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First Record of a Velociraptorine Theropod (Tetanurae, Dromaeosauridae) from the Eastern Gulf Coastal United States

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ABSTRACT - A single tooth recovered from the marine Mooreville Chalk Formation (Early Campanian) of western Alabama indicates the presence of dromaeosaurid theropods on the Appalachian subcontinent during the Late Cretaceous. The tooth compares closely with teeth referred to the small velociraptorine *Saurornitholestes*.

Introduction

Dromaeosaurid theropods were first described in the early 1920’s (Matthew and Brown, 1922; Osborn, 1924) from fossil remains recovered in Canada and Asia, and are now known to be an important component of Late Cretaceous North American dinosaur assemblages from the western side of the Interior Seaway. Dromaeosaurids have figured prominently in the continuing and often-heated debate over the ancestry of birds, beginning with the works of J. H. Ostrom on the velociraptorine *Deinonychus antirrhopus* (Ostrom, 1969) and proceeding to the spectacular recent discoveries of feathered dromaeosaurids from a Lower Cretaceous (Early Barremian) conservat-Lagerstätte deposit in Liaoning, China (e.g. Xu et al. 2001; Norell et al., 2002). Many workers currently view dromaeosaurids as the closest sister-group to birds (see Padian and Chiappe, 1997). Indeed, so many synapomorphies (derived similarities) are shared by birds and dromaeosaurs, it has even been speculated that the latter represent an early lineage of secondarily-flightless, predatory ground birds (Paul, 1984, 2001), though this idea has not gained widespread support. Two subtaxa of the Dromaeosauridae are presently recognized: the Velociraptorinae (including *Velociraptor*), and the Dromaeosauridae (represented by *Dromaeosaurus*, and perhaps others, including *Utahraptor*).

The origins of the Dromaeosauridae probably extend back at least as far as the Late Jurassic (Currie, 1997), but the oldest fossils are in the Lower Cretaceous. Dromaeosaurids are known from several Early Cretaceous (Neocomian) faunas of western North America, including the giant *Utahraptor ostrommaysi* (Kirkland et. al., 1993) from the Cedar Mountain Formation (Barremian) of Utah, and *Deinonychus antirrhopus* (Ostrom, 1969) from the Cloverly Formation (Albian) of Montana and Wyoming. Toward the close of the Cretaceous in North America, three dromaeosaurid species, *Dromaeosaurus albertensis* (Matthew and Brown, 1922), *Saurornitholestes langstoni* (Sues, 1978), and *Bambiraptor feinbergi* (Burnham, et al. 2000), were present in Cordilleran faunas from Judithian to Lancian times.

However, until recently, there has been little evidence to support the presence of dromaeosaurids in the Late Cretaceous dinosaur faunas of eastern North America. Lipka (1998) reported a single tooth, possibly velociraptorine, from the Arundel Clay facies of the Potomac Formation (Early Cretaceous, Aptian) of Maryland. Subsequently, Lipka (personal commun., 2000) has recovered a number of additional teeth from the Arundel which may be referable to the Velociraptorinae. Teeth identified as dromaeosaurid have also been recovered from the Marshalltown Formation (Late Campanian) near Ellisdale, New Jersey (B. Grandstaff, personal commun., 2000). In this paper, we report the discovery of a single dromaeosaurid tooth from the Mooreville Chalk Formation (Selma Group; latest Santonian—Early Campanian) of western Alabama, which provides the first evidence for the presence of dromaeosaurids in southeastern North America during the Late Cretaceous.

Abbreviations and Institutions — AGr, Alabama, Greene County; RMM, Red Mountain Museum, Birmingham, Alabama; RTMP, Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta; ALMNH, Alabama Museum of Natural History, Tuscaloosa.
Description and Discussion

ALMNH 2001.1 is well-preserved, though some minor crushing is evident on the lingual surface. The tooth is strongly recurved distally and laterally compressed. Though the lingual surface is slightly flattened, the tooth is not D-shaped in basal cross-section. Mesial denticles are present (Figs. 1.1, 1.2) but minute, and the denticulate portion of the mesial carina extends less than halfway from the tip of the crown. In contrast, the entire preserved length of the distal carina is denticulate, and the denticles are large and elongate (Figs. 1.1, 1.3). Some of the denticles along the distal carina are hooked apically. Distally, there are 23 denticles (approximately 7 per mm), and 19 to 22 denticles (approximately 9 per mm) are on the mesial carina. The tip of ALMNH 2001.1 is missing, and the root is not preserved. The preserved portion of the tooth has a length of 3.6 mm mesio-distally, and an apical-basal height of 4.9 mm. Currie et al. (1990) discussed the difficulties encountered when measuring small theropod teeth and suggested adoption of the fore-aft basal length (FABL) as a standard, as it exhibits a relatively constant relationship to the total tooth length. ALMNH 2001.1 has a FABL of 2.8 mm. All measurements were made with digital calipers.

Ordinarily, isolated dinosaur teeth are of limited use in identifying dinosaurian taxa to the genus or species level. However, previous authors (Currie et. al. 1990; Fiorillo and Currie, 1994; Baszio, 1997) have established the enhanced taxonomic utility of some isolated theropod teeth. Currie (et. al., 1990, 1995) considered the significant disparity in size between mesial and distal denticles in the teeth of many dromaeosaurids to be diagnostic for the Velociraptorinae. In this respect, and in general, ALMNH 2001.1 compares favorably with RTMP 82.19.180, which has been referred to Saurornitholestes langstoni (Currie et. al. 1990: fig. 8.2 S). Although this genus is a common component of dinosaur assemblages from the Late Campanian and Maastrichtian of the western U.S. and Canada, prior to this study the oldest and easternmost report of possible Saurornitholestes remains was from the Late Campanian Aguja Formation of Brewster County, Texas (Rowe et. al., 1992). However, small theropod teeth from the Marshalltown Formation (Late Campanian) of New Jersey also compare favorably with Saurornitholestes (B. Grandstaff, personal commun., 2000). ALMNH 2001.1 indicates that a small velociraptorine dromaeosaurid, possibly congenerr with Saurornitholestes, inhabited the Appalachian subcontinent during the Early Campanian. The possible occurrence of this genus on both sides of the Western Interior Seaway may provide evidence that western and eastern dinosaur faunas were not completely isolated during the Late Cretaceous. Alternatively, dromaeosaurid populations may have descended in parallel on either side of the Seaway from pre-Seaway (i.e. Middle Cretaceous) common ancestors. New studies and phylogenetic analyses (Carr et al., in press; Schwimmer and Kiernan, 2001) indicate that tyrannosauroid theropods of the eastern USA rep-
resent the latter situation (that of independent descent in place from basal common ancestors), rather than derivation from a western population. It is plausible that the dromaeosaurids of the eastern USA had a similar origin. In this latter case, their ancestry could have been either from Asia or Europe, where sparse remains of dromaeosaurs have been discovered (e.g. LeLeouff and Buffetaut, 1998; Allain and Taquet, 2000). Also, in this latter case, it is very unlikely that the Alabama velociraptorines would be congeneric with Saurornitholestes.

Remains of terrestrial animals are rare in the open marine facies of the Mooreville Chalk and, excluding volant (flying) birds and ornithocheirid pterosaurs, have previously been confined to fragmentary remains of crocodylians (Deinosuchus rugosus, Leidyosuchus sp. [Schwimmer, 2002]) and large to medium-sized saurischian and ornithischian dinosaurs (Ornithomimidae insertae sedis [Baird, 1986], the iguanodontian Lophorhothon atopus [Langston, 1960; Lamb, 1998] and nodosaurid ankylosaurs [Langston, 1960; Lamb, 1996]). Mooreville deposition occurred in deep water in an outer-shelf environment (Puckett, 1996) and the discovery of a small dromaeosaurid theropod tooth is unexpected. Schwimmer (1997) has most recently reviewed taphonomic and biogeographic models that may account for the distribution of dinosaur remains in the Mooreville Chalk (as well of those of its eastern clastic equivalent, the Blufftown Formation) most likely result from the fluvial transport of “bloat-and-float” carcasses originating in adjacent deltaic, estuarine, and marine coastal environments. ALMNH 2001.1 preserves delicate features (mesial and distal denticles) and doesn’t appear to have suffered wear in a high-energy surf zone setting. Therefore, it is likely that it dropped from a passing carcass (either a dromaeosaur itself, or the prey of a dromaeosaur), perhaps dislodged by scavenging sharks (Schwimmer et al. 1997), after reaching the sea by way of a river-mouth estuary.

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