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NEW UPPER CRETACEOUS TELEOST FISH FROM TEXAS

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ABSTRACT. —About 70 cm. in total length, a new genus and species of teleost fishes from Dallas, Texas, is the first plethodid described from the Austin Chalk (Upper Cretaceous). The single specimen upon which the species is established is distinguished from other plethodids by its narrow head, with ethmoid approximately as long as wide, premaxillary height contained twice in premaxillary length, and narrowness of the mandibular and maxillary dental bands. With addition of this representative of the Plethodidae, six teleostean families, including Pachyrhizodidae, Chirocentridae, Saurodontidae, Clupeidae, and Enchodontidae, are now known from both the Austin Chalk and the Niobrara Formation. The frequency of occurrence of members of these families differs in each stratigraphic unit.

INTRODUCTION

Upper Cretaceous teleosts of North America are known primarily from the Niobrara Formation of western Kansas. Another Upper Cretaceous formation which has yielded teleosts in moderate numbers of individuals and genera is the Austin Chalk of Texas. The new genus described in this paper represents the first Austin Chalk record of the clupeiform family Plethodidae. Several genera referable to this family have been reported from the Niobrara Formation. Thus, another teleostean family may be added to the five which occur in both of these two, approximately contemporaneous, deposits.

The plethodids were one of several geographically widespread teleostean families which appeared late in the Early Cretaceous and became extinct before the end of this period. To the seven genera, *Plethodus* DIXON (1850), *Paranogmius* WEILER (1935), *Ananogmius* WHITE & MOY-THOMAS (1940, *nom. subst.* for *Anogmius* COPE, 1877), *Thryptodus* LOOMIS (1900), *Pseudothrypotodus* LOOMIS (1900), *Syntegmodus* LOOMIS (1900) and *Martinichthys* MCCLUNG (1926) heretofore referred to the Plethodidae (ROMER, 1945), I would add *Niobrara* JORDAN (1924) and *Zanclites* JORDAN (1924) from the Niobrara Formation of Kansas, as well as the new genus described in this paper.

I wish to thank Mr. BOB SLAUGHTER, Shuler Museum, Southern Methodist University, for offering this specimen to me for description and providing information on its geologic position. Dr. JOHN A. WILSON, University of Texas, permitted me to examine fishes from the Austin Chalk at the Balcones Research Center. Examination of fishes at the University of Texas was made possible by Grant GB-582 of the National Science Foundation. Illustrations were prepared by Mr. M. C. BOWMAN.

Order CLUPEIFORMES Berg, 1940

Family PLETHODIDAE Loomis, 1900

Genus ENISCHNORHYNCHUS Bardack, n. gen.

Diagnosis. Body ovate-oblong. Head triangular in profile. Cranial bones relatively thin, without coarse striae characteristic of other plethodids. Snout narrower than long, thus unlike other genera except *Plethodus*. Parasphenoid not expanded laterally as in *Ananogmius*. Premaxillaries meet ventroanterior to ethmoid. Height of premaxillary contained twice in length. Dental border of maxillary and dentary not expanded laterally. Bands of teeth on upper and lower jaws narrower than in other genera. Sixteen branchiostegal rays. Dorsal fin arises above base of pectoral fin. Pectoral fin situated halfway between dorsal and ventral body line. Type-species, *E. dallasensis* BARDACK, n. sp. [*Enischnorhynchus,* from Gr. *enischnos* for slender and *rhynchos* for snout.]

ENISCHNORHYNCHUS DALLASENSIS Bardack, n. sp.

Holotype. Head and anterior part of body including basipterygium preserved on a block of shale. Shuler Museum of Paleontology, Southern Methodist University, no. 60891.

Horizon and Locality. Holotype and only known specimen comes from an old quarry at Peavy Road and Buckner Boulevard in Dallas, Texas. This site lies approximately 6 mi. N 54° E of the geographical center of Dallas County (personal communication from O. L. HILL, Dallas Geological Survey). The fossil comes from the Upper Austin Chalk about 50 feet from the top of this formation.

Diagnosis. Same as for genus.

Description. Body ovate-oblong, with gently convex dorsal profile and straight ventral border (Fig. 1). Maximum depth measured below 15th dorsal fin ray is 23 cm,; length from snout to most posterior preserved centrum, 40 cm. Posterior projection of dorsal and ventral body lines and comparison with nearly complete specimens of *Ananogmius* (Am. Mus. Nat. Hist., no. 2403, and Univ. Kansas Mus. Nat. Hist., no. 445) indicate that approximately 30 cm. of body length is missing.

In order to examine the head of this specimen more completely, its right side, which lies against the rock on which the fish is preserved, was exposed by removing a core of rock from the lower side of the block. The head (Fig. 2), in contrast with that of most other North American plethodid genera, is not expanded transversely and the snout is pointed rather than blunt. The skull roof is without supraoccipital or epiotic crests. From anterior end of the snout to posterior border of the operculum, the head measures 15 cm. Because of the manner in which the specimen is crushed, head height cannot be measured accurately. The neurocranium is 10 cm. long from ethmoid to supraoccipital and 7 cm. across the posterodorsal surface.

The ethmoid is approximately as long as wide. In other plethodids, except *Plethodus,* the ethmoid is almost twice as wide as long. Because premaxillaries are united ventroanteriorly to the ethmoid, this bone does not form the most anterior part of the head. The dorsal surface of the ethmoid is gently rounded. A remnant of the parethmoid is indicated by a stout prong of bone which projects ventrally from the roof of the anterior margin of the orbit. Its shape resembles that of *Synthegmodus* (LOOMIS, 1900, pl. 22, fig. 9) but the parethmoid of *Enischnorhynchus* is shorter dorsoventrally. The snout, measured from the anterior end of the head to the posterior border of the parethmoid, is contained 2.5 times in the neurocranial length.

The long, narrow frontals extend from the ethmoid anteriorly to meet parietals, pterotic, and sphenotic posteriorly. An elongate groove on the anterolateral surface of the frontal forms the dorsoposterior part of the nasal cavity. A slender ridge on the dorsal surface of the frontal ends anteriorly above this cavity and posteriorly intersects a transverse ridge formed by the sphenotic and frontal. The sphenotic, like that of other plethodids, bears a stout lateral projection. As in other plethodids, the square-shaped parietals are joined at the mid-dorsal line except posteriorly, where the supraoccipital forms a narrow posteromedial wedge on the cranial roof. The supraoccipital has no dorsal crest. A small part of the epiotic exposed on the skull roof meets the parietal medially and the pterotic laterally. On the posterior side of the neurocranium, the epiotic forms the medial wall of a small, transversely expanded post-temporal fossa. The central section of the posterior aspect of the neurocranium is crushed and in part not preserved; accordingly, relationships of bones in this region cannot be determined. The pterotic lies at the posterolateral corner of the neurocranium and constitutes lateral, ventral and dorsal surfaces of the post-temporal fossa. The dilatator operculi originated in a shallow, longitudinal depression incised in the posterolateral face of the sphenotic and anterolateral section of pterotic. A series of fine ridges radiates across the dorsal surface of the pterotic from the posterolateral corner of this bone and intersects similar ridges on the parietal. Structure of the lateral wall of the neurocranium cannot be determined from this specimen.

Orbitosphenoid and pterosphenoid apparently formed an osseous orbital septum as in *Syntegmodus.* Although not preserved in their entirety, parts of these bones situated beneath the neurocranial roof near the mid-sagittal line and other parts located above the parasphenoid indicate that such a septum was present. Lateral surfaces of pterosphenoid and orbitosphenoid fragments attached to the parasphenoid are characterized by fine ridges and lines of punctae as in *Martinichthys.* The parasphenoid is arched gently upward below the orbit. This bone is narrower

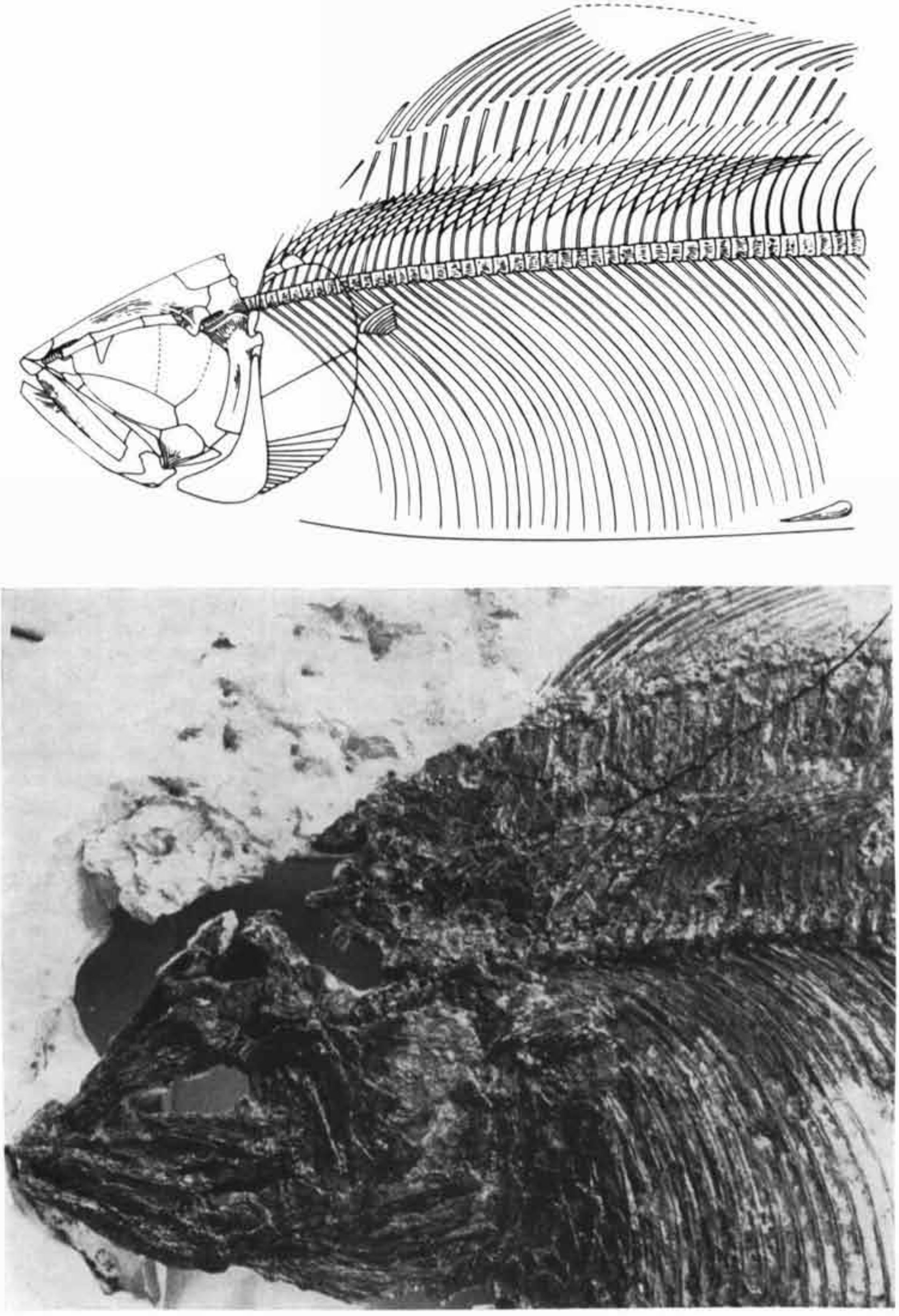

FIG. 1. *Enischnorhynchus dallasensis* BARDACK, n. gen., n. sp.——*A*. Restoration of holotype, approx. ×0.3.——*B*. Photograph of head and front part of body, approx. ×0.5.

and longer than in other plethodids, the greatest width being contained approximately 4 to 5 times in its length. A small part of the palate was removed in order to examine the ventral surface of the parasphenoid. As in other plethodids, this surface bears numerous closely spaced depressions in which small teeth probably were lodged; none are preserved.

The premaxillary is a short bone forming approximately one-ninth of the upper dental border. Premaxillary height increases posteriorly until it equals one-half the premaxillary length. These bones meet anteriorly below the ethmoid but are fused neither to each other nor to the ethmoid, as Woodward (1907) suggested was to be observed in *Plethodus*. A longitudinal band of spinous teeth, which do not exceed 1 mm. in diameter at their bases, lines the premaxillary dental margin, which is thicker than that of the maxillary. A series of fine ridges and grooves radiates posterodorsally from the dental margin across the lateral surface of the premaxillary.

The maxillary is the major element of the upper jaw. The distal end of this bone is not preserved. Anteriorly the maxillary is thickened at its suture with the premaxillary but posteriorly the maxillary becomes thinner and dorsoventrally deeper. A dorsally directed notch appears in the dental margin of the upper jaw at the suture between premaxillary and maxillary. A longitudinal band of fine teeth lines the ventral margin of the maxillary. The band is broader than that on the premaxillary and extends internally along the inner surface of this bone. Two supramaxillaries were present but the exact shape of the suture between them is uncertain.

The mandible is composed of dentary, angular, and retroarticular. The mandibulo-quadrate articulation lies below the middle of the orbit. From the anteroventral corner of the symphysis to the posteroventral corner of the retroarticular, the mandible measures 7.1 cm. Maximum height of the mandible is approximately one-half the maximum length. The symphysis is straight and rises at a right angle to the lower border of the mandible. The dental border anteriorly parallels the ventral margin of the mandible but rises sharply at the level of the premaxillary-maxillary suture. The profile of the dorsoposterior margin of the mandible cannot be determined. As in *Ananogmius*, the dorsoanterior margin of the dentary shows a slight lateral curvature. A narrow band of fine teeth lines the anterior section of the dental border. In lateral view one arm of the angular extends anterodorsally and another anteroventrally along the dentary. A hook-shaped ascending process of the angular rises posterodorsally behind the quadrate-articular joint. The small retroarticular at the posteroventral corner of the mandible is not fused to the angular.

The hyomandibular is expanded at its contact with the neurocranium. Below the contact the hyomandibular curves slightly forward from a line drawn vertical to the longitudinal body axis. The flat neurocranial head articulates at a slight angle with the horizontal axis of the body so that the anterior end of this head lies below the dorsal end. The central section of the vertical arm of the hyomandibular is thickened posteriorly, but ventrally this bone is thin and expanded anteroposteriorly. A stout opercular process projects dorsoposteriorly. The metapterygoid forms a major element of the palate. A part of the metapterygoid projects posteriorly between the hyomandibular and quadrate. Most of the metapterygoid extends dorsomedially along the anterior border of the hyomandibular so as to form the dorsoposterior roof of the oral cavity, but its dorsal edge is undetermined. The mesopterygoid is the largest longitudinal bone of the palate. From its medical contact with the parasphenoid, the mesopterygoid extends laterally to form the lateral roof of the oral cavity. Posteriorly it meets the metapterygoid and ventroposteriorly the quadrate. Like the orbitosphenoid and pterosphenoid, the external surface of the mesopterygoid is sculptured with fine punctae. Whether teeth were present on the internal surface of the mesopterygoid cannot be ascertained. The L-shaped ectopterygoid is typically clupeiform.

The triangular quadrate has a gently curved dorsal surface which was united flexibly with the metapterygoid. The articular head of the quadrate projects ventrally from a narrow neck. The slender symplectic extends ventroanteriorly along the posterior margin of the quadrate. Dorsally the symplectic does not reach the hyomandibular. The space between these bones probably was occupied by cartilage.

The preoperculum has a narrow dorsal arm and broadly expanded ventrolateral plate. No distinct pattern of sensory canals is found on this bone. The operculum is approximately rhomboidal in outline, with a gently curved dorsoposterior margin. A prong of the operculum projects anteriorly into the space above the opercular process of the hyomandibular. Fine longitudinal lines radiate posteriorly across the lateral surface of the operculum from the hyomandibular articulation. The suboperculum is longer than high. Its lateral surface exhibits longitudinal lines on the posterolateral surface and closely spaced irregularly shaped pustulations on the anterolateral

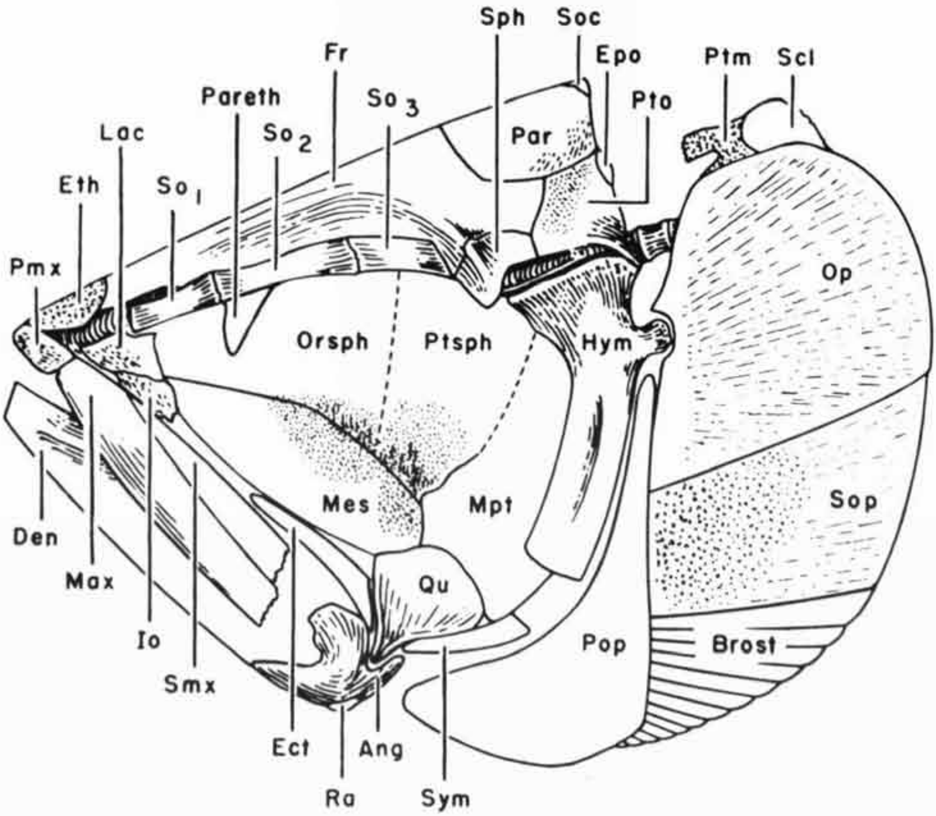

FIG. 2. Restoration of head of *Enischnorhynchus dallasensis* BARDACK, n. gen., n. sp., approx. ×0.8.

[EXPLANATION: *Ang.*, angular; *Brost.*, branchiostegals; *Den.*, dentary; *Ect.*, ectopterygoid; *Epo.*, epiotic; *Eth.*, ethmoid; *Fr.*, frontal; *Hym.*, hyomandibular; *Io.*, infraorbital; *Lac.*, lacrymal; *Max.*, maxillary; *Mes.*, mesopterygoid; *Mpt.*, metapterygoid; *Op.*, operculum; *Orsph.*, orbitosphenoid; *Par.*, parietal; *Pareth.*, parethmoid; *Pmx.*, premaxillary; *Pop.*, preoperculum; *Ptm.*, post-temporal; *Pto.*, pterotic; *Ptsph.*, pterosphenoid; *Qu.* quadrate; *Ra.*, retroarticular; *Scl.*, supracleithrum; *Smx.*, supramaxillary; So_1, So_2, So_3, supraorbitals; *Soc.*, supraoccipital; *Sop.*, suboperculum; *Sph.*, sphenotic; *Sym.*, symplectic.]

surface. Only fragments of the interoperculum are preserved and this bone is not figured in the restoration of the head. Sixteen elongate, slender branchiostegal rays are preserved.

The circumorbital series is incompletely preserved; three supraorbitals are seen. The most posterior one is short and wide, extending medially over the dorsolateral surface of the frontal. The anterior and middle supraorbitals are elongate and narrow, An elongate longitudinal groove on the middle bone indicates the position of the supraorbital sensory canal. A small, trapezoidal lacrymal lies at the anterior corner of the orbit and a small fragment of the infraorbital is attached to its posteroventral end. Pieces of dermal bone covering the metapterygoid and hyomandibular indicate that postorbital bones were present and suggest that the circumorbital ring was complete.

Vertebrae are represented by 43 preserved centra. The anterior centra are higher than long, but this proportion changes gradually so that mid-body centra are approximately as high as long. The lateral surface of each centrum is marked by several slender longitudinal ridges and grooves. Each centrum exhibits a pair of dorsal pockets for neural arches which were not fused to the centra. The arches with their attached neural spines form a broad curve concave posteriorly. Epineural ribs arise from the thickened bases of the anterior 35 neural arches. The ribs arch strongly backward and each terminates at a distance of four or five centra behind the vertebra from which it rises. Elongate, slender pleural ribs reach the ventral margin of the body. These ribs arise directly from each centrum.

Only dorsal elements of the pectoral girdle are displayed. Posterior parts of the intercalar and pterotic arms of the post-temporal are preserved. The lateral surface of the expanded posterior region of the post-temporal is partly covered by the broad dorsal end of the supracleithrum. The basipterygium of the pelvic girdle is expanded posteriorly into a broad spatulate plate. Anteriorly the basipterygium tapers to a narrow prong.

The pectoral fin is inserted halfway between the dorsal and ventral body margin. Eight rays of this fin are preserved. The first ray is twice as thick as the other rays. The pelvic fin is not preserved. The dorsal fin, which begins just above the pectoral fin, includes 24 rays. Additional rays certainly were present on the posterior section of the body. Distal ends of dorsal fin rays are not preserved. The proximal portions show no evidence of segmentation. The first ray is approximately one-fifth the length of the second. The second and largest ray is laterally flattened and measures more than 12 cm. in length. The third through tenth rays are also laterally compressed, whereas more posterior rays are round in cross section. The height of the dorsal fin probably diminished gradually, judging from the thickness of the preserved proximal portions of dorsal fin rays. Each ray is supported by a pterygiophore which interdigitates ventrally with neural spines. A single interneural lies anterior to the first pterygiophore.

Scales from the mid-body region are dorsoventrally ovoid. Although none are complete, they are approximately 1.5 cm. high. Scales from the region below the pectoral fin are rounded and slightly higher. The scale surface is characterized by numerous fine circuli. No radii or punctae are present.

Discussion. *Enischnorhynchus* is distinguished from other plethodid genera by (1) a narrow head which is triangular in profile, (2) an ethmoid of equal width and length, (3) a snout length contained 2.5 times in neurocranial length, (4) thin cranial bones without coarse striae, (5) premaxillary height equal to half of the premaxillary length, (6) the narrow dental border of maxillary and dentary, and (7) the relatively narrower bands of teeth on jaws and parasphenoid.

The new genus most closely resembles two other plethodid genera, *Syntegmodus* Loomis (1900), from the Niobrara Formation of Kansas, and *Plethodus* Dixon (1850), from the English Chalk. *Syntegmodus* is known only from the central and posterior part of a neurocranium which, if complete, would probably be 2 or 3 cm. longer than that of *Enischnorhynchus,* but as in the new genus the neurocranium is narrow. Judging from the only published description of *Syntegmodus* (Loomis, 1900), the frontals are heavier and the orbitosphenoid anteroposteriorly longer and better ossified than in *Enischnorhynchus.* The parethmoid of *Syntegmodus* is broader and dorsoventrally longer than in *Enischnorhynchus.* In lateral view, the parasphenoid of *Syntegmodus* is directed anterodorsally toward the snout at an angle of 30 degrees from the horizontal body axis. This angle is less than 20 degrees in *Enischnorhynchus.* If complete, the snout of *Syntegmodus* probably would be included 3 times in the length of the neurocranium, whereas in *Enischnorhynchus* the snout is included only 2.5 times in the neurocranium. These differences, particularly those related to thickness of bones, might be ascribed to a difference in growth stages if *Enischnorhynchus* were represented by a young individual. But the size of the fossil here described and the well-ossified condition of its visceral and postcranial skeleton indicate that the specimen is an adult. If more examples of *Syntegmodus* and *Enischnorhynchus* are discovered, relationships between these fishes will need to be reexamined. Until such time, *Enischnorhynchus* should be considered a distinct genus in view of the morphologic differences which have been noted and the separateness of geographic occurrence.

Plethodus is known from branchial dental plates and two incomplete heads. This genus resembles *Enischnorhynchus* in the laterally compressed character of the head, narrowness of the parasphenoid, and slender band of maxillary dentition. *Plethodus* differs from the new Texas genus in that the profile from frontal to ethmoid is steep (Woodward, 1907, pl. 22, fig. 9), giving the head a rounded rather than triangular appearance; the cranial roofing bones are characterized by coarse striations; the parasphenoid is not arched below the orbit; the mandible is approximately as long as high; and the lower limb of the preoperculum is elongated anteriorly.

Ananogmius White & Moy-Thomas (1940) and the nominal genera *Thryptodus* Loomis (1900) and *Pseudothryptodus* Loomis (1900) differ from the new genus in having a transversely broadened neurocranium with ethmoid 1.75 to 2 times wider than long, a broad parasphenoid the maximum width of which is less than twice the maximum length, and expanded dental margins with broad bands of teeth on maxillary and dentary. *Niobrara* Jordan (1924) differs from *Enischnorhynchus* in having an ethmoid broader than long, a shorter mouth with the quadrate articulation lying below the anterior end of the orbit, and a deeper, shorter mandible. *Zanclites* (JORDAN, 1924) is distinguished from the new genus by a broader head, and a short mouth with the quadrate articulation anterior to the orbit.

No systematic review of the plethodids has been undertaken. Therefore, it is worthwhile now to summarize the scope of the family and cite the structures which unite its members. In the present paper, ten genera are referred to the Plethodidae. These are *Ananogmius, Paranogmius, Plethodus, Thryptodus, Pseudothryptodus, Syntegmodus, Niobrara, Zanclites, Martinichthys*, and *Enischnorhynchus*. All exhibit (1) a common pattern of short spinous dentition on upper and lower jaws, parasphenoid, and palate, (2) a similar development of tooth-bearing plaques on the branchial apparatus, (3) a dorsal or dorsoposteriorly directed process rising from the angular just posterior to the quadrate-mandibular articulation, (4) anteroposteriorly shortened centra at the base of the caudal fin, (5) an elongate dorsal fin, and (6) pectoral fins inserted at a point midway or nearly so between dorsal and ventral body lines. Seven of the genera (*Ananogmius, Thryptodus, Pseudothryptodus, Syntegmodus, Niobrara, Zanclites*) have been described only from the Niobrara Formation (Upper Cretaceous) of Kansas. *Plethodus* is recorded from the upper part of the Lower Cretaceous and Upper Cretaceous of England and continental Europe (WOODWARD, 1907). *Paranogmius* comes from the Upper Cretaceous of Egypt (WEILER, 1935).

Approximately half-a-dozen nearly complete specimens of plethodids are known. One is assigned to *Zanclites*, another to *Niobrara*, and the remainder to *Ananogmius*. The major portion of preserved material consists of jaws, branchial, parasphenoid, and palatal dental plates, plus centra. Plethodids have been distinguished primarily by differences in shape of the branchial, parasphenoid and palatal dental plates. WOODWARD (1907) attempted to distinguish *Plethodus* from other plethodids, stating that the premaxillaries of this fish were fused with the ethmoid. LOOMIS (1900) thought that *Thryptodus* was distinguished from *Pseudothryptodus* in that the premaxillaries and ethmoid were fused in the former but separate in the latter genus. Judging from the type of material from which the plethodids have been described, premaxillaries are easily separated from their articulations with the head and maxillary so that commonly they are not preserved. Since the premaxillaries are present as separate bones in most genera of this family it would appear that their absence is indicative only of their not having been preserved.

Plethodus, with a narrow, deep, short head, is clearly distinct from other members of this family. *Paranogmius* is distinct from other plethodids in that, among other features (WEILER, 1935), these large fishes (head 45 cm. long) are characterized by a narrow parasphenoid quite unlike the short, broad plate of *Ananogmius*, the closest relative of *Paranogmius*. *Martinichthys* MCCLUNG (1926), from the Kansas Cretaceous, is represented by the snout ends of several neurocrania and one complete, laterally compressed neurocranium. The thick, tubular, usually elongate snout is heavier and longer in relation to the rest of the neurocranium than in other plethodids. The ethmoid projects in front of the premaxillaries which are firmly united to the ethmoid anterolaterally.

Two genera, *Zanclites* and *Niobrara*, named by JORDAN (1924) and assigned by him to a new family (Niobraridae), exhibit the plethodid suite of characters and must be included in this family. These two fishes, each represented by a single nearly complete specimen (*Zanclites*, Univ. Kansas Mus. of Nat. History, KU no. 52, and *Niobrara*, KU no. 179), differ from each other in a series of body proportions (JORDAN, 1924) and shape of the head, which is shorter and broader in *Zanclites* than in *Niobrara*. The four other genera from the Niobrara Formation (*Ananogmius, Thryptodus, Pseudothryptodus, Syntegmodus*) have been considered distinct from one another (LOOMIS, 1900), or they have all been placed in synonomy with *Ananogmius* (HAY, 1903). The narrow-headed *Syntegmodus*, with a slender parasphenoid, certainly warrants distinction from the other genera. HAY is correct in recognizing the similarities of *Thryptodus, Pseudothryptodus*, and *Ananogmius*, as evidenced by the common pattern of broad heads, transversely expanded parasphenoids, and wide dental bands on all jaws. In summary, the Plethodidae should be recognized as consisting of *Ananogmius, Niobrara, Zanclites, Syntegmodus, Martinichthys, Plethodus, Paranogmius*, and *Enischnorhynchus*. Whether all genera should be included in one family may be questioned. For example, the specialized elongate rostral developed by *Martinichthys* differentiates this genus from other plethodids.

The Plethodidae are the earliest representatives of the Osteoglossoidea (ROMER, 1945). All plethodids evolved and became extinct prior to the appearance of other osteoglossoids. Known plethodids and osteoglossids are sufficiently distinct that no direct relationships between these fishes can be traced. The earliest plethodid, *Plethodus expansus* DIXON, occurs in the Gault (Albian) at Folkestone, England (WOODWARD, 1901). Plethodids from the Niobrara Formation or English Chalk are the latest described representatives of this family. The similarity of plethodids and albulids was indicated by WOODWARD (1901) when he assigned *Ananogmius* to the Albulidae on account of the characteristic cluster of small teeth on its jaws, palatal, and branchial bones. The osseous interorbital septum is also suggestive of this family. Albulids, which appear first in the Upper Cretaceous, occur too late in the geological record to be ancestors of plethodids. Among elopoids, which include the albulids, several groups have developed palatal, parasphenoid, and branchial patterns of dentition similar to those of plethodids. These dental specializations, coupled with the retention of an essentially primitive teleostean neurocranium (flat roof, parietals joined at mid-dorsal line, post-temporal fossa present), suggest that the plethodids were derived from an elopoid stock.

Comparison of Austin and Niobrara teleostean assemblages. In addition to the family Plethodidae, representatives of which are now known to occur in the Austin Chalk of Texas and Niobrara Formation of Kansas, five other teleostean families are recognized from both of these essentially contemporaneous Upper Cretaceous deposits. The five families are Pachyrhizodidae, Chirocentridae, Saurodontidae, Clupeidae (*sensu* ROMER, 1945), and Enchodontidae.

Austin Chalk specimens referable to the following teleostean genera are present in the collection of the University of Texas, Bureau of Economic Geology: *Xiphactinus* and *Gillicus* (chirocentrids); *Saurodon* (saurodontid), *Apsopelix* (=*Leptichthys*, a clupeid); *Enchodus* and *Cimolichthys* (enchodontids). *Thrissopater* (pachyrhizodid), also from the Austin Chalk, is preserved at the University of Kansas, Museum of Natural History. Of these seven genera, only three have been reported previously in the literature on Austin Chalk teleosts. HILL (1901) cited *Xiphactinus* vertebrae from southwest of Waco, Texas. Complete specimens of this genus were collected near Celina, Collin County, and near Savoy, Fannin County (STOVALL, 1932). *Thrissopater* was found near Baylor (MOODIE, 1911). *Apsopelix, Enchodus,* and *Cimolichthys* come from sites near Sherman, Grayson County, and near Savoy. At least one specimen of *Gillicus* is known from the latter locality. *Saurodon* was found at an undetermined site in Fannin County.

HILL stated that his specimen of *Xiphactinus* came from the Eagle Ford Shale at its contact with the Austin Chalk. The better specimens of *Xiphactinus* and the other teleosts were collected in the Ector Chalk, which is the basal member of the Austin Chalk. The Austin Chalk horizon in which *Thrissopater* was found is uncertain. *Enischnorhynchus* from the upper Austin Chalk apparently occurs higher in this stratigraphic unit than any other teleost.

With the exceptions of *Ananogmius, Pachyrhizodus,* and *Saurocephalus,* the principal genera of the six families common to the Niobrara Formation occur also in the Austin Chalk. A number of genera described from one or a few specimens obtained from the Niobrara remain unknown in the Austin. These include *Kansanus* (a pachyrhizodid), *Eurychir* (? family), *Luxilites* (? family), *Ferrifrons* (? family), all named by JORDAN (1924), *Stratodus* (a dercetid), named by COPE (1872), *Oricardinus* (? family, HAY, 1903), *Leptecodon* (an ? enchodontid), described by WILLISTON (1898), *Kansius* (a berycoid), described by HUSSAKOF (1929), and several genera of plethodids discussed earlier. One genus, *Laminospondylus* SPRINGER (1957), of uncertain familial affinity, occurs only in the Austin Chalk.

Preliminary observations on the Austin Chalk assemblage of teleosts at the University of Texas indicate a proportionately larger number of individuals of *Apsopelix* than in the Niobrara Formation of Kansas. Chirocentrids and enchodontids are less numerous than in the Kansas chalk. Of approximately 1100 specimens of fossil teleosts from the Niobrara Formation of Kansas, catalogued in the American Museum of Natural History and University of Kansas Museum of Natural History, less than 3 percent are *Apsopelix,* approximately 37 percent are chirocentrid, and 37 percent enchodontid. For nearly 60 prepared specimens in the University of Texas collections the figures are 45, 10, and 19 percent, respectively. Plethodids form 8 percent of the Niobrara Formation teleostean assemblage. These figures must be considered tentative. First, Austin fishes are less numerous than those from the Niobrara. Discoveries of fishes in the Austin Chalk are rare. The majority of fossils have been obtained from a few quarry operations. Second, additional fish specimens at the University of Texas require preparation and identification. Third, the figures are probably biased in that complete parts, such as jaws of smaller fishes, which are more readily preserved and more easily collected, would tend to increase the percentage of such forms in museum collections. This appears to be true as regards the enchodontids.

The figures probably do indicate a general range of familial abundance. They suggest also that the smaller planktonivores (e.g., *Apsopelix*) were more common in the Austin Chalk than in the Niobrara Formation. On the contrary, the Kansas teleost assemblage appears to be dominated by carnivorous, engulfing types (chirocentrids and enchodontids).

Niobrara and Austin fishes are preserved in a similar manner—that is, parts of the head, body, and less commonly complete fishes, are found crushed laterally or dorsoventrally. There does not appear to be selection for particular structures such as vertebrae or fin rays. Although the former are encountered in large numbers in the field, they do not make up a significant proportion of museum material.

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