

6. A Theropod (Dromaeosauridae, Dinosauria) Sternal Plate from the Dinosaur Park Formation (Campanian, Upper Cretaceous) of Alberta, Canada

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Abstract

A right sternal plate of a small velociraptorine (Dromaeosauridae) theropod, recovered from the Dinosaur Park Formation (Campanian, Upper Cretaceous) of Alberta, Canada, exhibits several birdlike features. The length of the sternum is equal to or greater than the width of the paired sternal plates, a wide and well-developed coracoidal sulcus is present along nearly all its cranial margin, and there is a clustering of at least three costal processes on the craniolateral half of the element for the reception of three sternal ribs. Primitive features of the sternum include its paired structure with no development of a sternal keel.

Introduction

Fossilized vertebrate remains from Dinosaur Provincial Park are numerous and remarkably diverse taxonomically. Approximately 130 species, of which 38 are dinosaurs, have been described from the Dinosaur Park Formation (Mid-Campanian, Upper Cretaceous) of the

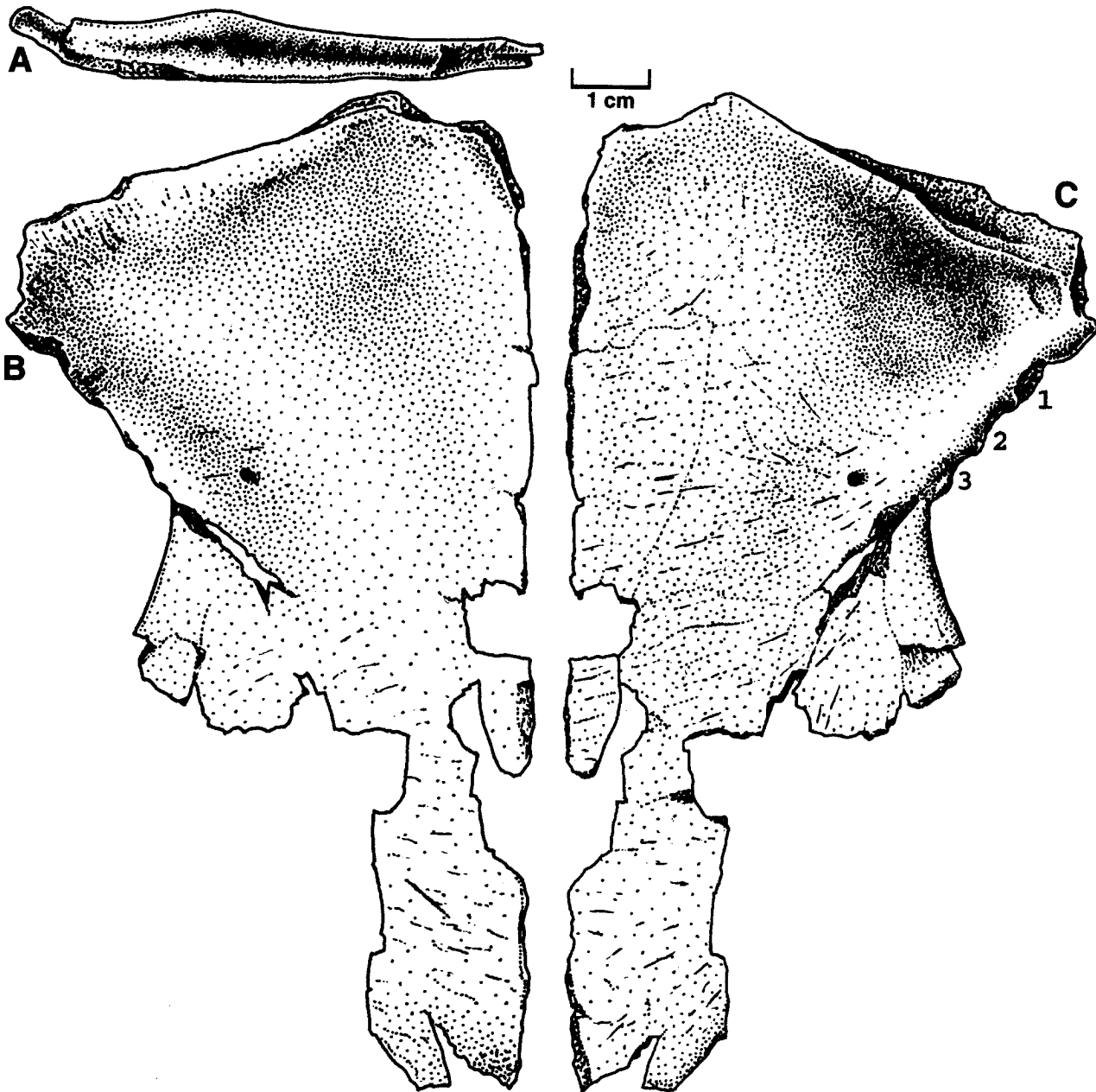


Figure 6.1. Specimen drawings of a right sternal plate (TMP 92.36.333). A, view of the cranio-lateral end, principally the coracoidal sulcus; B, ventral view; and C, dorsal (visceral) view. Scale bar equals 1 cm. #1-#3 mark the sites for the attachment of three sternal ribs.

Judith River Group within the park (Eberth et al. 2001). Two dromaeosaurids—*Dromaeosaurus* and *Saurornitholestes*—have been collected from these beds, although no complete skeletons have ever been found. During the 1992 field season, most of an isolated right sternal plate (fig. 6.1) was collected from Bone Bed 47 (UTM [WGS 84] 12U 0,463,976; 5,620,718) within the park. Although ornithischia sterna are relatively common, theropod sternals, especially those of small theropods, are exceedingly uncommon. In spite of its not being complete, the excellent preservational quality and rarity of this element prompted this note.

Institutional Abbreviations: GIN, Mongolian Institute of Geology, Ulaan Baatar, Mongolia; TMP, Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta, Canada.

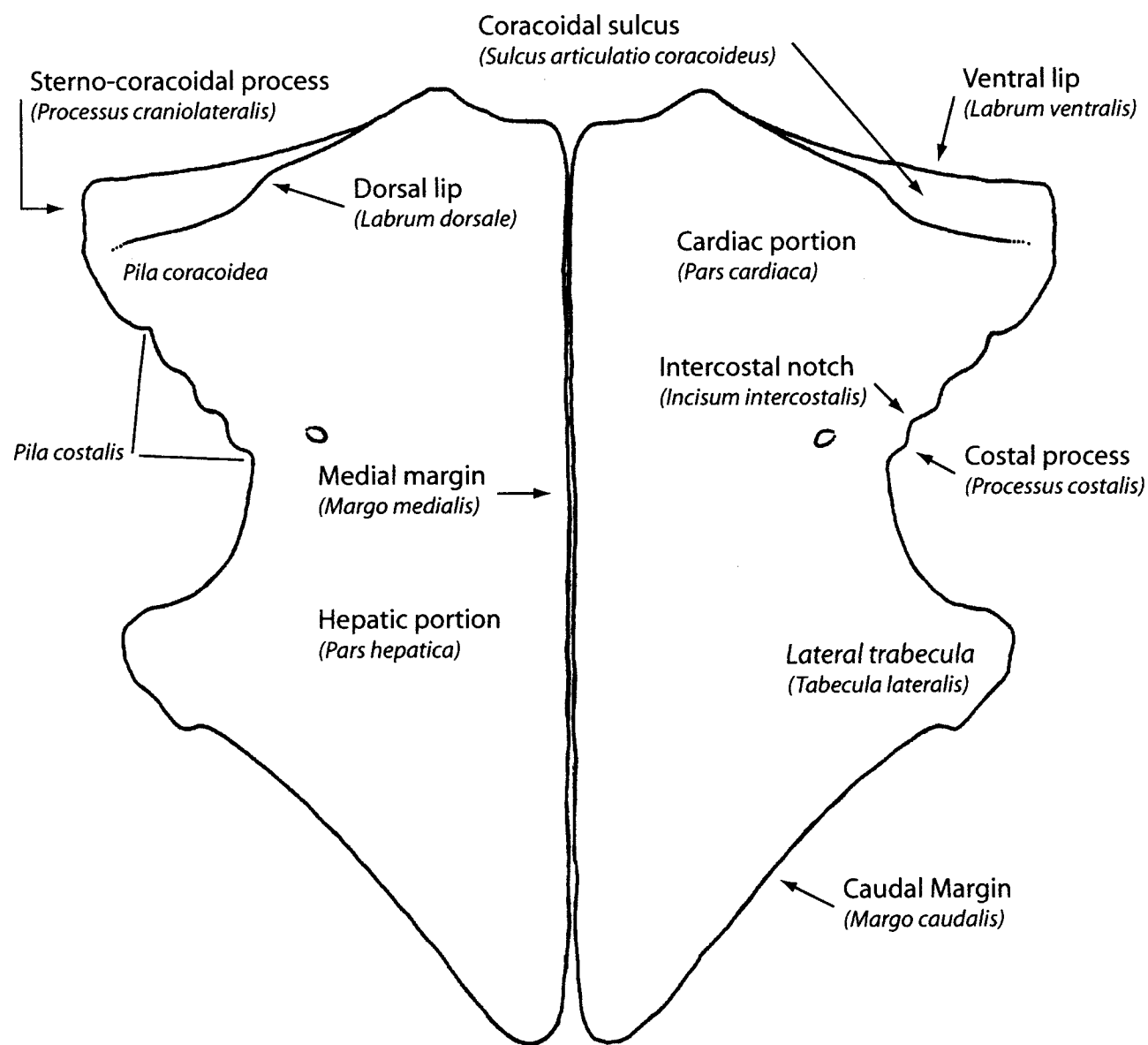


Figure 6.2. A restoration of the sternum based on TMP 92.36.333, drawn in dorsal (visceral) view. Both halves of the sternum are shown lying in the horizontal plane. In life, they were probably angled slightly dorsolaterally, resulting in a reduction in their width.

Description

The sandstone in which the bone was encased was removed mechanically and no restoration was performed (fig. 6.1). Although incompletely preserved, the bone in its present condition appears to have suffered little postmortem distortion. Approximately three-quarters of the element was preserved. It consists of an essentially flat, roughly triangular plate of bone conspicuously indented along its lateral margin. The sternal plate is 127 mm long, 66.5 mm wide, and 9 mm deep through the *pila coracoidea*. (Latin terminology, as applied to avian sterna, is taken from Baumel et al. 1979, and Baumel and Witmer 1993.)

The nearly straight medial margin of TMP 93.36.333 indicates that the two sternal plates abutted throughout most, if not all, of their lengths. At the midpoint in its length, the bone is only 2 mm thick along

its medial margin. Both cranial and caudal ends of the medial margin thicken to 3.5 mm.

The cranial end of the bone is dorsoventrally thickened to accommodate the coracoidal sulcus (figs. 6.1A, 6.2). Except for a small damaged segment mediocranially, this sulcus occupies the entire cranial end of TMP 92.36.333. The bone within the sulcus is pitted and pustulate, reminiscent of cartilage-covered bone. In dorsal view, the dorsal lip of the coracoidal sulcus obscures the ventral lip medially. Laterally, however, the ventral lip is clearly seen as the dorsal lip curves dorsally to form the *pila coracoidea*. The sterno-coracoidal process is incompletely preserved in TMP 92.36.333. As one passes caudolaterally along the coracoidal sulcus, the bone curves dorsally in the area of the sterno-coracoidal process.

Immediately caudal to the *pila coracoidea* the visceral surface of the bone is marked by a conspicuous circular concavity. Medial to this concavity, the cardiac portion of the sternum is slightly convex. In dorsal view, the bone medial to the cardiac portion is depressed slightly before thickening dorsoventrally along the medial margin of the bone. Within the cardiac portion of the sternal plate, the contours on the ventral surface of TMP 92.36.333 parallel those of the dorsal surface.

Immediately caudal to the sterno-coracoidal process, the dorsoventrally thickened bone (5.5 mm) curves caudomedially. This area, the *pila costalis*, presents on its lateral face three well-developed costal processes, each separated by an intercostal notch. We assume that each costal process articulated with one sternal rib. The centers of adjacent costal processes are separated by about 7 mm. The caudal-most process forms a smooth, roughly circular swelling. The other two processes appear to have been damaged, exposing the spongiosa within. From the top of the *pila costalis*, the bone dips forward into the aforementioned circular depression within the cardiac portion of the sternum. A small foramen pierces TMP 92.36.333 medial to the caudal-most costal process. On the ventral surface, the bone also thins medially, forming a shallow trough that extends from the sterno-coracoidal process back toward the hepatic region of the sternum. The bone also thins from 5.5 mm to 2 mm. Behind the costal processes, the bone curves abruptly caudolaterally. Were the bone complete in this area, it would likely have formed the lateral trabecula as seen in *Velociraptor* (Barsbold 1983) and birds (Baumel and Witmer 1993).

Although the caudal half of the sternal plate is incomplete, short segments of both the medial and caudal margins are intact, and were helpful in producing the restoration (fig. 6.2). The bone of the hepatic portion of the sternum is only 1.5 to 2 mm thick.

Discussion

Of the known sterna of small theropod dinosaurs, TMP 92.36.333 most closely resembles those of *Bambiraptor feinbergi* (Burnham et al. 2000) and *Velociraptor mongoliensis* (Barsbold 1983; Norell and Makovicky 1997, 1999). Close examination of the sternals of *Velociraptor mongoliensis* (GIN 100/25, 100/985, and a specimen with the

field number GIN 940728) confirms the presence of all the anatomical features displayed by TMP 92.36.333. The length of the sternum in each of TMP 92.36.333 and *Velociraptor* is equal to or greater than the combined width of the paired sternal plates. The sterna of oviraptorosaurs (Barsbold 1983; Clark et al. 1999) and *Gorgosaurus* (Lambe 1917; but see Brochu 2002), on the other hand, are shorter cranio-caudally and wider laterally than are those of *Bambiraptor*, *Velociraptor*, or TMP 92.36.333. This would lead us to suggest that short and wide sterna represent the primitive pattern from which the long dromaeosaur sternum is derived. Elongation of the sternum may be the only feature that renders the dromaeosaurid sternum more avian than that of oviraptorids. The most conspicuous non-avian features of TMP 92.36.333 include its paired structure with no development of a sternal carina. That there are paired sternal plates in an immature Mongolian dromaeosaur, GIN 100/985 (Norell and Makovicky 1997), leaves open the possibility that TMP 92.36.333 was also derived from a juvenile.

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