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[Cope.

PALEONTOLOGICAL BULLETIN No. 24.

A continuation of Researches among the Batrachia of the Coal Measures of Ohio.

BY E. D. COPE.

(Read before the American Philosophical Society, February 3, 1877.)

The material described in the following pages was obtained from the coal strata at Linton, Ohio, during the Summer of 1876, by Prof. J. S. Newberry, Director of the Geological Survey of Ohio.

ICHTHYCANTHUS OHIENSIS. Cope. Gen. et sp. nov.

Char. Gen. These are derived from the posterior dorsal and caudal vertebræ, with adjacent parts. Posterior limbs well developed, with distinct tibia and fibula, osseous tarsus, and probably five digits. Ribs elongate, simple, curved. Abdominal armature consisting of bristle-like rods in anteriorly directed chevrons. Dorsal vertebræ not elongate, with simple neural spines. Tail large, its vertebræ ossified, and furnished with slender chevron bones which terminate in a hæmal spine. Neural spines slender and directed backwards; the caudal series somewhat resembling that of a fish. All the centra amphicælian.

This genus differs from all those with enlarged and sculptured neural spines, and from those with abdominal scutæ. It is equally distinct from those without ribs, abdominal rods, or limbs. It is possible that some of the species referred to *Tuditonus*, in which these parts are unknown, may belong to it, or that it may be established on a small species of *Leptophrac-*

tus, a genus only known as yet from cranial remains. With present knowledge the reference of the *I. ohioensis* to the latter genus is inadmissible. The cranium, thoracic region, and fore-limbs of *Ichthyocanthus* are unknown.

Char. Specif. The centra of the dorsal vertebræ are about as long as deep, and their sides are deeply concave: there are four anterior to the pelvis which are without ribs. The caudal vertebræ are robust, and seven from the first, support a small tubercle-like diapophysis. The chevron bones are short and acuminate; the neural spines are a little shorter, narrow and truncate, and directed backwards at the same angle as the chevron bones. They are much reduced on the eighteenth caudal vertebra, where the chevron bones are considerably longer.

The abdominal rods are quite slender. The hind limb is quite stout for this order. The femur is regularly expanded at both extremities, but the distal is deeply and openly grooved, distinguishing the condyles, while the proximal end is plane. There is no trochanter visible. The ulna and radius are well separated, and are three-fifths the length of the femur. There is a large *fibulare* tarsal bone of a subquadrate outline. In immediate contact with it is the probably external digit with five phalanges or segments; the ungual is simply conic. The femur is as long as five dorsal vertebræ. The ribs have expanded, undivided heads, and extend to the abdominal armature.

<i>Measurements.</i>	M.
Length of last ten dorsal vertebræ.....	.047
“ “ first twenty-three caudal vertebræ.....	.117
“ “ a posterior rib.....	.029
“ “ “ dorsal vertebra.....	.005
“ “ twenty-second caudal vertebra.....	.005
“ “ femur.....	.025
Proximal diameter of femur.....	.008
Width of lower leg.....	.009
Length of fibula.....	.015
“ “ tarsal bone.....	.006
“ “ digit.....	.027

This salamander is about the size of the *Menopoma allegheniense*.

ICHTHYCANTHUS PLATYPUS. Sp. nov.

This batrachian is represented by almost the same portions of the skeleton as the preceding species, furnishing a good basis of comparison. It is very well preserved, displaying the characters especially of the hind foot, which is almost entirely represented.

Several features distinguish it from the *I. ohioensis*, one of which is of more than usual value if correctly indicated by the fossil. There are ten vertebræ from anterior to the sacrum preserved in place, and none of them supports a rib, nor are there any ribs visible anywhere on the block of shale. I suspect that they exist on more anterior vertebræ, or may have been displaced to a more anterior position than they normally occupy.

The abdominal chevrons are more anterior in position than are those of the *I. ohioensis*. The hind legs are longer than in that species; in this one the femur equals seven and a-half vertebral centra in length. The external digit on the other hand, while bearing five phalanges, is distinctly shorter. The fibular tarsal is of a transverse oval, not quadrate, form.

The dorsal centra are short and deeper than long; the neural arches are elevated, with short but distinct zygapophyses, and a flat subquadrate, superiorly truncate neural spine. They bear short, vertically compressed diapophyses near the bases of the arches. The neural spines of the caudal vertebræ become rapidly more slender, and also diminish in length, while the zygapophyses are continued to the fifteenth vertebra, where the series is broken off. The chevron bones are slender, and enclose a moderate hæmal arch.

The femur is gradually expanded to the extremities. Proximally there is a trochanteric ala besides the obtuse head. Distally the condyles are well distinguished, the external or fibular being truncate. The fibula is less than three-fifths the length of the femur, and is expanded at both extremities. Two proximal tarsals are distinct; the one next the fibula is larger than the other and transverse suboval in form. It has a median dividing ridge as though composed of the *fibulare* and *intermedium* coössified. The *tibiale* is subtriangular. There are five distinct phalangeal tarsals. The toes are in the order of their lengths beginning with the shortest, 1—2—5—3—4. Their phalanges (including metatarsals) are, in the proper order, commencing with the hallux, 3—3—4—?5—5; the distal end of the fourth finger being lost. These bones are rather stout, and the unguals are simply conic. The form of the foot is short and wide. The number of phalanges is nearly similar to that I have found in the *Amphibamus grandiceps*, excepting that in that species the fifth digit has but four. They are more numerous on most of the digits in *Sauroplevra digitata*.

Measurements.

<i>Measurements.</i>	<i>M.</i>
Length of ten dorsal vertebræ.....	.045
“ “ fifteen caudal “055
“ “ the centrum of a dorsal.....	.0038
Total elevation of a posterior dorsal.....	.014
“ of posterior of zygapophysis of dorsal.....	.010
Length of femur.....	.032
Diameter of femur medially.....	.0045
“ “ “ distally0083
Length of fibula.....	.018
Diameter of fibula proximally.....	.007
Width of sole at second row of tarsal bones.....	.017
Length of foot to end of third digit.....	.031
“ “ first digit.....	.010
“ “ third “022
“ “ fifth “020

LEPTOPHRACTUS LINEOLATUS. Sp. nov.

This large batrachian is represented by the middle portion of a cranium, including parts of both jaws with numerous teeth. It is not easy to determine which of the tooth-bearing bones preserved is maxillary and which dentary, but the lighter and thinner of the two is presumably the latter, although it has the greatest vertical depth. The opposing bone supports two types of teeth, and as this is only the case in the maxillary of *Leptophractus obsoletus*, the present bone may be provisionally referred to that position,

There is a great difference in the sizes of the two types of maxillary teeth, the larger having nearly three times the linear dimensions of the latter. The small ones are rather distantly placed, being separated by interspaces nearly equal to their lengths. They are cylindrical at the base, but become compressed, and have two opposite cutting edges on the apical third. They are of rather slender form, and are striate at the base. The longer teeth have a similar form, but are less strongly compressed distally, where there are two opposite cutting edges. The basal portion is quite closely striate. These teeth are on a different basal line from the small ones, since when their bases are removed the latter appear behind them. Three smaller teeth stand in the spaces between two large ones.

The mandibular teeth are intermediate in size between the large and small ones of the maxillary series, having a little more than half the linear dimensions of the former. Their terminal three-fifths are compressed, and furnished with fore and aft cutting edges.

The surface of the bone, where visible, does not display the punctate sculpture of that of the *L. obsoletus*, but is nearly smooth, displaying only fine parallel incised striæ.

Measurements.

M.

Depth of dentary bone at middle.....	.030
Length of mandibular tooth.....	.009
Antero-posterior diameter of mandibular tooth at base... .	.0035
Length of long maxillary tooth.....	.022
Antero-posterior diameter do. at base.....	.006
Length of small maxillary tooth.....	.007
Antero-posterior diameter do. at base.....	.002

The smaller size and slender form of the smaller maxillary teeth, as well as the peculiar sculpture distinguish this species from the *L. obsoletus*.

Another specimen of *Leptophractus* resembles the one above described in the form and disposition of the teeth, and has the osseous surface of both maxillary and dentary bones marked with shallow grooves and punctate impressions which do not inosculate. In this it resembles the maxillary bone of the large specimen figured on Plate XXXVII of the second volume of Paleontology of the Report of the Geological Survey of the State of Ohio.

TUDITANUS TABULATUS, Sp. nov.

This species is indicated by a specimen which includes a cranium, and the anterior part of the vertebral column. It is very well preserved on a block of shale, on both faces, and exhibits the constituent pieces of the cranium, the vertebræ, one of the thoracic shields with probable ribs. In all respects it conforms to the genus *Tuditanus* in characters; presenting a broad, flat head; osseous vertebræ and ribs; thoracic shields present, and abdominal chevrons probably absent. The last character is not absolutely assured, since the posterior two-thirds of the vertebral columns are wanting.

The cranium is wider than long, and the muzzle is broadly rounded. The orbits are wide ovals, and their posterior borders fall little behind the transverse line dividing the skull equally. The interorbital width equals the longitudinal diameter of the orbit. The posterior outline of the cranium is truncate in a straight, transverse line between the prominent epiotic angles. The distal extremities of the quadrates do not project so far backwards as the epiotic angles, and are still further removed from a transverse line marking the extremities of the occipital condyles. In this respect this species presents a strong contrast to the *Pelion lyellii*, where the ends of the quadrates extend posterior to the latter points. The composition of the superior cranial walls much resembles that of the *Tuditanus radiatus*. The epiotics are large bones, longer than wide, and present outwards strong angles, which correspond with the horns of *Ceraterpeton*. They enclose between them the posterior portion of the parietal, and the supra-occipital. The latter is a transverse bone, and not quite symmetrical in the specimen, one end having a greater antero-posterior extent than the other. The parietal is the largest cranial bone, is undivided, and is pierced by a median foramen behind the centre. Its general form is broadly wedge-shaped, the lateral borders expanding in front of the fontanelle, and contracting between the epiotics. The frontals are distinct and rather narrow. The post-frontals are rather large, are in close connection with the parietal on one side and the jugal on the other, and send a point backwards between the epiotic and supratemporal. The jugal widens fan-shaped backwards, joining two bones distally, a superior and an inferior. The former is the supra-temporal, but whether the inferior is quadratojugal or squamosal, I cannot determine. The boundaries of the bones of the extremity of the muzzle are not distinct.

The sculpture of the surface of the cranium consists of parallel ridges which are separated by grooves equal to them in width. The ridges radiate inwards on the epiotics and frontals, and outwards on the squamosal, and are transverse and interrupted on the supraoccipital. The lateral thoracic shield is covered with a similar sculpture of uninterrupted somewhat radiating ridges. The vertebræ are osseous, and rather small compared with the size of the skull. Opposite to the posterior extremity of the pectoral shields is a pair of slender bones, which are gently expanded and truncate at the extremities. It is not certain whether these belong to the

forearm, or are a pair of short ribs. Impressions only of the teeth remain ; they indicate small pleurodont denticles like those of the *Anura*.

<i>Measurements.</i>		M.
Length of cranium above.....		.029
Width " "037
" between epiotic angles.....		.018
" of interorbital space.....		.007
" " orbit.....		.006
Length " "007
" " skull to fontanelle008
" " from orbit to nares.....		.005
" " " " " to end of snout.....		.003
" " lateral pectoral shield.....		.015
" " atlas.....		.004
Width " "004

This species of *Tuditanus* differs from the *T. radiatus* in the larger and less anteriorly placed orbits, and in the large truncate posterior table of the skull. The proportions of the latter are more those of *P. obtusus*, but the epiotic angles have not been observed in this species, the sculpture is punctate not linear, and the form of the supraoccipital is quite different. Comparison with the other species referred to that genus is unnecessary, excepting in the case of the *T. mordax*. Further examination of the specimen on which the latter was founded leads to the belief that it is an imperfect cranium of *Ceraterpeton punctolineatum* Cope. The latter name, as the preferable one, may be adopted, and the former becomes a synonym.

COLOSTEUS SCUTELLATUS, Newberry; Cope, Rept. Geol. Surv. Ohio, Paleontology Vol. II, p. 407.

Another specimen of this species was obtained by Prof. Newberry during the past season, which includes some parts of the skeleton not previously observed.

The specimen presents a superior view of the ventral and thoracic protective armature, and of the posterior portion of the cranium. As heretofore, I find no indications of vertebrae, but along one side of the ventral scutellation, a series of slender ribs lies in the matrix. These I have not previously found in this genus. The cranial surface is only preserved on the lateral portions. Its sculpture consists of coarse grooves closely placed, directed outwards and forwards.