JOURNAL OF PALEONTOLOGY, V. 59, NO. 3, P. 674–676, 1 FIG., MAY 1985

FIRST PTEROSAUR RECORDS FROM GEORGIA: OPEN MARINE FACIES, EUTAW FORMATION (SANTONIAN)

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ABSTRACT—Two bones from the marine facies of the Upper Cretaceous (Santonian) Eutaw Formation in western Georgia may be definitely assigned to the Pterosauria, although lower taxonomic assignment is uncertain. These are the first pterosaur remains from Georgia and constitute their southeasternmost documented occurrence in North America. The fossils are also the first reptile records from Santonian strata in Georgia.

INTRODUCTION

FLYING REPTILES or Pterosauria are widespread but generally rare elements of global Mesozoic vertebrate assemblages. In North America, the preponderance of occurrences is in Cretaceous chalks of the western United States, especially the Niobrara Formation in Kansas (Eaton, 1910; Miller, 1972). Pterosaur remains are extremely rare in the marine strata of eastern North America and, to date, only two very fragmentary occurrences have been described formally. Lawson (1975) discussed unassigned fragments from the early Campanian Mooreville Chalk in Alabama, and Baird and Galton (1981) described several pterodactyloid bones from the contemporary Merchantville Formation of Delaware. A Maestrichtian-age pterosaur scrap-bone assemblage from New Jersey is now under study (D. Baird, telephone comm., 1983) and apparently belong to the *Titanopteryx–Quetzalcoatlus* group. We report here an additional eastern North American pterosaur occurrence, consisting of two bones from small-to-medium-sized pterodactyloids, found in marine facies of the Santonian-age Eutaw Formation in western Georgia. These constitute the southeasternmost North American discoveries, and the first pterosaur records from Georgia.

STRATIGRAPHY AND OCCURRENCE

The Eutaw Formation is recognized along the Gulf Coastal Plain between northeastern Mississippi (Stephenson and Monroe, 1940) and western Georgia (Eargle, 1955; Stephenson, 1957; Reinhardt, 1981), with the reference section located in western Alabama. Typically, the Eutaw Formation features a massive, glauconitic sandstone upper member, The Tombigbee Sandstone, and an unnamed, variable but generally more argillaceous lower member. Fossils from the Tombigbee yield a late Santonian age (Sohl and Smith, 1981), whereas the poorly fossiliferous lower Eutaw may range down through the early Santonian. In Georgia, at its extreme eastern exposure, the Eutaw Formation is relatively older than the formation to the west and has been dated by palynostratigraphy (Christopher, 1982) to no younger than the middle Santonian: thus, the entire Georgia Eutaw lies stratigraphically below the Tombigbee Member of western exposures.

Lithologically, across its extent, the Eutaw Formation is dominated by marine sandstone, marl, and clay, ranging from relatively clean, cross-bedded, barrier-bar sand to variegated, pebbly, glauconitic, lagoonal deposits. In Georgia, several such Eutaw lithofacies may be distinguishable (Frazier, 1982) within the limited area of outcrop, with the addition of an open-marine bay lithofacies featuring calcareous, concretionary sandstone with abundant fossils present as both molds and casts and as original shell materials. This latter lithofacies is the one from which the pterosaur fossils were retrieved; it lies near the bottom of the Georgia Eutaw section and is of probable early Santonian age. Detailed discussions and descriptions of the Eutaw Formation in Georgia may be found in Eargle (1955), Stephenson (1957), Reinhardt (1981), Frazier and Taylor (1980), and Frazier (1982).

Stephenson (1957) gave systematic descriptions of fossils from the Eutaw Formation in the Chattahoochee River valley of the Alabama–Georgia boundary, but he, as all

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0022-3360/85/0059-0674$03.00

authors, did not discuss vertebrate fossils beyond listing a few common shark species known from abundant teeth, and mentioning presence of "vertebrate bone." Analysis of fossil fish from the Eutaw Formation in Georgia is in progress (Case and Schwimmer, in prep.). Certainly no reports of pterosaur fossils from Georgia appear in the previous literature.

The pterosaur bones reported here were found on the western bank of Ochilee Creek, approximately 150 m upstream from its intersection with First Division Road (Fort Benning Military Reservation), Chattahoochee County, Georgia. This site is USGS 5374, 5378, and 25570 in Stephenson (1957). The specimens came from a calcareous sandstone ledge at approximate mean stream level, associated with numerous common invertebrate marine fossils, including *Ostrea cretacea* Morton, the guide fossil for the Eutaw Formation, and an endemic ammonite, *Placenticeras benningi* Stephenson. The two pterosaur bones were found in the same approximate 1 m^2 site, but two years apart. The discrepancy in their sizes, for the tentative identifications given below, suggests that the bones are from different animals. It is infeasible to quarry extensively for additional remains because the site is on Federal property and the fossiliferous stratum is generally under water.

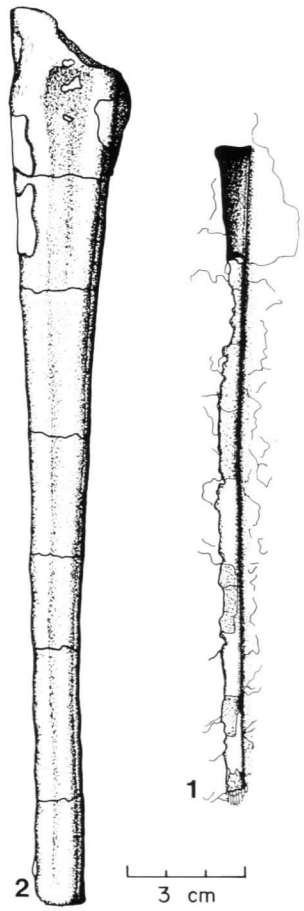

FIGURE *1*—Drawings of two pterosaur bones from the Eutaw Formation in western Georgia. Bone illustrated in white, approximately one-half actual size. *1*, a second or third wing-phalanx, proximal end up, cf. Pteranodon (CC-AFW-K-82-1-1). *2*, internal mold of undiagnostic longbone (CC-BD-K-80-1-1).

DESCRIPTION

The first pterosaur bone (Columbus College AFW-K-82-1-1) is an incomplete wing phalanx, comprising 165 mm of preserved length (Figure 1.1). The proximal 28 mm remain only as an impression, followed by 134 mm of preserved shaft and 3 mm of matrix that may once have been covered by bone. The proximal end is subrounded in cross-section, slightly concave, and 10 mm wide. Fifteen mm from the proximal end the shaft tapers to 6 mm and retains this width throughout the remainder of its preserved length. The thickness of the cortical bone of the shaft is approximately 0.5 mm. The medullary cavity has been infilled by sediment much finer than that comprising the sandy marl of its matrix, in which many pelecypod shells and other invertebrate remains have been preserved; this infilling probably accounts for its three-dimensionality, instead of the usual crushing afforded most pterosaur bones found in marine sediments.

Because of its stratigraphic position the bone is probably pterodactyloid, but there are no diagnostic characters. It is certainly one of the three distal phalanges of the wing-finger; since there is no noticeable tapering or bending, it is probably not the distal (fourth) phalanx. If it is a second wing-phalanx, it is about one-third the size of that from an average *Pteranodon* (wingspan = 17 ft [520 cm]: Eaton 1910). If it is a third wing-phalanx, it is about half the size of that from the same *Pteranodon*. This yields a rough estimate of 175–260 cm (5.6–8.5 ft) for the wingspan,

assuming that the preserved length of 165 cm is the actual length.

The second bone (Columbus College BD-K-80-1-1) is an internal mold with some bone scraps (thickness = 0.6 mm) still clinging to the matrix (Figure 1.2). The shaft is 227 mm long, as preserved, elliptical in cross-section, with maximum widths ranging from 11 to 30 mm. The steady increase in width and an atypical concavity along the wider part of the shaft suggest that this proximal end may have been crushed.

In the absence of much actual bone, this is difficult to verify, but no pterosaur bones normally widen so gradually. Even more so than with the first bone, the pterosaurian diagnosis comes in part from the extreme thinness of the cortical shaft. It may be from the wing, but no determination is possible for either the element or its taxon. However, if the other pterosaur bone is a second or third wing-phalanx (one of the largest bones in the skeleton), then the second specimen is almost certainly from another, larger animal.

Pteranodon Marsh 1876, reviewed by Eaton (1910), is well-known from the Coniacian-Santonian deposits of the western United States, notably the Upper Niobrara Formation of Kansas and elsewhere (Wellnhofer 1978; Lawson 1975), as is *Nyctosaurus* Marsh, 1876. These two genera are quite different, and there is the possibility that other kinds of pterodactyloids also lived at that time (Padian, in prep.). Although the presence of pterosaurs might have been expected in the easternmost Eutaw Formation, it is somewhat surprising to find their remains in good preservation (even if incomplete), given the near or total absence of known additional reptiles in Georgia Santonian strata.

ACKNOWLEDGMENTS

We thank Donald Baird, of Princeton University, for effecting the collaboration of the first two authors; and we acknowledge William Dillard of Columbus College, for the discovery of the specimen CC-BD-K-80-1-1.

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MANUSCRIPT RECEIVED APRIL 21, 1983
REVISED MANUSCRIPT RECEIVED SEPTEMBER 13, 1983

Columbus College contributed $300 in support of this article.