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A REASSESSMENT OF THE GIGANTIC THEROPOD *SAUROPHAGUS MAXIMUS* FROM THE MORRISON FORMATION (UPPER JURASSIC) OF OKLAHOMA, USA

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INTRODUCTION

During the 1930's the University of Oklahoma collected a gigantic theropod dinosaur from Quarry 1 near the top of the Morrison Fm. near Kenton, OK. Ray (1941) named this *Sauropphagus maximus* in a popular magazine article, but did not provide detailed descriptions of illustrations. Virtually nothing else of substance has been published on this taxon since that time. Because of the lack of published data *Sauropphagus* has largely been ignored. The general view is that it is probably referable to *Allosaurus* (Hunt and Lucas, 1987, Paul, 1988).

The lack of attention given to *Saurophagus* is surprising, especially considering its exceptionally large size and the renewed interest both in theropods and in the Morrison Fm. Much more material exists than published reports indicate. Here I give a preliminary description and illustration of the most significant material and assess the status of the taxon. A more detailed description of *Saurophagus* is in preparation.

DESCRIPTION

Based on the number of metatarsals and femora, at least two individuals of *Saurophagus* are present in Quarry 1 and they are of equal size. The association of bones is unknown as no maps exist for the quarry (Langston, 1989). The articulated hind limb shown in Ray (1941) is a staged photo taken in Permian redbeds near Norman OK (Langston, 1989 and pers. comm., 1993) and there is no evidence that these bones were found associated. However, I assume that all large theropod bones from Quarry 1 belong to *Saurophagus*. Matters are further complicated by the fact that much of the preparation done in 1930's was undertaken by untrained laborers hired via the WPA. "Consequently, the preparators simply ground and scraped away until they recognized something resembling bone--often the spongiosa!" (Langston, 1989: 33).

Cranial material is limited to a right postorbital, two partial quadrates, and three poorly preserved tooth crowns. The postorbital does not restrict the orbit. A quadrate foramen is present. The atlas is large. Its neurapophyses sweep upward and backwards, lack an articular surface for a proatlas, lack medal projections roofing over the neural canal, and are firmly sutured to their intercentrum. The atlas is similar to that described in *Tarbosaurus* (Maleev, 1974). Cervicals are strongly opisthocoelous. Cranial cervicals have moderately developed epipophyses and bear two pneumatic fossae on the lateral surface of the centrum. Mid-cervicals have well developed epipophyses and pneumatic diapophyses. Mid-dorsal vertebrae have hourglass centra with strongly flaring rims, as in *Allosaurus*. A deep elliptical depression is present just below the contact with the neural arch. The centra are weakly opisthocoelous. The only well preserved dorsal neural arch is probably from a mid-dorsal and is unique among theropods in having a horizontal lamina along the base of each side of the neural spine. The lamina arises from the spine base cranially, but is free caudally. It roofs over a craniocaudally elongated space floored by the dorsal surface of the transverse process. Caudal centra are moderately procoelous. There are no complete caudal neural arches so it is not known whether the cranial caudal neural arches have an excavated cranial border as in *Allosaurus*. Cranial chevrons are of typical theropod construction and have cranial processes. Mid-caudal and caudel chevrons differ markedly from those in *Allosaurus* in being craniocaudally elongated distally, as in *Tarbosaurus efremovi* (Maleev, 1974) and *Tyrannosaurus rex* (Osborn, 1917).

The humerus is robust and closely resembles that of *Allosaurus*. The manus is tridactyl and similar to the manus of *Allosaurus*. The claw on manal digit I is large, but not proportionately larger to the manus than in *Allosaurus*. The ilium has a narrow brevis shelf and a low, broad vertical ridge above the acetabulum. The pubis has an open obturator notch and a large foot well developed cranially and caudally. The obturator process of the ischium is proximal. The femur has a proximally placed lesser trochanter and the scar for the ascending process of the astragalus is like that in *Allosaurus*. The femur differs from that of *Allosaurus*

in being more laterally bowed. No astragalus or calcaneum is known. The pes is functionally tridactyl, not arctometatarsalian, and has a slightly divergent fourth metatarsal. Metatarsal I is reversed.

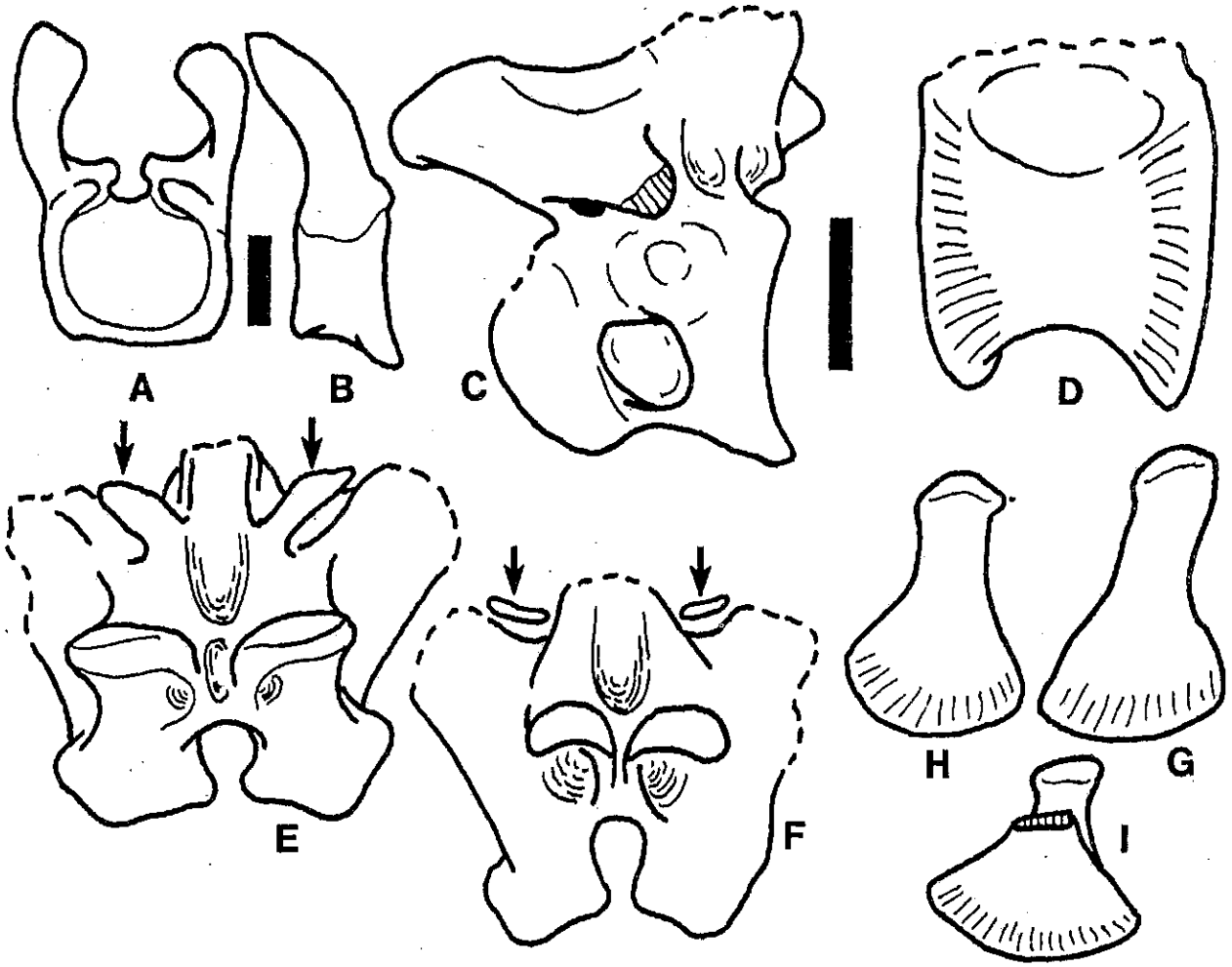

Figure 1 *Saurophaganax maximus*. Catalog numbers for Oklahoma Museum of Natural History. (A) 01135 Atlas in cranial and (B) right lateral view. (C) 01444 Cranial cervical, left lateral view. (D) 01190 dorsal centrum in left lateral view. (E) 01123 Holotype,mid-dorsal neural arch in cranial and (F) caudal view. (G) 01685 Mid-caudal, (H) slightly more caudal, and (I) more caudal chevrons in right lateral view. Scale bar=5cm. Arrows point to horizonal laminae along base of neural spine. Illustrations sharing same scale bar are (A-B), (C-I)

DISCUSSION

Morphologically *Saurophagus* is closed to *Allosaurus* and should be placed in the family Allosauridae. *Saurophagus* is approximately 25% larger than any described specimen of *Allosaurus*, although size alone is of dubious systematic value, especially in light of the similar morphology. However,there are several morphological differences between these taxa. The expanded chevrons are derived relative to the condition seen in primitive theropods, abelisaurids, and primitive tetanurans (megalosaurids, allosauroids, and torvosauroids). Although similar chevron morphology is present in tyrannosaurids, the condition in *Saurophagus* undoubtedly arose independently. A second distinctive feature is the lamina along the base of the neural spine, a feature unique among theropods. Finally, the atlas is quite different and resembles the condition in some tyrannosaurids. On the base of these features and the large size, I provisionally accept the generic separation of *Saurophagus* from *Allosaurus*. The fragmentary type of *Epanterias amplexus* can not be differentiated morphologically from either

Allosaurus or *Saurophagus*, although it is closer to the latter in size.

Much has been made of the large size of *Saurophagus*, although almost no data has been published. Measurement of the bones shown in the composite hindlimb in Ray (1941) places the acetabulum at a height of 2512mm (F=1135mm; T=907mm; MT3= 470mm). In a 12m long *Allosaurus* (composite skeleton) the acetabulum is 1924mm high (J. Madsen, pers. comm.). Following Anderson *et al.* (1985), the femur of *Saurophagus* indicates a weight of 2720kg, nearly three tons (OMNH 01708, L=1135mm; C=440). This is in contrast to published weights of 1400kg for *Allosaurus* and a weight of 4500kg for *Tyrannosaurus rex* using the same method (Anderson *et al.*, 1985). The femoral length in a 12 m long *Allosaurus* (composite skeleton, J. Madsen pers. comm., 1994) is 825mm, and the femoral length in *Saurophagus* (OMNH 01708) suggests that Stovall's estimate (in Ray, 1941) of a length of 14m for *Saurophagus* is approximately correct. Thus, while *Saurophagus* reached a length comparable to that of *T. rex*, it was not as massive, contrary to the claims of Paul (1988) and Ray (1941) that *Saurophagus* was more "bulky" than *T. rex*.

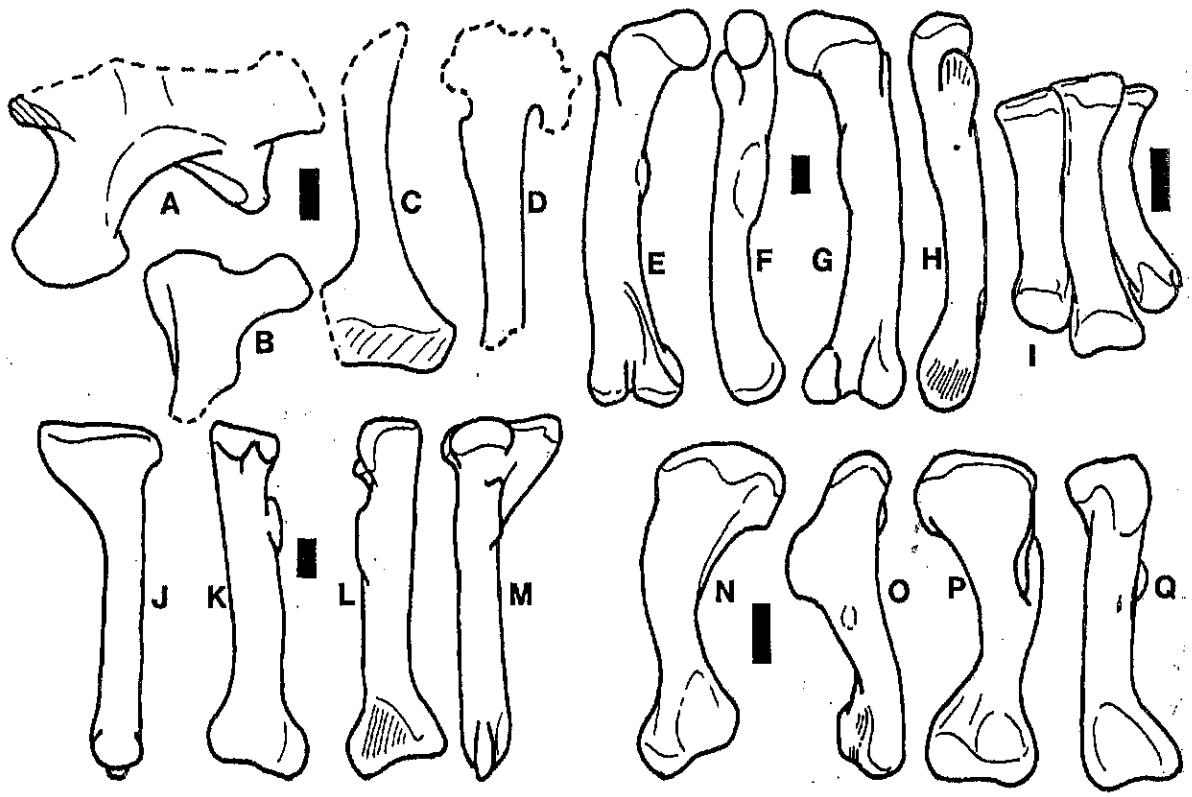

Figure 2 *Saurophaganax maximus*. Catalog numbers for Oklahoma Museum of Natural History. (A) 01338 Left ilium in lateral view. (B) 01737 Proximal end of right ischium, lateral view. (C) 01425 Distal half of right pubis, lateral view. (D) 01707 Proximal half of left pubis, lateral view. (E) 01708 Right femur in cranial, (F) medial, (G) caudal, and (H) lateral views. (I) Left pes, cranial view. (J) 01370 Right tibia in medial, (K) caudal, (L) cranial, and (M) lateral views. (N) 01935 Left humerus in caudal, (O) lateral, (P) cranial, and (Q) medial views. Scale bar=10cm. Illustrations sharing same scale bar are (A-D), (E-H), (I), (J-M), (N-Q)

Camp *et al.* (1953:412) noted that *Saurophagus maximus* was a nomen nudum and in addition was preoccupied. They have been followed by Chure and McIntosh (1989:89) and Czaplewski *et al.* (1994: 15). Hunt and Lucas (1987: 148) argued that the taxon is not a nomen nudum and was properly established. They designated OMNH 4666, a right tibia, as the lectotype. Interpreting whether Ray (1941) meets the International Code of Zoological Nomenclature is problematic. However, OMNH 4666 is not distinctive and the taxon it presents is not differentiable. Thus, a new name is needed for the quarry 1 theropod.

SAUROPHAGANAX MAXIMUS

Monophyletic Heirarchy Archosauria, Ornithodira, Dinosauria, Theropoda, Allosauridae.

Genus *Saurophaganax* new genus.

Etymology From the Greek saurophagos (reptile-eater) and anax (master, ruler, king), meaning "king of the reptile-eaters". This amplifies the meaning of the name in character with Stovall's original concept.

Species *Saurophaganax maximus* new species.

Etymology From the Latin maximus (greatest).

Holotype specimen OMNH 01123, a mid-dorsal neural arch (Fig 1E, F).

Diagnosis An allosaurid reaching extremely large size. It differs from other allosaurids in the presence of a horizonal lamina along the base of each side of the neural spine. This lamina arises from the spine base cranially, but is free caudally, and roofs over a craniocaudally elongated space floored by the dorsal surface of the transverse process. Differs from other allosaurids (based on referred material illustrated in fig. 1 and 2) in that the atlas lacks prezygopophyses for proatlas, does not roof over the neural canal, and chevrons are craniocaudally expanded distally.

Locality and Horizon Quarry 1, Morrison Formation, east of Kenton, Cimarron County, OK. Stratigraphic position is 12.04m (39. 5feet) below top of the Morrison Fm.,within beds equivalent to the upper part of the Brushy Basin Member of the Morrison Fm. on the Colorado Plateau (Fred Peterson, pers. comm. 1994).

ACKNOWLEDGEMENTS

Rich Cifelli (Oklahoma Museum of Natural History) allowed me to study the *Saurophagus* material under his care and kindly transported it to Utah. Jim Madsen (DINOLAB) transported the material to Dinosaur National Monument, provided photographs of the type material of *Epanterias*. Rich Cifelli and George Olshevsky critically read an early draft of the manuscript and provided constructive comments. Jack McIntosh calculated the weight of *Saurophagus*. Jack McIntosh, Brooks Britt, Jim Madsen provided stimulating discussions about Morrison saurischians. Ben Creisler (Seattle, WA) suggested the new name and George Olshevsky provided critical discussions on nomenclatorial matters. Dinosaur National Monument supported travel and photography.

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