A DINOSAUR-BEARING SECTION OF CRETACEOUS ROCKS IN THE EMPIRE MOUNTAINS, PIMA COUNTY, ARIZONA

By

Robert Moore and Halsey W. Miller

Department of Geology, University of Arizona

INTRODUCTION

Several years ago Mr. E. P. Hilton discovered several large nodules containing bone fragments south of the Empire Mountains about 40 miles southeast of Tucson. Mr. Hilton presented the nodules to the University of Arizona. During the winter of 1958-59, L. F. Brady of the Museum of Northern Arizona prepared and reassembled the bone fragments. This enabled the authors to identify the remains as a complete right femur (Figure 1) and two fragments of a left femur of dinosaurs.

Few dinosaur remains have been previously reported from southern Arizona. Stoyanow (1949, p. 59) reported finding teeth of Gorgosaurus associated with Unio, Viviparus, Physa, fish, and turtle remains in the late Cretaceous rocks of the Santa Rita Mountains south of Tucson. The identification of Gorgosaurus enabled these rocks to be dated.

Lull and Wright (1942, p. 27) reported the discovery of hadrosaurian remains in northern Sonora, 25 miles southwest of Douglas, Arizona, and 15 miles south of the International Boundary line. The remains were identified by Barnum Brown as a large hadrosaur equivalent in size to Trachodon mirabilis and marked the southernmost known occurrence of this group of dinosaurs.

Therefore, the occurrence of more dinosaurian material in southern Arizona was well worth further investigation.

ACKNOWLEDGEMENTS

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STRATIGRAPHIC SECTION

The dinosaur bones were found in the mainly non-marine shales and sandstones exposed near the Empire Mountains. They came from near the middle of a sedimentary section probably 15,000 feet thick. These sediments have been considered as a near shore facies, equivalent in age to the Aptian-Albian (Lower Cretaceous) marine sediments of the Bisbee area, about 50 miles southeast of the Empire Mountains.

The dinosaur bone-bearing portion of the section consists of a small block of sediments bounded by faults and covered intervals. The authors have plotted the extent of dinosaur bearing bed across the fault block on an aerial photograph to facilitate further search for dinosaur bones.

Partial section of the marine and non-marine shales and sandstones. Located in Sec. 26, T.18S., R. 16E, south of the Empire Mountains.

	Top	Thickness
1.	Mudstone, brown to red; thin limestone lens consisting of a hash of marine fossils, mainly pelecypods, bedding obscure.	3
2.	Shale and siltstone, red; section mostly covered	5
3.	Sandstone, green to white; bedding massive, medium grained	2 1/2

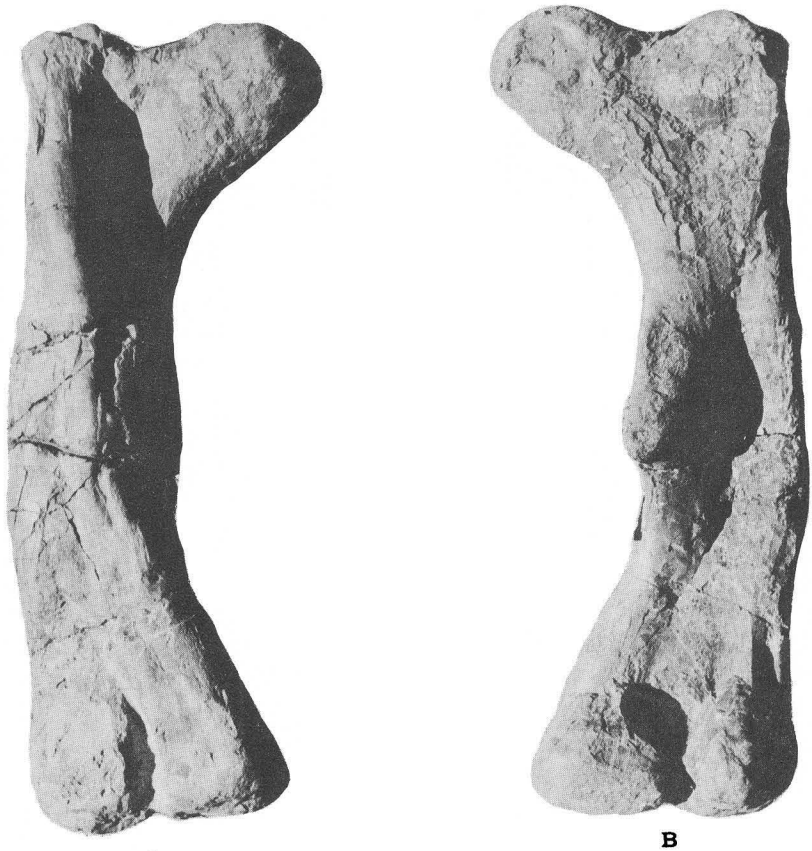

FIGURE 1

A. Anterior view of right femur of dinosaur. Specimen No. 6 of the University of Arizona Paleontological Collections. Specimen 700 mm. long.

B. Posterior view of the same femur. Specimen 700 mm. long.

4. Siltstone, red to green beds 1 to 2 feet thick with shale lenses.	4
5. Sandstone, gray to white; cross bedded; medium grained with siliceous cement.	12
6. Siltstone and shale, green; bedding uncertain; covered in places.	15
7. Sandstone, green to brown; beds 2 to 4 feet thick, fine to coarse grained; siliceous cement.	6
8. Siltstone and shale, green; bedding obscure; contains very coarse silt lenses.	11
9. Sandstone, green to brown; fine to coarse grained; calcareous; bedding not apparent.	14 1/2
10. Siltstone and shale, brown and green; bedding 1 to 3 feet thick.	9
11. Siltstone, purple to brown to green, medium to coarse grained; bedding not apparent because of cover and some fracturing.	8 1/2
12. Covered section. Probably soft shale or silt section.	11 1/2
13. Sandstone, very dark green, fine grained; massive; calcareous.	7
14. Shale and siltstone, red to green; contains some lenses of coarser material.	22
15. Sandstone, white to red to purple, medium grained; massive; slightly calcareous.	3
16. Shale, well cemented siltstone and fine grained sandstone; red to dark green to brown; consists of thin beds 1 foot thick to fractured and fissle shales with a massive sandstone bed near the bottom. Dinosaur remains were found in this bed.	19 1/2
17. Sandstone, gray, medium grained; beds massive; very slightly calcareous.	5
18. Siltstone, dark green; bedding not apparent; mostly covered.	12
19. Covered interval	7 1/2
20. Siltstone and shale, dark green to brown; highly weathered and fractured; contains concretions.	21
21. Siltstone and shale; similar to the above bed.	16
22. Covered interval.	14
23. Siltstone and shale, brown to red; bedding not apparent.	8
24. Sandstone, light gray to white, medium grained; calcareous marine? invertebrate fossils were found in this bed.	3
25. Siltstone, dark green with some shale near top; bedding not apparent in the siltstone.	11
26. Shale(?), section mostly covered and fractured.	8
27. Siltstone, dark green, weathers black; beds 1 to 4 feet thick.	14
28. Sandstone, white to gray, medium to coarse grained; massive beds.	6

29.	Conglomerate, rounded to sub-rounded quartz and weathered feldspar pebbles; size 1/2 to 1 1/2 inches.	2 1/2
30.	Sandstone, green-gray, medium grained; massive; non-calcareous.	9
31.	Siltstone, green; very hard; fractured; contains shale partings.	13 1/2
	Total thickness	304 feet

Section measured by Robert Moore.

PALEONTOLOGICAL DESCRIPTIONS

Description of Dinosaurian Material

The specimens consist of a complete right femur of one individual and two fragments of the left femur of a larger individual. The complete femur is about 700 mm. long. The axis is nearly straight, the medial surface is concave, and the lateral surface is very slightly convex. The head of the femur is large and well rounded. The great trochanter is large, nearly a fourth of the length of the femur, and is located in approximately the central region of the femur, toward the posterior on the medial side. The trochanter arises gradually proximally and ends abruptly distally.

The lower condyles are distinct, rounded posteriorly and incompletely rounded anteriorly.

The fragments of the left femur consist of a section from the central portion of the bone and the distal end of the bone. The size of the great trochanter and the diameter of the femur indicate these fragments were part of a larger individual, and the two femora were not from the same individual.

Identification of Dinosaurian Material

Exact identification of the femora is not possible at the present time. More material must be discovered first. The femora resemble those of ceratopsian dinosaurs, however the great trochanter is much larger than the trochanter of any known ceratopsian. The femora resemble most closely that of a hadrosaur (see Lull, 1942, pl. 6, C, D.). However, the proportions of the Empire Mountain specimens differ in that they are relatively thicker and shorter than typical hadrosaurian femora.

Description of Invertebrate Material

Invertebrate fossils have been found at two levels within the measured section. The uppermost bed consists of a hash of replaced shells and casts of pelecypods. Gastropods are rare in this bed. The specimens are dark in color and their substance recrystallized. This makes certain identification difficult. However, the specimens seem mostly to be species of Ostrea ? and possibly a relative of Nucula. These clams could have lived in a brackish water invironment.

Similar shell hash beds occur elsewhere in the Empire Mountain area.

The lowermost bed with invertebrate fossils contains numerous ostracods, abundant gastropods, and a few pelecypods. The pelecypods appear to be a species of Crassatellites. Both internal casts, showing muscle scars, and external casts have been found. None of the casts show the hinge line. Final identification of the pelecypods pends on the discovery of better material.

The gastropods are small, one inch or less in height, with medium spire height and resemble Lunatia in general. They can not be definitely identified. The ostracodes are mainly internal casts of a small, smooth-shelled species with a large sulcus. They have not yet been identified.

AGE OF THE SECTION

The age of the mainly non-marine shales and sandstones in the Empire Mountain area is still an open question. It is entirely possible that part of the section could be a land or near shore facies of the Triassic and Jurassic marine rocks exposed in northern Sonora. It seems more probable that a part of the section could be a near shore facies equivalent in age to the Comanchean marine deposits of the Bisbee area.

The evidence reviewed in writing this paper tends to indicate an upper Cretaceous age for the portion of the Empire Mountain section considered in this paper. The pelecypod genus Crassatellites occurs in Upper Cretaceous to Recent rocks. The Lunatia type gastropods could be either Lower or Upper Cretaceous or younger. However, the presence of a dinosaur bone means the rocks can not be younger than Cretaceous. Therefore, the section is Upper Cretaceous in age, if the pelecypod has been correctly identified as Crassatellites. This agrees with the age assignment by Stoyanow (1949, p. 59) of the non-marine shales and sandstones exposed in Adobe Canyon at the southern end of the Santa Rita Mountains, about 20 miles southwest of the Empire Mountains, and by Taliaferro (1933) of the non-marine sediments in northern Sonora, 25 miles southwest of Douglas.

More sediments, as yet undated, overlie the portion of the section discussed in this paper. These sediments may also be Upper Cretaceous or they may extend into the Cenozoic. Confomable successions of Cretaceous to Paleocene rocks have been described from the San Juan Basin and elsewhere in the Rocky Mountain region.

CONCLUSIONS

The Empire Mountain sandstone and shale section is fossiliferous and can be dated. More geologic work in this area is necessary and will result in better correlations for this section.

The University of Arizona has graduate students working on theses in this area, and the authors are searching for more vertebrate and invertebrate fossils.

REFERENCES

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