

SMALL METOPOSAURID AMPHIBIANS FROM THE TRIASSIC OF WESTERN NORTH AMERICA AND THEIR SIGNIFICANCE

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Abstract - The taxonomy of Dictyocephalus elegans from the Triassic Cumnock Formation of North Carolina is reconsidered. Evaluation of the metoposaurid genera of North America is based upon recent discoveries of two skulls of small metoposaurids from the Late Triassic Dockum Formation of West Texas. The new Texas specimens, plus a small specimen from the Upper Triassic Petrified Forest Member of the Chinle Formation, are described and compared using Cartesian transformations and biometric analyses.

INTRODUCTION

In 1856, Joseph Leidy described a small metoposaurid recovered from the Triassic coal beds of the Cumnock Formation in central North Carolina. Leidy's original description of this tiny specimen included two major points: "...parietal foramen near the centre of the bones.... posterior outline of the cranium with superficial transverse concavity on each side and not a deep sinus." One hundred years later, in their review of the metoposaurs, Colbert and Imbrie (1956) were perplexed by Leidy's find: "Perhaps the most striking character of Dictyocephalus elegans is its small size, which makes comparison with the large metoposaurs of western North America difficult. This specimen may well represent the juvenile stage of the large metoposaur, closely comparable to some of the large metoposaurs of the western states, but in view of the fragmentary nature of the specimen there is no way to prove or disprove this possibility."

Thirty years later another small metoposaur was discovered in the Late Triassic Dockum Formation sediments in Post, Garza County, West Texas (hereafter referred to as the Post quarry). This specimen (TTUP 9216), represented by a skull, partial lower jaw, partial clavicle and interclavicle, is similar to Leidy's Dictyocephalus. As metoposaurs are quite abundant in the Dockum Formation, it was initially believed that this specimen represented a juvenile member of the genus Metoposaurus. Studies failed to yield any satisfactory conclusions as to its status until 1987 when another small skull was found in the Dockum with similar characters. Still, these two specimens are distinct among themselves and suggest some interesting possibilities with regard to the morphogenesis and taxonomic relationships of metoposaurids. These two new skulls, one specimen from the Petrified Forest of Arizona and some undescribed specimens from New Mexico's Redonda Formation, may provide some answers to the

problem of Dictyocephalus.

NOMENCLATURAL HISTORY OF THE METOPOSAURS

Metoposaurs are characteristic Late Triassic labyrinthodont amphibians with a cosmopolitan distribution from North America, Germany, North Africa and India. The family Metoposauridae, named from the European genus Metoposaurus, is distinguished by its flat skull and the position of the orbits anterior to the midlength of the skull. Bones of the skull roof are deeply sculpted on their dorsal surfaces (Plate 4I).

There has been considerable disagreement among paleontologists concerning generic metoposaur taxonomy. Colbert and Imbrie (1956) reviewed the Metoposauridae and concluded that the American specimens were sufficiently distinct from the Eurasian specimens to warrant placing the former into the genus Eupelor Cope, 1868. The Eurasian specimens they placed into the genus Metoposaurus Lydekker, 1890. More recently, Roy-Chowdhury (1965) doubted that the differences between the Eurasian and American specimens were great enough to justify their placement in separate genera. He proposed placing all American and Eurasian specimens in the genus Metoposaurus, which takes precedence over other generic names. Metoposaurus is characterized by a robust skull with deeply incised otic notches along its posterodorsal margin. The otic notch is partially enclosed on its interior margin by a projection of the tabular element called the tabular process or horn. Two other genera of metoposaurids are recognized. The first of these is the aforementioned Dictyocephalus based upon the single specimen described by Leidy (Plate 4G). This genus is characterized not only by its small size, but also by the absence of tabular horns and shallow otic notch. Contrary to the suggestion by Colbert and Imbrie that Dictyocephalus may be a juvenile of a large Metoposaurus, Baird (pers. comm.) believes that Dictyocephalus is a valid genus based upon the above characters.

Gregory revised metoposaur taxonomy on the basis of the presence or absence of the otic notch and tabular horn. He concluded that for those specimens lacking tabular horns and bearing shallow otic sinuses, the genus Anaschisma Branson, 1905, was valid (Plate 4H). Anaschisma is founded upon two specimens from the Triassic Popo Agie Formation of Wyoming. Gregory placed Dictyocephalus in Metoposaurus believing the former represents a juvenile of an individual that would later develop tabular horns and accompanying notches. He clarified this decision by stating that such an argument is questionable because it "involves assumptions that are not demonstrable beyond question concerning the otic notch of Dictyocephalus and concerning the relationship of the small Dictyocephalus to the larger Metoposaurus" (Gregory, 1980). Baird (oral comm.) suggests that Dictyocephalus may represent a juvenile of Anaschisma based upon the shared notchless and hornless characters. If that proves the case, then Anaschisma would be the junior synonym of Dictyocephalus. The purpose of this article is thus twofold. First, the stratigraphic occurrence and

morphology of the new specimens will be described. Second, those specimens will be compared to members of the three existing genera as a means of evaluating their position within the family Metoposauridae to determine the taxonomic validity of the genus Dictyocephalus.

MATERIALS AND METHODS

Discovered by Michael W. Nickell at the Post quarry, TTUP 9216 was encased in a small block of red mudstone. Chemical and mechanical preparation methods were employed to remove the matrix from the delicate bones. TTUP 9237 was recovered from surface collecting at the Collier ranch locality, Crosby County, Texas. This specimen required little preparation.

Specimen repositories are identified by the abbreviation preceding the specimen number: AMNH, American Museum of Natural History; TMM, Texas Memorial Museum; TTUP, The Museum, Texas Tech University; UCMP, University of California Museum of Paleontology, Berkeley. Nine specimens were used in this study:

1. AMNH 5661: type specimen of Dictyocephalus elegans, partially intact postorbital region; Cumnock Formation, North Carolina; skull length estimated at 78-80 mm.
2. TTM 31100-42: well-preserved complete skull; Howard County, Texas; skull length = 455 mm.
3. TTM 31100-124: well-preserved skull; Howard County, Texas; skull length = 400 mm.
4. TTM 31099-12B: excellent skull of juvenile metoposaur complete with both stapes and lower mandibles; Howard County, Texas; skull length = 160 mm.
5. TTUP 9042: well-preserved skull; Howard County, Texas; skull length = 380 mm.
6. TTUP 9083: large complete skull; right side partially distorted by crushing; Crosby County, Texas; skull length = 630 mm.
7. TTUP 9216: well-preserved small skull and lower jaw; Garza County, Texas; skull length = 73 mm.
8. TTUP 9237: small skull, posterior border only; Crosby County, Texas; skull length estimated between 110-120 mm.
9. UCMP 82/39/37: small skull in good condition, but partially distorted from crushing; Chinle Formation, Petrified Forest National Park, Arizona.

GEOLOGIC SETTING

The Upper Triassic sediments of the Dockum Formation were deposited in a broad continental basin. A major source of the Dockum sediments was the Ouachita orogenic belt that bounded the Dockum depositional basin to the south. Sedimentological and mineralogical evidence supports the existence of a hot, semi-arid to sub-humid climate for Dockum time. In general, the Dockum sediments are of fluvial origin, deposited during numerous phases of river cycles meandering over the broad floodplains (Frelief, 1987).

The Post quarry consists of a thick red mudstone unit

(Small, 1989). It was from the distinct 30-cm-thick bone layer in this mudstone that the small metoposaurid, TTUP 9216, was recovered. Also from this quarry, new tetrapod fauna, including taxa to date unknown from the North American Triassic, have been excavated. The fauna includes parasuchids (=phytosaur), aetosaurs, coelurosaurs, protosauroids, squamates, poposaurs, fabrosauroids, an ictidosaur and a bird (Chatterjee, 1986). These forms indicate a relatively late age, perhaps extending into the Norian, for the Dockum. Chatterjee (1985) has postulated the scenario that the Post quarry represents a catastrophic event, such as a flash flood, that initially carried the animals to their burial site, followed by a second flood that disarticulated the elements.

The locality from where the second metoposaurid, TTUP 9237, was recovered represents a very different local environment. Here, bones of squamates, pterosaurs, sphenodontids and other microvertebrates are spread over a 10-sq m-area. All of the elements are completely disarticulated and are recovered only after rain has exposed them at the surface. Surface collecting and screen-washing of the "lime-pellet" rocks and mudstone has revealed that fish scales are a major faunal constituent of this site which is believed to represent a small pond with a quiet depositional regime. The amount of disarticulation by attrition supports that environmental interpretation. This metoposaurid specimen is the most completely articulated fossil found to date at this Carnian aged (Tecovas Member) locality.

The specimen from Lacey Point, Petrified Forest National Park, was collected from a depositional environment similar to that of the Dockum. It was probably buried in river deposits, but the specific geologic nature of the exact location has not been determined. This area, in the Painted Desert of the park, is of Late Triassic, possibly early Norian, age.

Dictyocephalus elegans was recovered from the Cumnock Formation (Chatham Group) in the Sanford Basin of North Carolina. The black and gray fine clastics and minor calcareous beds of the Cumnock include two formerly mined coals ranging from .1-1.5m in thickness. The Cumnock is approximately middle to late Carnian in age (Olsen, 1982).

Those specimens assigned to the genus Anaschisma were recovered from the Popo Agie Member of the Chugwater Formation in Wyoming. The Popo Agie has been described as being lacustrine in origin. These sediments are stratigraphically older than those of the Dockum and perhaps even the Cumnock. The Redonda Formation of northeastern New Mexico, on the other hand, is stratigraphically younger than the Dockum. It is from this section that three undescribed notchless specimens have been excavated. The Redonda is also of lacustrine origin (Adrian Hunt, oral comm, 1988).

DESCRIPTION OF NEW SPECIMENS

The most striking characters of TTUP 9216 are its small size and delicate osteology, two features unusual among the Metoposauridae. Although this specimen is in good condition, some

portions of the skull are either missing or damaged. The skull is separated, transversely between the orbits, into two sections (Fig. 1).

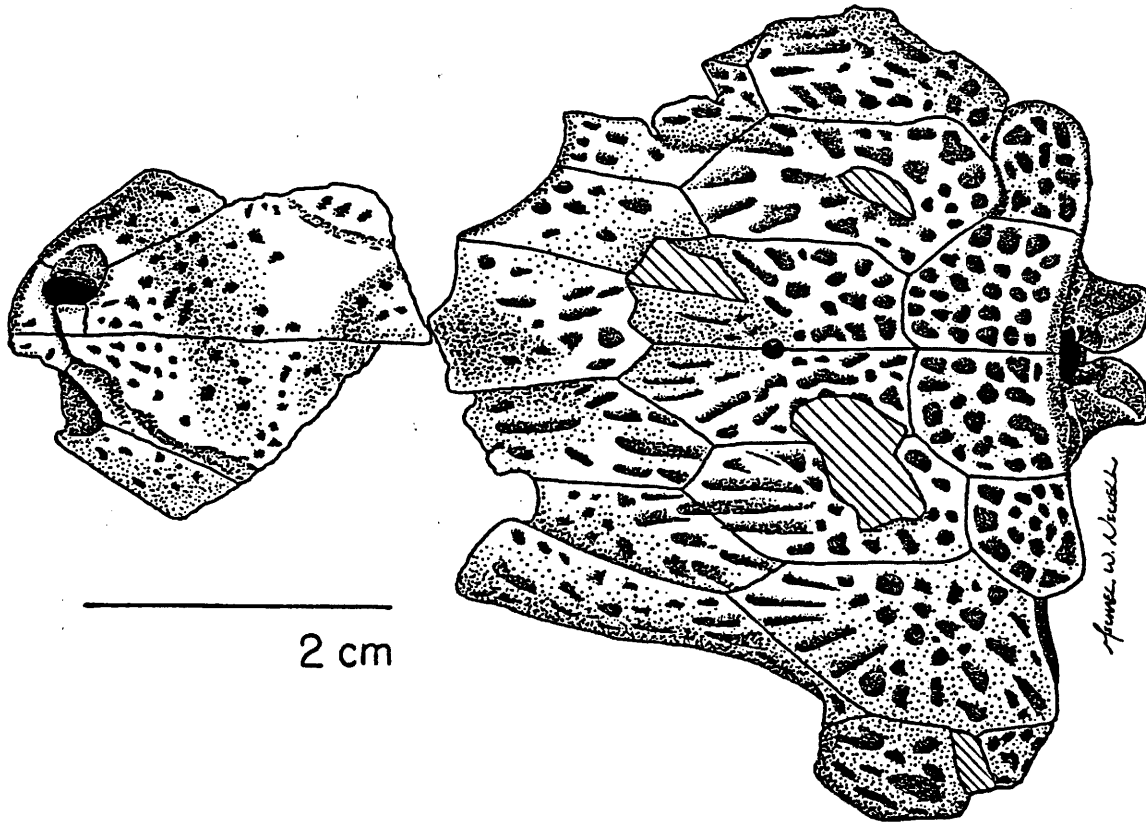


FIGURE 1. TTUP 9216, dorsal view, Post quarry, Garza County, Texas.

The posterior section of the skull sustained damage along the right lateral margin. The squamosal has been broken from its tabular connection, and the entire margin of the squamosal is absent. A small section of the jugal is evident, but the remainder of that element is gone. The quadratojugal, likewise, is missing.

Anterior to the tabular, the supratemporal is intact, but the rear portion of the latter element has separated a fraction from its suture with the tabular. In front of the supratemporal the medial side of the postorbital is intact. The lateral margin of the postorbital is absent. The postparietals are in excellent condition. The ornamentation is clearly visible on these bones, and the otic sinus, albeit extremely shallow, is well-defined lateral to the tabular on the left side of the skull. The tabular does not exhibit a horn-like projection, but is smoothly rounded off at its margin. Of great interest are the parietals. The pineal foramen is located along the midline where the two parietals elements meet. On all other metoposaurs examined, the pineal foramen was located on the rear third of the parietal