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NOTES

A giant pterosaur (Reptilia: Archosauria) from the Judith River (Oldman) Formation of Alberta

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A specimen discovered in the Judith River Formation, Dinosaur Provincial Park, documents the presence of a giant pterosaur in Alberta during Campanian times. The element lacks both ends, but is probably a femur. The size suggests that the wingspan of the animal from which it was derived would have been about 13 m. A diagnostic vertebra from a smaller specimen demonstrates that the giant pterosaur is probably *Quetzalcoatlus*.

Un spécimen découvert dans la formation Judith River, au Parc provincial des Dinosaures, renseigne sur la présence d'un ptérosaure géant en Alberta durant les temps campagniens. Les deux extrémités de l'ossement manquent, mais il s'agit probablement d'un fémur. La dimension indique que l'envergure des ailes de l'animal qui aurait fourni cet ossement serait environ de 13 m. Une vertèbre caractéristique provenant d'un plus petit spécimen permet d'affirmer que ce ptérosaure est probablement le *Quetzalcoatlus*.

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Introduction

Remains of giant pterosaurs are among the rarest of Mesozoic fossils, having been identified only in Cretaceous strata of Jordan (*Titanopteryx*, Armabourg 1959), Kansas (*Pteranodon sternbergi*, Miller 1972*a*), Texas (*Quetzalcoatlus*, Lawson 1975; Langston 1981), Montana (J. Horner, personal communication, 1980), and Senegal (P. Taquet, personal communication, 1981).

During the summer of 1980, in the course of a paleontological survey in Dinosaur Provincial Park, Alberta, another giant pterosaur element was discovered. We place this occurrence on record and speculate on the possible size of the pterosaur from which the specimen was derived.

The specimen (Provincial Museum of Alberta, PMA P80.16.1367) was found in Dinosaur Provincial Park (1sd 13, sec. 26, tp. 21, rge. 12, W 4th mer.) at an elevation of 673 ± 3 m. It was oriented with its long axis bearing 45° from north in an extensive bone bed that covers at least 125 000 m^2 and has a maximum thickness of 15 cm. The following taxa (long axes bearing 30–135°) were noted within 100 m of the specimen, listed in approximate order of decreasing abundance:

Baenidae, genus indeterminate
Aspideretes sp.
Weathered fragments of unidentifiable megafaunal elements
Hadrosauridae, genus indeterminate
Ceratopsidae, genus indeterminate
Theropoda (small), family indeterminate
Ornithomimidae, genus indeterminate
Basilemys sp.
Champsosaurus sp.
Ankylosauridae, genus indeterminate
Tyrannosauridae, genus indeterminate
Acipenser, sp.
Petrified log

Turtle remains constitute the most abundant specimens in the rest of the bone bed, where remains of *Myledaphis* sp., *Lepisosteus* sp., Crocodylidae genus indeterminate, and *Troodon* sp. were also identified. An abundant palynofloral suite recovered from the immediate vicinity of the pterosaur specimen is under study by D. M. Jarzen. The bone bed, including the pterosaur specimen, is located at the contact of a dark grey siltstone below, and a white, cross-bedded sandstone above in the upper part of the Judith River (Oldman) Formation (McLean 1971).

Description

When discovered, the bone was inclined at a low angle from horizontal, and one end (left side of Fig. 1 *a* and *b*) had been damaged by erosion. The oblique cross section exposed at the surface of erosion resembled a

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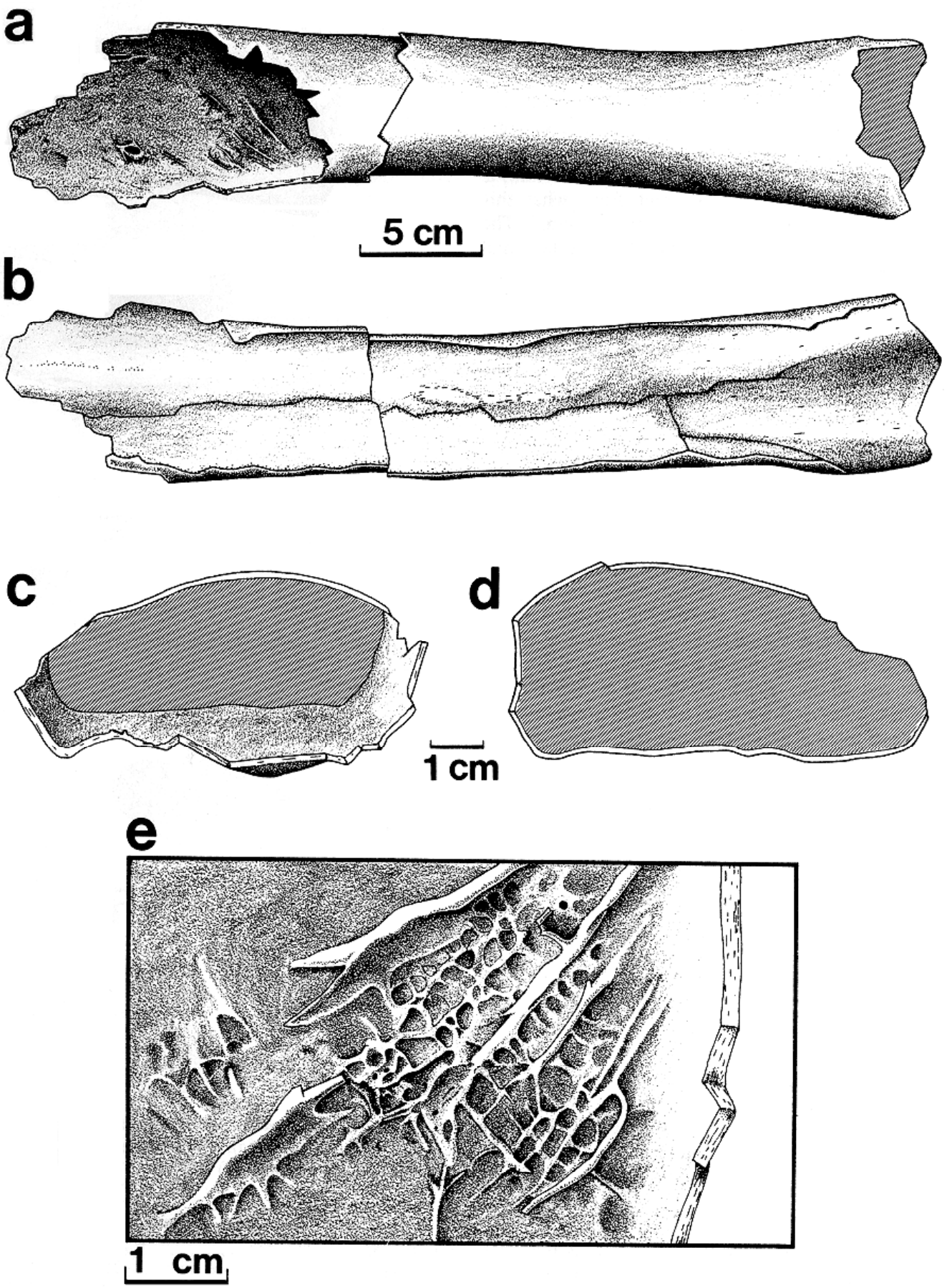

FIG. 1. cf. *Quetzalcoatlus* sp., femur (PMA P80.16.1367) in anterior (*a*), posterior (*b*), proximal (*c*), and distal views (*d*); (*e*) enlargement of internal surface of proximal end showing development of struts and buttresses. Cross-hatching represents unprepared matrix.

large egg because the cortical bone of the specimen was so thin (1.2–1.7 mm). Most of the element was still *in* situ but the other end of the bone had been lost before burial. As preserved, the specimen measures 425 mm in length. The upper surface of the bone (Fig. 1*a*) as found is smoothly convex in section, and shows little evidence of crushing. The minimum shaft diameter (63.2 mm) is probably not significantly different from what this dimension would have been in the living animal. The lower surface (Fig. 1*b*) is somewhat crushed and telescoped so that the vertical shaft diameter of 40 mm has no significance. The specimen expands at both ends to more than 80 mm. A prominent ridge on the lower side of the exposed end (Fig. 1*c*) is offset from the centre of that surface. A shallow longitudinal trough lies along the longitudinal axis, becoming more distinct at the other end where it is bounded by a pair of low ridges. Near the centre of the lower surface is an elongate, low ridge with light sculpturing that is interpreted as muscle scarring. Fine buttressing and delicate struts of bone are evident (Fig. 1*e*) on the internal surface. The struts, which measure less than 1.5 mm in diameter, collapsed when the lower surface was crushed postdepositionally.

The extreme lightness of construction and the presence of finely sculptured buttressing on the internal surface are persuasive evidence of pterosaurian affinities. The bone generally resembles the ulna and femur of *Pteranodon* (Eaton 1910). Although it superficially resembles a cervical vertebra of *Quetzalcoatlus*, the presence of internal strutting suggests that the specimen is an appendicular rather than axial element (W. Langston, personal communication, 1981). Because of the curved longitudinal axis, its sinuous margins, the presence of scars on the lower surface (for caudifemoralis musculature?), and an intercondylar notch, the bone is probably a femur rather than an ulna.

Discussion

If the large pterosaur element is indeed a femur, then an approximation of the size of the animal can be made (numerical data in Eaton 1910; Mateer 1976; Miller 1972*b*; Sternberg and Walker 1958; Wellnhofer 1970; Young 1964, 1973). The absolute minimum length of the bone, if the ends had been complete, would have been 45 cm, about 75% longer than the type specimen of *Pteranodon ingens* (Eaton 1910). The length of the humerus (L_h, cm) in five pterodactyloids is related to the length of the femur (L_f, cm) according to:

$$L_h = -1.34 + 1.10L_f \qquad r = 0.98 \qquad n = 13$$

A minimum humeral length of 48 cm is thus indicated for the Alberta specimen. This is about 10% shorter than the large humerus of *Quetzalcoatlus* (Langston 1981), implying that the animal from which the femur was derived is the second-largest known pterosaur. On the basis of size, the specimen is identified as cf. *Quetzalcoatlus* sp. In six pterodactyloids, L_h is related to wingspan (b, cm) according to:

$$\log b = 1.21 + 1.14 \log L_h \qquad r = 0.98 \qquad n = 6$$

This expression yields a wingspan of 13.38 m.

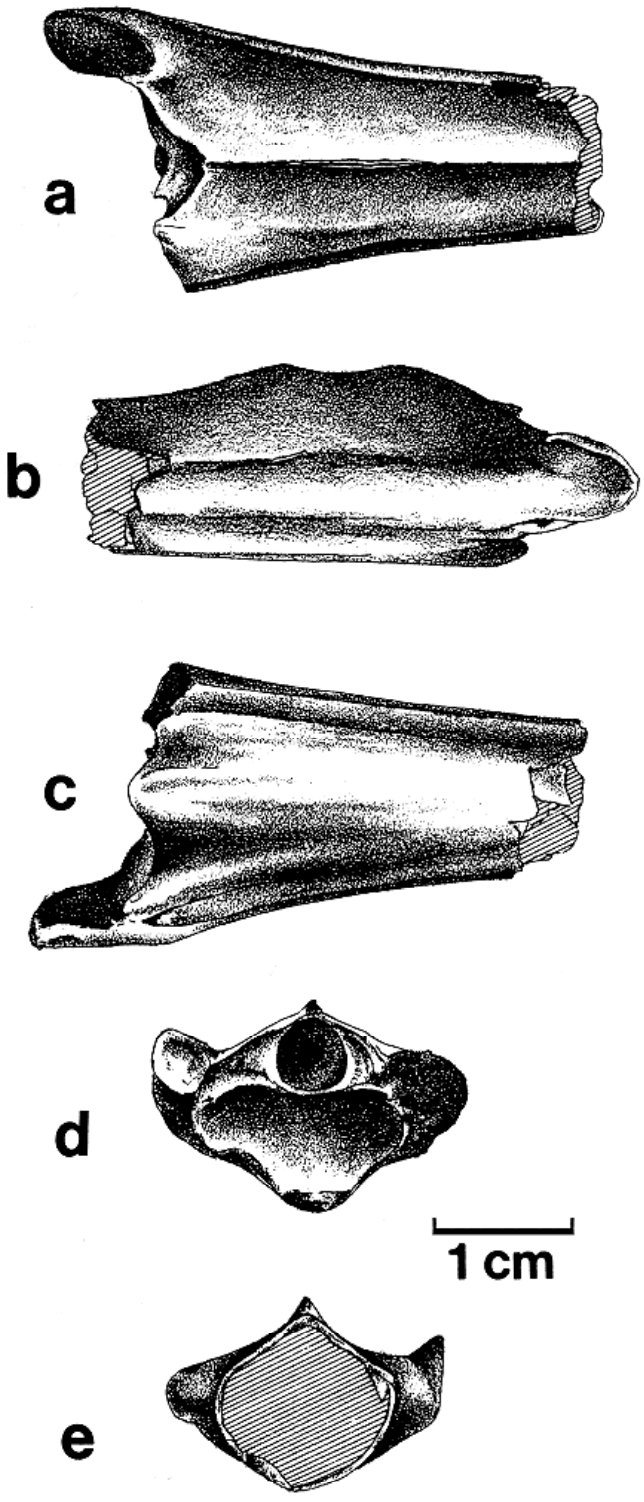

FIG. 2. *Quetzalcoatlus* sp., cervical vertebra (PMA P81.16.107) in dorsal (*a*), right lateral (*b*), ventral (*c*), anterior (*d*), and posterior (*e*) views.

Because at least one species of *Pteranodon*, *P. sternbergi* (Miller 1972*a*), may have attained a size comparable with *Quetzalcoatlus*, the length of PMA P80.16.1367 is not a good basis for identification. Fortunately, the anterior part of a cervical vertebra (PMA P81.16.107, Fig. 2) was found in a wash in the same region as the femur. It is impossible to know what stratigraphic level the specimen was washed out of, but it may have come from the same bone bed. The specimen is relatively small (38 mm long), and could not have come from the same individual. The cervical is elongate and hollow, with thin walls (0.7 mm) and no internal supporting struts. The neural canal (Fig. 2*d*) is confluent with the vacuity in the centre of the centrum (Fig. 2*e*). All of these characteristics are diagnostic for *Quetzalcoatlus* (Lawson 1975; Langston 1981), which strongly suggests that this genus lived in Alberta during Campanian times, and gives the identification of the femur more credibility.

Dinosaur Provincial Park contains the most diverse dinosaurian assemblage known (Béland and Russell 1978). The fact that only three pterosaurs of greatly different wingspan are known (1 m, Currie and Padian, in press; 3.5 m, Russell 1972; and 13 m, this paper) suggests that the diversity of pterosaurs within the assemblage could have been high as well (cf. rarefaction curves in Raup 1975). However, it must be remembered that the *Quetzalcoatlus* cervical is probably from a juvenile, and that the other records (Russell 1972; Currie and Padian, in press) may represent immature specimens as well.

Acknowledgments

PMA P80.16.1367 was discovered by the second author and PMA P81.16.107 was collected by Bill Altimari (Philadelphia). The femur was skilfully prepared for study by Mr. G. P. L. Danis. Figure 1 was drawn by the first author and Fig. 2 was prepared by Linda Krause. The authors wish to express their gratitude to Dr. Wann Langston, Jr. (University of Texas) for his assistance in the identification of the elements and for providing information on his unpublished research.

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