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BY

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UNIVERSITY OF KANSAS

LAWRENCE

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## Two New Pelycosaurs from the Lower Permian of Oklahoma

BY

RICHARD C. FOX

In the course of examining material from fissure deposits of early Permian age collected from a limestone quarry near Fort Sill, Oklahoma, the author recovered several tooth-bearing fragments of small pelycosaurs. The fragments were examined, compared with descriptions of known kinds appearing in the literature, and determined to be new genera within the Nitosauridae (Edaphosauria) and Sphenacodontidae (Sphenacodontia).

Appreciation is expressed to Prof. Theodore H. Eaton, Jr., for permission to examine the collections of the University of Kansas from Fort Sill, and for the financial assistance furnished by his National Science Foundation grant (NSF-G8624). I am grateful both to Prof. Eaton and Mr. Dale L. Hoyt for their suggestions regarding this manuscript. The accompanying figures have been drawn by the author.

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### Family NITOSAURIDAE

#### **Delorhynchus priscus new genus and new species**

(*delos*, Gr., evident; *rhynchos*, Gr., neuter, nostril; *priscus*, L., ancient. *Delorhynchus* is masculine because of the ending that it acquires when transliterated into Latin.)

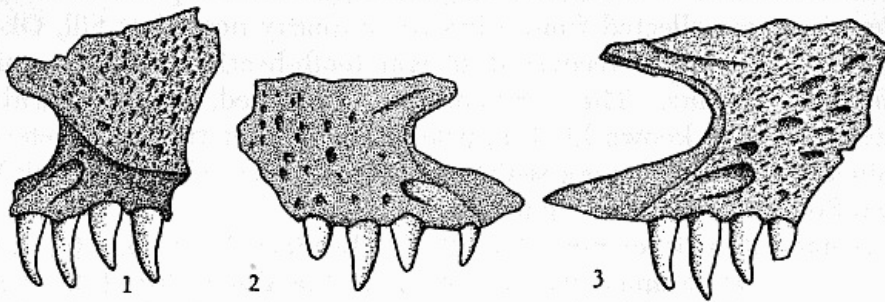
*Type specimen*.—Fragmentary left maxilla, bearing four teeth, KU 11117.

*Referred specimens*.—Fragmentary right maxilla having four teeth, KU 11118; fragmentary left maxilla having four teeth, the most posterior of which has been broken, KU 11119.

*Horizon and locality*.—A fissure deposit in the Arbuckle limestone at the Dolese Brothers Limestone Quarry, approximately six miles north of Fort Sill, in sec. 31, T. 4 N, R. 11 W, Comanche County, Oklahoma. These sediments are of early Permian age, possibly equivalent to the Arroyo formation, Lower Clear Fork Group of Texas (Vaughn, 1958: 981).

*Diagnosis*.—Small; marginal teeth conical, slender and recurved at tips; marginal tooth-row without caniniform enlargement; narial opening enlarged and bordered dorsally, posteriorly and ventrally by maxilla; maxilla with foramen opening laterally at posteroventral corner of naris.

*Description* (based on 3 maxillary fragments, see Table 1).—Each of the maxillary fragments bears four thecodont teeth. These are conical, slender and sharply pointed; in their distal third they are slightly recurved, laterally compressed, and have anterior and posterior non-serrated cutting edges. In medial aspect at their bases, the teeth are longitudinally striated. The bases of the teeth are circular in cross-section and are slightly bulbous. There is no caniniform enlargement of any of the teeth, the longest tooth of each fragment being differently placed in the series of teeth and little longer than the others. There is no swelling on either the internal or external surfaces of the maxillae. The teeth are in a continuous series; no diastema or maxillary step is evident.



FIGURES 1-3. *Delorhynchus priscus*, lower Permian, 6 miles north of Fort Sill, Comanche County, Oklahoma. All  $\times 3$ .

- FIG. 1. KU 11117 (type specimen), lateral view of left maxilla.  
 FIG. 2. KU 11118, lateral view of right maxilla.  
 FIG. 3. KU 11119, lateral view of left maxilla.

The fragments have been broken along similar lines of fracture, and each is approximately rhomboidal in shape. The maxilla encircles the posterior border of the naris and extends dorsally above the naris to an extent sufficient to indicate the probable exclusion of the lacrimal bone from the narial border. At the posteroventral corner of the naris a foramen opens onto the lateral surface of the maxilla. The opening is the entrance to a canal that runs posteriorly above the tooth-row throughout the length of each specimen. Beneath the naris the maxilla extends as a broad tapering shelf, the ventral surface of which articulates with the premaxilla. The narial rim is wide, but wider ventrally than dorsally. The plane of the narial rim is oblique to the lateral surface of the maxilla. The external surface of each fragment is grooved and pitted. The ossification of each fragment appears to have been complete.

TABLE 1.—DIMENSIONS, IN MILLIMETERS, OF THREE MAXILLARY FRAGMENTS OF *DELORHYNCHUS PRISCUS*

Key:

- A. Anterior height of fragment  
 B. Posterior height of fragment  
 C. Length of fragment at tooth-row  
 D. Dorsal length of fragment  
 E. Mean length of teeth  
 F. Anterior width of naris

CATALOGUE NUMBER AND MEAN	A.	B.	C.	D.	E.	F.
KU 11117	6.0	8.0	6.0	8.0	3.0	3.0
KU 11118	6.0	6.0	9.0	8.0	2.0	3.0
KU 11119	6.6	8.0	10.0	11.0	?	4.6
Mean	6.2	7.3	8.3	9.0	2.5	4.5

*Discussion.*—The Nitosauridae are small primitive edaphosaurs with a moderately elongate face, sharp subisodont teeth, little development of canines and few specializations. The jaw is of a primitive type and articulates on a level with the tooth-row. The palatal dentition is primitive (Romer, 1956:280). The nitosaurids are thought to be related to the later Caseidae, and the most obvious structural similarities are found in the postcranial skeleton (Vaughn, 1958:989). Cranial resemblances between the families are fewer, but nevertheless indicate that a nitosaurid-caseid relationship exists.

Vaughn (1958) described a small pelycosaur, *Colobomycter pholeter* (Eothyrididae, Ophiacodontia) that structurally resembles the Caseidae. This individual also was obtained from the Fort Sill locality. In Vaughn's opinion the features of *Colobomycter* indicate a close relationship between eothyridids and caseids and the possibility that the caseids may well have been of eothyridid rather than nitosaurid derivation.

In view of this historical uncertainty of the relationships between the Nitosauridae, the Eothyrididae and the Caseidae, it is well to consider how the maxillary fragments described above differ from and resemble representatives of each of these three families as reported in the literature.

*Delorhynchus* resembles *Colobomycter* in size. The mean extra-maxillary length of the undamaged teeth of the three fragments is 2.5 mm., equal to that reported by Vaughn (1958:985) for teeth about midway in the postcanine series of *Colobomycter*. None of the teeth of *Delorhynchus* extends beyond the maxillary rim as far as does the canine of *Colobomycter* (3.5 mm.).

The teeth in both genera are conical and sharply pointed. The naris in each is enlarged, and the lacrimal is excluded from the narial margin in each (by inference in *Delorhynchus*.)

The differences between the maxillae of *Colobomycter* and *Delorhynchus* are most striking in the lack of canines in the latter and the correlated absence of modifications of the maxillary for support of canines. Additionally, *Delorhynchus* bears an infraorbital canal in contrast to the groove in similar position in *Colobomycter*. The recurvature of the four teeth present in the fragments of *Delorhynchus* differs from that in the teeth of *Colobomycter* in which only the canine and precanine are recurved. Vaughn implies that anterior and posterior cutting edges extend the length of the teeth in *Colobomycter*; these are restricted to the distal third of the teeth in *Delorhynchus*. The external surfaces of the maxillae of *Delorhynchus* are pitted and ridged; Vaughn was unable to discern sculpturing of the corresponding surfaces in *Colobomycter*.

*Delorhynchus* resembles the nitosaurids in size, the shape and sharpness of the teeth, their recurvature and the slight enlargement of their bases, the exclusion of the lacrimal bone from the narial margin (in *Mycterosaurus*) and the apparent lack of a special canine pair of teeth. Resemblances to the caseids are to be noted in the enlargement of the naris (4.5 mm. in height as opposed to 1.7 mm. in *Colobomycter*), lack of development of canines, presence of an infraorbital canal (in *Cotylorhynchus*) and absence of many replacement gaps in the marginal row of teeth.

The absence of caniniform enlargement and the extension of the maxilla dorsad of the naris exclude *Delorhynchus* from the Eothyrididae (Ophiacodontia) but are no bar to its inclusion in the Nitosauridae (Edaphosauria). The marginal teeth of *Delorhynchus* are simple and primitive, being much like those of the nitosaurids that are described in the literature.

The large narial opening and its posterior, dorsal and ventral enclosure by the maxilla, the infraorbital canal, and the sculptured external surfaces of the maxillary fragments indicate that *Delorhynchus*, in these features at least, is close to achieving the caseid grade.

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## Family SPHENACODONTIDAE

### ***Thrausmosaurus serratidens* new genus and new species**

(*Thrausmosaurus* is formed from the neuter Greek noun, *thrausma*, meaning fragment, and the masculine Greek noun, *sauros*, meaning reptile. The specific name, *serratidens*, is formed from the Latin *serratus*, meaning serrate, and the masculine Latin noun, *dens*, meaning tooth. The specific name is used as a substantive in apposition with the generic name.)

*Type specimen*.—Fragmentary left dentary, bearing five teeth, the most posterior of which is broken at the base, KU 11120.

*Referred specimens*.—Fragmentary ?left maxilla, having two teeth, KU 11121; fragmentary left dentary having two teeth, KU 11122.

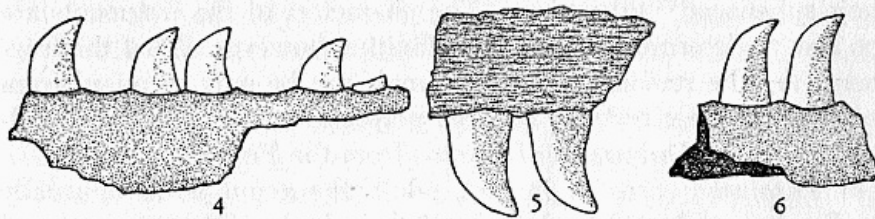
*Horizon and locality*.—From the early Permian fissure deposits in the Arbuckle limestone of the Dolese Brothers Limestone Quarry, approximately 6 miles north of Fort Sill, in sec. 31, T. 4N, R. 11 W, Comanche County, Oklahoma.

*Diagnosis*.—Small; teeth thecodont, compressed laterally, recurved distally, and bearing anterior and posterior cutting edges; anterior serrations limited to recurved portions of teeth, posterior serrations extending nearly entire length of teeth; lateral compression of teeth more pronounced medially than laterally; bases of teeth expanded.

*Description*.—The type specimen is 16 mm. long. It bears five teeth that are implanted in a straight row. Empty sockets are present between the first and second teeth, and the third and fourth teeth. The first tooth is 3.0 mm. long, the middle two are each 2.5 mm. long, and the fourth tooth is 2.0 mm. long. The fifth tooth is broken off at its base.

The empty sockets are large. The mouth of each is circular and approximately 2.0 mm. in diameter. Both sockets are 1.25 mm. deep. The bases of the teeth are expanded to fill the sockets, although the blades of the teeth arise from only the lateral portions of the bases. The edge of the dentary rises above the bases of the teeth medially, thereby producing a small depression at the junction of each base with the dentary bone.

The lateral compression of the teeth is pronounced but asymmetrical, in that the lateral surface of each blade is more convex than the medial surface.



FIGURES 4-6. *Thrausmosaurus serratidens*, lower Permian, 6 miles north of Fort Sill, Comanche County, Oklahoma. All  $\times 3$ .

FIG. 4. KU 11120 (type specimen), lateral view of left dentary.  
 FIG. 5. KU 11121, lateral view of left maxilla.  
 FIG. 6. KU 11122, lateral view of left dentary.

The recurvature of the anterior cutting edges is much more severe than that of the posterior edges, but the recurvature of both is limited to the distal half of each tooth.

The serrations of the cutting edges are not visible to the naked eye and are limited on the anterior edges of the teeth to those portions of the blades that are recurved. The posterior serrations extend nearly to the junction of the blade of each tooth with its base. The serrations tend to be more nearly crenulate than cuspidate.

A portion of the lateral wall of the dentary surrounding the Meckelian canal is present. The external surface of the wall is gently convex and smooth, without sculpturing. The internal surfaces of the canal are unmarked either by muscle scars or foramina.

The fragment is a piece from the posterior portion of the dentary, since the decrease in height from the first tooth to the fourth is pronounced.

KU 11122, a fragment of the left dentary bearing two teeth, is 7.5 mm. long. The anterior tooth is 3.0 mm. long; the posterior tooth is 3.5 mm. long. The shape of the teeth and their implantation conform to the description of the type specimen. The lateral surface of the fragment is smooth and gently convex. What little is present of the surface bordering the Meckelian canal is unmarked.

The ?maxillary fragment bears two teeth which are 3.0 mm. long, and which conform in their characters to the type. The lateral, medial and ventral surfaces of the fragment have been sheared off, so that an exact identification of the bone is impossible. Presumably the fragment is too deep dorsoventrally to be a piece of the dentary, and no sign of the Meckelian canal is present.

*Discussion.*—The implantation, lateral compression, recurvature and cutting edges of the teeth borne by these fragments make clear their sphenacodontid nature. The characters of the fragments are too few to determine subfamilial affinities, however. That the fragments are the remains of adult animals can be only surmised from the lack of bones or teeth of large pelycosaurs in the extensive collections of the University of Kansas from the Fort Sill locality.

If *Thrausmosaurus* is, in fact, adult, the genus is an unusually small sphenacodontid, and of significance both on that account and because of the resemblance of the teeth presently known to those of its far larger relatives.

*The Fort Sill Locality.*—Peabody (1961) suggested that the fissures of Fort Sill had been used as dens by predatory animals in the early Permian, and that the unusually abundant bones in the fissures were the remains of animals eaten there by these occupants. Evidence now known to me affords an alternative explanation that is presented here as a preliminary to a more complete study of the fauna and paleoecology of these deposits currently being undertaken.

The suggestion that the skeletal material found in the fissures is the remnant of the prey of other animals is questionable because of:

1. The absence of tooth marks on the fossils.
2. The recovery from the matrix of skulls and portions of articulated skeletons that are undamaged or damaged only by pressure after burial.
3. The rarity in the deposits of animals of larger body size than *Captorhinus*, the exceptions being a few limb fragments and skull fragments of labyrinthodont or pelycosaurian nature.
4. The absence of coprolites in the matrix.

If the fissures were the dens of predators, at least some and probably many of the bones would show tooth marks. A predator feeding on other animals would be expected to leave some evidence of its habits on the bones of its prey. No such evidence is known to me, either from my own examination of several thousand bones or from the reports in the literature by others who have studied aspects of the early Permian fauna of Fort Sill.

If the predators were larger than *Captorhinus* and occupied the fissures for a long enough time to account for the accumulation of the tremendous numbers of individuals that are represented, a considerable amount of the skeletal material of the larger animals would be present in the fissure

deposits. Even if for some reason the predators died in areas other than within the fissures, thereby accounting for the absence of large bones, coprolites should appear in the deposits if, in fact, the fissures were feeding places. In view of the nearly undamaged condition of many of the bones recovered from the fissures, it is reasonable to expect that fecal material would be preserved.

The character of the matrix of the deposits varies from a homogeneous clay to clay interrupted by layers of soft, limy, conglomeratic rock, to a hard, well-cemented, calcareous conglomerate. In general the bone in each kind of matrix is colored characteristically and exhibits a characteristic degree of wear. The bones entrapped in the homogeneous clay are relatively few, black, usually disarticulated, little worn and not unduly fragmented; consequently the discovery of undamaged limb bones, for example, from this kind of matrix is not unusual. The bones found in the stratified portion of the matrix are more numerous within the layers of conglomerate than between. The bones are black, brown or white, highly fragmented and waterworn to a variable degree. The fragments recovered from the hard, calcareous matrix are numerous, range in color from white through various shades of brown, to black, are highly fragmented, and are usually worn by water.

These categories for bone and matrix, however, are not mutually exclusive, since bones of any of these colors and exhibiting any degree of wear and fragmentation are found in any of the kinds of matrix described above. That water was the agent of wear is suggested by the highly polished appearance of the worn bones and pebbles that are found in the matrix.

The variability of the matrix and of the color and condition of the bones indicates that the agencies of burial and fossilization differed from time to time and that the agency of transportation of the bones from the site of burial to the fissures was running water. One can easily visualize a stream coursing the early Permian landscape that was subject to periodic flooding and droughts. Along the banks of the stream and in its pools lived a variety of microsaur, captorhinids, small labyrinthodonts and small pelycosaurs. Some of the animals, after they died, were either buried near the site of their death or were swept along and buried in sediments further downstream. Burial was for a length of time sufficient to impart a color to the bones characteristic of the site in which they were buried. Later floods reexposed the sites of burial, picked up the bones and carried them to the openings into the fissures. Presumably, too, a proportion of the bones was carried to the fissures without previous burial.

The differences in wear exhibited by different bones within the same block of matrix is attributable to differences in distance that the bones were transported before final deposition. The final sites of deposition, the fissures, were inundated occasionally by floods alone, or because of changes in location of the channel of the stream at the time of flooding. The periodicity of deposition of the sediments within portions of the fissures is indicated by the stratification of the bone conglomerate mentioned earlier.

In summary, it seems that there is little or no evidence beyond the numbers of bones involved to support the hypothesis that the concentration of bones in the fissures of Fort Sill represents the remains of food of predators, and that the fissures were used as dens by their predatory occupants. On the contrary, the evidence indicates that the deposition of the bones in the fissures was secondary and that the agency of transportation, deposition and accumulation of the bones was an early Permian stream characterized by periodic flooding.

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