



A juvenile *Ornithomimus Antiquus* (Dinosauria: Theropoda: Ornithomimosauria), from the Upper Cretaceous Kirtland Formation (De-na-zin Member), San Juan Basin, New Mexico

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1997, pp. 249-253. <https://doi.org/10.56577/FFC-48.249>

in:
Mesozoic Geology and Paleontology of the Four Corners Area, Anderson, O.; Kues, B.; Lucas, S.; [eds.], New Mexico Geological Society 48th Annual Fall Field Conference Guidebook, 288 p. <https://doi.org/10.56577/FFC-48>

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A JUVENILE *ORNITHOMIMUS ANTIQUUS* (DINOSAURIA: THEROPODA: ORNITHOMIMOSAURIA), FROM THE UPPER CRETACEOUS KIRTLAND FORMATION (DE-NA-ZIN MEMBER), SAN JUAN BASIN, NEW MEXICO

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Abstract—A tibia of a juvenile theropod, from the Kirtland Formation of the Alamo Wash region, San Juan Basin, New Mexico, bears a distinctive cnemial crest and is identified as *Ornithomimus antiquus*. The diagnosis of *O. antiquus* is expanded to include this feature, but a comprehensive revised diagnosis of this dinosaur is deferred to a more comprehensive study. *Ornithomimus velox* and *O. edmontonicus* are junior subjective synonyms of *O. antiquus* as there are no morphological features that distinguish them from one another.

INTRODUCTION

Theropods, particularly small forms, are very rare in the Upper Cretaceous Kirtland Formation in the San Juan Basin, New Mexico. Those that have been reported include (from older, pre-Naashoibito Member units): cf. *Struthiomimus* sp., Dromaeosauridae gen. et sp. indet., *Albertosaurus* sp. and *Aublysodon* cf. *A. mirandus*. The last taxon, reported by Lehman and Carpenter (1990), is considered to be a juvenile albertosaur by Sues (personal commun., 1997). Taxa from the Naashoibito Member include

Ornithomimidae gen. et sp. indet., Dromaeosauridae gen. et sp. indet., ?*Albertosaurus* sp., cf. *Tyrannosaurus* sp. and Saurornithoididae gen. et sp. indet. (Lehman, 1981; Lucas et al., 1987; Hunt and Lucas, 1992, 1993). Most of these taxa are known from isolated teeth, terminal phalanges, metatarsals, and other limb elements that are not useful for generic and/or specific diagnoses. Partial skeletal remains of these dinosaurs are rarer still, and complete skeletons are not known from the San Juan Basin. The San Juan Basin ornithomimid occurrences and the status of the species of *Ornithomimus* are the focus of this report.

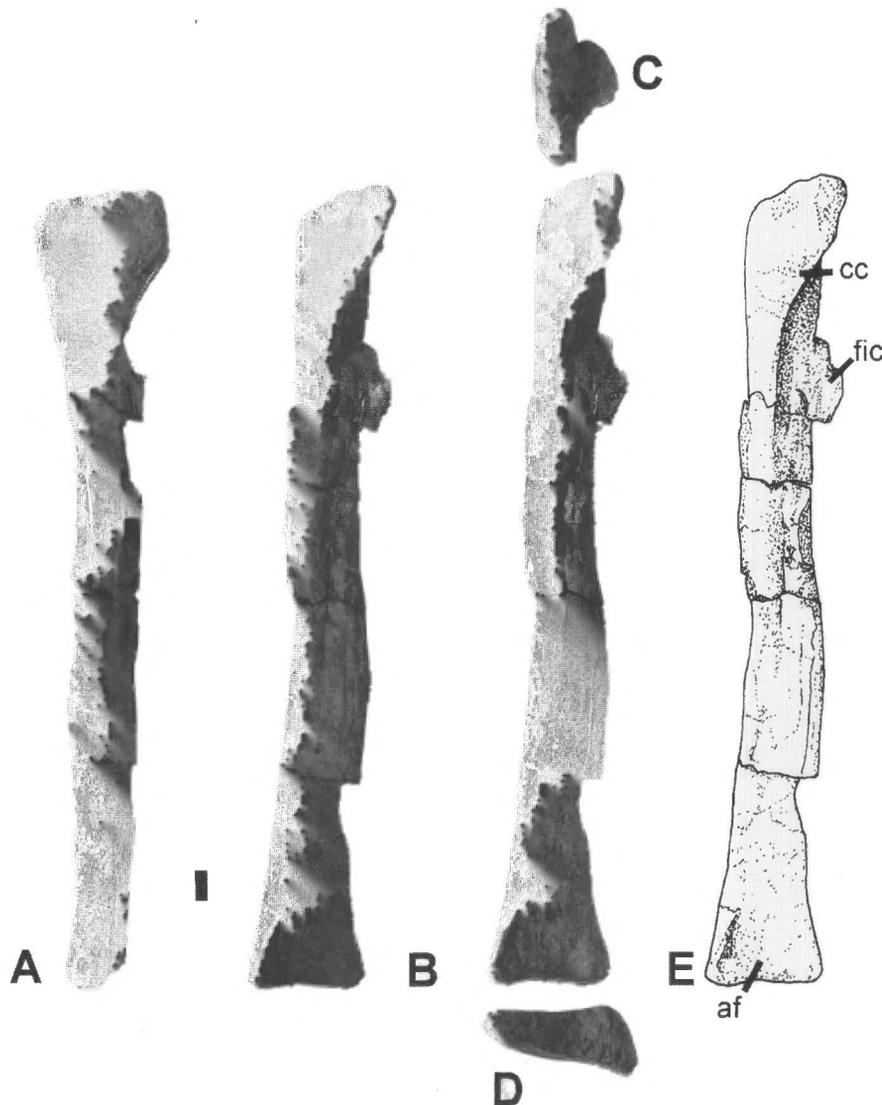


FIGURE 1. SMP VP-714, left tibia. A, medial view; B, anterior (cranial) view (stereo pair); C, proximal end; D, distal end; E, drawing of anterior (cranial) view. Abbreviations: af = astragalar facet; cc = cnemial crest; and fic = fibular crest. Bar scale = 10 cm.

The first documented discoveries of ornithomimids in the San Juan Basin were reported by Kues et al. (1977). These were later mentioned, and duly listed, by Lucas et al. (1987). Again, most of the ornithomimid material consists of fragmentary remains of metatarsal, phalanges (including claws) that defy generic identification (Lucas et al., 1987). Only three of the specimens cited by them, now housed in the collections of the New Mexico Museum of Natural History and Science (NMMNH) in Albuquerque (NMMNH P 22525, formerly UNM [University of New Mexico, Department of Geology] B-433C, distal end of a phalanx; NMMNH P 22911, formerly UNM B-741A, claw; and NMMNH P 22660, formerly UNM FKK-019, partial claw), are from the Kirtland Formation. Specifically, these specimens are from the "lower shale member" (now the Hunter Wash Member), middle part of the Kirtland (presumably either the Farmington Member or possibly the De-na-zin Member), and Naashoibito Member of the Kirtland Formation, respectively (Lucas et al. 1987; Hunt and Lucas, 1992).

In the summer of 1995, I discovered a nearly complete left tibia (SMP [State Museum of Pennsylvania] VP-714, Figs. 1 and 2) of a small, juvenile ornithomimid dinosaur in the De-na-zin Member of the Kirtland Formation (Late Cretaceous: late Campanian–early Maastrichtian), San Juan Basin, New Mexico. The tibia was found lying completely exposed on the surface of the outcrop broken in four main pieces. Assembled, this bone is distinctive in that bears a prominent cnemial crest and has other features (see below) that permit referral to *Ornithomimus*. This report documents this first *bona fide* occurrence of *Ornithomimus* as part of the vertebrate fauna from the Kirtland Formation (De-na-zin Member). Previously, only one specimen (NMMNH P 26232 formerly UNM B-476,) had been tentatively referred to *Ornithomimus* (*edmontonicus*?); a terminal phalanx (digit II of left manus) from the Fruitland Formation (Lucas et al. 1987, p. 36).

SYSTEMATIC PALEONTOLOGY

DINOSAURIA Owen, 1842

SAURISCHIA Seeley, 1887

THEROPODA Marsh, 1881

ORNITHOMIMOSAURIA Barsbold, 1976

ORNITHOMIMIDAE Marsh, 1890

ORNITHOMIMUS Marsh, 1890

Type species—*Ornithomimus velox* Marsh, 1890, p. 84.

Diagnosis—Same as for species (see below).

Ornithomimus antiquus (Leidy, 1865)

Coelosaurus antiquus Leidy 1865, p. 119 (non *Coelosaurus* [Owen, 1854]).

Ornithomimus velox Marsh 1890, p. 84.

Struthiomimus currelli Parks 1933, p. 4.

Ornithomimus edmontonicus Sternberg 1933, p. 79.

Ornithomimus antiquus (Leidy). Baird and Horner (1979, p. 10, 25–26).

Ornithomimus edmonticus (lapsus calami). Lucas et al. 1987, p. 35.

Ornithomimus edmontonensis (lapsus calami). Barsbold and Osmólska, 1989, p. 226.

Diagnosis—Russell (1972, p. 379) diagnosed *Ornithomimus* (based on the holotype of *O. edmontonicus*, ROM [Royal Ontario Museum, Toronto, Canada] 851) as follows: "Length of presacral vertebral column less than combined lengths of femur, tibia-astragalus, and third metatarsal. Tail incompletely known. Humerus longer than scapula. Antebrachium about half as long as femur, lightly constructed. First metacarpal longer than metacarpals 2 and 3, manus digits subequal in length, neither heavily recurved nor powerfully constructed. Ungual of third digit of manus shorter than penultimate phalanx of third digit. Antilium relative to femur longer

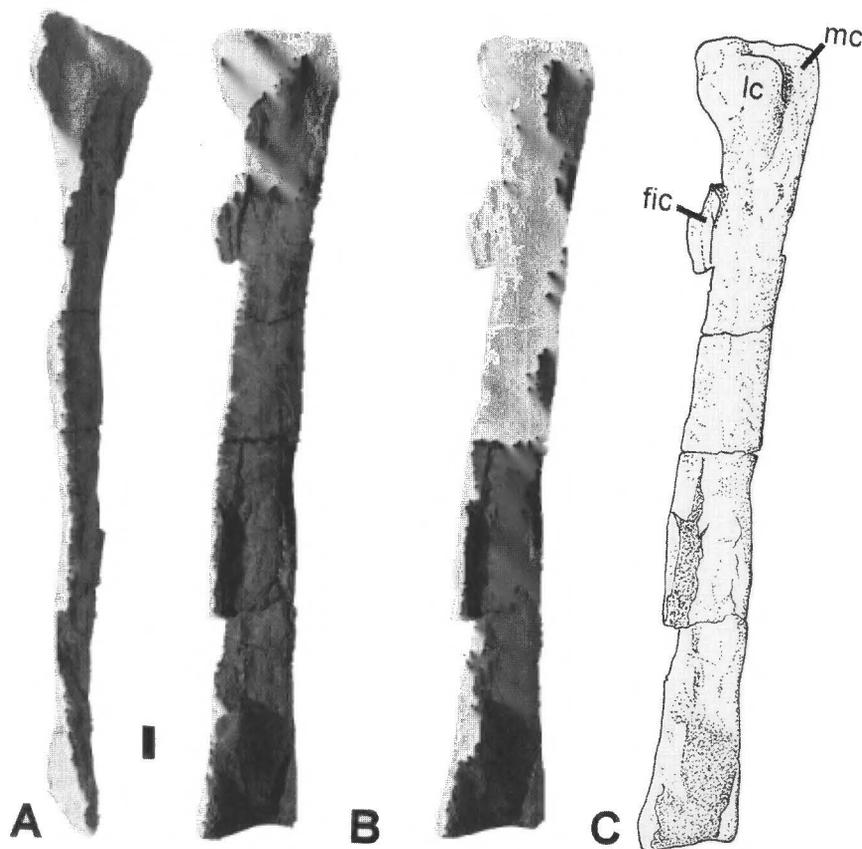


FIGURE 2. SMP VP-714, left tibia. A, lateral view; B, posterior (extensor) view (stereo pair); C, drawing of posterior (extensor) view. Abbreviations: fic = fibular crest; lc = lateral condyle; and mc = medial condyle. Bar scale = 10 cm.

than *Struthiomimus*, shorter than in *Dromiceiomimus*. Tibia and metatarsus shorter relative to femur than in *Struthiomimus* and *Dromiceiomimus*.”

Remarks—The above diagnosis is based largely on relative proportions and thus is wholly subjective; it lacks the critical morphological characters necessary to differentiate putative ornithomimid species from one another, making it largely inadequate for diagnostic purposes, a conclusion reached also by Baird (1986). However, a revised diagnosis of the taxon *Ornithomimus* is not possible at present and is beyond the scope of this paper. Nevertheless, the above diagnosis can be expanded to include the character of the distinctive cnemial crest described below, a feature that is also present on the holotype (right tibia, ANSP [Academy of Natural Sciences, Philadelphia]-9222) of *Coelosaurus antiquus* (Leidy, 1865), a specimen of a subadult *Ornithomimus*, from the Upper Cretaceous of New Jersey. I have examined this specimen which is illustrated here (Fig. 3).

Referred Material—SMPVP-714, nearly complete left tibia (Figs. 1, 2).

Locality—Willow Wash, SW 1/4 sec. 2, T24N, R12W, San Juan County, New Mexico.

Horizon—Kirtland Formation (De-na-zin Member).

Age—Late Cretaceous (early Maastrichtian).

Collector and Date—Robert M. Sullivan, 16 August 1995.

Description—The tibia (Figs. 1, 2) is 25 cm long. A very thin veneer of matrix covers the surface of the bone in places. The shaft is hollow, crushed and deformed for its entire length, with the most severe crushing confined

to the distal 75% of the element. Proximally, in medial view (Fig. 1A), the cnemial crest forms a prominent anterior ridge that descends along the shaft for nearly one quarter of its length. The anteriorly directed edge of the upper cnemial crest is nearly parallel to the shaft of the tibia for a length of 2.3 cm. It descends sharply toward the shaft, forming a distinctive, somewhat angular ridge, in medial view (Fig. 1A). The lateral condyle is larger, and more inflated, than the adjacent medial condyle. In superior view, the medially directed surface of the cnemial crest is relatively straight. The fibular crest (Figs. 1B,E, 2B,C) is incomplete, broken off the shaft both proximally and distally, suggesting that its full extent was about one quarter the length of the tibia. Distally, there is no evidence of an astragalus and calcaneum. Moreover, there is no evidence of their articulation with the extensor and distal surfaces of the tibia.

Discussion—Comparison of SMP VP-714 to the tibiae of the holotypes of *Ornithomimus antiquus* (ANSP 9222), *O. edmontonicus* (ROM 851) and *Dromiceiomimus brevitertius* (=holotype of *Struthiomimus brevitertius*) (ROM 797), clearly indicates that the new specimen can be referred to *O. antiquus*, and cannot be referred to either of the latter two species, based on the presence of this distinctive cnemial crest. This unique feature also precludes reference to the other known ornithomimids (i.e., *Archaeornithomimus*, *Gallinimus* and *Struthiomimus*). Based on photographs of SMP VP-714, Philip Currie (personal commun., 1996) believed that the specimen may be referable to the dromaeosaurid *Saurornithoides*



FIGURE 3. ANSP-9222, holotype of *Coelosaurus antiquus*, right tibia . A, medial view; B, anterior (cranial) view; C, proximal end; D, distal end; E, lateral view; F, posterior (extensor) view. Bar scale = 10 cm.

langstoni (Sues, 1978) based on the "size, proportions, and positions of condyles and the fibular crest" and the "lack of elongation." However, my study of ROM 851 suggests that the morphology and position of the condyles is consistent with the holotypes of *Ornithomimus antiquus* and *O. edmontonicus* (see below) and reference to any taxon of the Dromaeosauridae also cannot be substantiated. Moreover, Currie (personal commun., 1996) did concur that the distinctive cnemial crest supports reference to the Ornithomimidae. The absence of a fused astragalus and calcaneum, and the fact that the tibia is slightly larger than half the size of the holotype of *O. edmontonicus*, corroborates that this tibia was from a juvenile.

TAXONOMIC HISTORY OF *COELOSaurus* AND *ORNITHOMIMUS*

Although Russell (1972) reviewed and revised the ornithomimids, it is clear that another taxonomic revision, one that utilizes phylogenetic systematic analysis (cladistics), is now needed. However, such a revision is not the intent of this contribution; rather I present what I consider to be the current status of the taxa in question based on the existing type material.

The taxon *Coelosaurus antiquus* was named by Leidy (1865) based on ANSP-9222, a right tibia (from Burlington County, New Jersey) and syntypes ("fragments of a tibia and metatarsal bone, and phalanges, from Monmouth Co., N. J.") that are not diagnostic to genus. *Coelosaurus antiquus* was coined in his "synopsis," a list of illustrated specimens. Leidy did not provide a diagnosis for either the genus or species in his monograph, describing the syntypic material only in relation to that of *Hadrosaurus*.

Twenty-five years later, *Ornithomimus velox* was described by Marsh (1890), based on incomplete material consisting of a distal end of a tibia (with astragalus and calcaneum), metatarsals, phalanges and three associated metacarpals, presumably belonging to the same individual (see Russell, 1972, p. 379). Matthew and Brown (1922) reassessed the status of *Coelosaurus antiquus*, recognizing that it was related to either (or both) *Struthiomimus*, an ornithomimid named by Osborn (1916), or Marsh's *Ornithomimus*. Moreover, they recognized that Gilmore's *Ornithomimus affinis* (Gilmore 1920, p. 137) from the Arundel Formation of Maryland, was probably referable to *Coelosaurus antiquus*. However, Russell (1972) transferred this species to a new genus *Archaeornithomimus* based on "recurved nature of the pedal unguals." Barsbold and Osmólska (1989) considered both *Ornithomimus affinis* (= *Archaeornithomimus affinis*) and *Coelosaurus antiquus* to be nomen dubia. The species *Ornithomimus edmontonicus* was established by Sternberg (1933) and revised by Russell (1972). Baird and Horner (1979) revisited the status of Leidy's *Coelosaurus antiquus*, and correctly recognized the genus *Coelosaurus* to be a junior homonym of *Coelosaurus* Owen 1854. Accordingly, they transferred the species *C. antiquus* to the genus *Ornithomimus* (hence the combination *O. antiquus*). However, no morphological reason was given by Baird and Horner (1979) for this assignment. Baird (1986) noted additional fragmentary material from the Severn Formation of Maryland, and argued parsimony as the rationale for assigning the material to *O. antiquus*.

Contrary to the point of view expressed by Barsbold and Osmólska (1989), I believe the cnemial crest present on the type of *Ornithomimus* (= "*Coelosaurus*") *antiquus* to be diagnostic. To date, all of the presently recognized *Ornithomimus* species (*O. antiquus*, *O. velox* and *O. edmontonicus*; Baird and Horner, 1979; Barsbold and Osmólska, 1989) possess this distinct cnemial crest, which I consider to be a generic character based on my survey of ornithomimid material. The validity of previously synonymized species of *Ornithomimus*, *Archaeornithomimus affinis*, and other ornithomimids will have to wait for a more comprehensive study. For now, I accept the revisions published by Russell (1972) with the exceptions noted above.

STRATIGRAPHIC AND PALEOGEOGRAPHIC CONSIDERATIONS

The stratigraphic position of the two western *Ornithomimus* "species" has been the only criterion used for separating them; *Ornithomimus velox* is from the late Maastrichtian and *O. edmontonicus* is from the late Campanian to early Maastrichtian (Russell, 1972; Barsbold and Osmólska, 1989). However, Russell (1972) reported that these two "species" cannot

be distinguished morphologically from one another on the basis of the known material. Russell did not consider the status of *Coelosaurus antiquus* and transferred Gilmore's Mongolian species "*Ornithomimus asiaticus*" (Gilmore, 1933) and the Maryland species "*O. affinis*" (Gilmore, 1920) to the new genus *Archaeornithomimus*. Despite this fact, he retained, rather than synonymized, the two "species" based solely on their respective stratigraphic occurrence. Retention of all three "species," in the absence of osteological characters, is indefensible. Moreover, morphology, not the stratigraphic and/or geographic positions, is the only valid criterion for distinguishing species. Therefore, *Ornithomimus antiquus* is the sole species of the genus *Ornithomimus*; *O. velox* and *O. edmontonicus* are here recognized as junior subjective synonyms of *O. antiquus*. Consequently, *Ornithomimus antiquus* is now known from the late Campanian through Maastrichtian of North America.

ACKNOWLEDGMENTS

I thank Hans-Dieter Sues and Kevin Seymour (Royal Ontario Museum) for access to ornithomimid specimens in the ROM's collection and Ted Daeschler (Academy of Natural Sciences, Philadelphia) for the loan of ANSP 9222 (type of *Coelosaurus antiquus*). I thank Ruby Williamson (New Mexico Museum of Natural History and Science) for providing me with the corresponding NMMNH numbers for the ornithomimid material previously housed in the collections of the University of New Mexico (UNM). Special thanks are extended to Hans-Dieter Sues for directing my attention to the *Coelosaurus* problem. I thank Philip Currie (Royal Tyrell Museum of Paleontology) for his insights on the identification of these poorly known and understood theropods. Spencer G. Lucas (New Mexico Museum of Natural History and Science) and Hans-Dieter Sues reviewed the manuscript and I thank them for their insights and suggestions. Claire Messimer (The State Museum of Pennsylvania) took the photos of SMP VP-714. Martin L. Ginter (Commonwealth Media Services) took the photos of ANSP-9222.

Finally, I thank Michael O'Neil (Bureau of Land Management, Albuquerque District), and the BLM, for providing me with the necessary permit to collect in the De-na-zin Wilderness area. The specimen was collected under BLM Paleontological Resource Use Permit no. SMP-8270-RSW-95-A.

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