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Koparion douglassi, a New Dinosaur from the Morrison Formation (Upper Jurassic) of Dinosaur National Monument; The Oldest Troodontid (Theropoda: Maniraptora)

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ABSTRACT

Koparion douglassi is established for an isolated theropod maxillary tooth from the Brushy Basin Member of the Morrison Formation. The tooth possesses several troodontid synapomorphies (strongly recurved crown, blood pits, constriction between crown and root). *Koparion*, the most primitive troodontid dentally, is the first record of the family from pre-Cretaceous sediments. Screenwashing of Morrison sediments has produced a variety of teeth of small carnivorous dinosaurs and is a promising avenue for improving our knowledge of these poorly known theropods.

INTRODUCTION

Theropod dinosaurs are a moderately diverse component of the Morrison dinosaur fauna. At least four families are present: Ceratosauridae (*Ceratosaurus* Gilmore 1920); Megalosauridae (*Torvosaurus* Britt 1991, *Marshosaurus* Madsen 1976a); Allosauridae (*Allosaurus* Madsen 1976b); and Ornithomimidae (*Elaphrosaurus* Galton 1982). *Stokesosaurus* has been tentatively referred to the Tyrannosauridae (Madsen 1974), and the recent discovery of additional material indicates that this assignment may be correct (Chure and Madsen, in prep.). In addition, there are a number of taxa whose familial assignments are unknown (*Coelurus, Ornitholestes, Saurophagus,* a maniraptoran from the Dry Mesa Quarry, and a new large theropod from Dinosaur National Monument). However, this diverse record is strongly biased in favor of moderate to large theropods. *Ornitholestes,* with a length of about 2 m and a weight of 12.6 kg (Paul 1988), is the smallest Morrison theropod known from adequate material. Callison (1984) mentions the remains of a *Compsognathus*-size theropod from the Fruita Paleontological Area, but provides no details. Jensen and Padian (1989) refer a femur and the distal part of a radius previously identified as avian (Jensen 1981) to an indeterminate small maniraptoran theropod.

An extensive screenwashing and hand quarrying program in the Morrison Formation at Dinosaur National Monument has provided important new data on microvertebrates (Chure 1992; Chure and Engelmann 1989; Chure, Engelmann, and Madsen 1989; Engelmann, Chure, and Madsen 1989; Engelmann, Greenwald, Callison, and Chure 1990). Among the specimens collected are a number of small theropod teeth that are quite distinct from those of the larger theropods in the formation and indicate a more diverse small theropod fauna than was previously known. The purpose of this paper is to describe one of these teeth, a specimen that belongs to a previously unknown Jurassic troodontid and is the earliest record of the family.

DESCRIPTION

SYSTEMATIC PALEONTOLOGY

Dinosauria Owen 1842
Theropoda Marsh 1881
Maniraptora Gauthier 1986
Troodontidae Gilmore 1924
Koparion nov. gen.

Etymology. From the Greek *koparion,* a small surgical knife; an allusion to the small size of the serrated tooth that is the type specimen.

Diagnosis. As for the species.

Koparion douglassi nov. sp.

Etymology. In honor of Earl Douglass, who discovered and excavated the great dinosaur quarry for which Dinosaur National Monument was created.

Holotype. DINO 3353, a single, nearly complete maxillary tooth crown.

Horizon and locality. Near the top of the Brushy Basin member of the Morrison Formation, Dinosaur National

Monument. Locality number is DNM 94; detailed locality information is in the files at Dinosaur National Monument.

Diagnosis. Tooth crown small (height = 2 mm) and recurved, with crown apex forming the first posterior denticle; blood pits present between successive denticles; a constriction present between crown and root. *Koparion douglassi* is more primitive than other troodontids in lacking large posterior denticles, in lacking a pronounced size difference between anterior and posterior denticles, and in having posterior denticles that bend toward the tooth apex but are not hooked.

The tooth is small (crown height = 2 mm) and strongly recurved, with the apical denticle forming the most distal posterior denticle (pl. 1A). The anterior denticles end short of the base of the crown (pl. 1B), and the anterior crown base curves posteriorly, resulting in a constriction between the crown and the root (pl. 1A). A fore-aft basal length measurement is not possible because the crown base is incomplete. Fore-aft maximum crown length is 1.9 mm. This maximum is a midheight because of the constriction at the crown base.

The posterior denticles are about twice the height of the anterior ones and curve weakly toward the tooth apex (pl. 1C). There are twelve posterior denticles, counting the tooth apex as the first posterior denticle. They extend the entire length of the crown as preserved and undoubtedly continued to the base. They become slightly larger proximally (pl. 1A). Blood pits, circular depressions surrounding the inter-denticle slits (Currie 1987; Currie, Rigby, and Sloan 1990), are moderately developed and are more pronounced on the posterior denticles (pl. 1C, E). The anterior denticles are fourteen in number, are smaller proximally, and end short of the crown base. They differ from the posterior denticles in being lower, having more weakly developed blood pits, and not pointing toward the tooth apex (pl. 1E). Both anterior and posterior denticles have thin, bladelike cutting edges and rectangular bases (pl. 1D, F).

DINO 3353 has a crown morphology strikingly different from that of other Morrison theropods. Currie (1987) described features unique to the teeth of troodontids, and Osmolska and Barsbold (1990) suggested that tooth characters probably have familial taxonomic value. Several of these synapomorphies are present in DINO 3353 (blood pits, strongly recurved crown with apex forming most distal posterior serration, and a constriction between the crown and root). On the basis of these features DINO 3353 is referred to the Troodontidae.

Troodontid teeth vary according to position and tooth-bearing element. Currie (1987) could differentiate premaxillary, maxillary, and dentary teeth in *Troodon formosus*. Comparison of *Troodon* with DINO 3353 indicates that the latter is a maxillary tooth on the basis of anterior and posterior denticles being on the longitudinal tooth axis, the presence of anterior serrations rather than an anterior carina, the lateral compression of the tooth crown, and the anterior margin being more strongly recurved than the posterior margin (Currie 1987). It is not possible to determine whether it is a left or right maxillary tooth.

Although I am reluctant to inflict another tooth taxon upon fellow dinosaur workers, DINO 3353 is distinctive and can be separated from both other Morrison theropods and other troodontids, and formal systematic recognition is appropriate.

EXPLANATION OF PLATE 1

Koparion douglassi, holotype tooth DINO 3353, Brushy Basin Member, Morrison Formation, Dinosaur National Monument.

A. Crown in side view. It cannot be determined whether this is a labial or lingual view. Scale bar = 1 mm.

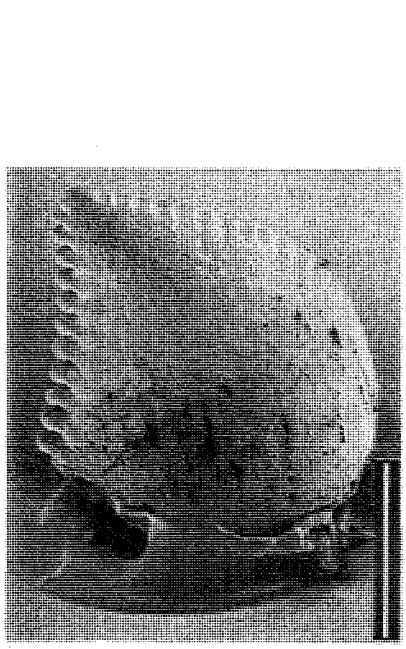
B. Crown in anterior view. Scale bar = 100 micrometers.

C. Side view of posterior serrations five through seven (same side as shown in A). Tooth apex toward top of page. Scale bar = 100 micrometers.

D. Apical view of posterior serrations five through seven. Scale bar = 100 micrometers.

E. Side view of anterior serrations two through five (same side as shown in A). Tooth apex toward top of page. Scale bar = 100 micrometers.

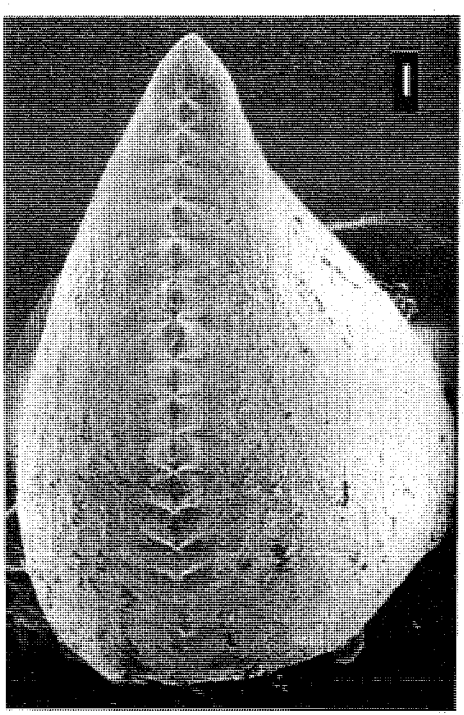
F. Apical view of anterior serrations two through five. Scale bar = 100 micrometers.



A

C

D



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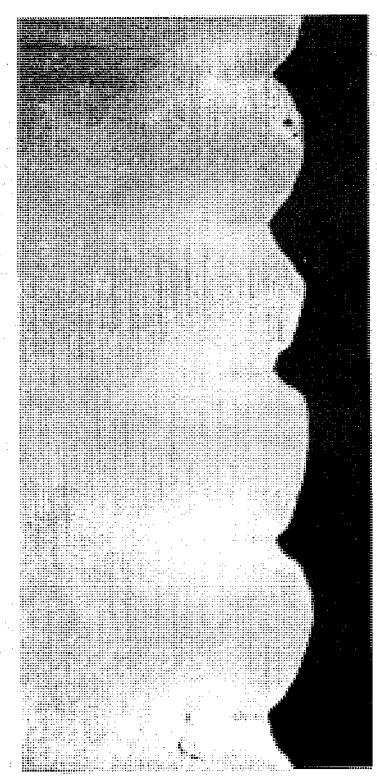

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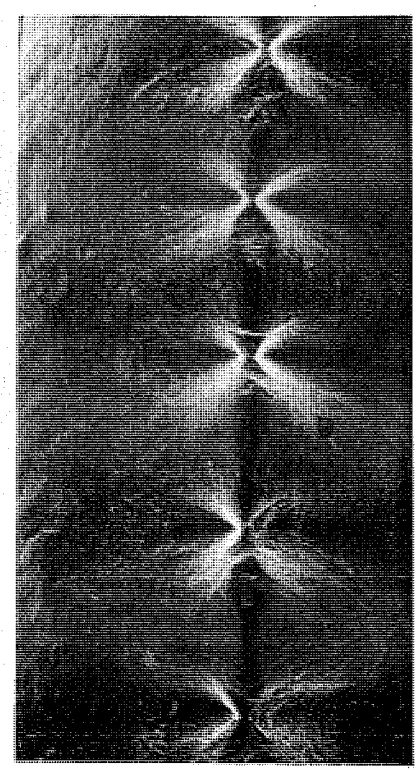

F

DISCUSSION

The Troodontidae is a small family with a Laurasian distribution. It consists of *Troodon formosus* from the Late Cretaceous of North America, *Saurornithoides mongoliensis, S. junior, Borogovia gracilicrus,* and *Tochisaurus nemegtensis* from the Late Cretaceous of Asia, an indeterminate troodontid from the Early Cretaceous of Asia (Kurzanov and Osmolska 1991, Osmolska and Barsbold 1990), and a new genus from the Early Cretaceous of Asia currently being described by Dale Russell and Dong Zhiming. Several indeterminate tarsometatarsi from Romania indicate the presence of troodontids in Europe in the Late Cretaceous (Osmolska and Barsbold 1990). A tooth from the early Cretaceous of Utah referred to the Troodontidae by Nelson and Crooks (1987) was later identified as a velociraptorine dromaeosaur (Currie, Rigby, and Sloan 1990). Thus, all valid Early Cretaceous records of troodontids are from Asia.

Koparion is the only known Jurassic troodontid and the oldest member of the family. A Jurassic troodontid is not unexpected, if Currie (1987) is correct in suggesting that troodonts and birds are sister taxa—because birds are certainly present by the late Jurassic, as evidenced by *Archaeopteryx. Koparion* already possesses several of the dental specializations of the family, suggesting that troodontid origins may extend back further.

The record of small theropods in the Morrison Formation is very poor. Recent work at Dinosaur National Monument shows that screenwashing for Morrison microvertebrates can be extremely productive, even in areas where no microvertebrates have been reported. Based on data from microvertebrate recovery programs at Dinosaur National Monument, Utah, and Fruita, Colorado, it would appear that Morrison microvertebrate remains are much more common than generally thought. Thus, our limited knowledge of Morrison small vertebrates is probably the result of sampling bias rather than a reflection of their true relative abundance.

Although small size and fragile bones make troodontid remains rare and often fragmentary, their teeth have several unique features that make them easily recognizable. *Koparion* is a significant addition to our knowledge of the biodiversity of Morrison theropods and shows that screenwashing may be an important tool for gathering information about troodontids and other small theropods.

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