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A NEW SPECIES OF THE FOSSORIAL MAMMAL ARCTORYCTES FROM THE OLIGOCENE OF COLORADO

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Arctoryctes terrenus Matthew (1907) has as its type a single left humerus from the early Miocene of South Dakota. No other example of this unique fossorial species has been recorded, but Galbreath (1953, p. 49) briefly described three humeri from the middle Oligocene of Logan County, Colorado, and tentatively assigned them to this genus. When Galbreath's paper appeared, there was already in press (Reed, 1954a) a description of a new but related genus and species, *Cryptoryctes kayi*, from the early Oligocene of Montana, based on six humeri.

Of these two genera, *Arctoryctes* is not only later in time than is *Cryptoryctes* but it is also more specialized, particularly in the fusion of the teres tubercle and the medial epicondyle. The middle Oligocene humeri described by Galbreath are not only intermediate in time between *C. kayi* and *A. terrenus* but are also intermediate morphologically. It is considered, however, that they more closely resemble *Arctoryctes terrenus* than they do *Cryptoryctes kayi* and so will be described as a new species of Matthew's genus. Actually, these mid-Oligocene humeri differ from humeri of both *Arctoryctes* and *Cryptoryctes* to such a degree that they could validly be considered to belong to a new genus, but until more is known of the affinities of these peculiar forms it seems better not to introduce more names.

Arctoryctes galbreathi[1] sp. nov.

Holotype.—Univ. Kansas Mus. Nat. Hist. Vert. Pal. Coll. no. 9837, a right humerus lacking the capitulum and medial epicondyle.

[1] Named in honor of Dr. Edwin C. Galbreath, who collected and first published a paper on the specimens here named.

Hypodigm.—The hypodigm consists of the holotype and two other specimens: Univ. Kansas Mus. Nat. Hist. Vert. Pal. Coll. no. 9838, distal two-thirds of a left humerus, lacking medial and lateral epicondyles; and no. 9839, a right humerus lacking the medial epicondyle, the tip of the pectoral process, and most of the lateral border.

Horizon and locality.—Orellan horizon (middle Oligocene), Cedar Creek member (middle) of the White River Formation, Logan County, Colorado (see Galbreath, 1953, p. 49, for more exact locality data).

Diagnosis.—Resembles the humerus of *A. terrenus* more closely than any other known humerus; differs from it primarily by its smaller size (fig. 130), and in not having the teres tubercle and the medial epicondyle completely fused; assigned to *Arctoryctes* rather than to *Cryptoryctes* because of the marked similarity in structure, and presumably in function, of the greater tuberosity and pectoral process of this species and *A. terrenus*, as contrasted with the extremely high and narrow pectoral process of *C. kayi*.

Description.—The figure shows the similarities and differences between the humeri of the three species under consideration much better than words can do. I would only point out, aside from the details mentioned above, that *A. galbreathi* has a lesser tuberosity much shorter than have the other two; the fusion of the teres tubercle and the medial epicondyle, although incomplete, is far advanced toward the condition found in *A. terrenus*, whereas there is no indication of such fusion in *C. kayi;* the head of *A. galbreathi* is slightly more rounded and directed somewhat more laterally than are the heads of *A. terrenus* and *C. kayi*, both of which are high and narrow and directed somewhat more posteriorly; and *A. galbreathi* is quite similar to *A. terrenus* in the closeness, in anterior view, of the trochlea and the pit for the great ligament of the M. flexor digitorum profundus, whereas in *C. kayi* these structures are separated by a wide depression emanating from the supracondyloid foramen. The capitulum of *A. galbreathi* (not shown on figure 130, C, but present on no. 9838) is extremely similar to that of *C. kayi*, and thus more bulbous and not so elongate as in *A. terrenus*.

Discussion.—My ideas on the major functional aspects of the humeri of these animals have already been presented (Reed, 1954a), and the humeri of *A. galbreathi* shed no new light upon these problems. Only the discovery of associated skeletal remains will help answer the existing questions of function and ordinal relationships.

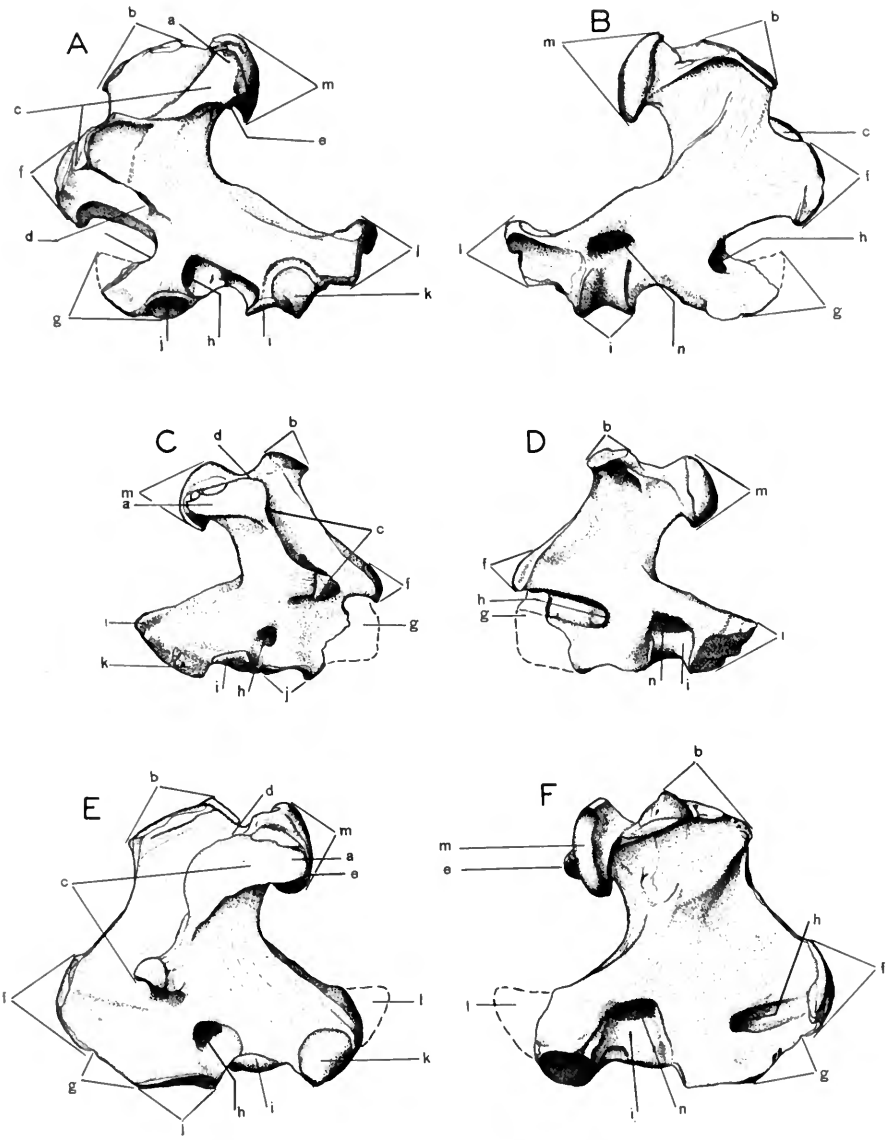

FIG. 130. A. *Cryptoryctes kayi*, left humerus, anterior aspect (composite specimen, based mostly on CNHM-PM 1009). B. Posterior aspect of A. C. *Arctoryctes galbreathi*, right humerus, anterior aspect (KUMNH no. 9837). D. Posterior aspect of C. E. *Arctoryctes terrenus*, left humerus, anterior aspect (cast of AMNH no. 12864). F. Posterior aspect of E. All × 3.25.

Abbreviations: *a*, greater tuberosity; *b*, lesser tuberosity; *c*, pectoral process; *d*, bicipital groove; *e*, deltoid process; *f*, teres tubercle; *g*, medial epicondyle; *h*, supracondyloid (entepicondylar) foramen; *i*, trochlea; *j*, fossa for origin of the great ligament of the M. flexor digitorum profundus; *k*, capitulum (missing in C); *l*, lateral epicondyle; *m*, head; *n*, olecranon fossa.

With regard to more minor details, however, it appears to me that the similarity in the structure of the pectoral processes of the humeri of *A. galbreathi* and *A. terrenus* indicates a similarity in the use of the pectoral musculature, whereas the quite different shape of the pectoral process of *C. kayi* presupposes a somewhat different usage of these muscles. (It would be rash to attempt to judge which condition is more specialized.) At the same time, it would seem that the relations between the teres tubercle and the muscles that insert upon it (Mm. teres major and latissimus dorsi) would have been quite similar in *A. galbreathi* and *A. terrenus*, whereas this relationship would be somewhat less specialized, due to the more proximal position of the teres tubercle, in *C. kayi*. In both *A. galbreathi* and *A. terrenus* the presence of a groove, carrying the median nerve and the brachial artery, indicates a basic similarity caused in turn by the tendency (complete in *A. terrenus*) toward fusion of the teres tubercle and the medial epicondyle; *C. kayi* has no such groove.

The identity of the deltoid process (even though labeled on *C. kayi* and *A. terrenus*) continues to puzzle me, as does the location of the boundary between the greater tuberosity and the pectoral process. We are dealing here with extremely specialized bones, and, as with moles (Reed, 1951), final identification of all details of the humerus can be accomplished only after a thorough comparison with more primitive forms. In this instance, however, such primitive forms await discovery in the Eocene.

Both Galbreath (1953) and myself (Reed, 1954a) have expressed a firm disbelief in the conclusion of Schlaikjer (1933) that the humerus of *A. terrenus* (the only specimen known to Schlaikjer) could be that of a mole. But the idea cannot be discarded that perhaps there existed, in *Cryptoryctes* and *Arctoryctes*, a functional humero-clavicular joint, for the greater tuberosity of *A. galbreathi* has an extremely smooth surface, very much like the articular surface of the humeral head. The condition in *A. terrenus* is similar, for Dr. G. G. Simpson of the American Museum of Natural History, who was asked to examine the original type, has written as follows (personal communication): "The *Arctoryctes terrenus* type humerus has, all over the bone, a matte surface much like unglazed porcelain. The greater tuberosity is smooth, without any roughening for muscle attachment. It is as smooth as the apparent articulation for the scapula, but no smoother than some non-articulating surfaces on the bone. It is not polished. I think that it could well be an articular surface, but do not consider this certain."

The greater tuberosity of *Cryptoryctes kayi* is not as smooth as in *Arctoryctes* and is thus less similar to an articular surface. It is interesting in correlation with these observations that in the primitive talpid *Galemys*, the desman of the Pyrenees, the whole of the greater tuberosity appears smooth, as if it were a synovial surface, but actually the clavicle articulates with only a small part of this greater tuberosity. A smooth surface does not, therefore, prove an articulation.

No matter what the final decision may be as to the presence or absence of a humero-clavicular joint in *Cryptoryctes* and *Arctoryctes*, it will be difficult to consider them as talpids unless a direct phylogenetic relationship can be shown in the fossil record. For I have previously expressed my belief (Reed, 1954b), based upon anatomical studies within the Talpidae, that a change in the relationship between the pectoral process and the tendon of the long head of the M. biceps brachii was the primary (pre-adaptive?) change in morphology in this family that led to fossorial specialization, and that the humero-clavicular joint was a secondary specialization. Even if *Cryptoryctes* and *Arctoryctes* are shown eventually to have had a humero-clavicular joint, they definitely lack the peculiar relationship between the pectoral process and the biceps tendon found in all talpids (see Reed, 1951, 1954a, for functional details)—a relationship, furthermore, which is always specialized in exact correspondence with the degree of fossorial behavior. It is difficult to believe that even an aberrant line of talpids would have become increasingly fossorial, as *Cryptoryctes* and *Arctoryctes* did become, if they had previously lost the primary talpid specialization.

In addition, as pointed out by Galbreath (1953, p. 49), the discovery of a typical humerus of a true talpid in the middle Oligocene of Colorado weakens Schlaikjer's argument for an association between the humerus of *Arctoryctes* and the skull of the late Oligocene and early Miocene mole, *Proscalops*.

As to the possible relationships of the three species within the *Cryptoryctes–Arctoryctes* group, it is my opinion (and not a particularly defensible one) that a common Eocene ancestor gave rise to two known phylogenetic lines, one leading to *Cryptoryctes*, and the other, probably through *A. galbreathi*, to *A. terrenus*. Although I had previously stated (Reed, 1954a) that *Cryptoryctes* could have been ancestral to *Arctoryctes*, the finding and study of the humeri of *A. galbreathi* make this statement seem less probable than when those words were written.

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ADDENDA

In the two years since this paper was written, several fossils have been found and several papers published that should be discussed, and I wish to thank the press of Chicago Natural History Museum for allowing me to insert these remarks.

Saban (1954) has left open the possibility that *Arctoryctes* and *Cryptoryctes* might be included in the Chrysochloridae, contrary to my opinion (Reed, 1954a) that the chrysochlorids belong to a totally different fossorial type. It is true that Matthew originally thought that *Arctoryctes* was a chrysochlorid, and this designation was copied in many subsequent papers, but I can see no possibility of such relationship.

White (1954, p. 403) discussed three humeri which he assigned to the Talpidae, genus and species undetermined. These specimens are from the Canyon Ferry Reservoir area, Montana, and are Chadron (early Oligocene) in age. When I tried to borrow this material, two of the three specimens had been misplaced, but the one available (USNM no. 18915) definitely belongs to *Cryptoryctes kayi*. Presumably the other two specimens do, too, for if White had had in hand a mixture of humeri from moles and from *Cryptoryctes*, he would have noted the differences immediately. The removal of these humeri from the Talpidae to *Cryptoryctes* leaves as the oldest known North American moles the material from the mid-Oligocene of Colorado and Wyoming mentioned by Galbreath (1953, p. 49), unless the *Proscalops?* listed by Hough and Alf (1956) from the early Oligocene of Nebraska is definitely determined to be talpid.

It is very possible that the humeri of *Cryptoryctes kayi* and the partial skull named *Kentrogomphios strophensis* by White (1954,

p. 404) will some day be found to belong together, but until associated remains are discovered this idea is purely conjectural.

One recently found and hitherto undescribed humerus deserves mention, as extending the range of *Arctoryctes galbreathi* into Montana. USNM no. 21310 is a left humerus from the Toston Formation, Orellan horizon (mid-Oligocene), and definitely belongs to *A. galbreathi*. This humerus lacks the lateral epicondyle, the capitulum, and part of the trochlea, and the edge of the head and greater tuberosity are eroded, but it has preserved the medial epicondyle, missing on all specimens of the hypodigm. This fortunate preservation has allowed me to publish a more accurate reconstruction (fig. 130, C, D) of the missing medial epicondyle of the type specimen than I could otherwise have done.

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