but a large enough series is not available to show the individual variation in the two populations.

Geomys adamsi sp. nov.

(FIG. 3A-D)

Nerterogeomys cf. *minor* Hibbard 1950.

Holotype.—UMMP 25091, part of a left lower jaw with P_4-M_3 (Figs. C and D). Collected by Claude W. Hibbard and party in the summer of 1947.

Paratypes.—Parts of left lower jaws with P_4-M_3 Nos. 25090, 25093, 28266-28272; and right lower jaws, Nos. 25092, 28259-28264, from Loc. UM-K1-47, were collected by Claude W. Hibbard and parties in the summers of 1947 and 1951.

Horizon and type locality.—Upper Pliocene, Rexroad formation, Fox Canyon local fauna, Loc. UM-K1-47, in SW$\frac{1}{4}$ NE$\frac{1}{4}$ Sec. 35, T. 34 S., R. 30 W., XIT Ranch (formerly a part of the XI Ranch), Meade County, Kansas.

Diagnosis.—A pocket gopher smaller than *Nerterogeomys? minor* (Gidley) and *Pliogeomys buisi* Hibbard. The pit between M_3 and the ascending ramus is shallow and poorly developed. The mental foramen is anterior to the anterior extremity of the masseteric crest.

Description of holotype.—The lower jaw (No. 25091) is that of an adult gopher. The occlusal length of P_4-M_3 is 5.2 mm. The incisor is missing. The distance from the posterior surface of the articular condyle to the posterior border of the alveolus of M_3 is 7.5 mm. The greatest width of the occlusal surface of P_4 is 1.6 mm, of M_1 is 1.8 mm. The mental foramen is 1.8 mm anterior to the masseteric crest. The cheek teeth are ever-growing. This species is named for David Adams of the XIT Ranch, who was most cooperative in our study.

Description of paratypes.—In all of the paratypes the mental foramen is anterior to the masseteric crest. The pit between the M_3 and the lingual side of the ascending ramus for the insertion of

the temporal muscle is shallow. It is slightly deeper in the holotype of *Pliogeomys buisi*. The *Nerterogeomys* cf. *minor* with which *Pliogeomys* was compared by Hibbard (1954, p. 353) were specimens from the Fox Canyon locality. The pit in *Geomys smithi* is much deeper and larger than that of *P. buisi*. In the series of paratypes there are lower jaws Nos. 28259, 28263, and 28268 of immature specimens. The occlusal length of P_4-M_3 is 4.4, 4.6, and 4.6 mm. In 10 adult specimens the occlusal length of P_4-M_3 ranges from 4.7 to 5.5 mm, average 5.02 mm. The maximum width of the

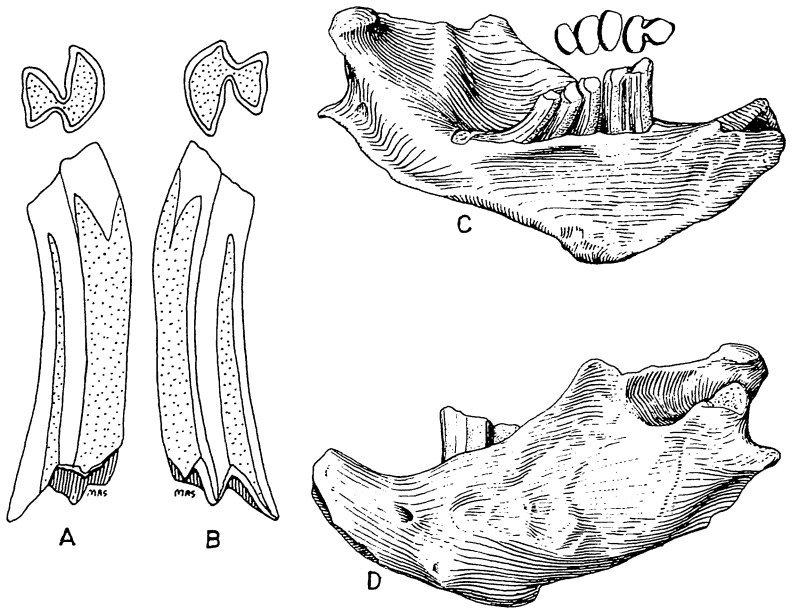

FIG. 3. *Geomys adamsi* sp. nov. A and B, left P^4, UMMP 43880, of young adult, A, lingual and occlusal, and B, labial and occlusal views. × 8. C and D, UMMP 25091, left lower jaw with P_4-M_3 of holotype, lingual, occlusal, and labial views. × 3. (Figs. C and D drawn by Michael O. Woodburne.)

cutting edge of the incisor in 5 specimens ranges from 1.6 to 1.7 mm, average 1.66 mm. At left P^4 (No. 43880, Figs. 3A and B) of a young individual shows the tooth in an early stage of wear.

Remarks.—No specimens of *Geomys adamsi* have been recognized from Locs. KU 2, 2A, 3, and 22, and UM-K3-53 of the Rexroad local fauna in Meade County (Hibbard 1950 and Woodburne 1961). Because of the shallow pit between M_2 and the lingual side

of the ascending ramus *G. adamsi* is considered as a more primitive *Geomys* than those recovered from Loc. 3 of the Rexroad local fauna. The difference between the faunas recovered from Fox Canyon (Loc. UM-K1-47) and Loc. 3 (the type locality of the Rexroad local fauna) has been noted in earlier studies. Taylor (1960, p. 68) in the study of *Gastrocopta franzenae* Taylor suggested that there might be a time difference between his Loc. 4b (part of Loc. UM-K1-47) and Loc. 3. Hazard (1961) in his study of *Citellus rexroadensis* Hibbard from Fox Canyon (Loc. UM-K1-47) found it to be smaller than specimens from Loc. 3. He concluded that, "It is perhaps more likely that a relatively short time interval separated the two deposits." Zakrzewski from his study of *Ogmodontomys* (in this volume) found that the population from the Fox Canyon locality is intermediate between the species *O. sawrockensis* Hibbard and *O. poaphagus* Hibbard. The specimens from Fox Canyon (Loc. UM-K1-47) are more closely related to *O. poaphagus* than to *O. sawrockensis*. On the basis of this evidence and that of *Zapus* as reported by Klingener (1963) and the gophers from the two localities, the local fauna is separated from the Rexroad local fauna and considered as a distinct and older local fauna from the Rexroad formation.

Geomys jacobi sp. nov.

(FIGS. 4A-D)

Geomys quinni Franzen, 1947.
Geomys quinni Hibbard and Riggs, 1949.
Geomys quinni Hibbard, 1950.
Geomys cf. *quinni* Hibbard, 1954, p. 353.
Geomys quinni Taylor, 1960, p. 28.

Holotype.—UMMP 41189, part of a right lower jaw with incisor, P_4-M_2 and the alveolus for M_3 (Figs. 4C and D). Collected in the summer of 1959, by Claude W. Hibbard and party.

Paratypes.—Parts of a right and a left lower jaw, UMMP 29648, from Loc. 3; and part of a right lower jaw with P_4, UMMP 35080; and a part of a left lower jaw with P_4-M_2, No. 35076, Loc. UM-K3-53 (Wendell Fox pasture).

Horizon and type locality.—Upper Pliocene, type locality of the

Rexroad local fauna, W½ SW¼ Sec. 22, T. 33 S., R. 29 W., KU Loc. 3, Meade County, Kansas.

Diagnosis.—*Geomys jacobi* is a pocket gopher, smaller than *G. quinni* McGrew from the Sand Draw local fauna of Nebraska. The pit for the insertion of the temporal muscle, between the lingual side of the ascending ramus and M_3 is much shallower than the pit in *G. quinni* and in *G. bisulcatus* Marsh from the Pleistocene of Nebraska, which is developed as in Recent *G. bursarius.*

Description of holotype.—The articular condyle and M_3 are missing. The incisor has a transverse width of 3.0 mm. The diastemal length is 9.0 mm. The occlusal length of P_4-M_2 is 6.1 mm. The masseteric ridge is distinct, but it is not as ventrally located as in specimens of Recent *Geomys bursarius.* The mental foramen is anterior to the masseteric crest.

Description of paratypes.—Parts of two lower jaws (No. 29648) lack the articular condyle and the capsular process for the base of the incisor. They have a shallow pit for the insertion of the temporal muscle between the lingual side of the ascending ramus and M_3 as in the holotype of *Geomys jacobi.* The pit is deeper than the pit in *G. adamsi* and shallower than the pit in *G. smithi.* Both of these specimens are from Loc. 3.

A right lower jaw, No. 35080 from UM-K3-53 in the Wendell Fox pasture in SW¼ SW¼ Sec. 33, T. 33 S., R. 29 W., Meade County, Kansas has the articular condyle and the capsular process for the base of the incisor. The pit between M_3 and the ascending ramus is shallow as in the other specimens. The capsular process and the angular process are not as well developed as in Recent specimens of *Geomys bursarius.* The left lower jaw, No. 35076, is of an old adult, the temporal pit is deeper than in the holotype.

A palate, No. 35079, with right and left P^4-M^3 was recovered at Loc. UM-K3-53. The occlusal length of the left P^4-M^3 is 7.5 mm.

Recovered at Loc. 3 were three deciduous fourth premolars. Occlusal patterns of a left DP_4, No. 53921 (Fig. 4A) and of a right DP^4, No. 53920 (Fig. 4B) are illustrated.

This species is named for Harry Jacob, who helped to collect the Rexroad local fauna and to develop the washing technique.

Remarks.—The gophers from the early Pleistocene Deer Park local fauna of Meade County, Kansas are assigned to *Geomys quinni* McGrew. A good series of *G. quinni* should be carefully compared

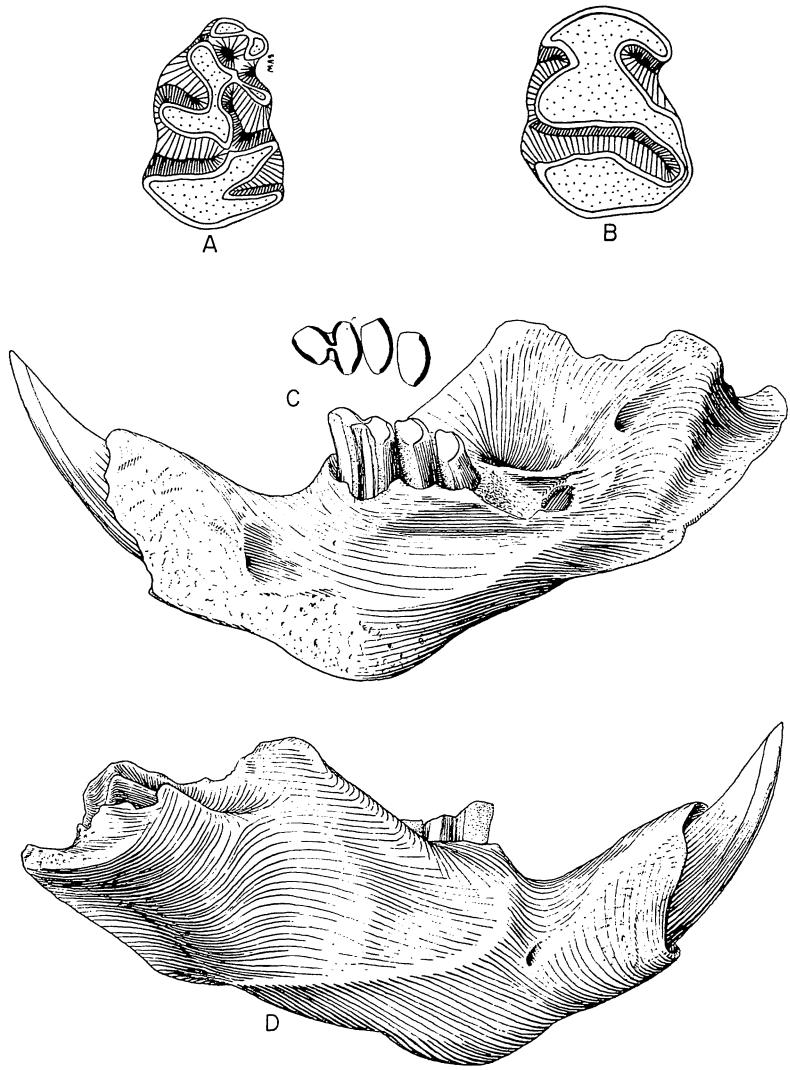

FIG. 4. *Geomys jacobi* sp. nov. A, left DP_4, UMMP 53921, occlusal view. × 10. B, right DP^4, UMMP 53920, occlusal view. × 10. C and D, right lower jaw with P_4-M_2, UMMP 41189, holotype, lingual, occlusal, and labial views. × 3. (Figs. C and D drawn by Michael O. Woodburne.)

with *G. bisulcatus* Marsh from the Pleistocene of Nebraska. On the basis of fragmentary jaws they appear to be the same species.

Family Cricetidae

Genus *Neotoma* Say and Ord (Wood Rat)

Neotoma Say and Ord. Jour. Acad. Nat. Sci. Phila. 4 (2) : 345.

Paraneotoma subgenus nov.

Type.—Parahodomys quadriplicatus Hibbard 1941.

Characters of the subgenus.—Neotoma (Paraneotoma) quadriplicatus Hibbard differs from all other Recent *Neotoma* in having shorter crowned teeth and thicker enamel. The anterocone of M^1 is narrower. Some M^1s in the early stage of wear have a shallow anteromedian groove. The paracone, hypocone, and metacone of M^1 and M^2 are more distinct as individual cusps than in Recent species. In *Paraneotoma* they wear to form a C-shaped occlusal pattern. Not all M^3s consist of four parts separated by four reentrant angles as shown by Hibbard (1941, pl. 2, figs. 4, 6, and 8). Some unworn M^3s lack the posterior internal reentrant angle and wear to a normal pattern as in Recent species. All of the upper molars possess better developed roots and the two posterior roots are not fused in old adults.

M_3 has a distinctive S pattern as in the subgenus *Hodomys*, though the enamel is thicker and the reentrant angles broader and shallower. The anterolabial reentrant angle is much shallower in *Paraneotoma*.

Remarks.—Parahodomys spelaeus Gidley and Gazin (1933) has much higher crowned teeth and thinner enamel as in Recent species. The M_3 is not normal, possesses a lingual posterior reentrant angle, and the occlusal surface will not wear to a typical S pattern as observed in *Neotoma (Hodomys) alleni* and *N. (Paraneotoma) quadriplicatus*. Posterior internal reentrant angles were observed on the LM_3, UMMZ 76066; and the right and left M_3s, UMMZ 76082, of *N. floridana osagensis* Blair. The genus *Parahodomys* will be discussed by John A. White in a future publication.

Neotoma (Paraneotoma) sawrockensis sp. nov.

(Figs. 5A and B)

Holotype.—UMMP 41396, a right M^1 of an adult. Collected by Claude W. Hibbard and party in the summer of 1953.

Paratype.—No. 53782, a left M_2, collected in the summer of 1953.

Horizon and type locality.—Lower Upper Pliocene, XI member of the Rexroad formation, Saw Rock Canyon, near the center of the west line of Sec. 36, T. 34 S., R. 31 W., XIT Ranch (west part of the old XI Ranch), Seward County, Kansas. Taken from the main quarry with the type of *Dipoides wilsoni* Hibbard.

Diagnosis.—Smallest of the known wood rats, with short crowned teeth. The anterolingual reentrant angle of M^1 poorly developed. The reentrant angles deepen near the center of the crown and will produce enamel lakes in an old stage of wear.

Description of holotype.—The right M^1 (Fig. 5A) is of an adult, and the reentrant angles do not extend to the base of the crown on the sides of the tooth. There is a 0.5 mm band of enamel around the side of the tooth below the reentrant angles. It is distinguished from *Neotoma (P.) quadriplicatus* by its smaller size. The greatest anteroposterior occlusal length of M^1 is 2.8 mm. The greatest width is 2.0 mm. The occlusal length of M^1 of *N. (P.) quadriplicatus* of comparable stage of wear is 3.5 mm and the width is 2.5 mm.

The left M_2 (Fig. 5B) is from a young adult. The anterior external reentrant angle extends more toward the mid axis of the occlusal surface than does this reentrant in *N. (P.) quadriplicatus.* The reentrant angles deepen toward the midline of the crown of the tooth. The occlusal surface of the tooth in adult and old adult stages of wear will form isolated enamel lakes. The greatest anteroposterior length of the occlusal surface is 2.4 mm. The greatest width is 1.9 mm.

Remarks.—The teeth of *Neotoma sawrockensis* have been compared with those of *Pliotomodon primitivus* Hoffmeister, UCMP 36030 and 37535, from the lower Middle Pliocene Mulholland local fauna of California. The occlusal length of M^1-M^3 of the holotype is 7.6 mm. The occlusal length of M^1 is 3.2 mm. Hoffmeister (1945) gave a detailed description of the teeth of *Pliotomodon*

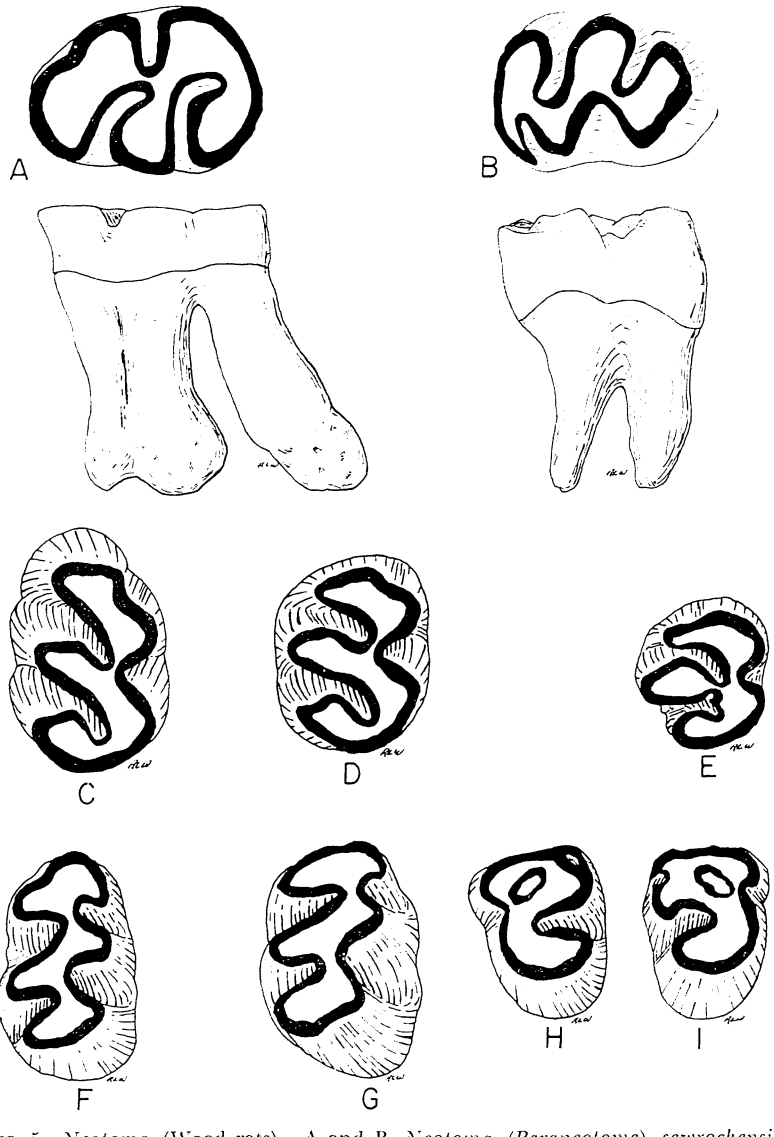

FIG. 5. *Neotoma* (Wood rats). A and B, *Neotoma* (*Paraneotoma*) *sawrockensis* sp. nov. A, right M^1, UMMP 41396, holotype. Occlusal and lingual views. × 8. B, left M_2, UMMP 53782, paratype. Occlusal and labial views. × 8. C-I, *Neotoma* (*Paraneotoma*) *taylori* sp. nov. All × 6. C, right M^1, UMMP 53841, holotype. Occlusal view. Paratypes, D, RM^2 (UMMP 53842); E, RM^3 (UMMP 53843); F, RM_1 (UMMP 53844); G, RM_2 (UMMP 53845); H, RM_3 (KU 6474a); and I, LM_3 (KU 6474b). Occlusal views. × 6.

and the assigned lower dentition. If the lower dentition does not belong to *Pliotomodon*, it then belongs to a closely related form and both are related to the ancestral *Neotoma* stock. I consider *P. primitivus* as a specialized side branch that split off from the ancestral *Neotoma* stock during Lower Pliocene time. The stock that gave rise to *Neotoma* must have separated off from a generalized cricetine in the Upper Miocene.

In general, lower dentitions are not as specialized as the upper teeth in cusp and cusplet development. The development of isolated enamel pits on teeth has occurred in a number of genera of rodents, e.g., *Oryzomys fulvescens* (Saussure), *Scotinomys teguina* (Alston), and *Mimomys stehlini* Kormos.

The large number of closely related genera (*Onychomys, Symmetrodontomys, Bensonomys, Baiomys, Reithrodontomys, Peromyscus,* and *Neotoma*) without lophs, lophids, styles, and stylids or, if present, are rudimentary in Middle and Upper Pliocene populations seems to indicate that the ancestral stock was a cricetine with simple dentition.

Neotoma (Paraneotoma) taylori sp. nov.

(Figs. C-I)

Parahodomys sp. Hibbard, 1942.

Holotype.—UMMP 53841, a right M^1. Collected in the summer of 1952 by Claude W. Hibbard and party.

Paratypes.—All of the paratypes were recovered from the Borchers Quarry. In the University of Kansas, Museum of Natural History are 45 isolated teeth No. 6474, collected in the summer of 1941 by Claude W. Hibbard and party. The 45 teeth consist of 3 LM_1s, 6 LM_2s, 2 LM_3s; 2 RM_1s, 4 RM_2s, 4 RM_3s; 7 RM^1s, 6 RM^2s, 1 RM^3s; 8 LM^2s, and 2 LM^3s. In the University of Michigan collection are 65 isolated teeth which consist of 9 LM_1s, 5 LM_2s, 1 LM_3; 4 RM_1s, 11 RM_2s, 3 RM_3s; 4 RM^1s, 8 RM^2s, 4 RM^3s; 7 LM^1s, 6 LM^2s, and 3 LM^3s, Nos. 53842-53857.

Horizon and type locality.—Middle Pleistocene, at the type section of the Crooked Creek formation, from the Atwater member, Borchers local fauna, interglacial (Yarmouth); $NE\frac{1}{4}$ Sec. 21, T. 33 S., R. 28 W., in the Borchers pasture, Meade County, Kansas.

Diagnosis.—Slightly smaller than *Neotoma quadriplicatus,* with

higher crowned teeth and less distinctive roots. The anterolingual reentrant of M^1 is shallow. Occlusal pattern of M^3 with two external and one lingual reentrant angles or folds. Occlusal pattern of M_3 S-shaped.

Description of holotype.—The right M^1 is from an adult wood rat (Fig. 5C). The anterolingual reentrant angle separating the anterocone and protocone is shallow as observed in some individuals of *Neotoma fuscipes* Baird and *N. micropus* Baird. The occlusal length is 3.3 mm. The occlusal width is 2.2 mm. The greatest length of the crown is 3.8 mm.

This species is named for William Ralph Taylor, who helped to collect the Rexroad and Borchers faunas in the summers of 1939, 1940, and 1941.

Description of paratypes.—There are 7 right M^1s, No. 6474, in the University of Kansas collection; 7 LM^1s, No. 53855, and 4 RM^1s, No. 53852, in the University of Michigan collection. These specimens lack the fourth small root present under the paracone of *Neotoma quadriplicatus.* In a series of 23 RM^1s of *N. quadriplicatus,* two teeth lacked the fourth root; in the rest it ranged in length from a slight protuberance to 1.0 mm in length. The anterolingual reentrant is shallow on all the M^1s of *N. taylori.* This angle or loop is better developed in *Pliotomodon primitivus.* The occlusal length of RM^2 (No. 53842, Fig. 5D) is 3.0 mm.

The roots of M^3 are generally three in number, though in some specimens the two anterior roots have fused. In *Neotoma quadriplicatus* there are three distinct and well-developed roots. The pattern of M^3 is made up of one lingual and two labial loops (Fig. 5E). The occlusal length of No. 53843 is 2.0 mm.

The occlusal length of the RM_1 (No. 53844, Fig. 5F) is 3.2 mm. The occlusal length of 3 RM_1s, No. 53849 is 3.1, 3.2, and 3.6 mm. The occlusal length of RM_2 (No. 53845, Fig. 5G) is 3.0 mm.

The M_3 wears to a typical S pattern (Figs. H and I, KU 6474a and 6474b). The occlusal length of RM_3 (KU 6474a) is 2.2 mm. The two roots are fused. The occlusal length of LM_3 (KU 6474b) is 2.1 mm. The two roots are distinct.

Summary

The Pliocene and early Pleistocene local faunas of the Meade Basin region have contributed to a better knowledge of the sequence of morphological changes in various groups of vertebrates.

The oldest geomyid recovered from the area is *Pliogeomys buisi* Hibbard (1954) from late Hemphillian deposits. *Pliogeomys* belongs to the *Geomys* group. The upper incisors have two grooves but the cheek teeth series are rooted; that is, in adult forms the molars close off at the base to form a single root. A broken occlusal enamel pattern occurs in old adults. The pit for the insertion of the temporal muscle, between the lingual side of the ascending ramus and M^3, is shallow. Teeth of *Pliogeomys* have been recovered with the Saw Rock Canyon local fauna.

The development of ever-growing cheek teeth occurred between the time the Buis Ranch and Saw Rock Canyon local faunas lived and the time the Fox Canyon local fauna lived. The Fox Canyon *Geomys* have ever-growing cheek teeth. *G. adamsi* from the Fox Canyon local fauna is not as advanced in the development of the temporal pit as it is in *G.* (*N.*) *smithi* from the same fauna. A more advanced *G. jacobi* replaces *G. adamsi* in the later Rexroad local fauna. Enough time separates the Rexroad local fauna and the later Deer Park and Sand Draw local faunas to allow the development of a larger and deeper temporal pit labial to M_3 and lingual to the ascending ramus in *G. quinni* from the two later faunas as in Recent *Geomys*.

Neotoma (*P.*) *sawrockensis* is the smallest species of *Neotoma* so far recovered from the Pliocene. The occlusal pattern of M_3 is unknown. Only two teeth of *Neotoma* are known from the Fox Canyon local fauna. *Neotoma* is abundant in the Rexroad local fauna. These specimens have an M_3 with an S-shaped occlusal pattern as in *N.* (*Hodomys*) *alleni*. This type of M_3 pattern persists in *N. taylori,* which occurs in the area in the Borchers local fauna of Yarmouth age. No series of specimens of *Neotoma* from intermediate ages between the Rexroad and Borchers local faunas of that region is known. It is not possible at the present time to demonstrate from tooth characters that *N.* (*Paraneotoma*) *quadriplicatus* is ancestral to the later groups of Recent *Neotoma*. It appears that it is closely related to or is the stock that gave rise to *N. alleni*.

ACKNOWLEDGMENTS

I am greatly indebted to many people of the Meade Basin area for their friendly interest and cooperation in our studies.

This study was greatly aided by permission to examine specimens under the care of W. H. Burt, of the University of Michigan

Museum of Zoology: William A. Clemens, Museum of Natural History, University of Kansas; C. Lewis Gazin and Clayton E. Ray of the U.S. National Museum; and R. A. Stirton, Museum of Paleontology, University of California.

Financial support to me for fieldwork in Meade County during the summer of 1959, and for the line drawings by Michael O. Woodburne (MOW) and Margaret A. Skeels Stevens (MAS), was provided by the National Science Foundation (Project-G5635). Fig. 1 and line drawings initialed RLW were made by Richard L. Wilson, Museum assistant.

LITERATURE CITED

FRANZEN, DOROTHEA S. 1947. The Pocket Gopher, *Geomys quinni* McGrew, in the Rexroad Fauna, Blancan Age, of Southwestern Kansas. Trans. Kans. Acad. Sci. 50 (1): 55-59.

GAZIN, C. LEWIS. 1942. The Late Cenozoic Vertebrate Faunas from the San Pedro Valley, Arizona Proc. U.S. Nat. Mus. 92 (3155): 475-518.

GIDLEY, J. W., AND C. L. GAZIN. 1933. New Mammalia in the Pleistocene Fauna from Cumberland Cave. Jour. Mammal. 14 (4): 343-357.

HAZARD, EVAN B. 1961. The Subgeneric Status and Distribution in Time of *Citellus rexroadensis*. *Ibid.* 42 (4): 477-483.

HIBBARD, CLAUDE W. 1941. New Mammals from the Rexroad Fauna, Upper Pliocene of Kansas. Am. Midl. Nat. 26 (2): 337-368.

——. 1942. Pleistocene Mammals from Kansas. Kans. Geol. Surv. Bull. 41 (6): 261-269.

——. 1950. Mammals of the Rexroad Formation from Fox Canyon, Meade County, Kansas. Univ. Mich., Contrib. Mus. Paleon. 8 (6): 113-192.

——. 1954. A New Pliocene Vertebrate Fauna from Oklahoma. Pap. Mich. Acad. 39 (1953): 339-359.

—— AND E. S. RIGGS. 1949. Upper Pliocene Vertebrates from Keefe Canyon, Meade County, Kansas. Geol. Soc. Am. Bull. 60: 829-860.

HOFFMEISTER, DONALD F. 1945. Cricetine Rodents of the Middle Pliocene of the Mulholland Fauna, California. Jour. Mammal. 26 (2): 186-191.

KLINGENER, DAVID. 1963. Dental Evolution of *Zapus*. *Ibid.* 44 (2): 248-260.

TAYLOR, DWIGHT W. 1960. Late Cenozoic Molluscan Faunas from the High Plains. U. S. Geol. Surv. Prof. Pap. 337: 1-94.

WOODBURNE, MICHAEL O. 1961. Upper Pliocene Geology and Vertebrate Paleontology of Part of the Meade Basin, Kansas. Pap. Mich. Acad. 46 (1960): 61-101.

ZAKRZEWSKI, RICHARD J. 1967. The Primitive Vole. *Ogmodontomys* from the Upper Cenozoic of Kansas and Nebraska. *Ibid.* this volume.