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BRACHYPOTHERIUM FROM THE TERTIARY OF NORTH AMERICA

By

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Preface.—The manuscript for this publication was near final form before the tragic automobile accident which took Dan Yatkola's life on March 12, 1976. The manuscript remains essentially as it was prior to his death, because we had already arrived at the conclusion that this rhinocerotid is the first record of *Brachypotherium* on the North American continent. Present plans are that the stratigraphic and biostratigraphic evidence regarding the Marsland Formation and the Hemingfordian fauna which was accumulated by Dan Yatkola will be published.

A "*Teleoceras*" skull (U.K. 9857) was reported by Galbreath (1953:108) from the Tertiary sediments of Martin Canyon in northeastern Colorado. It was found in University of Kansas collecting locality "Quarry A." Dr. Larry D. Martin, University of Kansas, loaned the skull and limb bones to Lloyd Tanner for study in 1974. Recently, additional research was accomplished by Daniel Yatkola, as a part of his Ph.D. dissertation. This included a comprehensive study of the stratigraphy and biostratigraphy of the Marsland Formation of northwestern Nebraska and adjacent areas. The research prompted a renewed interest in the Martin Canyon local fauna, including additional comparison of this unusual rhinoceros skull, and the limb bones which were found in the quarry near the skull, with other rhinoceros material in the University of Nebraska Study Collection. We both had the opportunity to com-

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pare the skull with other rhinoceros remains in the study collection of the American Museum of Natural History, and Frick Laboratory, New York. Yatkola also visited the Carnegie Museum in Pittsburgh and the Field Museum in Chicago to study fossil vertebrates from sediments connected with this study. We found no species comparable to the Martin Canyon "*Teleoceras*" in these collections. We conclude that the specimen belongs to the Old World genus *Brachypotherium* as discussed below.

Wood (1941:91) explained the "assignments" of the genera, *Brachypotherium* and *Teleoceras* as follows:

> The genus *Brachypotherium* is represented by successively more specialized species from the earliest Miocene into the Pliocene of Eurasia and north Africa. A direct derivative, *Teleoceras*, appears in the upper Miocene of North America . . . so similar is a primitive *Teleoceras* to a moderately specialized *Brachypotherium* that assignment between the two genera is based simply on locality, so that essentially indistinguishable specimens from Japan and Nebraska have been assigned without objection to *Brachypotherium* and to *Teleoceras* (*Mesoceras*).

Below, we describe the first New World *Brachypotherium* and discuss the genus. In our description, the following abbreviations are used for Institutions: A.M.N.H., American Museum of Natural History; K.U., University of Kansas Natural History Museum; U.N.S.M., University of Nebraska State Museum.

Brachypotherium Roger

Type species.—*Rhinoceros brachypus* Lartet, 1837.

Included species.—The type species, *B. aurelianensis* (Nouel, 1866), *B. snowi* (Fourtau, 1918), *B. heinselini* Hooijer (1963), *B. goldfussi* (Kaup, 1854), *B. stehlini* Roman and Viret (1934), *B. lewisi* Hooijer and Patterson, 1972; and *B. americanus* n. sp. (this paper).

Known range.—Lower Burdigalian through Pontian of Europe; lower Miocene through upper Pliocene of Africa; Upper Oligocene to Middle Miocene of Kazakhstan; Miocene of Japan; and early mid-Miocene of North America.

Diagnosis.—The following features distinguish *Brachypotherium* from *Teleoceras:* foramen ovale and foramen lacerum medius separate, post tympanic process light and just in contact with post glenoid process, M2/ anteroposterior length not much greater than M3/ length, P1/ large, basilar mound on sphenoid small, greatest breadth across frontal lies above anterior portion of orbit, lacrimal expanded anteriorly, infraorbital foramen located outside of narial notch, teeth relatively low crowned, 2nd metapodials more elongate than in *Teleoceras*.

Discussion.—Rhinoceroses with broad skulls, strong, chisel-shaped I1/, and short plump limbs are grouped together in the Tribe *Teleoceratini* Hay, 1902 (Heissig, 1973). The Afroeurasian teleoceratine rhinos are generally referred to the genus *Brachypotherium*, while the North American teleoceratine rhinos are referred to *Teleoceras*. The specimen described below from northeastern Colorado represents the first documented occurrence of *Brachypotherium* in North America. The University of Kansas specimen herein identified as *Brachypotherium* cannot be referred to any North American genus. The primitive Oligocene genera (*Subhyracodon, Caenopus, Trigonias*) as well as *Menoceras* and *Diceratherium* (see Tanner, 1969, p. 398) are easily distinguished from this skull. The brachypothere skull described below differs from the genoholotype skull of *Aphelops* (A.M.N.H. 8292: Cope and Matthew, 1915; Plates CXXV-CXXVII, CXXXV) in having a distinct rugosity at the tips of the nasals, suggesting a nasal horn on the anterior portion of the nasal. The outline of the nasal is V-shaped in cross-section, whereas it is essentially flat in *Aphelops*. The narial notch is retracted to a point perpendicular to P3/ in *Brachypotherium*, while in *Aphelops* it is retracted to the anterior portion of P4/. The occiput is vertical, broad at top as well as at base and wider than greatest breadth across frontals. In *Aphelops* the occiput is tilted slightly posteriorly, considerably narrower at top than at base and narrower than greatest breadth across frontals. The occipital crest of *Brachypotherium* is anteroposteriorly more massive when compared to *Aphelops*. These characteristics separate the Colorado brachypothere from all valid species of *Aphelops* (see Tanner, 1967:11).

The genoholotype skull of *Peraceras* (A.M.N.H. 1880: Cope and Matthew, 1915; Plate CXLIV a-b) differs from the Colorado brachypothere in having an anteriorly directed occiput, occipital crest thin, broader skull (especially across frontals), flattened, broader nasals, narial notch retracted to anterior of P4/, post tympanic process not in contact with post glenoid process, I1/ alveolus very small, and premaxilla reduced. In a forth-coming publication (Tanner) evidence will be presented that the nasals of *Peraceras* probably have paired lateral horns, and therefore differ significantly from those of *Brachypotherium*.

Among North American rhinocerotids, only specimens referred to *Teleoceras* closely approach the morphology of K.U. 9857. This skull was compared with skulls of all *Teleoceras* species in the University of Nebraska State Museum collection. The following similarities were observed: skulls short and broad, occiput vertical, broad at top as well as at base, narial notch relatively short (above P3/), nasals have rugosities for terminal horn, I1/ alveoli large, and nasals U-shaped in cross-section. This combination of char-

acters separates the Tribe Teleoceratini Hay (1902) from the Tribe Aceratherini Dollo (1885; cf. Heissig, 1973). The dentition, especially upper molars two and three, of *Teleoceras* are very distinct from other rhinoceroses of the Pliocene. The known geologic span for *Teleoceras* is Valentinian through Kimballian, Tanner (1975: 23).

It is unfortunate that the remaining teeth of K.U. 9857 are so badly worn that it makes it difficult to discern the tooth pattern. However, if a comparison is made of K.U. 9857 with upper molars two and three of U.N.S.M. 62097, a right maxillary (P3/-M3/) of a *Teleoceras* from Clarendonian age deposits, from U.N.S.M. Coll. Loc. Bw-101 (Quinn Rhinoceros Quarry of Skinner and Quinn), Brown County, Nebraska, there is a distinct difference. The combined greatest diameter of M2/-M3/ (along the buccal side) for K.U. 9857 is 90 mm, this same dimension for U.N.S.M. 62097 is 125, or about 40 percent larger. Other differences of *Brachypotherium americanus* new species from *Teleoceras* are included in the generic diagnosis in this paper. The following species of *Teleoceras* are valid: *T. major; T. fossiger; T. hicksi; T. schultzi,* Tanner (1975: 23). Comparisons were made with known illustrations of *Brachypotherium* skulls, and also the cast of the holotype skull of *B. aurelianensis* in the American Museum of Natural History Collection. The differences between K.U. 9857 and *Teleoceras* also apparently separate the Afroeurasian *Brachypotherium* species from *Teleoceras.* Based on this evidence we assign specimen K.U. 9857 from northeastern Colorado to *Brachypotherium;* and considering the small size of the skull and lack of a frontal rugosity, we propose a new species, *Brachypotherium americanus.*

Brachypotherium americanus new species

FIGS. 1, 2, 3

Holotype.—K.U. 9857, a nearly complete skull.

Type Locality.—Northeast one-quarter, Section 27, Township 11 North, Range 53 West, University of Kansas Museum of Natural History, Quarry A, Martin Canyon, Logan County, Colorado.

Stratigraphic Occurrence.—Silty sands in the Pawnee Creek Formation, approximately 20′ above indurated, lithic conglomerate (see Galbreath, 1953; 26, Section XV). The evidence for the stratigraphic occurrence and biostratigraphic correlations of the Martin Canyon local fauna and deposits containing the vertebrates will be presented in Yatkola's dissertation which will be published by the University of Nebraska Conservation and Survey Division in the near future.

The vertebrate assemblage from Quarry "A" sediments is older than the Marsland Quarry assemblage U.N.S.M. Coll. Loc. Bx-22, Box Butte County, Nebraska, located approximately 25′ below the

top of the Marsland Formation; probably older than the Bridgeport Quarries, U.N.S.M. Coll. Loc. Mo-113-114, Morrill County, Nebraska; and younger than Runningwater Quarry U.N.S.M. Coll. Loc. Bx-58, located approximately 20′ above the base of the Marsland Formation. The faunas collected from the Marsland Formation were considered in the establishment of the Hemingfordian, North American Land Mammal "Age" (Wood *et al.*, 1941). Quarry "A" Local Fauna of Martin Canyon is best considered to be earliest Hemingfordian, which as defined by the Wood Committee, represents middle Miocene "time" in North America.

Diagnosis.—Smaller than all described species of *Brachypotherium* except *B. aurelianensis* var. *gailiti* (Borissiak, 1927). Only slightly smaller than *B. aurelianensis* (Nouel, 1866). *Brachypotherium americanus* lacks the well-defined frontal rugosity which is a definite character of *B. aurelianensis*, it also lacks a distinct nasal cleft, and has a more excavated occiput.

Description.—The type skull (K.U. 9857), is only slightly distorted. Tooth wear indicates the remains of a very aged individual. The premaxilla is pushed dorsally reducing the depth of the nasal incision and its anterior end is missing. All the cheek teeth are missing except the M2/-M3/ on each side. The right zygomatic arch is pushed in slightly and the left side of the face was accidentally cut away. The specimen was discovered while making a soil core.

The skull is short, broad and low.

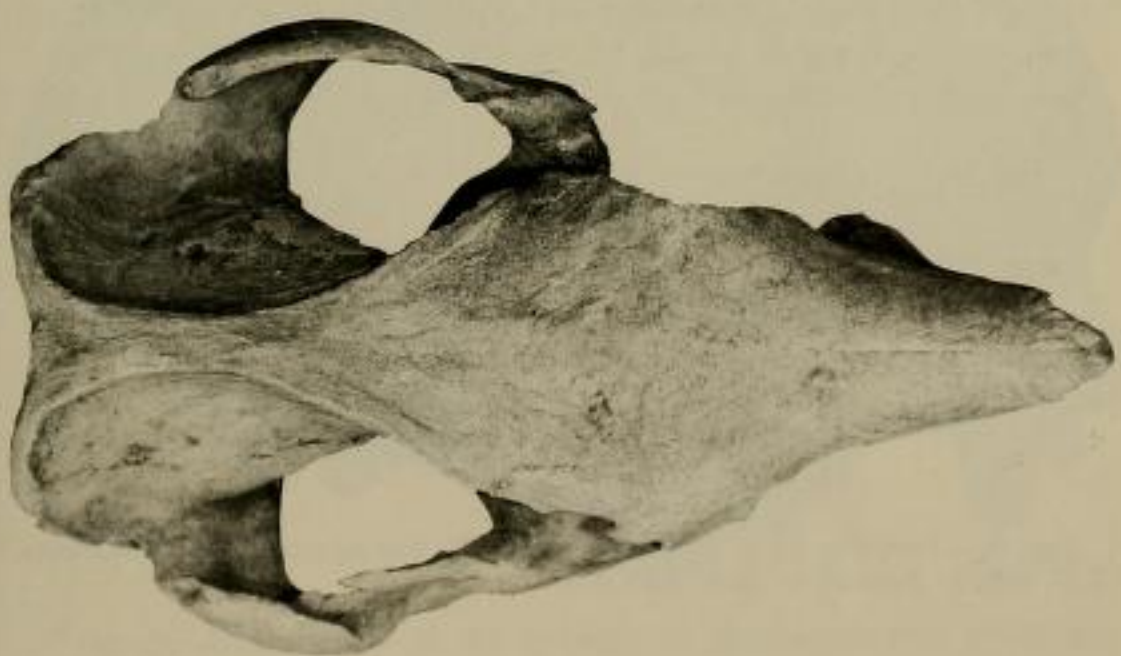

FIG. 1.—Dorsal view of the holotype of *Brachypotherium americanus* (K.U. 9857). Length of skull: 440 mm.

The free portion of the nasal is rather long (144 mm from the narial notch to the tip of the nasals), U-shaped in cross-section,

inclined at an angle of about 10 degrees above the plane of the frontal, gradually tapers anteriorly and has a distinct rugose area at the anterior end. The posterior margin of the narial notch is perpendicular to the center of the P3/ alveolus. The infraorbital foramen is located outside and about 14 mm behind the posterior margin of the narial notch, placing it well out on the face.

The lacrimal is large, ovoid and expanded well onto the face (53 mm from the front of the orbit to the anterior margin), which amounts to about 70 percent of the distance between the narial notch and front of the orbit. The lacrimal foramen is large (7 mm in diameter) and located internal to a distinct tuberosity on the anterior margin of the orbit.

The frontal is broadly concave and widest at a point directly above the anterior margin of the orbit. The frontal nasal suture is not evident. There is no apparent rugosity but arterial nutritive

FIG. 2.—Posterior view of the holotype of *Brachypotherium americanus* (K.U. 9857). Breadth of skull: 285 mm.

depressions radiate from a convex surface on the frontal as in *B. aurelianensis*. The frontal crests are low and extend forward at a 35 degree angle from the plane of bilateral symmetry.

The occiput is vertical to the condyles and distinctly elevated above the plane of the frontal—the angle between the plane of

the frontal and the anterior slope of the saggital crest is approximately 145 degrees. The sagittal crest is broad, measuring 23 mm at a point 50 mm from the posterior margin of the occiput, distinctly elevated above the parietal and sharply defined. In dorsal view the occipital crest is relatively broad, amounting to 63 percent of the maximum skull width.

In posterior view (Fig. 2) the top of the occiput is almost as broad as the base, tapering only slightly dorsally, and is more broad than high. The external occipital protuberance forms a low crest with deep emarginations on either side. The lateral occipital area is also deeply pocketed.

The occipital condyles are well developed, widely placed, amounting to 58 percent of the basal width of the occiput. The dorsal and ventral margins of the foramen magnum exhibit distinct U-shaped notches; the ventral notch is deeper.

The basicranial length, measured from the center of the foramen magnum to a point midway between the posterior end of the maxilla, makes up about 35 percent of the skull length. The post-glenoid process is very massive, measuring at the base, 36 mm anteroposteriorly and 31 mm transversely, and extends further ventrally (57 mm below the basicranial plane) than the paraoccipital process. The anterior margin is oriented nearly perpendicular to the basicranial plane. It is anteroposteriorly elongate with the transverse width tapering gradually towards its tip.

The paraoccipital process is much lighter than the post-glenoid and tapers to a less, anteroposteriorly elongate tip. The process is

FIG. 3.—Lateral view of the holotype of *Brachypotherium americanus*. Length of skull: 440 mm.

roughly triate in form, being divided by distinct ridges extending the length of the process. The internal sulcus is the deepest.

The hypoglossal foramina are small and located just internal to

the base of the paraoccipital processes, measuring 45 mm across. The foramina ovale are located just internal to the articular groove of the temporal bone and are separated by a large bony plate from the foramen lacerum medius. The bulla tympanica is not preserved.

The mastoid process is much expanded into a broad light plate-like process in thickness that almost comes into contact with the post-glenoid process and extends ventral to the glenoid surface. The laterally expanded post-glenoid process and the mastoid enclose a long, horizontally oriented passageway leading towards the external auditory meatus.

The basal part of the occipital is not much expanded above the plane of the basicranium. There is a narrow, median, antero-posteriorly oriented crest located on the body of the sphenoid and a low basal mound. In *Teleoceras* there is a distinct arched basal mound on the body of the sphenoid. The body of the sphenoid is flat and broad in *Brachypotherium* but expanded in *Teleoceras*.

The maxillary teeth extend nearly to the posterior margin of the maxilla, which projects well back into the orbitotemporal fossa. The maxillary tuberosity is not as well developed as in *Teleoceras*. The widely separated pterygoid processes flare externally and are roughened posteriorly.

The palate is approximately the same width between M2/ (64 mm) as between P1/ (71 mm). The broad palatal notch extends forward to the anterior end of the M3/ and fills most of the breadth of the palatal area.

The zygomatic arch does not rise very high or steeply. The widest part of the arch is 67 mm at a point located just posterior to the M3/. The zygomatic process of the temporal is low, rectangular-shaped, and not much expanded below the ventral margin of the zygomatic arch. A distinct fossa is anterior to the zygomatic process of the temporal on the ventral surface of the arch. The malar extends posteriorly to a point 54 mm anterior of the front of the zygomatic process of the temporal and well in front of the fossa anterior of this process. In *Teleoceras* the M3/ extends posteriorly to the anterior end of this depression. The malar narrows anteriorly and extends slightly into the face, and forms the ventral margin of the orbit. The malar is very narrow (29 mm) below the center of the orbit. The facial crest is low and not well defined anteriorly.

The premaxilla is somewhat distorted, but is broad and tapers only slightly anteriorly. The I1/ alveolus is large, implying a large incisor.

The only teeth preserved are the last two molars in each side. These teeth are badly worn. The only observable feature is the presence of a low, weak internal cingulum around the internal

margin of the tooth. The ectoloph length of the M2/ is not much greater than the ectoloph length of M3/.

Discussion.—Skulls are known for only four of the described species of *Brachypotherium: B. aurelianensis* (Nouel, 1866), *B. goldfussi* (Kaup, probably a junior synonym of *B. brachypus*), and *B. lewisi* (Hooijer and Patterson). The remaining species are based on dental features.

Brachypotherium americanus is smaller than all previously described species except *B. aurelianensis* var. *gailiti* (Table 1). *B. lewisi* is much larger and differs in the following features: shorter nasals, narial notch retracted to above anterior of P4/ and a broader skull. *B. americanus* differs from *B. brachypus* in its smaller size.

TABLE 1.—Comparative measurements (mm) of *Brachypotherium americanus* new species and *B. aurelianensis* var. *gailiti* (after Borissiak 1927)

	B. americanus K.U. 9857	*B. aurelianensis* var. *gailiti*
Occipital condyles to tip of premaxillary	(450)*	
Occipital condyles to tips of nasals	492	
Midpoint occipital crest to tips of nasals	440	(369)
Anterior margin of P^1 to occipital condyles	390	
Narial notch to occipital crest	335	
Palatal notch to foramen magnum	210	
Palatal notch to palatal foramina	...	
Narial notch to tips of nasals	150	
Zygomatic breadth (maximum)	285	
Width across palate between M^2	64	
Occipital height, base condyles at midpoint to crest	165	
Occipital width (maximum) ..... base	195	
midpoint	180	
Condylar width (outer margins occ. condyles)	100	
Post. M^3 occipital condyles	187	
Length M^2 (maximum)	43.3	34.7
Width M^2 (maximum)	(53.6)	41.2
Length M^3 (ectoloph)	46.6	36.5
Width M^3 (maximum)	45.6	36.9
Length M^3 midline	42.4	31.5
I^1 alveolus ..... A-P	31	
trans	14.5	
P^1 alveolus ..... A-P	14.6	
trans	12.7	
Post. margin narial notch to ant. end orbit	75	54
Width nasals at post. end narial notch	94	
Width supraoccipital processes	156	
Ant. border orbit—external aud. meatus	228	
Width post-glenoid process (external)	124	
Max. width braincase	144	
Distance between foramina ovale	59.4	

* Numbers in parentheses are approximate diameters.

Brachypotherium americanus is closest in morphology and size to *B. aurelianensis*. The holotype skull of *B. americanus* is 15 percent smaller than the holotype *B. aurelianensis*. This size difference seems significant, since both skulls probably represent males. The skull referred to *B. goldfussi*, which was originally referred to *B. brachypus* (Osborn, 1904a; Roger, 1900), is approximately 15 percent larger than *B. aurelianensis*. *B. aurelianensis* has a frontal rugosity, which is absent in *B. americanus* and all other species of *Brachypotherium*. It is present on *Teleoceras mediocornutus*, Osborn 1904b. The nasal cleft is not distinct in *B. americanus*, as in *B. aurelianensis*. This may be an old age feature, although very aged *Teleoceras* individuals retain a distinct nasal cleft. The occiput of *B. americanus* is distinctly more excavated than *B. aurelianensis*, but this may be an artifact of preservation. *Brachypotherium americanus* is most closely related to *B. aurelianensis*. We consider *B. americanus* to be derived over *B. aurelianensis*, based on the lack of a frontal rugosity and an emarginate occiput.

The presence of *Brachypotherium* in North America is of great significance for intercontinental correlation. Specimens of *B. aurelianensis* have been recovered from Neuville—aux—Bois in France. Mayet (1908) and most European vertebrate paleontologists consider the age of the vertebrate assemblage from Neuville —aux—Bois, and its principal correlatives, Chilleurs—Aux—Bois and Wintershof West, to be early Burdigalian. The Quarry "A" assemblage cannot be much younger than faunas from these European localities. Wilson (1960, 1968) has already pointed out the similarity between the early Burdigalian rodents and insectivores and those of Quarry "A."

The limb bones from Quarry "A," which are reported to have been associated with the skull K.U. 9857, are not being assigned to a species at this time. It is necessary that a further study of these post axial elements be made before a conclusive assignment can be made. A preliminary study indicates that the dimensions are near those of *Menoceras falkenbachi* Tanner, from the Bridgeport Quarries U.N.S.M. Collecting Locality Mo 113-114, Morrill County, Nebraska. The elements are not the short heavy limb bones typical of the *Teleoceras* from the Pliocene deposits.

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