A SKELETON OF THE GEOMYOID RODENT, *GREGORYMYS CURTUS* (MATTHEW) FROM THE EARLY MIOCENE OF SOUTH DAKOTA

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ABSTRACT. — The features of the skeleton suggest closer relationship of *Gregorymys curtus* to the heteromyids than to the geomyids. Fossorial adaptations in *Gregorymys* are not like those seen in the geomyines.

These skeletal parts of *Gregorymys curtus* (Matthew) were collected from the lower part of the Rosebud formation, early Miocene, in Tylee Canyon, near Wounded Knee, Shannon County, South Dakota. I am indebted to the Chicago Natural History Museum for the privilege of studying the specimens and to the American Museum of Natural History for the use of comparative material.

Specimens from the Chicago Natural History Museum collection used in this study are: P26253—anterior part of skull, lower jaws, and part of skeleton; P26247—anterior part of skull, and lower jaws; P26248, P26249, P26251, P26254—anterior parts of skulls; P26259—a lower jaw; and P26252 — part of skeleton. The elements of the postcranial skeleton represented in this collection are: scapula, humerus, ulna, radius, pelvis, femur, tibiofibula, tarsus, and two lumbar and two caudal vertebrae.

In the following account comparisons are, for the most part, made with *Geomys bursarius* (Shaw), *Thomomys umbrinus* (Richardson), *Liomys pictus* (Thomas), and *Aplodontia leporina* (Richardson).

DESCRIPTION

Dimensions of these bones are presented in TABLE 1.

Skull — This new material permits certain additions and emendations to Matthew's account (1907) of the skull of *Gregorymys curtus*.

The muzzle is broader and shorter than that of *Thomomys* and tends to narrow slightly toward the tip. The postorbital area, on the other hand, is not as wide. The zygomatic arches equal those of *Thomomys* in width but are directed back at a greater angle. A crest for the attachment of the anterior part of the lateral masseter muscle is present on the zygomatic arch. This crest extends for a short distance, generally about two millimeters, onto the maxillary bone at the anterior border of the junction of the lateral and superior surfaces of the muzzle, where a ridge, confluent with the arch, extends forward. The anterior opening of the infraorbital canal has been forced forward on the rostrum as is characteristic of the "sciuromorph" zygomasseteric structure. The incisive foramina, varying in width from one-fourth to one-half their length, lie on the posterior part of the rostrum; the premaxillaries form the lateral and anterior borders of the foramina and the maxillaries form the posterior borders. The angle of divergence of the upper cheek-teeth, measured on four undistorted skulls at the protoloph of the fourth premolar, is 41, 41½, 42 and 42 degrees. Posteriorly, the nasals terminate in positions ranging from the ends of the maxillaries to a point 1.1 millimeters forward of the ends of the maxillaries. In all of the skulls the

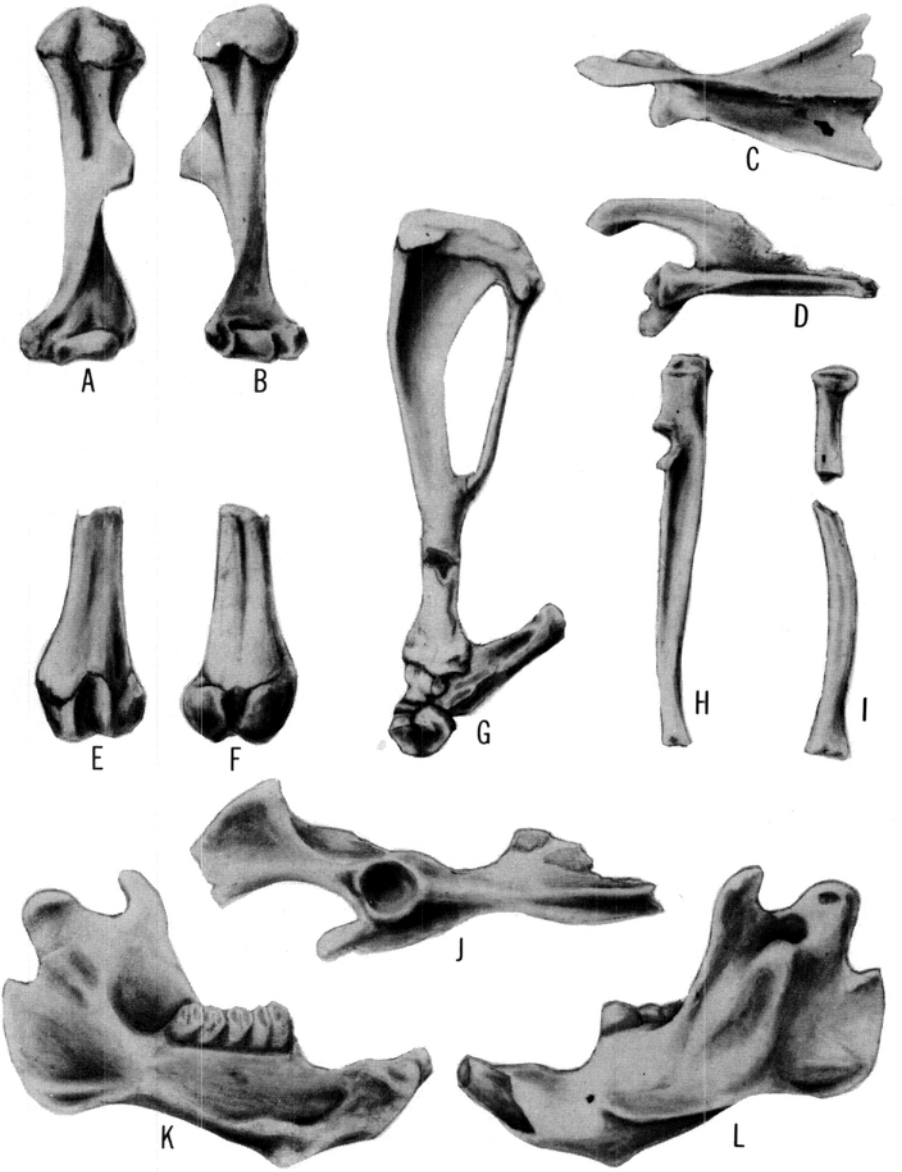

FIGURE 1.—*Gregorymys curtus* (Matthew); Chicago Natural History Museum No. P26252 (post-cranial skeleton) and No. P26253 (left jaw). (A, B) anterior and posterior views of left humerus; (C, D) lateral and posterior views of left scapula; (E, F) anterior and posterior views of distal end of left femur; (G) lateral view of left tibiofibula and tarsus; (H) lateral view of left ulna; (I) anterior view of proximal end of left radius and lateral view of distal end of right radius; (J) lateral view of right innominate; (K, L) medial and lateral views of left jaw.

TABLE 1.—Measurements (in mm) of the Skeletal Parts of *Gregorymys curtus* (Chicago Natural History Museum nos. P26247-8, P26251-4, and P26259).

SKULL	P26251	P26254	P26248	P26247	P26259	P26252	P26253
Width at zygoma	....	21.0	22.0	21.8	....	....	....
Width of muzzle at middle of nasals	8.0	7.2	8.2	7.5	....	....	7.6
Width of postorbital constriction	6.1	5.6	6.0	....	....	....	5.5
Height of skull at postorbital constriction	12.9	13.3	13.2	12.4	....	....	....
Length of diastema, alveolus to alveolus		10.8	12.5	9.6	....	....	11.3
Transverse width between outer borders of M^1		7.8	8.0	7.5	....	....	7.6
Width of palate exclusive of teeth at P^4		1.8	2.3	1.7	....	....	2.0
Width of palate exclusive of teeth at M^3		3.2	....	2.5	....	....	3.0
Width of right incisor		2.0	2.1	2.1	....	....	2.2
Crown length of right tooth row		6.8	....	6.5	....	....	6.7
Crown length of left tooth row		6.6	....	6.9	....	....	6.8
Alveolar length of right tooth row		8.3	....	....	....	....	8.6
Alveolar length of left tooth row		8.5	....	....	....	....	8.3
MANDIBLE							
Crown length of right tooth row				7.2	....	....	7.0
Same, left tooth row				....	7.2	....	6.7
Apex of coronoid process to ventral edge of angular process, right jaw				....	....	....	15.4
Same, left jaw				....	....	....	15.6
Apex of condyloid process to ventral edge of angular process, right jaw				....	....	....	13.0
Same, left jaw				....	....	....	13.5
Inner border of incisor alveolus to posterior border of angular process, right jaw				....	....	....	23.4
Same, left jaw				....	....	....	23.2
Crown of P_4 to posterior end of symphysis, right jaw				9.1	....	....	10.0
Same, left jaw				....	9.9	....	9.9
Lowest point in diastema to notch at posterior end of symphysis, right jaw				6.2	....	....	6.3
Same, left jaw				....	5.9	....	6.1
Alveolar depth of ramus at M_1, internal surface, right jaw				5.4	....	....	6.0
Same, left jaw				....	5.9	....	6.1
Crown depth of ramus at M_1, internal surface, right jaw				7.0	....	....	7.5
Same, left jaw				....	17.3	....	7.6
VERTEBRAE							
Length of centrum of lumbar vertebra (a)						3.8	....
(b)						3.8	....
Length of centrum of caudal vertebra						4.7	....
SCAPULA							
Mediolateral diameter of glenoid fossa						2.7	....
Width of neck						2.7	....
Depth of neck						1.9	....
Internal margin of acromion at base to tip of acromion						7.6	....
Depth of acromion at a point even with fossa						1.8	....
Width of spine at a point even with fossa						0.8	....
HUMERUS							
Overall length						21.8	21.3
Transverse width, proximal end						6.5	6.2
Transverse width, distal end						6.9	....
Transverse width of head						3.6	3.8
Proximodistal length of head						4.0	4.2
Top of head to apex of lateral crest						10.0	11.4

ULNA		
Length minus distal epiphysis	23.9	25.9
Width of bottom of semilunar notch	1.7	1.9
Depth, coronoid process to lateral ridge	3.8	4.2
Length from proximal lip of semilunar notch to end of olecranon	4.3	4.8
RADIUS		
Length (estimate)	[1]19.0	
Width of proximal head	2.9	
Width of distal end	2.9	
PELVIS		
Anteroposterior diameter of acetabulum	3.5	
Depth of iliac shaft	2.6	
Center of acetabulum to tip of dorsal ischial tuberosity	9.1	
Center of acetabulum to tip of ventral ischial tuberosity	12.2	
Estimated length of pelvis	30.0	
FEMUR		
Estimated length of femur	28.0	
Thickness of shaft at point 7.7 mm above the distal tip of bone	1.4	
Width of shaft at point 7.7 mm above the distal tip of bone	3.6	
Width of epicondyles	6.6	
Thickness of medial condyle	5.2	
Width of condyles on posterior side	5.6	
Width of patellar notch	1.9	
TIBIOFIBULA		
Length of tibial element	26.8	
Length of fibular element	15.0	
Greatest width of head	7.7	
Greatest width of distal end	5.3	
Diameter of shaft below union	2.0	
CALCANEUM		
Length	8.6	

[1] Slight damage.

lacrimals are poorly preserved but it seems evident that they are similar to the lacrimals seen in Recent heteromyids, although forming less of the orbital rim. The orbital area and the foramina are intermediate in development between those of *Heliscomys* Cope and *Liomys*. Most of the skulls have a smooth frontal area with rounded sides, but two of the specimens have a faint ridge starting on the frontal area that give rise to postorbital ridges and eminences that unite posteriorly.

Lower jaw — The lower jaw, with its angular part below the alveolar border, is somewhat like the jaw of *Pleurolicus* Cope in shape, but shorter. Both the masseteric fossa and masseteric crest are prominent in P26253 (FIG. 1K-L) but are noticeably weak in other jaws in the collection. The crest begins at the mental foramen, under P_4, and ends at the antero-inferior edge of the angle of the jaw. A second crest, marking the location of the root of the incisor, leads from the masseteric crest to the large projecting incisor capsule. The posterior end of the symphysis is prominent and projects ventrally below the body of the ramus. The angle of the jaw is enlarged, being almost as deep as the body, and has the posterior and ventral borders projecting medially. Thus the immense, cuplike mandibular pterygoid fossa is formed on the internal surface of the jaw. Below the mandibular pterygoid fossa a small elongate fossa, separated from the mandibular pterygoid fossa by a ridge, provides an area of attachment for the superficial masseter

muscle. A tuberosity marks the outer surface of the upwardly directed, small angular process. The ascending ramus flares outward, laterally and posteriorly, from the body and bears the weak coronoid and condyloid processes. A large space lies between the tooth row and the ascending ramus, more like a groove than a pit.

Cheek teeth — The upper and lower teeth of *Gregorymys* have been described by Wood (1936) and the teeth in this collection are typical of teeth found in members of the genus. The premolars and molars are not excessively long-crowned in comparison to those of *Liomys* and *Heteromys* and are much nearer to the teeth of heteromyids than to those of geomyines in relative size and in pattern. Within the subfamily Entoptychinae, the teeth are closer to the teeth of *Pleurolicus* than to those of *Entoptychus* in crown length.

Scapula — This bone (FIG. 1 C-D) is incomplete, lacking the cranial and caudal angles, vertebral border, and crest of the spine. Both the cranial and axillary borders appear as though straight, such an impression being intensified by the absence of the vertebral border. However, the cranial border does have less of a concave curve than does the scapula of *Liomys* and does not at all resemble the scapular notch found in *Geomys* and *Thomomys*. The axillary border has a ridge like that found in the scapula of *Liomys* but with more prominent muscle attachments as in *Geomys* and *Thomomys*. The supraspinous fossa (not greatly reduced by the scapular notch) and infraspinous fossa are nearly equal in size and depth, as in *Liomys*. The coracoid process is directed ventro-medially as in *Liomys* and is not as curved as in *Geomys*. The notch between the inner lip of the glenoid fossa and the coracoid process is deeper than in *Geomys* and not shaped like that of *Liomys*. The supraglenoid tuberosity is well-developed, more prominent than in either *Thomomys* or *Liomys*, and projects from the cranial lip of the shallow fossa. A well-developed fossa (*Liomys* has a similar, shallow fossa) occupies the position taken by the infraglenoid tuberosity in the Recent geomyids and probably serves as an attachment for the tendon of the triceps brachii muscle. The neck of the scapula differs from that of *Geomys* and is like that of *Liomys* in being narrow, evidently due to the rounded glenoid fossa. On the medial surface of the scapula a troughlike, parallel-walled depression corresponds in position to the spine on the lateral surface. The cranial border of the subscapular fossa is well marked.

The acromion is high, sturdy, proportionately larger than in *Geomys* and extends over one-half its own length beyond the glenoid fossa. At the base the internal border of the acromion lies close to the articular surface of the glenoid fossa, having its origin on the neck of the scapula as in *Aplodontia* and *Geomys* and in contrast to the situation in *Liomys*. On the acromion there is a well-developed surface for the attachment of the acromiotrapezius muscle. The metacromion process is enlarged, knob-like, and directed anteromedially. The root of the spine indicates that this element is relatively heavy and robust.

Humerus. — The humerus (Fig. 1A-B) resembles that of *Geomys* in the degree of development of the muscular processes, is closer to that of *Thomomys* in size and general proportions, and lacks the slenderness seen in that of *Liomys*. The neck is reduced like those in the geomyines, but the head is more nearly spherical as in *Liomys*. The lesser tuberosity is similar to that in *Geomys* and much more elongate than the corresponding structure in *Liomys*. The greater tuberosity is large, directed posteriorly, and separated from the head by a notch. Below this notch is a prominent fossa, which is also present in *Liomys* but absent in *Geomys* and *Thomomys*. The intertubercular groove is deep and opens distally into a long fossa extending down the shaft, being weaker but otherwise comparable to that in *Geomys*. An extraordinarily well-developed ridge, which is not duplicated in either the heteromyids or geomyines, supports the lateral part of the greater tuberosity. The lateral ridge is longer than the corresponding structure in *Liomys*, thus placing the crest nearer the middle of the bone as in *Geomys*. The crest curves forward, but does not form a knob. The upper part of the medial ridge is not as sharp as in *Geomys* and *Thomomys*, but is more distinct than in *Liomys*. The lateral epicondylar ridge is sharp and flared caudally, like that in *Geomys* and *Thomomys* and more so than in *Liomys*. Much as in *Geomys*, a ridge leads distally from the crest of the lateral ridge across the anterior surface of the shaft to join the medial epicondyle anterior to the medial ridge. Between these two

ridges on the proximal surface of the epicondyle is the entepicondylar foramen leading to the anterior surface above the medial condyle. In geomyine humeri this proximal surface is excavated for the insertion of the coracobrachial muscle and the foramen is absent, whereas in heteromyid humeri the foramen is present.

Ulna — The ulna (Fig. 1H) does not differ markedly from the ulnae of *Geomys*, *Thomomys*, or *Liomys*. It is slightly larger than the ulna in *Thomomys* and does not have the rough, angular appearance of that of *Geomys*. The semilunar notch is wide and the lateral fossa is well-developed. Grooves for the extensor tendons are present at the distal end. A depression is present under the coronoid process, being distal to the position of the corresponding depression in the ulna of *Geomys*. The ulnar tuberosity is well-developed.

Radius — This bone (FIG. 1I) has an ovoid head with a distinct notch dividing the anterior border of the articulating surface. The medial part of the divided anterior border forms a process. The anterior ridge (cranial ridge of Hill, 1937) is weakly developed, and the shaft at this point is more like the shaft of *Thomomys* than of *Geomys* or *Liomys*. A groove for the tendon of the adductor pollicis longus muscle is present on the lateral surface of the shaft. The tuberosity of the radius resembles that of *Geomys* and is much weaker than in *Liomys*, although its position is more caudad, as in *Liomys*. The arched condition of the radius, which appears to be in contact with the ulna only at each end, is very different from those of the Recent geomyines and heteromyids. The distal epiphyseal surface of the bone indicates that this end was large.

Innominate — The only part of the pelvis (FIG. 1J) present, the right side, lacks the anterior end of the ilium and all of the pubis except a small part bordering the obturator foramen. I think that approximately three-fifths of the total length of the pelvis lies anterior to the acetabulum.

The iliac shaft is triangular in cross-section and short in length, but anterior to the shaft the ilium rapidly broadens along the medial border—a feature common to the ilia of *Geomys* and *Thomomys*. In *Liomys*, like such forms as *Aplodontia*, *Sciurus*, and *Cynomys*, this medially directed expansion is more gradual. However, the geomyine ilial wing, once spread out from the initial expansion, narrows anteriorly; a tendency toward continued expansion is seen in some males of *Geomys*. On the other hand, the ilium of *Liomys* does not narrow anteriorly and, as a result, presents a larger surface—the gluteal fossa. In this, the ilium of *Gregorymys*, with its broad, upturned medial wing, resembles the ilium of *Aplodontia* and *Liomys* more than it does those of the geomyines and presents a relatively wider gluteal fossa. The iliac fossa is shallow and elongate. The iliac ridge is well-developed anteriorly and at the acetabulum but weak on the narrow part of the shaft, thus being comparable to the ridge in *Liomys*. The tubercle on the iliac ridge, relatively as well-developed as that of *Liomys*, is located anterior to the acetabulum as in *Liomys* and *Aplodontia*. In these features the tubercle differs from those of *Geomys* and *Thomomys* where the tubercle is smaller and more medial in position. The area for attachment to the sacrum is extensive. As in the pocket gophers, the iliopectineal eminence is weak.

The shaft of the ischium is directed posteriorly and has a large depression postero-medial to the acetabulum. The lesser sciatic notch, unlike the notch in *Geomys* and *Thomomys*, is large, its arc being as great or greater than that of the obturator foramen. The dorsal tuberosity is knob-like; in front of it is a narrow groove for the tendon of the obturator muscle. The ischial spine is weak. The margin of the ischium is slightly swollen and shows more similarity to that of *Thomomys* than to that of *Liomys*.

The preserved part of the pubis, directed postero-ventrally at an angle of 45 degrees to the longitudinal axis of the innominate, is more heteromyid-like than geomyine-like.

The acetabular fossa in the acetabulum is well-developed. The acetabular notch is wide and extends postero-medially so that the rear wall of the acetabulum appears as a ventrally projecting spur.

Femur. — Only the distal part of the femur (FIG. 1E-F) was recovered. It differs from femora of the geomyines in that the medial condyle does not form the medial border of the distal end. Instead, a prominent epicondyle, enlarged medially and with a sharp ridge running up the medial side of the shaft, is present. The popliteal groove is narrow and deep and has about the same relation to the patellar groove as is seen in *Liomys*. Above the epiphyseal line,

the shaft is flat transversely, somewhat like that of *Aplodontia*, and is turned outward, more so than in either *Liomys*, *Geomys*, or *Thomomys*. A ridge, unlike anything seen in *Liomys*, *Geomys*, or *Thomomys*, is folded forward on the lateral surface above the epiphyseal line, forming a fossa that extends distolaterally parallel to the patellar groove. The attachment scars for the medial head of the gastrocnemius muscle and tibial collateral ligaments are present on the medial condyle; the attachment scar for the lateral head of the gastrocnemius on the lateral condyle is well-marked.

Tibiofibula. — The tibiofibula (FIG. 1G) is almost as large as that of *Geomys*. The two elements are fused together for one-half their lengths. The proximal articular surface is simple, with the posterior part of the medial condyle extending farther distally than the small lateral condyle. The condyles are not concave transversely. No patellar scar is present. Both the anterior and lateral borders of the tibia are more prominent than the medial border. The anterior border begins at the tuberosity of the epiphysis and remains cranial in position until it terminates on the shaft below the union of the two bones. The lateral fossa is well-developed and deep. The interosseous crest is rounded and blunt. The depression for the semitendinosus muscle is nearer the proximal end than in the Recent pocket gophers and crosses to the lateral surface. Below the junction of the two bones, the common shaft is round and the distal end is broad and flat. The lateral malleoleus extends farther caudad than the medial malleoleus. Grooves for tendons are present on the lateral surface of the distal end but are obscure on the posterior surface because of poor preservation. Deep and narrow grooves for the peroneus longus and brevis muscles are present on the lateral malleoleus. The free part of the fibular shaft is very light.

Tarsus — The calcaneum, astragalus, navicular, cuboid, and cuneiform bones are present and attached to the tibiofibula. The trochlear (or peroneal) process on the lateral side of the calcaneum is not as well-developed as in the Recent geomyines. The head of the astragalus has a flattened, oblong, articulating surface whose long axis parallels the transverse axis of the joint between the astragalus and the navicular. In this feature the *Gregorymys* astragalus resembles that of *Liomys* but is more flattened on the articular surface and less oval in the shape of the head. The astragali of *Geomys* and *Thomomys* have a rounded articular surface that is oblique to the transverse axis of the bones. It would seem that the heads of the astragali of *Gregorymys* and *Liomys* are more primitive than those of *Geomys* and *Thomomys*. The cuboid in *Gregorymys* is short and rests under the calcaneum, being an arrangement similar to that in the myomorphs and the geomyoids instead of being longer and resting against the calcaneum as in the sciuromorphs.

Vertebrae — Two lumbar vertebrae are preserved, but their position in the series is indeterminable. Both resemble the lumbars of geomyoids structurally, except that the medial ventral ridge of the modern forms is lacking. A first or second caudal vertebra shows no structural differences from those of the geomyoids.

Discussion

The skeleton that has been described offers some evidence concerning phylogenetic relationship and adaptation to habitat of the entoptychids. In regard to *Gregorymys curtus*, Matthew (1907, p. 221) pointed out the similarity of the skull to those of the fossorial geomyoids but declined to pronounce it (or the other species which Matthew associated with *Entoptychus*) to be fossorial because of the lack of postcranial skeletal parts. (Possibly Matthew overlooked Cope's (1884, p. 857) description of some skeletal parts that were considered to belong to some species of *Entoptychus* and to resemble the skeleton of *Thomomys*.) He did think that this similarity indicated closer relationship to the Recent geomyines than to the heteromyids.

Wood (1936, p. 4, 28) recognized the similarity of *Gregorymys* to both the geomyines and the heteromyids. While Wood never commented on

Gregorymys in detail, his opinion that the *Entoptychinae* was a group intermediate between the Geomyinae and the Heteromyidae, but best classed with the Geomyinae because of skull structure, reflected his views concerning *Gregorymys*. It is also important to point out that Wood thought that at least part of the Entophychinae were fossorial, although none were so specialized as the Geomyinae.

In the light of our current knowledge of fossil geomyoids, it is evident that the skull of *Gregorymys* is closer to the heteromyid skull than was realized by Matthew. (Such a statement is grossly unfair to Matthew, of course, inasmuch as he had only the skulls of Recent heteromyids for his comparison. Secondly, the statement is true only insofar as the skulls of heteromyids that are not specialized are similar to those of their geomyoid ancestors. It is questionable whether or not the ancestral geomyoid skull is really represented by the known fossil or Recent heteromyid skulls. The elongate snout and thin zygomatic arch in these forms suggest that the heteromyid skull may have undergone modifications in the direction of reduction in mass and weight of the individual bones.) The post-orbital constriction of *Gregorymys* is similar to that in *Heliscomys* and, probably, *Florentiamys* Wood. This is a primitive rodent character and is not necessarily a geomyine character or a fossorial adaptation. The muzzle is relatively short, but it is not as arched on the under side as in *Thomomys*. While the zygomatic structure is broad, it is more like that of the heteromyids in that it does not have the angular flare to each side that is seen in the geomyines. The tubular meatus, sometimes cited as a fossorial adaptation and as a geomyine character, is also a heteromyid character (for example, see *Liomys* and *Florentiamys*) but is more extremely developed in *G. curtus*. The squamosals are intermediate between those of the heteromyids and geomyines. Wood (1936) has commented on the similarity between these cheek teeth and those of the heteromyids. On the other hand, certain features differentiate the skull of *Gregoymys* from the skulls of heteromyids, such as short nasals, long and broad incisors, short and broad muzzle, and heavy, solid skull. These characters are not only found in varying degrees of development in *Thomomys* and *Geomys* but also occur in such unrelated genera as *Aplodontia, Castor, Ondatra,* and *Cynomys*. These features could be indicative, to me, of fossorial adaptation as much as close phylogenetic relationship.

Although heavy, the jaw of *Gregoymys curtus* is more like the jaw of a heteromyid than a geomyine—especially in having a large mandibular pterygoid fossa. The angular process, both in structure and position, points to the heteromyids and not to the Recent geomyines. Nor does the angular process show any similarity to the process in *Cynomys, Aplodontia,* or the fossorial microtines. Miller and Gidley (1918, p. 434) utilized the fact that the angular part of the jaw was below the alveolar border as an aid in distinguishing the Entoptychinae from the Geomyinae. However, this feature also aids in distinguishing the Heter-

omyidae from the Geomyinae and appears to me to be a point of similarity between entoptychids and heteromyids.

The post-cranial skeleton has been modified for fossorial function, but its affinities seem to lie with the heteromyids. The scapula differs in many specific features from the scapulae of *Geomys* and *Thomomys* and is similar, in general, to that of *Liomys*. The acromion process shows heteromyid-like features but is greatly enlarged as in *Geomys* and *Aplodontia*. Relationship to the heteromyids, but with modification away from the terrestrial type and toward the digging type, is indicated. The humerus shows relationship to the heteromyids in the details of its structure. Where the bone has been modified for a fossorial function, there is a similarity to the humerii of the geomyines. However, none of the similarities to the geomyines are so important that they can be interpreted as demonstrating a closer relationship of *Gregorymys curtus* to the geomyines than to the heteromyids. The ulna and radius do not show enough modification, except in size relative to the other limb bones, to aid in determining the habitat of *Gregorymys*. Nor are there any features present that would aid in determining relationship. The innominate of *Gregorymys* is much closer to the heteromyid than the geomyine innominate. However, it bears modifications, such as the angular ischium, which are similar to those in *Geomys*. The femur is considerably wider but otherwise is similar to the femur of *Liomys*. The greater width is a fossorial modification but, as has been the case with other bones in *Gregorymys*, this modification has been gained through changes different from those accomplishing the same purpose in the geomyines. In practically all respects the tibiofibula resembles the tibiofibula of *Liomys* more than it does that of *Geomys*. The only differences are the stronger crests and ridges. The tarsus is similar to that of *Liomys*.

It is my opinion that when the teeth and the characters of the skull, jaws, and skeleton suggestive of the heteromyids are considered and since the differences between the skulls of *G. curtus* and the heteromyids do not necessarily prove closer relationship of *Gregorymys* to the geomyines, the weight of the evidence favors heteromyid affinities. Whatever the affinities might be, these features show that *Gregorymys* was adapted to a habitat different from that occupied by such heteromyids as the Dipodomyinae or the Heteromyinae. In all probability the habitat was burrowing, or possibly aquatic—similar to that occupied by the muskrat. However, the skeleton is not extremely modified for a fossorial habitat as is that of *Geomys* nor are the modifications that have taken place similar in detail to the modifications undergone by the Geomyinae.

My opinion would imply, therefore, that the Heteromyidae, Geomyinae, and *Gregorymys* (and perhaps all the Entoptychinae) had independent origins from the same geomyoid ancestors—a possibility that gains considerable support from their dissimilar fossil histories.

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