AN AETOSAUR (REPTILIA:ARCHOSAURIA) FROM THE UPPER TRIASSIC CHINLE GROUP, CANYONLANDS NATIONAL PARK, UTAH

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Abstract—A partial skeleton of the aetosaur *Stagonolepis* sp. is the first tetrapod body fossil recovered from Upper Triassic strata in Canyonlands National Park. The specimen consists of a partial tooth and numerous disarticulated vertebrae, ribs, and scutes found in the Blue Mesa Member of the Petrified Forest Formation (Chinle Group) near Upheaval Dome. *Stagonolepis* is an index taxon of the Adamanian land-vertebrate faunachron, and indicates a late Carnian (228-218 Ma) age for the Blue Mesa Member in Canyonlands National Park, an age supported by lithostratigraphic and biostratigraphic correlations to other Stagonolepis-bearing strata.

INTRODUCTION

The Chinle Group, as defined by Lucas (1993), consists of all nonmarine Upper Triassic strata in the western United States. These deposits were laid down in a vast depositional system that spanned at least 2.5 million km^2. Despite more than 120 years of vertebrate paleontological research on the Chinle, we are not aware of any Upper Triassic tetrapod body fossils from Canyonlands National Park (CANY), even though there are extensive, well-exposed Chinle outcrops throughout the park. Recently Hasiotis (1995) described Upper Triassic crayfish burrows from CANY, and Lucas et al. (1995) described an Upper Triassic dinosaur footprint from CANY. Here we provide a description of the first Chinle body fossil reported from CANY, a partial skeleton of the aetosaur *Stagonolepis* sp., and discuss its biochronological significance. In this paper NMMNH = New Mexico Museum of Natural History and Science, Albuquerque.

STRATIGRAPHY

Previous studies of the Chinle Group in the vicinity of CANY include Stewart et al. (1972) and O'Sullivan and MacLachlan (1975). Here, we follow the lithostratigraphy of Stewart et al., (1972), with some subsequent modification as advocated by Lucas (1993).

The stratigraphic section we use here was measured near Upheaval Dome, where Chinle strata disconformably overlie the Lower-Middle Triassic Moenkopi Group and are overlain disconformably by the Upper Triassic-Lower Jurassic Wingate Sandstone. Due to stratigraphic disruption caused by the salt diapir that forms Upheaval Dome (Jackson et al., 1998), the section dips 20 degrees to N60 degrees east. The Chinle Group at this section consists of the following named units (ascending): Shinarump Formation, Cameron Formation, Petrified Forest Formation, Owl Rock Formation, and Rock Point Formation (Fig. 1). The Petrified Forest Formation is readily subdivided into the lower Blue Mesa Member, medial Moss Back Member, and upper Painted Desert Member. The complete Chinle Group section is approximately 138 m thick (Fig. 1).

The partial skeleton we describe here was found in a grayish-green, pisolitic calcrete ledge 11.5 m above the base of the Blue Mesa Member of the Petrified Forest Formation (Fig. 1). The fossiliferous horizon, designated NMMNH locality 3279, consists of an 0.7-m-thick, slightly sandy, very well-indurated pisolitic calcrete to calcarenite. The matrix is grayish yellow-green, unweathered, with some grayish red mottling, and locally weathers to yellowish gray. We interpret this deposit as representing a fluvial deposit that was subsequently subjected to extensive pedogenic modification. The tetrapod bones are jumbled and occur throughout this massive, non-stratified unit.

PALEONTOLOGY

The specimen we describe here is housed at the NMMNH, where it is catalogued as NMMNH P-26938. It consists of a nearly complete and prepared dorsal paramedian scute (Figs. 2-3), a partial tooth, and 14 matrix blocks with scattered vertebrae, ribs, and scutes (Tab. 1).

At least four groups of tetrapods known from the Chinle possess armor or armored elements that have a sculptured texture of pits and ridges—metoposaurid amphibians, phytosaurs, sphenosuchians, and aetosaurs. The scutes of NMMNH P-26938 are rectangular osteoderms and clearly not skull fragments, clavicles, or interclavicles of metoposaurid amphibians. Furthermore, the vertebrae associated with the

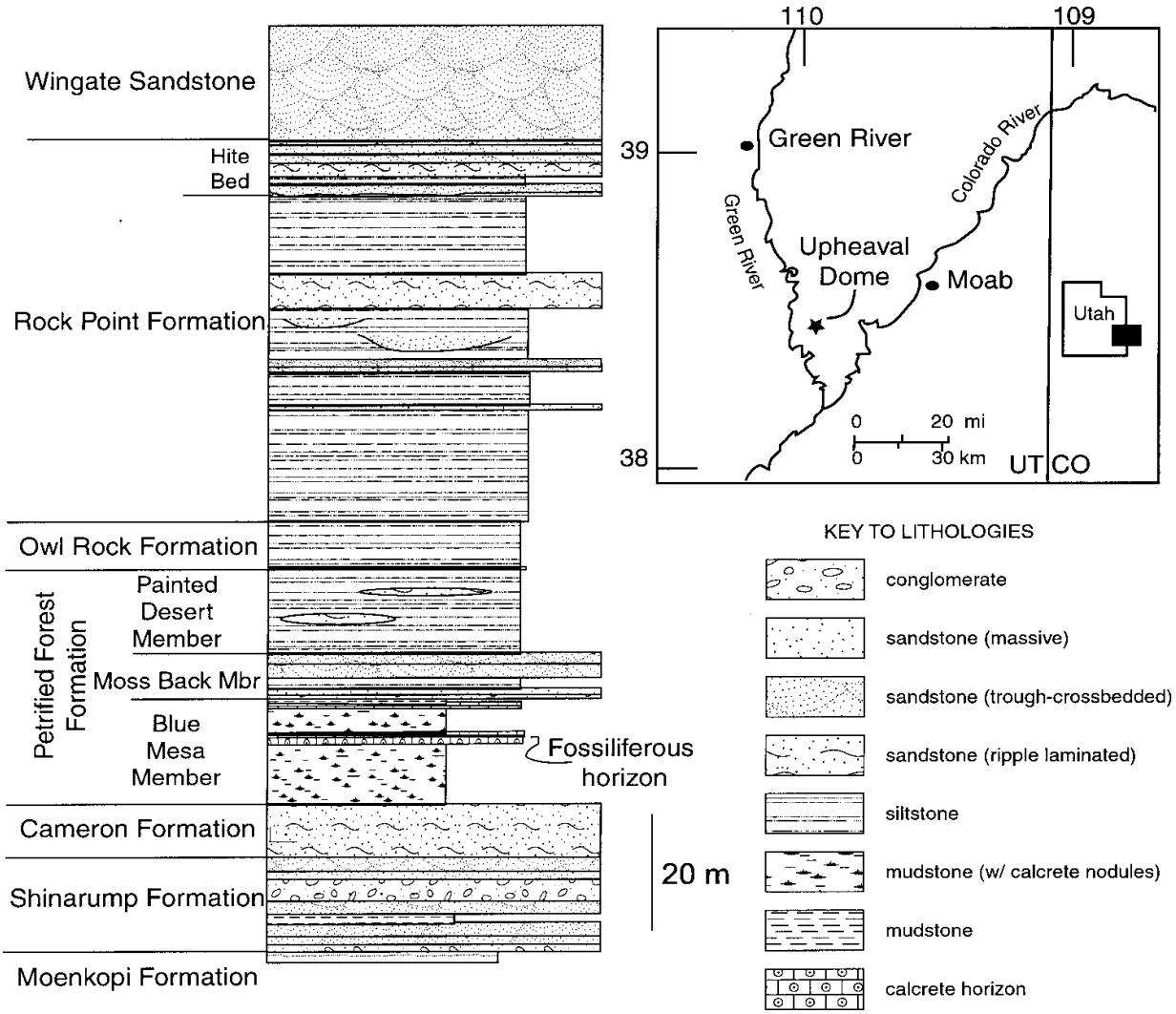

FIGURE 1— Location map and stratigraphic section showing the location and stratigraphic position of the fossil described here. Index map modified from Jackson et al. (1998).

specimen are taller than wide, and medially constricted, as are those of many archosaurs, and thus cannot represent metoposaurs. The flat, rectangular shape, presence of an anterior articulating surface, and lack of anteriorly- or posteriorly- projecting lappets on scutes assigned to NMMNH P-26938 preclude their assignment to any of the other armored archosaur groups. Phytosaur scutes are typically keeled and oblate to circular, and lack an articular surface. Sphenosuchian scutes (including those of rauisuchians) are flat, but generally either rhomboidal and/or possess anteriorly or posteriorly projecting lappets. Therefore, NMMNH P-26938 clearly pertains to an aetosaur.

The most diagnostic element of P-26938 is the incomplete dorsal paramedian scute (Fig. 2). Heckert and Lucas (1999) recently reviewed the phylogenetic significance of aetosaur scutes, and our taxonomy follows their conclusions. Diagnostic features of this scute include the lack of a ventral keel, its low width:length (W:L) ratio, the presence of an anterior bar (Figs. 2A, 3), the generally radial pattern of the shallow pits on the dorsal surface (Fig. 3), and the transverse arching (Fig. 2C,D). The lack of a ventral keel precludes assignment to the aetosaurs *Redondasuchus* and *Typothorax*.

As preserved, this scute is 35 mm long and 57 mm wide, yielding a low (1.6) W:L ratio. This size and low W:L ratio preclude assignment to the aetosaurs *Typothorax*, *Paratypothorax*, and *Aetosaurus ferratus*. The presence of an anterior bar precludes assignment to *Desmatosuchus*. The presence of pitting precludes assignment to *Coahomasuchus*. The scute is exceedingly fragile, and a block of matrix obscures details regarding the presence, position, and size of the dorsal boss. Normally, this structure is quite pronounced and contacts the dorsal margin of the scute in *Stagonolepis* (Case, 1932: pl. 1; Long and Ballew, 1985: figs. 13-14; Long and Murry, 1995: figs. 69-72). In this specimen the boss clearly does not extend anteriorly past the middle of the scute as a longitudinal keel, which precludes assignment to *Aetosaurus crassicauda*. The scute is gently arched transversely (Fig. 2C), as is typical in caudal paramedian scutes of *Stagonolepis* (Long and Ballew, 1985). Therefore, we assign this scute, and the associated partial skeleton, to *Stagonolepis* sp.

Of the other material assigned to P-26938, the tooth consists of a partial crown. The crown is short and bulbous, and conforms well to an aetosaur tooth (Walker, 1961), but is otherwise undiagnostic. The remaining material consists primarily of incompletely exposed vertebrae and ribs. Some of the vertebrae appear to have extensive transverse processes, a characteristic of *Stagonolepis* (Long and Murry, 1995), but are not well enough exposed to measure. The few other scutes that can be discerned are only exposed ventrally. A large, fragmentary phytosaur tooth is also exposed on one block, but is otherwise undiagnostic.

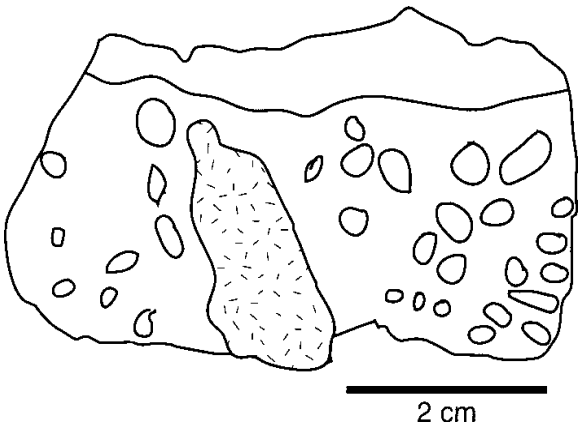

FIGURE 3— Interpretative sketch of NMMNH P-26938, a partial dorsal paramedian scute of *Stagonolepis* sp. from the Blue Mesa Member of the Petrified Forest Formation in CANY, based on the photograph in FIGURE 2A.

AGE

The aetosaur *Stagonolepis* is an index taxon of the Adamanian land-vertebrate faunachron (lvf) of Lucas and Hunt (1993). The type Adamanian fauna is from the general vicinity of "Dying Grounds" in the Blue Mesa Member at Petrified Forest National Park (PEFO). The Adamanian is of well-constrained latest Carnian age, and spans the time interval of 228-218 Ma (Lucas, 1997, 1998). The presence of *Stagonolepis* in the Blue Mesa Member of CANY indicates an Adamanian age for that unit. *Stagonolepis* was widely distributed during this time interval and can be used to correlate strata in North America, South America, and the United Kingdom (Lucas and Heckert, 1996).

CONCLUSIONS

An incomplete scute facilitates identification of a partial aetosaur skeleton as *Stagonolepis* sp. This aetosaur is an age-diagnostic fossil, and confirms lithostratigraphic correlation of the Blue Mesa Member in CANY to the Blue Mesa Member in PEFO. The presence of *Stagonolepis* indicates an Adamanian (latest Carnian) age for these strata.

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FIGURE 2— Photographs of NMMNH P-26938, a partial dorsal paramedian scute of *Stagonolepis* sp. from the Blue Mesa Member of the Petrified Forest Formation in CANY. (A) dorsal view; (B) ventral view; (C) anterior view; and (D) posterior view.

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