A NEW PALEONISCID FISH FROM THE TEXAS PERMIAN.

DAVID H. DUNKLE

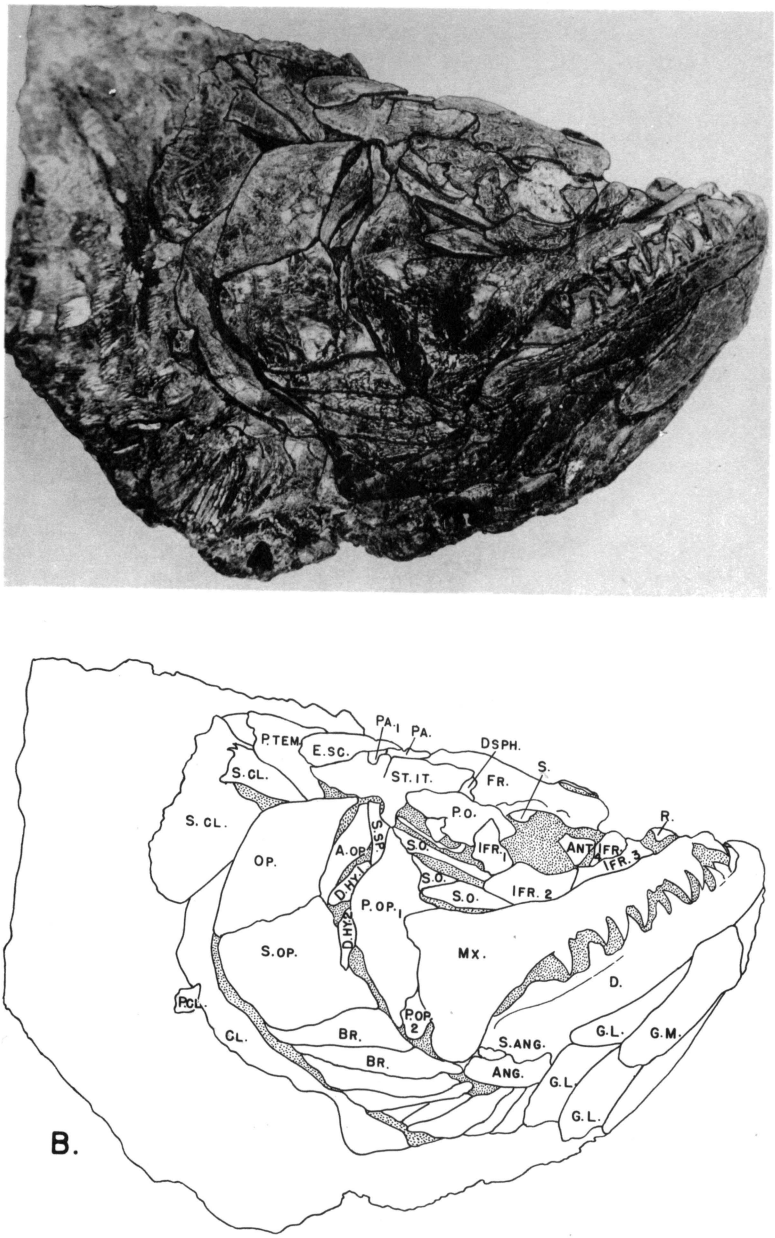
ABSTRACT. The skull of a Paleoniscid fish, *Brachydegma caelatum* gen. et sp. n., from the Lower Permian (Clear Fork) of Texas is described in detail. *Brachydegma* is compared with other Texas Redbeds' Paleoniscid material and its phylogenetic position is briefly discussed.

ACTINOPTERYGIAN fish remains from the Permo-Carboniferous Redbeds of Texas are remarkably few both in number of specimens collected and in variety of forms represented. From an ecological standpoint and for comparative anatomical and faunal purposes any addition to the known fauna of these formations is of interest. During the summer of 1935 a party from the Museum of Comparative Zoology obtained the remains of a Paleoniscid fish, consisting of an almost complete skull and a number of associated fragments covered with scales. The skull exhibits a number of modifications and a combination of features which most certainly mark the specimen as a new form.

The material is excellently preserved and it has been possible to make out almost the complete structure of the head when studied with a low powered dissecting microscope under liquids: water, xylol, and oil of anise. The fossil was contained in a matrix which varied considerably in nature, from crystalline calcite through fine to coarse grained ferruginous sandstones. This was carefully picked away with needles. The ganoine layer was unavoidably destroyed in several places where the coarse silicious sand grains were embedded in it.

During the course of this work a similar specimen, obtained by Mr. C. H. Sternberg in May of 1882, was found by the writer among the Museum collections. It consists of a skull and numerous body fragments. Unfortunately, it is covered with a most exasperatingly tenacious matrix which as yet has proven too difficult to remove. By sectioning and reconstructing this latter specimen, I propose in the near future to make a detailed morphological study of its neurocranium.

I wish to express acknowledgment of my indebtedness to Prof. A. S. Romer of the Museum of Comparative Zoology, Harvard University, for allowing me the privilege of making



Brachydegma caelatum gen. et sp. n. Retouched photograph and explanatory sketch (B) of the skull from the right side. Slightly more than 9/10 nat. size. M. C. Z. Ct. Fos. Fish No. 6503.

this study. Prof. W. K. Gregory and Mr. G. Miles Conrad have been most kind in permitting my examination of certain Permian fish remains from Texas in the collections of the American Museum of Natural History, New York.

Brachydegma caelatum gen. et sp. n.

Genoholotype.—M. C. Z. Cat. Fos. Fishes No. 6503: a laterally crushed skull with complete opercular apparatus and pectoral region, lacking only the rostral elements; also several associated fragments showing body scales.

Geological Horizon and Locality.—Arroyo Formation, Clear Fork Group of the Lower Permian on Indian Creek, Baylor Co., Texas.

Referred Specimen.—M. C. Z. Cat. Fos. Fishes No. 6504: a dorsally crushed skull of approximately the same size as the type and numerous body fragments, collected by Mr. C. H. Sternberg from the same horizon on Coffey Creek, Baylor Co., Texas, 1882.

Generic Diagnosis.—Skull deepened and broad. Orbit small and not forwardly placed. Suspensorium but slightly inclined backwards. Gape wide. A single pair of transversely ovate extrascapulars. Parietals represented by two bones on each side of an irregular suture: a larger medial one and a smaller L-shaped one lying at the postero-lateral corner of the former. Frontals large; nearly as broad anteriorly as behind; slightly indented anteriorly for the reception of the postrostral; suture between, sinuous; possessing lateral processes somewhat behind the middle of their length. Supratemporo-intertemporal large with irregular lateral borders; a strongly pronounced antero-mesial process fitting into a notch behind the lateral processes of the frontals. Dermosphenotics short though relatively broad, articulating with the lateral processes of the frontals. Postorbitals long and narrow, proportionately large. A supra-spiracular plate, with lateral spiracular notch, situated lateral to the anterior portion of the supratemporo-intertemporal and posterior to the dermosphenotic. Three infra-orbitals border the orbit behind and below; a possible fourth is excluded from the orbital border by the short, deep antorbital. A single supra-orbital separates the antorbital and postorbital. Three low suborbitals in vertical series present behind the infra-orbitals. Two pre-operculars on each side: a large dorsal one

with the ventral shank much broadened antero-posteriorly and with the expanded dorsal portion but little longer than high, and a small quadrangular one below. Maxillary triangular in outline; dorsal edge just slightly concave toward orbit; deepened posteriorly by a strong postero-ventral process. A pair of dentigerous rostral elements overhanging the maxillary symphysis anteriorly. Lower jaw broad, elongate and shallow. Supra-angular appearing as a small, round element in a notch between the angular and dentary. Angular with postero-dorsal corner produced into a low process. A large median gular plate. Two lateral gulars, one behind the other, on each side. Radii branchiostegii numbering nine on either side, with the antero-lateral corner much produced. Suboperculum roughly square in shape with the lower front angle produced into a ventrally projecting process; a little overlapped by the operculum above. Operculum obliquely situated; very slightly higher than the suboperculum; the dorsal and posterior borders confluent by the sharp rounding of the postero-dorsal angle. A wedge-shaped antoperculum in contact with the anterior face of the operculum. Two dermohyal elements, one above the other, between the preoperculum and opercular series.

Dentition consisting of very strong conical teeth in a single row, confined to the anterior two-thirds of both upper and lower jaws; these lanaries curved in at almost right angles to the lateral margins of the maxillae and dentaries.

Sensory canals of the head enclosed within the bone, opening externally at intervals by large pores; arrangement in the Paleoniscid pattern.

Ornament of the head bones consisting of very fine striations and rugae in the thin ganoine covering of the bone.

Observable membrane bones of the pectoral girdle consisting of post-temporal; two supracleithral elements, a small dorsal one and much expanded ventral one; a very small postcleithrum. The post-temporal and supracleithral bones exhibit denticulated posterior borders.

Body scales ganoid and rhombic. Those from the more posterior dorsal portion of the specimen smooth with all margins entire. Those from the flank and from more anteriorly in the dorsal region, with low oblique ridges which extend as projections from the posterior margins of the scales. Structurally, the scales composed of bone, cosmine, and ganoine layers.

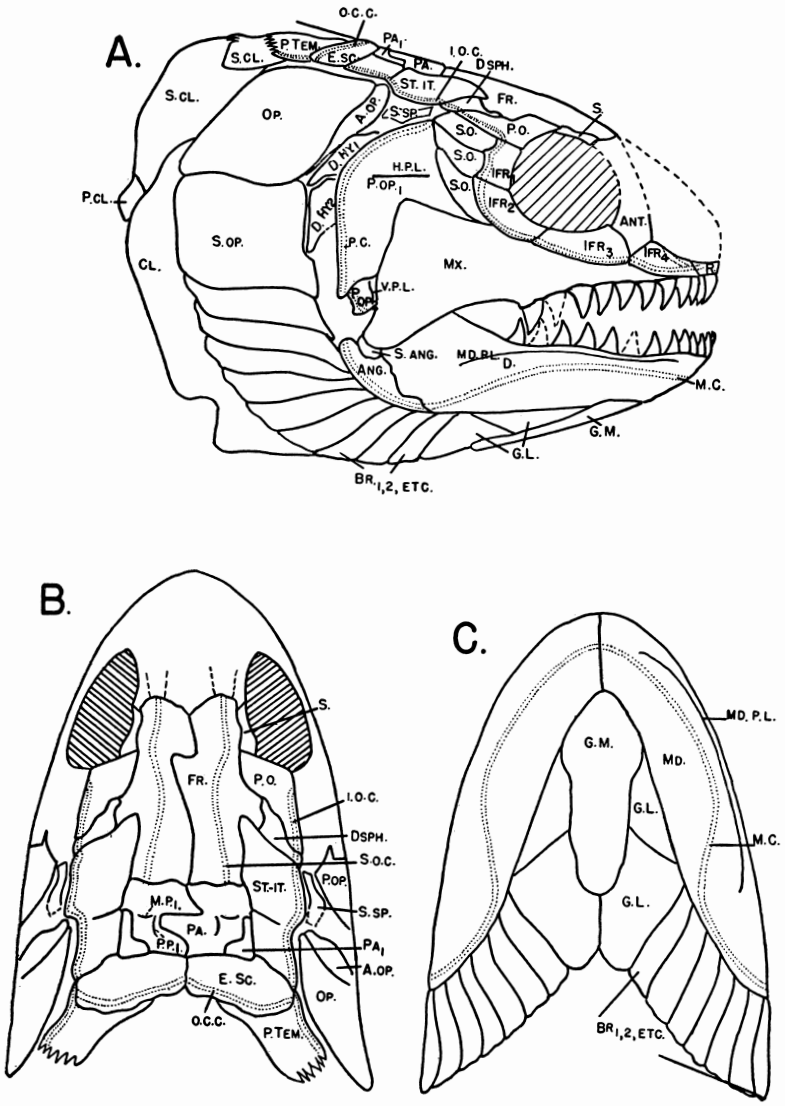


Fig. 1. Attempted restoration of the skull of *Brachydegma caelatum* gen. et sp. n., x 9/10 approx. A. lateral, B. dorsal, and C. gular.

The cosmine canal plexus consists of longitudinal canals laid down successively outside one another parallel to the periphery, and of radial cross canals. The canalicular system and the ascending canals which pierce through to the external surface of the ganoine layer arise only from the longitudinal canals. Canals infrequent at the center of the scale and somewhat irregular in the anterior portion.

Specific Diagnosis.—At this time the same as the generic diagnosis.

DESCRIPTION.

It is impossible at this time to give figures concerning general body proportions. The skull, on which this account is based, measures approximately 7.9 cm. from the mandibular symphysis to the farthest point on the posterior margin of the operculum. This would seem to indicate a fish of from 35 to 40 cm. in total length. The head has been subjected to lateral compression and as a consequence the bones of the left cheek have been badly displaced and the entire rostral region destroyed. The skull roof, the gular and pectoral regions, and the right side with the exception of the pre-orbital portion are intact.

Bones of the Head.—As restored (Text Fig. 1), the skull is broad and deep. The extrascapular series consists of a single pair of transversely ovate bones, each twice as broad as long. The left one was removed during preparation in order that the full dimensions of the underlying parietals might be determined. A transverse series of four bones occur at the level normally occupied by the parietals. The larger median two are each somewhat longer than broad and are separated by a very sinuous suture. At the postero-lateral corners of these lie two small L-shaped elements which are here arbitrarily termed "accessory parietals." The short arm of the "L" adjoins the posterior margin of the medial plate, and the long shank extends along the lateral margin of this bone for approximately one-half its antero-posterior length. I have not intended to indicate homology with the lateral pair of parietals (Pa_1) described by Stensiö (1932, p. 99) in *Birgeria mougeoti.* It will be noticed that the lateral pair in *Brachydegma caelatum* do not come in contact with the frontals as they do in *Birgeria.* Conversely, because these "accessory parietals" do not meet in the median line, they can not with any certainty be homologized with the bones found in certain Catopterids which Brough

(1931) has called dermosupra-occipitals. It is equally hard to homologize them with the so-called extrascapulars of *Acrolepis* and *Acropholis* (Aldinger, 1937) and *Pteronisculus* (Piveteau, 1934).

The length of each frontal is approximately three times its average width, and the bone is little broader behind than anteriorly. Each bears on its lateral margin, somewhat behind the middle of its length, a strong process. The anterior margins are embayed for the reception of the postrostral. The median suture is sinuous.

The supratemporo-intertemporal is in this case truly a compound element as evidenced by the incomplete fusion of the suture toward the median side. The antero-median corner of this large bone is much produced and fits into a deep notch immediately behind the lateral process of the frontal. The short, broad dermosphenotic articulates directly with this lateral process of the frontal.

The orbit is small and is situated well back, over the middle of the maxillary length. The large postorbital forms the postero-dorsal margin of the orbit. Tapering at both ends, this bone articulates mesially with the dermosphenotic and the frontal. Three infra-orbitals limit the orbit posteriorly and ventrally. The full dimensions of the antorbital could not be determined but it is indicated to be a short, deep bone which together with the narrow supra-orbital forms the anterior orbital border. The pointed ventral margin of the antorbital is wedged between the most anterior infra-orbital ($Ifr._3$) and a small triangular bone, which I have tentatively called an infra-orbital ($Ifr._4$) in order to avoid a doubtful homology. On the left side, crushed out of position, this so-called fourth infra-orbital articulates in front with a veritable sliver of a bone bearing one tooth. Careful measurements made in connection with the attempted restoration, indicate that the maxillaries meet each other in a median suture. This small dentigerous bone and its fellow from the opposite side must have overhung the maxillary symphysis anteriorly. I have called these bones tooth-bearing rostral elements (Westoll, 1937a). That this is a correct interpretation is further evidenced by the presence of one sensory pore at the lateral extremity of the element, showing that the infra-orbital sensory canal is continued at least part way into this bone.

Three low and short suborbitals, one above the other, occupy the space between the infra-orbital series and the pre-operculum. The pre-operculum is represented by two elements on each side, a large dorsal one and a small, quadrangular ventral one. The dorsal member is of characteristic form, although modified in two major respects by the vertical straightening of the suspensorium: (1) the ventral shank lengthening antero-posteriorly and (2) the expanded dorsal portion becoming but slightly longer than high. The inferior margin of the dorsal pre-operculum is acutely concave. Into it fits the postero-dorsal corner of the maxillary. Following Westoll (1937b, p. 371), I have chosen to include the small ventral element in the pre-opercular series, rather than calling it the quadrato-jugal (Nielsen, 1937, p. 37).

The maxillary is a massive element, triangular in outline. The dorsal edge is very slightly concave toward the orbit. The posterior expanded portion owes its depth to the exaggerated downward development of the postero-ventral angle, which overlaps the mandible to considerable extent. The mandible is heavy and elongate. In lateral view it is deep behind but gradually rotates anteriorly so as to appear quite shallow. The supra-angular is a small, round bone situated in a notch between the dentary and angular on the dorsal margin of the mandible. The angular forms the entire observable posterior border of the mandible. Its postero-dorsal angle is produced into a low process. The gape is wide. Both maxillary and dentary are provided with a single row of large conical teeth confined to the anterior two-thirds of the oral border. These lanaries number a possible ten on the right maxilla and thirteen on the dentary. They are incurved at almost right angles from the lateral margins of these bones.

The median gular plate is much enlarged, broad anteriorly, and narrow behind. It is bordered laterally and posteriorly by two pairs of enlarged lateral gulars. The branchiostegal rays number nine on each side. Their antero-lateral angles are produced. The size of each succeeding ray from anterior to postolateral becomes progressively larger. The area of overlap is small. The suboperculum is nearly square with its antero-ventral angle produced into a small process. It is very shallowly overlapped by the operculum above. The operculum, which is of approximately the same size as the suboperculum, is obliquely

situated and is but slightly deeper than long. It is roughly quadrangular in shape. Its posterior and dorsal margins appear to be confluent by the rounding of the postero-dorsal angle. A narrow, ventrally tapering antoperculum extends along the anterior face of the operculum. Wedged between the opercular series and the dorsal preoperculum are two elements, which I have called dermohyals after Nielsen (loc. cit.). These two bones are ornamented with fine rugae which are directed along the ventral axes of the bones. Although crushed out of position, their anterior edges lie at a deeper level than the posterior margin of the preoperculum. A supraspiracular plate, with lateral spiracular notch, is situated lateral to the anterior portion of the supratemporo-intertemporal and posterior to the dermosphenotic. This bone is entirely devoid of ganoine.

Sensory Canals.—The sensory canals of the head are enclosed within the bones and open on the surface through large, round pores at rather irregular intervals. The supra-orbital canal passes through the length of the frontal. There is no evidence that it passes on back into the median parietal. The posterior and median pit lines are indicated by series of closely set small pits on the surfaces of the medial parietal plates. The anterior extension of the supra-orbital canal from the frontal is not associated with the bone here termed the antorbital. In fact the junction of this canal with the infra-orbital canal can be seen on the "fourth infra-orbital" bone, well ahead of the anterior margin of the antorbital. These facts would rather support the interpretation that a true nasal element was present. The main sensory canal traverses the lateral edges of the supratemporo-intertemporal and dermosphenotic into the post-orbital, where it turns down and is continued as the infra-orbital canal through the infra-orbital series of bones and the dentigerous rostral. The occipital commissure crosses through the extrascapulars. The pre-opercular canal passes down the posterior borders of both dorsal and ventral pre-opercular elements. The horizontal pit line groove can be seen passing antero-posteriorly across the upper expanded portion of the dorsal pre-operculum. A regular line of closely set pits extending along the anterior face of the ventral pre-operculum is here designated as the vertical pit line. The mandibular canal and pit line have been prepared and their courses may be seen in the restored figures.

Ornamentation.—With the exception of the supraspiracular plate, all of the bones described in the preceding paragraphs are covered with ganoine and are delicately sculptured with extremely fine ridges and striations. In places it may be observed that the sides of the ridges bear transverse series of parallel striae. On the roofing bones of the skull the rugae are concentrically arranged near the margins. Toward the centers of the bones they appear to be generally longitudinal but frequently anastomose and are interrupted. The circumorbital bones are ornamented with concentric rugae. The "fourth infra-orbital" and the dentigerous rostral element are smooth. The maxillae and mandibles bear only longitudinal ridges. Certain anterior areas as well as those adjacent to the tooth bearing portions of these bones are devoid of ornamentation. On the gulars and branchiostegal rays the ridges are directed longitudinally for the most part. A few of the dorsal ridges on the branchiostegals continue around the postero-lateral corners to parallel the lateral margins. The longitudinal rugae are bent down at right angles along the full extent of the anterior margins of the three most dorsal rays. The ganoine is very thin on the operculum, suboperculum, and dorsal preoperculum. The rugae are coarse along the posterior border of the pre-operculum, but elsewhere on this bone they are fine and concentrically arranged. On the suboperculum, they radiate irregularly in the center but parallel the periphery near the margins. Very fine rugae on the operculum radiate obliquely down and back from a center situated near the antero-dorsal angle.

Pectoral Girdle.—The post-temporal is a large, triangular element which in front underlies to some extent the extrascapular. Two supracleithral elements are present. A small, quadrangular dorsal one, ornamented with fine concentric striations and denticulated postero-dorsal angle, articulates with the post-temporal above. The large ventral one is greatly expanded posteriorly. It is highly ornamented with oblique ridges and denticulated posterior margins. Due to the crushing to which the specimen has been subjected, the presence or absence of clavicles could not be determined. The dorsal arm of the cleithrum is ornamented with fine striae directed obliquely antero-ventrally across the vertical axis of the bone.

The proximal portion of the pectoral fin shows a relatively

wide unconstricted base. The number of lepidotrichia can not be accurately determined but all observable are completely articulated. The anterior edge of the fin is covered, at least proximally, with enlarged fulcral scales.

Squamation.—The scales are typically ganoid, thick and rhombic. The margins are entire and ornamentation is lacking on the most posterior of the dorsal scales available. More anteriorly in the dorsal region and on the flanks, the scales are somewhat larger. The posterior margins of these are denticulate, the projections being continued onto the scales as low ridges extending obliquely antero-dorsally. Regular lines of pits are present along the shallow grooves between these ridges.

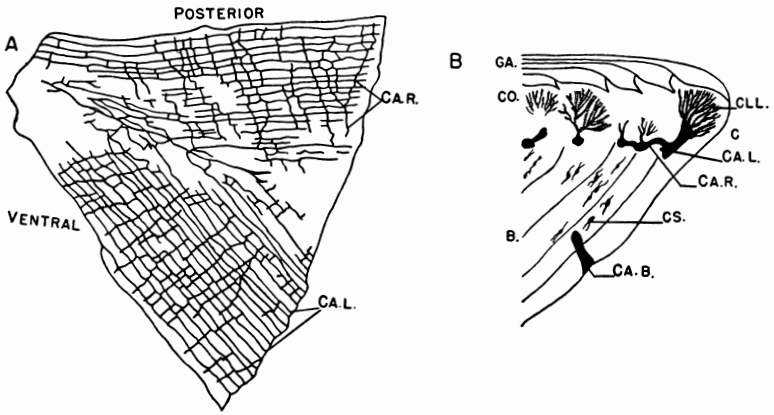


Fig. 2. *Brachydegma caelatum* gen. et sp. n. Scale from the dorsal body region. A. Horizontal section through the cosmine layer at the postero-ventral angle of the scale, x 17 approx. B. Vertical section near the posterior margin, x 51 approx.

Horizontal and vertical sections through one of the more postero-dorsal scales show the bone, cosmine and ganoine layers. The bony foot plate consists of numerous successive lamelli. A large canal is enclosed within this layer in the posterior portion of the scale. The cosmine layer above is quite attenuated. It contains a canal plexus made up of longitudinal canals laid down one outside another parallel to the periphery and radially arranged cross canals. In the center of the scale the canals are infrequent and irregular in disposition. Paralleling the anterior margin of the scale, the canals are also but to lesser degree irregular. It appears that only the longi-

tudinal canals give rise to the canalicular system and the few ascending canals which pierce through the thin superficial ganoine layer. Ganoine is not present on the anterior edge of the scale, where that scale is overlapped by the next preceding one.

DISCUSSION.

Four Actinopterygian fishes have previously been described from the Texas Redbeds: *Platysomus palmaris* Cope, *Eurylepidoides socialis* Case, *Sphaerolepis arctata* (Cope), and *Pyritocephalus* sp.? *Brachydegma* is obviously distinct from *Platysomus* and *Eurylepidoides*. It can also be distinguished from the genotypes of *Sphaerolepis* Fritsch and *Pyritocephalus* Fritsch. The reports of these Bohemian genera, however, are based upon such fragmentary material that their occurrence in the Texas formations seems best considered problematical. *B. caelatum*, lacking the grooved teeth, can be distinguished specifically from the dentigerous plates now referred to as *S. arctata* should this latter prove to be a valid Paleoniscid species. The writer has examined the fragment ascribed to the genus *Pyritocephalus*. In shape and general characters this fragment does not seem to fit into the skull pattern of the present form.

The phylogenetic affinities of *Brachydegma* within the great assemblage of Paleoniscid fishes are not clear. Such clues to generic relationships as might be gained from general body proportions, shape and position of fins, etc., can not be considered because this form is known only from the skull and most anterior body regions. *B. caelatum* is similar to *Elonichthys caudalis* Traquair (Watson, 1928) in the shape of the frontal, the size of the postorbital, and the manner of articulation of the dermosphenotic and supratemporo-intertemporal bones with the frontal. The same general relationships of these bones occur in *Paleoniscus freieslebeni* Blainville (Aldinger, loc. cit., p. 105, after Westoll) although the postorbital is of much smaller size in this latter form. It differs from both *Elonichthys* and *Paleoniscus*, however, in the form of the maxillary, the modification of dentition, and the vertical straightening of the suspensorium with the consequent change in shape of the dorsal preoperculum and development in the suborbital series. In certain of these latter respects *Brachydegma* seems to parallel conditions found in the South African genus *Dicellopyge* (Brough,

1931). The microscopic scale structure of *Brachydegma* suggests affinities with *Elonichthys* (Aldinger, 1937) but approaches more closely that of *Amblypterus beaumonti* (Egerton). It differs from *A. beaumonti* in the presence of more numerous radial canals within the posterior portion of the scales.

The above points are only suggested and it is to be hoped that further exploration may uncover more complete material which will facilitate a more conclusive interpretation of these phylogenetic relationships in question.

KEY TO THE TEXT FIGURES.

Ang. Angular.
Ant. Antorbital.
A. op. Antoperculum.
Br. 1, 2, etc. Branchiostegal rays.
Cl. Cleithrum.
D. Dentary.
D.hy. 1 and 2. Dermohyal elements.
D.sph. Dermosphenotic.
E.Sc. Extrascapular.
Fr. Frontal.
G. L. Lateral gular plates.
G. M. Median gular plate.
Ifr. 1, 2, etc. Infra-orbitals.
Md. Mandible.
Mx. Maxillary.
Op. Operculum.
Pa. Parietal.
Pa_1. "Accessory parietal."
P. cl. Postcleithrum.
P. op. 1 and 2. Parts of the preoperculum.
P. o. Postorbital.
P. Tem. Post-temporal.
R. Dentigerous rostral element.
S. op. Suboperculum.
S. o. Suborbital.
S. ang. Supra-angular.
S. Supra-orbital.
S. cl. Supracleithrum.
S. sp. Supraspiracular plate.
St.-it. Supratemporo-intertemporal.
h. p. l. Horizontal pit line.
i. o. c. Infra-orbital canal.
m. c. Mandibular canal.
m. p. l. Median pit line.
md. p. l. Mandibular pit line.
o. c. c. Occipital commissure.
p. c. Pre-opercular canal.
p. p. l. Posterior pit line.
s. o. c. Supra-orbital canal.
v. p. l. Vertical pit line.
b. Bone layer.
ca. b. Canal in bone layer.
ca. l. Longitudinal canal.
ca. r. Radial canal.
cll. Canaliculi.
co. Cosmine layer.
cs. Cell space.
ga. Ganoine layer.

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HARVARD UNIVERSITY,
CAMBRIDGE, MASSACHUSETTS.