TYRANNOSAURUS REX FROM THE McRAE FORMATION (LANCIAN, UPPER CRETACEOUS), ELEPHANT BUTTE RESERVOIR, SIERRA COUNTY, NEW MEXICO

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Abstract—In April 1983, D. Staton and J. LaPoint of Las Cruces, New Mexico, discovered a large jaw and other fossil material on the east side of Elephant Butte Reservoir. This material is referred to *Tyrannosaurus rex* Osborn on the basis of morphology and direct comparison to casts of the type specimen. The Staton–LaPoint locality lies within purple and maroon shales of the Hall Lake Member of the McRae Formation, probably several meters above the Hall Lake–Jose Creek contact now submerged beneath the waters of the reservoir. The fossil material consists of a nearly complete left dentary, and incomplete articular, a right prearticular, incomplete isolated teeth, and one nearly complete chevron. The presence of *T. rex* in the McRae Formation, taken together with data developed elsewhere, supports a Lancian age assignment of these rocks.

INTRODUCTION

In April of 1983, Donald Staton and Joe LaPoint of Las Cruces, New Mexico, discovered fossils on the eastern side of Elephant Butte Reservoir while on an outing with a sailing club. LaPoint, a biologist, astutely deduced that they had a jaw of *Tyrannosaurus*, the large predatory dinosaur of the Late Cretaceous. In early May 1983, Gillette and staff from the New Mexico Museum of Natural History (NMMNH) visited the site with LaPoint and Staton and observed additional fossils in situ, some of which were removed. Preparation, restoration, and casting of the specimen was conducted by the NMMNH under Gillette's supervision and the material was loaned to Wolberg and Hunt at the New Mexico Bureau of Mines & Mineral Resources (NMBM&MR) for joint study. This report represents the results of the study of the Elephant Butte *T. rex* specimen by NMMNH and NMBM&MR and provides significant data related to the age of the McRae Formation, the relationship of the McRae to other Upper Cretaceous rocks in New Mexico and elsewhere, and Upper Cretaceous paleobiogeography. These relationships are discussed by Wolberg et al. (this guidebook).

PREVIOUS STUDIES

Lee (1905, 1907) recognized the McRae Formation as a distinct lithostratigraphic unit, but Kelly & Silver (1952) actually named the unit after a fort present in the area in the late 19th century. Lee (1905) noted the presence of dinosaur bones in outcrops in the area, and subsequent collections of fossil material were referred to *Triceratops* (Lee 1907, Lull 1933).

Bushnell (1953, 1955) distinguished two members of the McRae Formation, the lower Jose Creek Member and the upper Hall Lake Member, and suggested that the McRae Formation may approach 1,000 m in thickness. In 1968, J. Hawley and W. Seager were notified of the discovery of a ceratopsian skull (Hawley oral comm.). Lozinsky (1982, 1986) conducted detailed geologic studies in the Elephant Butte area and discovered a number of vertebrate localities (Lozinsky et al. 1984). According to these authors, it is likely that the fossil material collected by Lee is not referable to *Triceratops* and, therefore, prior to the rediscovery of the McRae localities the only identifiable Late Cretaceous dinosaur remains in New Mexico came from the Fruitland and Kirtland Formations of the San Juan Basin. Cf. *Tyrannosaurus rex* has recently been found in the Naashoibito Member of the Kirtland Shale (M. O'Neill oral comm.).

LOCALITY

The Staton–LaPoint *Tyrannosaurus* locality is 1.1 km north of Kettle Top Butte on the eastern shore of Elephant Butte Reservoir, at 33°14′32″N, 107°8′59″W, on lands managed by the U.S. Bureau of Reclamation. The locality lies within the Hall Lake Member of McRae Formation, probably several meters above the Hall Lake–Jose Creek contact. The lithologies of these units are described by Lozinsky (1982, 1986) and Wolberg et al. (this guidebook). At the Staton–LaPoint locality, the Hall Lake Member is dominated by well-indurated purple to maroon shale intercalated with fine-grained sandstone. When the lake level is lower, we expect to conduct additional excavations at the site in a jointly organized project.

SYSTEMATIC PALEONTOLOGY

Class REPTILIA
Order SAURISCHIA
Suborder THEROPODA
Family TYRANNOSAURIDAE Osborn 1905
Genus *TYRANNOSAURUS* Osborn 1905
TYRANNOSAURUS REX Osborn 1905
Figs. 1–9

Material—NMMNH P-1013-1, a nearly complete left dentary, an incomplete articular, and a right prearticular, incomplete isolated teeth, and one nearly complete chevron.

Description—The dentary (Figs. 1–4) has a total length of 89.5 cm and is 22.3 cm deep at a position immediately behind the last tooth. Thirteen alveoli are present with roots of the 1st, 6th, 7th, 10th, 11th, and 12th teeth. Tooth 4 is emergent and lacks only the apical tip. Tooth 9 is also emergent and complete. The 7th tooth in the row is the largest. The alveoli are separated by alveoloar septae which expand internally into rugose interdental plates or rugosae (Figs. 1, 2, 6). The interdental

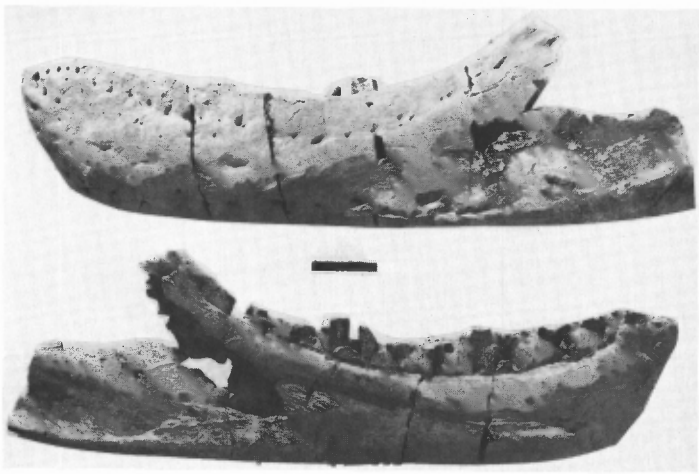

FIGURE 1—Left dentary of *Tyrannosaurus rex* (NMMNH P-1013-1): top, buccal (outer) side; bottom, lingual (inner) side. Bar scale = 10 cm.

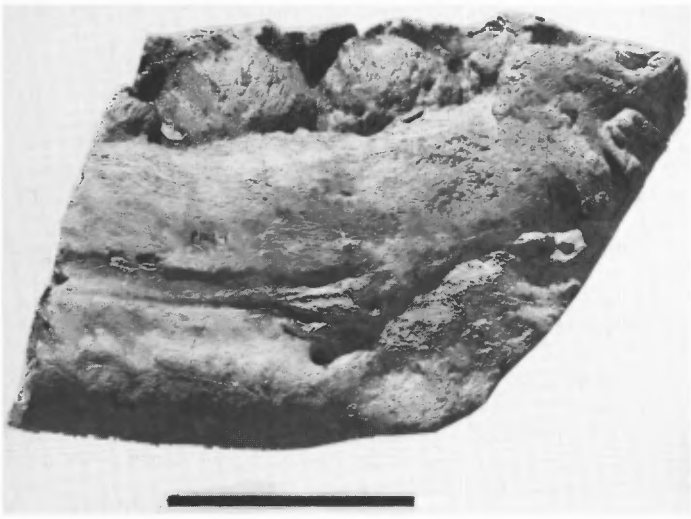

FIGURE 2—Detail of anterior extremity of lingual surface of left dentary NMMNH P-1013-1, including the symphysis. Interdental plates are the rugose bone at upper edge of dentary, lining the alveoli. Bar scale = 10 cm.

plates are most strongly developed anteriorly. The interdental plates are arranged in a staggered fashion so that the anterior half of a plate surrounds the posterior portion of the tooth in front of it, and the posterior half of a plate surrounds the anterior portion of the tooth behind it.

A shallow longitudinal groove at the base of the posterior interdental plates provided the path for the dental artery, which issued side branches from a point low between the interdental plates that were directed toward the lower portions of the teeth. The symphyseal surface (Fig. 2) bears four longitudinal, anteroposteriorly directed ridges that are less than 40 mm long and are raised slightly above the symphyseal surface. The lingual surface of the dentary is traversed by a well-defined Meckelian groove approximately 7 mm deep and 3 mm wide. Beneath the 3rd and 4th alveoli, the Meckelian groove flattens to the contour of the dentary surface. A prominent foramen penetrates the Meckelian groove below the 10th tooth.

The buccal surface of the dentary (Fig. 3) is convex and pitted by more than 50 foramina which are concentrated anteriorly. More than 30 foramina occur below the first five teeth. The foramina emarginate the dorsal, ventral, and anterior edges of the buccal surface of the dentary. A less well-developed series of foramina in turn emarginates the main series of foramina more medially (Fig. 1).

FIGURE 3—Detail of anterior extremity of buccal surface of left dentary NMMNH P-1013-1. Bar scale = 10 cm.

The posterior portion of the dentary consists of a vertical sheet of bone less than 1 mm thick that becomes shallower and broader anteriorly to form the stout, tooth-bearing ramus. The posterior margin of the dentary is not preserved.

The teeth (Figs. 4–6) are laterally compressed and recurved. Both anterior and posterior margins are serrated (Figs. 5, 6). The anterior serrations lie on the antero-posterior tooth planes, and the posterior servations are deflected labially (Fig. 6). A prominent dorso-ventral groove marks the buccal surface of the teeth at their base. All of the isolated teeth except one can be fitted to the left dentary. Based on the position of the medial groove and posterior serrations, one isolated, incomplete tooth must have come from the right dentary or left maxilla (Fig. 7). Serration counts for the known teeth range from 6 to 10.5 per 5 mm. This is in agreement with data on serration counts in other tyrannosaurids (Ostrom 1969), and it is lower than in other carnosaurs (Tab. 1).

The right prearticular (Fig. 8) is complete except for broken anterior and posterior ends and a damaged angular articulation (Fig. 8). It is approximately 43 cm long, rather curved, and markedly concave dorsally. Both the anterior and posterior ends are laterally compressed, but the medial portion broadens to support three ridges and two furrows on the external surface that form the articulation for the angular. The prominent groove along the entire buccal surface of the prearticular is probably the Meckelian groove. The articulation of the prearticular with the articular is broken and the coronoid articulation is missing.

The chevron (Fig. 9) is stoutly constructed but incomplete. It is broken at the origin of the dorsal processes and has a damaged antero-ventral margin.

DISCUSSION

Comparison with the lower jaw of the type specimen of *Tyrannosaurus rex* (American Museum of Natural History) shows the NMMNH

FIGURE 4—Isolated lower teeth associated with left dentary NMMNH P-1013-1; top, buccal sides; bottom, lingual sides. Bar scale = 5 cm.

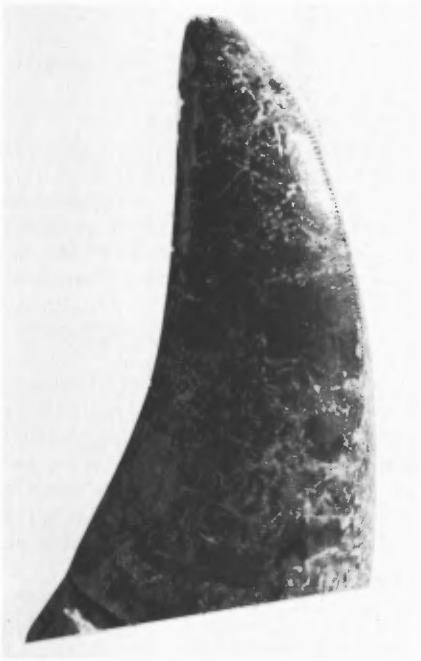

FIGURE 5—Closeup of anterobuccal edge of largest isolated tooth in Fig. 4, illustrating serrations.

FIGURE 6—Dorsal view of anterior extremity of left dentary NMMNH P-1013-1, anterior to right. Broken tooth in alveolus no. 4 illustrates cross-sectional shape of the tooth. Interdental plates surround the alveoli. Bar scale = 10 cm.

FIGURE 7—Isolated tooth associated with left dentary NMMNH P-1013-1, from either right dentary or left maxilla.

P-1013-1 to be referable to *T. rex*. This assignment includes the dentary, prearticular, and probably the chevron, which was closely associated with the other elements and closely resembles the anterior chevrons of *T. rex* described by Osborn (1912: pl. 27).

Tyrannosaurus rex was described in a series of papers by Osborn (1905, 1906, 1912). This taxon has a broad geographic distribution in the Western Interior of North America, but it is usually thought to be narrowly constrained to rocks of Lancian age. This age assignment for the dinosaur-bearing portion of the McRae is consistent with arguments developed elsewhere (Lozinsky et al. 1984, Wolberg et al. in this guidebook).

Current high lake levels at Elephant Butte Reservoir have submerged the Staton–LaPoint locality. It is not likely that lake levels will fall significantly in the next two years. When water level falls, we intend to reinvestigate the locality and excavate any additional material. The fact that a left dentary, a right prearticular, an isolated tooth from either a right dentary or left maxilla, and an isolated chevron have been collected suggests the possible presence of at least a partial skeleton.

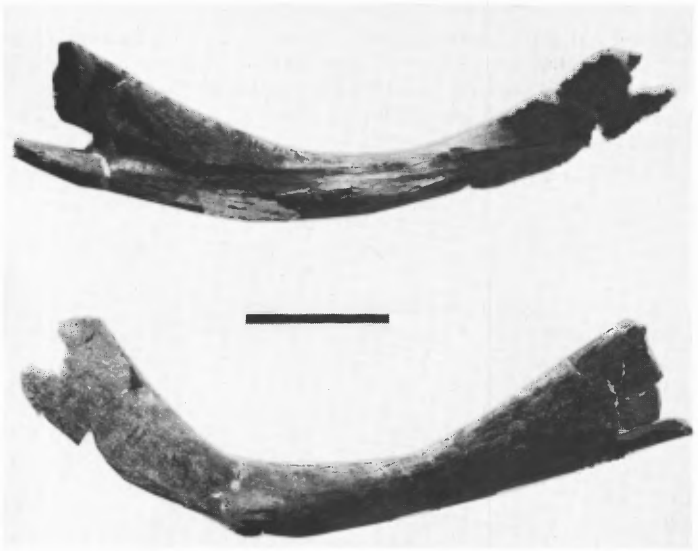

FIGURE 8—Right prearticular NMMNH P-1013-1; top, buccal surface; bottom, lingual surface. Bar scale = 10 cm.

FIGURE 9—Isolated chevron NMMNH P-1013-1. Bar scale = 10 cm.

TABLE 1—Serration counts (per 5 mm of edge length) for teeth of NMMNH P-1013-1 compared to other carnosaurs (Ostrom 1969).

	Anterior	Posterior
NMMNH P-1013-1		
Mandibular tooth 6	7-8.5	7-9
Mandibular tooth 7	6-8	7.5-8
Mandibular or maxillary tooth, position uncertain	6.75-10.5	8.75-10.5
Allosaurus	10-12	10-12
Ceratosaurus	10	10
Gorgosaurus	12-13	9-12
Tyrannosaurus	8-9	6.5-8

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