Technical Session XVII, Saturday 9:00

NEW INSIGHTS INTO THE LOCOMOTORY CAPABILITIES OF THE EARLY EOCENE EQUID *HYRACOTHERIUM*

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A nearly complete skeleton of *Hyracotherium grangeri* (UM 115547) was found in 2007 at the University of Michigan early Wasatchian (Wa-1) locality SC-16 in the northwestern Bighorn Basin, Wyoming. The skeleton has a vertebral formula of 7 cervical, 17 thoracic (T), 7 lumbar (L), 6 sacral, and 2+ caudal vertebrae with well preserved processes and zygapophyses. The neutral posture of the five vertebrae (T15-17, L1, and L2) posterior to the anticlinal T14 forms an arc that is slightly convex dorsally based on the orientation of zygapophyses and the articular surfaces of the centra. The sagittally-oriented portion of the zygapophyses increases in height from T15-L2, constraining flexibility to the sagittal plane. Cranial orientation of the spinous processes and width and length of spinous process apices also increase from T15 to L1 such that the spinous process of L1 overhangs half the centrum length of T17. The transverse processes of L1 and L2 are much more ventrally oriented than those of the remaining lumbars. These features likely prevented hyperextension without precluding ventral flexion. Furthermore, epaxial musculature would have been advantageously positioned to provide stability during locomotion. In contrast, L3-7 exhibit a straight neutral posture, weakly revolute zygapophyses, posteriorly decreasing cranial orientation of the spinous processes, and horizontal transverse processes. Stability in this region was primarily facilitated by the zygapophyses with a reduced contribution from the musculature. Previous studies based on fragmentary vertebral elements interpreted the locomotion of *Hyracotherium* as energetically efficient with back motion minimized by a stable lumbar region and propulsion limited to the limbs. The highly flexed position of the hindlimb, robust femoral trochanters, and presence of a large gastrocnemius sesamoid in UM 115547 suggest that *Hyracotherium* was capable of powerful acceleration. The ability to ventrally flex a localized region of the vertebral column (T15-L2) may have assisted in accelerating without compromising the efficiency provided by a stable lumbar region.

Poster Session I (Wednesday)

AN UNEXPECTEDLY LARGE, MID-CRETACEOUS STEM EUTHERIAN MAMMAL FROM NORTHEASTERN CHINA (JILIN PROVINCE)

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In 2000 and 2002 Jilin University Geological Museum field parties excavated small dinosaur and mammal fossils from the Quantou Formation near Gongzhuling City. A new hypsilophodont ornithopod and a new zalambdalestid eutherian have been published by the team. The age of the locality remains unresolved, but earlier studies of the formation have suggested a range from Aptian to Cenomanian, with early Cenomanian a most likely upper limit. During the 2002 field season one of us (J.C.) uncovered an almost complete (if somewhat compressed) skull and left dentary of a larger and different eutherian mammal, which is the subject of this report. It is only the eighth Mesozoic eutherian known by associated skull and mandible. As preserved the skull measures 44.8 mm from anterior margin of canine alveolus to post-glenoid crest. The same dimension on the stem eutherian *Maelestes gobiensis* is approximately 25 mm. The skull shares with *Maelestes* a mosaic of plesiomorphic and derived characters including a fusiform ectotympanic, medially directed epitympanic wing, and raised crista interfenestrialis; evidence of five premolars; three molars with relatively narrow stylar shelf and lingual protocone (but lacking pre- and post-cingula); and trenchant ultimate lower premolar plus lower molars with compressed trigonids, transverse protocristid, and narrow, elongated talonids. The greater size, emphasized carnassality in the dentition, and age for the Gongzhuling specimen possibly 20-30 million years older than *Maelestes*, raise some fascinating questions regarding diversity and evolution of Late Cretaceous eutherians.

Technical Session XIV, Friday 2:30

MODELING AN *ORYCTODROMEUS CUBICULARIS* (DINOSAURIA) BURROW

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The hypsilophodont *Oryctodromeus cubicularis* from the Cretaceous Blackleaf Formation of Montana represents the first dinosaur recovered from within a burrow trace. The specimens occurred within an incompletely preserved chamber at the end of an S-shaped tunnel. Unlike many fossil vertebrates associated with burrows, the *Oryctodromeus* remains were disarticulated and elevated within the graded burrow fill. To test whether this skeletal arrangement reflected burial from within or transport into the chamber, we constructed a half-scale burrow model using PVC pipes and conducted a series of infilling experiments. The model followed the *Oryctodromeus* burrow proportions but was scaled to accommodate the available rabbit skeletons used. Experimental trials varied sediment input (low vs. high energy), sediment supply (en masses vs. incremental), chamber conditions (dry vs. water-filled), bone placement (mixed with sediments, external to tunnel, within chamber), and bone condition (dry vs. water soaked). A number of trials produced similar conditions to the *Oryctodromeus* assemblage. Twelve of the 13 trials exhibited complete disarticulation, six trials elevated bones to the upper portion of the sediments, and six resulted in graded bedding. Two trials produced unusual but noteworthy results. Trial #8 using saturated bones uniquely preserved the skeleton on the chamber floor and largely articulated. Trial #13 tested the effects of the bones mixed with the sediment prior to deposition. Although the bone distribution was not unusual, this trial resulted in numerous broken bones. The upper sediment surface in several trials exhibited a soft-sediment deformation structures. Overall, the experiment failed to falsify the hypothesis that the *Oryctodromeus* bones were in the chamber prior to burial and results from several trials would favor this interpretation. This is supported by the nearly identical bone distributions and similar sedimentology in both the model and original *Oryctodromeus* burrow assemblage. Results from these experiments may clarify the taphonomy of other within-burrow vertebrate assemblages.

Poster Session IV (Saturday)

NEW FOSSILS AND MORPHO-ECOLOGIC DIVERSITY OF SAURICHTHIDAE (ACTINOPTERYGIAN) FROM THE MIDDLE TRIASSIC OF SOUTHWESTERN CHINA

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New fossils discoveries from the Middle Triassic marine deposits in localities near the border between Guizhou and Yunnan of China include various marine reptiles and fishes. Five to six morphotypes of saurichthid fish can be recognized from the fish assemblages, all belonging to the genus *Saurichthys*. Study of the material reveals that two of them from Panxian of Guizhou and Luoping of Yunnan, respectively, unquestionably are new forms diagnosed with a boot-shaped cleithrum and dorsal-positioned pectoral fins, while the rests are of ventral-positioned pectoral fins and an ordinary triadiate-shaped cleithrum. The new form documented by materials from Panxian has pectoral fins about 15 cm long, more than 200 neural arches in the axial skeleton, and paired “clasper”-like gonopondium while the second new form represented by materials from Luoping has pectoral fins about 4-5 cm long and less than 150 neural arches in the axial skeleton. Both new forms bear six longitudinal rows of spine-decorated scales and have a large caudal fin. The peculiar cleithrum and pectoral fins indicate that the two new forms may achieve a different locomotion mode and ecological adaptation from the common species of the genus, possibly similar to the living needle fishes to active in surface water in school. The large caudal fin and spine-decorated scales may imply that these fishes are one of the fast swimmers in the marine realm of that time. The other important feature of these new forms is that their parasphenoid is perforated not only by the common carotids but also by the efferent pseudobranchials, which provides important information to concern the phylogenic change of the course of the common carotids and development of the basipterygoid process from endoskeletal to dermoskeletal in *Saurichthys*. Discovery of these new forms indicates *Saurichthys* not only has high morphological diversity but also has diversified ecological adaptations and locomotion modes during the Middle Triassic.

Technical Session III, Wednesday 2:15

AN UPPER CRETACEOUS LIZARD WITH A COMPLETE LOWER TEMPORAL BAR

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Squamata (including lizards, snakes, and leg-less lizards) form a large group of Diapsida [also including dinosaurs (plus birds), crocodiles, and pterosaurs]. All fossil or extant squamates have an incomplete or totally missing lower temporal bar/arcade and a quadrate potentially movable (streptostylic) relative to the skull and mandible. It has been documented that the mandible protracts anteriorly at the beginning of the bite cycles and retracts posteriorly at the end of the cycles in many lizards because strong jaw ligaments connecting the jugal and quadrate or the surangular of the lower jaw prevent the mandible from retracting posteriorly when the jaws open and because the M. pterygoideus atypicus or the anterior portion of the M. pterygoideus is entirely lost, which would make the anterior protraction of the mandible impossible at the beginning of the bite cycles if the muscle were present. It has been recently well-demonstrated that the mandible does not have such a fore-aft motion during the bite cycles in many lizards; this is because the quadrate is stabilized by the jaw ligaments in those lizards. A new fossil lizard recently discovered from the Upper Cretaceous of Henan Province, central China possessed a complete lower temporal bar and an essentially unmovable quadrate. This is the first squamate with such a morphotype, which is superficially similar to that of *Sphenodon*, the only living taxon of Rhynchocephalia. The anatomical relationships indicate that the completeness of the lower temporal bar was secondarily obtained in the new lizard, which may have served as a brace to support the quadrate-jaw articulation and thus prevent it from twisting anteriorly rather than posteriorly during the bite cycles. This represents an entirely new pattern of jaw-muscle functions within Squamata.