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*On some new or little known Reptiles and Fishes of the Cretaceous No. 3,  
of Kansas.*

BY E. D. COPE.

(Read before the American Philosophical Society, August 17, 1877.)

**TOXOCHELYS LATIREMIS** Cope.

Final Report U. S. Geol. Surv. Terrs. II, pp. 98, 299.

Two nearly complete crania of this species found by Mr. Sternberg, enable me to give the genus a definite position in the system.

The prefrontals have an extensive mutual contact, and extend to the external nares, where they are somewhat contracted by the superior processes of the maxillary. They descend to the vomer, and are extensively in contact with it. There are no distinct nasal bones. Lachrymal foramen rather small. The temporal fossa is extensively roofed, and the supraoccipital crest much produced backwards.

The posterior nares are rather anterior, and are separated, and not underroofed by the osseous vomer. This element expands in front of the nares, where it separates the maxillaries.

A foramen separates the maxillaries from the palatines, and the ectopterygoids expand laterally. The superior alveolar surface is wide, and slightly concave. The external border is elevated and acute, and the inner border is slightly prominent and is roughened.

The characters above adduced show that the genus *Toxochelys* is one of the *Cryptodira*, and that it is distinct from *Euclestes* (Cope) of the cretaceous No. 5. In that genus the posterior nares are underrun by a production of the vomer, and the alveolar faces of both jaws are much wider. The general form of the skull of *Toxochelys* is much like that of many *Trionychidæ*, but from these the characters of the marginal bones of the carapace, and the form of the extremities separate it.

**ICHTHYODECTES GOODEANUS** sp. nov.

This largest species of the genus is represented by a right premaxillary and a large part of the maxillary bones. The alveolar border is concave at the anterior part of the latter, and then becomes convex. The maxillary border is incurved at its anterior extremity, so that the line of teeth is turned inwards as well as strongly upwards, the middle part of the border being the most prominent. In this respect it differs from the other species, where the anterior part of the alveolar border is the most prominent. The anterior border is sigmoidally curved, and the vertical diameter is twice the transverse. The premaxillary teeth number thirteen and are somewhat compressed so as to have opposed cutting edges; they are without grooves or ridges. The maxillary teeth are round in section. The posterior maxillary condyle is not protuberant, and is decurved anteriorly. The maxillary underlaps the premaxillary to near its anterior border.

<i>Measurements.</i>	M.
Depth of maxillary behind condyle.....	.047
“ “ at “ .....	.053
“ premaxillary.....	.069
Length “ at middle.....	.037
Four functional maxillaries in.....	.020

This species is dedicated to my friend Prof. G. Brown Goode, of Middleton, Conn., collaborator of the Smithsonian Institution.

I may here state that another very distinct species of this genus is the *Ichthyodectes arcuatus* (*Portheus accuatus* Cope. 4to Report U. S. Geol. Surv. Terrs. II. p. 204). It is characterized by the attenuation of the bones of the face, and jaws, and the small size and large number of its teeth. Those of the maxillary bone are so small as to become obsolete on the posterior half in old individuals.

#### ICHTHYODECTES ACANTHICUS sp. nov.

The smallest species of the genus, distinguished by the attenuated and curved crowns of the teeth. It is represented in my collection by portions of the dentary, parasphenoid, and other bones. The teeth on the anterior part of the dentary bone are nearly round in section, and their enamel is smooth. The crowns are curved inwards towards the apices, which are slender and acute. The anterior tooth is on the extremity of the dentary. The lateral processes of the parasphenoid are wide and flat, and are pierced at the base by the usual two foramina. The interorbital portion of the bone is concave in the section of its inferior surface.

<i>Measurements.</i>	M.
Length of the crown of a tooth.....	.005
Diameter “ “ “ .....	.001
Five mandibular teeth in.....	.012
Width of parasphenoid at middle.....	.006
Depth of parasphenoid at middle.....	.004

This species and the last described were obtained by my assistant, Chas. H. Sternberg, from the chalk of the Cretaceous No. 3 of Kansas.

#### ORICARDINUS TORTUS gen. et sp. nov.

*Char. gen.* Teeth inserted in shallow aveoli, with the roots more or less exposed; on the posterior half of the maxillary bone unequally so, so as to be pleurodont. The anterior part of the maxillary bone depressed, with superior articular facet, and united with the premaxillary by a ginglymus.

This genus is apparently nearly allied to *Pachyrhizodus* as I have defined it. In that genus the anterior maxillary teeth are strongly pleurodont, and the maxillo-premaxillary suture is squamosal. To *Oricardinus* must probably be referred the *P. shearerii* m.

*Char. specif.* This is derived from a right maxillary bone and a num-

ber of vertebræ, supposed to belong to the same individual by my assistant, Russell Hill, who discovered it.

The proximal extremity of the maxillary bone is depressed, both the external and internal aspects presenting prominent ribs. The inner rib soon disappears, and the alveolar border becomes interior in position, the teeth then assuming a more pleurodont character. The external rib continues, and rises so as to form the superior border of the jaw, but continues to have an oblique direction outwards. It is separated by a longitudinal concavity from the portion that bears the alveoli. The teeth are subcylindric in section, and the crowns are acute and incurved. The proximal end of the maxillary forms a condyle for transverse movement, which is divided by a transverse groove. Above this groove the extremity is fissured.

The vertebral centra are somewhat hour-glass shaped, and present a deep longitudinal fossa on each side of the base of each neural and hæmal arch, which is divided by a vertical rod on partition of bone, which strengthens the arch. The arrangement is that seen in the genus *Empo*, The sides of the centra are marked with rather regular linear grooves, which disappear at the contraction.

<i>Measurements.</i>	M.
Length of maxillary bone preserved.....	.066
Distal depth.....	.011
"    width.....	.005
Proximal depth.....	.005
"    width.....	.006
Eight teeth in.....	.020
Diameter of caudal centrum { longitudinal.....	.010
{ transverse.....	.009
{ vertical.....	.010
Diameter of anterior centrum { longitudinal.....	.009
{ transverse.....	.011
{ vertical.....	.009

In the *O. shearerii* the dental alveoli are transverse to the long axis of the maxillary bone, while here they are longitudinal or round; the bone is more laminiform in the *O. tortus*.

#### ANOGMIVS FAVIROSTRIS sp. nov.

The characters of the genus *Anogmius* Cope having up to the present time rested upon but one species (*A. aratus*), it is satisfactory to be able to confirm them by the study of new material. This, which was obtained in Kansas by Mr. Sternberg, consists of the almost entire superior part of the skulls of two individuals, one of them with thirteen vertebræ.

The vertebræ, which undoubtedly belong to the skull, have no lateral grooves, but the superior and inferior pairs of fossæ are present. The inferior fossæ are separated by a plane interval on the anterior centra, which rapidly narrows posteriorly. The centra are not elongate nor

contracted at the middle, and are sculptured with fine longitudinal grooves.

The cranium is depressed, and was so in life. The form of the muzzle is the extremity of an oval, at the apex of which are the two short premaxillaries, while the sides are composed of the long maxillaries. The top of the head is nearly smooth, marked only posteriorly by a few delicate radiating grooves and dots.

The inferior view displays the vomer, palatine, and maxillary bones with their myriad teeth *en brosse*. Those of the maxillaries form a narrow band, those of the premaxillaries a little wider one. The palatines are long flat bones similar to those of the *Stratodus apicalis*, but of less elongate proportions, and the teeth they bear are relatively smaller and not in longitudinal rows as in that fish. The teeth of the median line of the palate form an elongate tongue-shaped patch, flat and acuminate in front, but gently convex, and with lateral bevels more posteriorly. The teeth it supports are very close together as on the palatine bones. The posterior portion of this patch is broken away. The mandibular ramus is not deep and the symphyseal surface is a rectangular truncation of the nearly parallel inferior and superior edges. The teeth are in many rows, the number diminishing posteriorly. The dentary is incurved to the symphysis. The premaxillary bone is not smooth like the others of the cranium, but is pitted anteriorly, and radiately ridged posteriorly.

<i>Measurements.</i>	M.	
Length of cranium.....	.102	
Width of cranium behind.....	.050	
Length of premaxillary bone.....	.015	
Depth of the dentary.....	.009	
Length of palatine bone.....	.052	
Width " " " ".....	.010	
" " vomerine dentate patch.....	.010	
Diameter of a cervical vertebra	{ longitudinal.....	.005
	{ transverse.....	.009
	{ vertical.....	.007

#### ANOGMIVS EVOLUTUS Cope.

This fish is represented by an entire left mandibular ramus. As corresponding parts are preserved in the typical specimens of *A. aratus* and *A. favirostris*, comparison with these species is easy.

The ramus is less curved than in either of the species mentioned, indicating an elongate and wedge-shaped head. The symphysis is short; deeper than wide, and but little incurved. The ramus is much contracted vertically at the glenoid cavity, which is deeply impressed and decurved on the inner side, having thus a convex transverse section. The angle is recurved behind the glenoid cavity, and also produced for a short distance in line with the inferior margin of the ramus, this portion being separated by a sinus from the superior process. The form of the angle is then that

of a boot with the toe elevated. The inferior edge of the inferior process is acute.

The inferior border of the ramus is thin. The superior border is thickened, and its tooth bearing surface descends on both the internal and external faces of the bone. Posteriorly, this face is presented inwards, but this tooth-band narrows forwards on this side, and widens on the external face. Its greatest width on the latter is posteriorly, an inch in front of the widest internal exposure; it then gradually contracts, its inferior border rising to a short distance behind the symphysis.

The dental alveoli are small and round, densely packed, and sub-equal in size. Near the middle of the ramus, thirty longitudinal rows may be counted. Not a tooth remains. A transverse section of the greater part of the length of the dentary is strongly convex; anteriorly it is flattened above.

<i>Measurements.</i>	M.
Length of ramus.....	.234
“ “ tooth band.....	.150
Depth of symphysis.....	.016
“ at posterior end of tooth band.....	.050
“ at glenoid cavity.....	.019
“ at angle.....	.030

#### STRATODUS OXYPOGON Cope.

This fish is represented in Mr. Sternberg's collection by a dentary bone, a probable maxillary, and a portion of the palatine, both the latter without their extremities. A number of vertebræ accompany the jaws, which probably belong to the same individual.

The dentary is narrow and cuneiform, and rather robust for its depth. The tooth band is wide, covering more than half the vertical diameter of the bone, and is bounded below by a groove. The external face is convex. A delicate groove extends along the superior margin just below it; and a wide open groove commences behind the middle of the length and above the middle of the vertical diameter, opening widely behind. The inferior edge is compressed and flat, and is abruptly distinguished from the convex portion. The symphyseal surface is short, and the infero-anterior border is produced into an acute angle. The teeth are in six rows on the widest part of the band. Of these one contains larger teeth than the others; at one point it is the second from the external margin, but its position becomes more interior on the anterior part of the band. The teeth are recurved, round in section, and with simple, very acute apices. These are transparent and vitreous; the remaining portion of the tooth is opaque, and marked with whitish dots. At the anterior extremity of the dentary, but two rows of the smaller sized teeth remain.

The alveolar fossæ of the teeth of the three interior series of the dentary band, have a peculiar character. The internal half of the border has short radiating lines touching its circumference, but the external half supports

three convex lobes of dense tissue. The lateral of these are divergent and dorsal; the median is narrower, and is radial to the circumference. This structure does not appear in the alveolar fossæ of the three external rows. It is probably a hinge like attachment permitting elevation and depression of the teeth of the inner rows.

The supposed maxillary bone presents a wide open groove on both sides. The superior border is convex in section and not so wide as the tooth bearing face, which is slightly oblique. But for this obliquity the section would be that of a T-rail. The groove of the internal face is continued further forward than that of the external face. There are six rows of teeth arranged as in the dentary bone, but in reversed order.

The fragment of palatine bone is densely packed with teeth, which are longer than those of the jaws. Their apices are as in the latter, simple. Those of one border are longer than those of the other, and the alveolar fossæ of these (the only ones I can see) bear the three adjacent tuberosities above described.

The vertebræ considerably resemble those of *Empo*. Their centra in both abdominal and caudal regions are elongate and contracted medially. There is a shallow longitudinal groove at the bases of the neural and hæmal arches, which are divided vertically by a median rib-like buttress. The median lateral portion is smooth or nearly so.

	<i>Measurements</i>	M.	
Length of dentary bone preserved.....		.0550	
Depth " " " at middle.....		.0080	
" " dentary tooth band at middle.....		.0050	
" " " at symphysis.....		.0045	
Length of maxillary bone preserved.....		.0530	
" " " tooth.....		.0045	
Depth " " at middle.....		.0060	
Width " " " " .....		.0050	
" " palatine bone.....		.0100	
Diameter of an abdominal vertebra	}	longitudinal.....	.0160
		transverse.....	.0115
		vertical.....	.0125

This species differs from the *S. apicalis* in the simple form of the apices of the teeth. The type specimen is much smaller than that of *S. apicalis*.

*Descriptions of Extinct Vertebrata from the Permian and Triassic Formations of the United States.*

By E. D. COPE.

(Meeting of the American Philosophical Society, November 2d, 1877.)

The Triassic formation of North America has yielded many of the reptilian types which characterize the horizon in other parts of the world. A Labyrinthodont has been recognized in North Carolina, and I have determined the existence of the genus *Belodon* in the formation in both that State and Pennsylvania. Of *Dinosauria* three types occur in both Europe and North America. The *Palæosaurus* of the former country is represented by the American *Clepsysaurus*, and *Zanclodon* is somewhat similar in dental characters to the *Zatomus* of North Carolina. Of genera with compressed teeth which have a lenticular section, and both edges denticulate, *Bathygnathus* has been found in North America, and *Cladiodon* and *Teratosaurus* in Europe. This type has, however, been wanting heretofore from the extinct Triassic fauna of Pennsylvania and North Carolina. The present communication introduces it for the first time from the former State, under a form generically different from any of the preceding, and with the name

PALEOCTONUS APPALACHIANUS.

The specimens on which this determination rests, were found by my friend Charles M. Wheatley, A. M., in one of his copper pyrites mines. The most characteristic are two teeth which differ somewhat from each other in form. One of them has a greater transverse, and less anteroposterior diameter, indicating an anterior position in the series. The other is more compressed, and presents a greater anteroposterior width. Judging by the analogy of the genus *Lalaps*, this tooth occupied a position posterior to the first one. The two were found in close proximity, though not in actual contact, in a fragile, argillaceous portion of the copper-bearing rock.

The profile of the anterior tooth is regularly conic with a slight recurvature, which is not seen in the apex, but in the basal portion of the crown, and in the root. The section is almost semicircular at all points, but the inner and flatter face is slightly convex; rather strongly so at the apex. The denticulation of the edges is minute, measuring M. .00033. It continues to the base of the crown both fore and aft. At this point the edges are as elsewhere, at one side of the anterior and posterior aspects. There are no ridges nor facets on the crown, and the enamel possesses an obsolete minute rugosity of short linear ridges.

The crown of the second tooth is not only flatter and wider than that of the first, but is little more than half as long. Both edges are crenate to the base. The marked peculiarity of the tooth is seen in the division of the crown into facets by angular ridges. The convex face is divided into two, an anterior-looking and a posterior-looking, the former half as wide



as the latter. The angle separating them is not continued on the apical third of the crown. The section of the antero-external face is nearly plane. The division of the interior or flatter face is similar, but the angle is less pronounced. The anterior and narrower face is slightly concave. In this crown, as in the first described, there are weak transverse undulations near the basal third.

<i>Measurements.</i>		M.
Length of anterior tooth preserved.....		.080
Length of crown of same.....		.055
Diameter of base of crown	{ antero-posterior.....	.022
	{ transverse.....	.016
Diameter near apex of same	{ antero-posterior.....	.010
	{ transverse.....	.008
Length of posterior tooth preserved.....		.040
Length of crown of second tooth.....		.029
Antero-posterior diameter at base of crown.....		.025
“ “ at middle of crown.....		.019
Transverse diameter “ “ “.....		.010

These dimensions indicate an animal of the general proportions of the gigantic carnivorous *Dinosauria* of the genera *Laelaps*, *Megalosaurus* and *Teratosaurus*. They exceed those of the *Bathygnathus borealis* and the only known species of *Cladiodon*, *C. Lloydii*.

The characters which demonstrate that this Saurian belongs to a genus distinct from any of the above are, Firstly, the presence of the external and internal longitudinal ridges which divide the crown of the posterior tooth into four facets. Second, the shortness of the crown as compared with its width, a point in which it approaches *Palæosaurus*. Thirdly, the semicircular section of the anterior tooth, a form not found in either *Bathygnathus* or *Teratosaurus*, where almost the entire series is known. It is only approximated in some of the Western species referred to *Laelaps*, but is not inconsistent with the characters of that genus as represented by them.

To the genus thus characterized, the name *Palæoconus* is given, and to the species, the name *Palæoconus appalachianus*.

Associated with the teeth of this species, were found several leaves resembling those of *Pterophyllum*; and stems of *Calamites* occur in the same locality.

Additional specimens received from Mr. Wheatley include anterior, intermediate and posterior teeth of a larger animal than the one above described, and intermediate and posterior teeth of a much smaller individual of probably the same species.

The large half-conical tooth of the large individual, presents a slight groove-like constriction at the basal portion of the posterior cutting edge. Length of crown above base .060; width at base .025. Width of posterior tooth at base .030. The form of the intermediate tooth is between those of the others. Its external face is very convex and is not faceted. The

approach of the external face to the anterior or cutting edge is much more abrupt than to the posterior.

The teeth of the smaller saurian only differ from the others in their size. The more posterior is probably anterior in position to those described above, as its external face is more convex, especially anteriorly, and is not faceted. Length of crown of the anterior tooth .032; width at base .019. Width of base of posterior tooth .015; length .019.

PALÆOCTONUS AULACODUS, sp. nov.

The teeth of this saurian differ from those of the *P. appalachianus* in having their basal portion sculptured with parallel shallow grooves. These are quite close together, leaving ridges between them which are narrower than themselves. The surface of the crown displays the silky sculpture of minute raised lines more distinctly than in the other species. But one tooth of this animal has been so far obtained by Mr. Wheatly, and this one is from the middle of the series of an animal rather smaller than the second individual of the *P. appalachianus*. In accordance with this position the crown is short and half conic with the external face strongly convex, most so in front. The denticles are well exhibited on both edges, but only descend on the anterior to the middle of the length of the crown. In both large and small specimens of *P. appalachianus* the denticles descend nearly or quite to the base. Length of crown .022; width at base .011.

CLEPSYSAURUS VEATLEIANUS, sp. nov.

Represented by a single large tooth in perfect preservation. In accordance with the characters of the type species, *C. pennsylvanicus* of Lea, the tooth is straight, and possesses two cutting edges. The posterior of these is denticulate and perfectly straight; the other is less extensive and is separated from the posterior by very unequal surfaces.

In the present saurian the tooth is compressed, and rounded in front, the section throughout the basal half being an oval with one end acute. The antero-interior edge only exists on the apical half of the crown, and is separated from the posterior edge by a somewhat convex face two-thirds the width of the external face. It is not denticulated, and its lower extremity falls behind the anterior margin of the crown when viewed in profile. The enamel is perfectly smooth. Length of crown from base of enamel layer .047; longitudinal diameter at base .018; transverse do. 011.

As compared with the *C. pennsylvanicus* of which several teeth are known, the *C. veatleianus* differs in its more compressed form, and in having the anterior cutting edge not denticulated. The position of this edge is more internal than in the longer known species, but this may indicate a more anterior position in the jaw.

This saurian is named in compliment to Charles M. Wheatley, A.M., of Phoenixville, Pa., to whose exertions we owe nearly all the material hitherto obtained from the Triassic formation of Pennsylvania.

## SUCHOPRION CYPHODON, gen. et sp. nov.

*Char. gen.* As no portion of the animals referred to this genus is known, other than teeth, the characters are derived from these only. Their crowns are elongate, conical and curved, and are furnished with denticulate cutting edges. In the teeth preserved these are separated by very unequal extents of surface, as they form the anterior and posterior borders of the inner face. The crown is penetrated by a very minute pulp cavity, and it consists of a number of distinct concentric cones.

It is probable that teeth have been discovered in Europe which belong to saurians of this genus, but I cannot find that they have ever received a distinctive name. They resemble those of *Crocodylia* rather than *Dinosauria*.

*Char. specif.* The only species of *Suchoprion* as yet known to me is represented by four teeth found in the same beds and formation as those above described. One of these is of large size, indicating that it reached the adult dimensions of the Gangetic gharrial. They display some difference in the degree of convexity of the external surface, which is sometimes opposite the imaginary plane of the inner face, sometimes oblique to it. The degree of convexity is always greatest at the base of the crown. The inner face is also convex. The curvature in the long direction is not great, and is directed to the inner side. The surface presents a minute silky sculpture; one tooth presents a very few shallow sulci.

*Measurements.*

M

Diameter of largest tooth	{ antero-posterior.....	.021
	{ transverse.....	.020
Length of crown of tooth No. 2.....		.045
Diameter crown tooth 2	{ antero-posterior.....	.009
	{ transverse.....	.016

## BELODON CAROLINENSIS, Emmons.

Cope, Trans. Amer. Philos. Soc. 1869, p. 59.

Teeth of the anterior portions of the jaws were obtained by Mr. Wheatley.

## BELODON PRISCUS, Cope.

Trans. Amer. Philos. Soc. 1869, p. 59.

Teeth from the anterior part of the jaws. In addition to the six species of saurians above noted, Mr. Wheatley obtained the tooth of a Stegocephalous Batrachian, probably a Labyrinthodont.

## CRICOTUS GIBSONII, Cope, sp. nov.

While examinations into the Clepsydrops shale of Eastern Illinois have revealed a great abundance of individuals, and three species of *Clepsydrops*, the genus *Cricotus* has remained without addition, and the three vertebræ hitherto found, appear to belong to but one species, the *C. heteroclitus*. The present notice describes a second form, represented, like the first, by but few

remains. The vertebra which is best preserved, and which may be regarded as typical, is probably from the caudal series, and is thus well contrasted with the corresponding typical vertebra of the longer known species.

On this vertebra there is no trace of diapophysis, and the neuropophysis rises from the external side of the superior face. The wall of the neural canal is not preserved, but the inference is that the diameter of the latter is large. This fact and the absence of definite chevron articulations leads me to doubt the caudal position of the vertebra; but the usual marks of the dorsal and cervical vertebræ are totally wanting from it. As in *C. heteroclitus*, the *foramen chordæ dorsalis* is large, its diameter being one-third of the total. The articular faces descend steeply into it, that of one extremity more so than the other. The rim of the latter face is beveled outwards, the plane thus produced appearing on the inferior face something like the united faces of the chevron bones.

The centrum is a little deeper than wide, and the inferior face is truncate so as to give a subquadrate outline. The inferior plane is concave, the concavity being divided by a longitudinal rib. The sides are somewhat concave, with a longitudinal rib at the middle. Diameters of centrum: vertical .010; transverse .009; longitudinal .008. Width of inferior plane .005; width above, including neuropophyses, .008.

As compared with *C. heteroclitus* this species differs in the presence of parallel ridges enclosing a median fossa on the inferior side of the centrum. The small size may be here considered, but it is uncertain whether the two animals represented by the vertebræ are fully grown.

This reptile is named in recognition of the services of William Gibson of Newport, Ia., who has added a number of interesting facts to the geology of the Wabash region.

*CRICOTUS DISCOPHORUS*, Cope, sp. nov.

A vertebra, representing an animal as large as the *C. heteroclitus*, presents characters so much at variance with those of the latter as to require special notice. Three other vertebræ of smaller size present similar features.

The centrum is disciform, with very short antero-posterior diameter, which is, however, greater at one part of the surface than at the opposite point. The *foramen chordæ dorsalis* occupies about one-fifth of the transverse diameter, which is subequal in all directions. The articular faces of the centrum are slightly concave. The margin of that of one side is beveled for the superior two-thirds of the circumference, the bevel running out below by turning into the articular face. The latero-inferior border of the latter turns out into an obtuse angle at this point. The superior part of the bevel runs into the lateral face of the centrum. The attachment of the neural arch is obscure or wanting in the specimen, and the same is true of any facet for chevron bones.

Diameter of articular face	{	vertical.....	.025
		transverse.....	.025
Length of centrum below.....			.009
"          "      above.....			.007

Another vertebra of nearly the same character, and one-half smaller size, presents a greater difference between the long diameters of the upper and lower sides. The superior diameter is only one-half the inferior, and the foramen chordæ dorsalis much nearer the superior than the inferior margin. Its diameter is one-fourth the vertical and one-third the transverse diameter.

From the same locality and discoverer as the *C. gibsonii*.

LYSOROPHUS TRICARINATUS, Cope, gen. et sp. nov.

*Char. gen.* Vertebra amphicealian, perforated by the foramen chordæ dorsalis. Neural arch freely articulated to the centrum. Floor of neural canal deeply excavated. No processes nor costal articulations on the centrum, which is excavated by longitudinal fossæ. Centrum not shortened.

This genus resembles in the proportions of the centrum, the genus *Olepsyrops*, but differs in many details.

*Char. specif.* Two centra and a portion of a third represent this species. The former are a little longer than wide and a little depressed. The facet for the neural arch is an elongate plane truncating the border of the fossa of the neural canal on each side, for one-half to three-fifths the length of the centrum. Two deep longitudinal fossæ extend on each side of a median rib of the inferior face; and they are separated above by a narrower rib from another longitudinal fossa which is below the base of the neural arch.

	<i>Measurements.</i>	M.
Diameter of centrum	{ longitudinal.....	.0055
	{ vertical.....	.0038
	{ transverse.....	.0040
Length of facet for neurapophysis.....		.0035
Width of neural canal.....		.0020

Discovered by Wm. Gurley, near Danville, Illinois.

DIPLOCAULUS SALAMANDROIDES, gen. et sp. nov.

*Char. gen.* Vertebral centra elongate, contracted medially, and perforated by the foramen chordæ dorsalis; coössified with the neural arch, and supporting transverse processes. Two rib articulations one below the other, generally both at the extremities of processes, but the inferior sometimes sessile. No neural spine nor diapophysis; the zygapophyses normal and well developed.

The vertebrae of this genus much more nearly resemble those of a salamander than any hitherto found in this formation, but it will be necessary to observe the cranium before this point can be determined.

*Char. specif.* One of Dr. Winslow's and two of Mr. Gurley's sendings contain vertebrae of this species. One from the latter gentleman is contained in a mass of clay in immediate contact with a mandibular ramus which supports a number of teeth. The ramus appears rather too

large for the animal to which the vertebra pertained, but the proportion is not different from that which I describe below in the genus *Eryops*.

The surface of the centrum is smooth and is without grooves. The diapophyses and parapophyses are rather elongate, and are closely approximated one above the other. The superior process issues from the centrum opposite the superior margin of the articular faces. They stand equidistant from the extremities of the centrum, and are directed obliquely backwards. The anterior zygapophyses occupy the same level. The neural spine is a compressed longitudinal ridge; it divides behind, leaving a notch between the posterior zygapophyses.

<i>Measurements.</i>		M
Diameter of centrum	longitudinal.....	.0060
	vertical.....	.0025
	transverse.....	.0025
Depth of centrum and neural arch.....		.0060
Width with transverse processes.....		.0070
Expanse of posterior zygapophyses.....		.0050

The mandibular ramus which accompanied one of the vertebræ is shallow and stout. Its external surface is sculptured with sharp longitudinal ridges, which inosculate more or less. The teeth have cylindric roots which occupy shallow alveoli sunk in a plane surface. The crowns are rather elongate and compressed near the apex, and without grooves or serræ. In contact with the jaw is an osseous fragment with a pitted or reticulated surface.

Depth of ramus.....	.0030
Length of crown of tooth.....	.0023
Four teeth in.....	.0040

#### ERYOPS MEGACEPHALUS Cope gen. et. sp. nov.

*Char. gen.* The details of the structure of this genus are derived from an almost entire cranium with underjaw, which is accompanied by numerous vertebræ and other bones. The form is Labyrinthodont, and embraces the largest species of that group yet known from this continent.

The skull is not elongate, and the quadrate bones are produced far backwards. The epiotic processes are present but not remarkably elongate. The temporal fossa is covered in by the usual roof. The orbits are round, posterior in position, and small. There is no postorbital depression or groove, and the lateral epiotic sinus is not deep. The nostrils are large and widely separated. There is no angular process of the mandible. The maxillary teeth are of different sizes, although arranged in a single row. The posterior are small and not closely placed; large teeth appear anterior to the middle. The premaxillary bone supports a number of large teeth. Those of the mandible which are visible in the specimen in its present state, those opposite the nares, are of medium size. The form of the crowns of the teeth is conic, with weak fore and aft cutting edges. There

are no distinct fissures of the surface although these may be represented by some fine parallel lines.

Vertebræ referred to this genus are small in proportion to the dimensions of the skull. They are not discoidal but somewhat elongate; are biconcave, and are not perforated for the notochord. The middle portion of the centrum is contracted. One articular extremity has the borders of the concave centre, convex. Zygapophyses large. Ribs present short; neural spines elongate, stout.

In comparing this genus with those described by authors and arranged by Mr. Miall in his family *Euglypta*, its exclusion from the latter is evident in view of the absence of angular process of the mandible, and the nondiscoidal vertebræ. Its posteriorly placed orbits distinguish it from the genera of his second family, the *Brachyopina*, excepting perhaps *Rhinosaurus*. It is with the genera of the third family, the *Chauliodonta*, that affinity appears to exist. It is unnecessary to compare *Eryops* with *Loxomma*, which has immense and irregularly shaped orbital openings, and trenchant teeth; but with *Zygosaurus* and *Melosaurus* the affinity is closer. The deep postorbital depressions, and the grooved maxillary teeth, described by Eichwald in the former genus, separate it at once. The teeth of *Melosaurus* are equally distinct, being, according to Meyer, conical and deeply grooved at the base. In *Rhinosaurus* the maxillary and mandibular teeth are said to be sub-equal. *Leptophractus* has deeply grooved teeth with strong cutting edges.

*Char. specif.*—In this category I include many of those introduced into the generic diagnosis by Mr. Miall in the very useful report to the British Assoc. for the Advancement of Science, 1874, p. 149, by the Committee on the Structure and Classification of the Labyrinthodonts. Such are the width of the interorbital space, the outline of the muzzle, the details of the sculpture, the approximate number of the teeth, etc.

The cranium has a sub-triangular outline, with the sides a little longer than the base, and the apex (muzzle) very obtuse. The profile is elevated behind, and the sides slope steeply to the mandible; the slope of the muzzle is rather steep, but less so than that of the cheeks. The extremity of the snout is broadly rounded and depressed, and overhangs the mandible. The supra-occipital outline is concave, and the epiotic angles only moderately prominent. The quadrate bones extend far posteriorly, and are horizontal above at their distal extremities. The orbits are nearly round, although somewhat wider than long, and they are directed equally outwards and upwards. The inner margin is slightly flared upwards, and it terminates anteriorly and posteriorly in a slight tuberosity, at the junction with the canthus rostralis and temporal ridge respectively.

The orbit occupies the anterior portion of the posterior third of the length of the skull, including the epiotic angles; and its long diameter is one-seventh that of the skull from the epiotics to the muzzle inclusive. The same diameter is about half of the interorbital width. The parietal region is plane, the frontal gently concave, and the muzzle depressed convex

in cross-section. The face in front of the orbit is concave below the canthus rostralis. The nostrils are not large, and are sub-round. They are widely separated, being nearer the maxillary border at its junction with that of the premaxillary, than to the median line. The mandible is shallow, and not very stout. Its inferior border rises from below a point a little in front of the fundus of the epiotic sinus to the angle, which is at the quadrate articulation. Symphysis short.

The sculpture of the anterior portions of the muzzle is coarsely punctate; on the posterior portions of the upper and lower jaws it is ridged and pitted. Most of the upper surface of the skull is still covered with a thin layer of the matrix, so that the sculpture and the character of the lyra, if any there be, remains unknown.

The teeth, as has been observed, are not visibly grooved, but the characteristic feature of the group may be represented by numerous delicate crack-like lines which one sees on the basal portions. These, however, look like the result of weathering. The sections of all the teeth would be round, but for the cutting edges, which are not very prominent. In addition, the premaxillary teeth are coarsely fluted on the median half of their length. The fluting is not visible on an antero-lateral mandibular tooth, nor on a posterior maxillary tooth. The microscopic structure of the teeth is not yet investigated.

The bodies of the vertebræ have concave sides, and a sub-round section. Their neural spines terminate in an obtuse enlargement. Many of the characters of the vertebral column are yet concealed in the matrix. The distal portions of the ribs are straight, cylindrical, and become stouter at the extremity.

<i>Measurements.</i>	<i>M.</i>
Length of cranium from the extremity of the os quad-	
raturum . . . . .	.433
Length of cranium on middle line . . . . .	.335
Length from end of muzzle to nostril . . . . .	.073
Width of cranium between quadrates . . . . .	.306
"    "    "    epiotics . . . . .	.118
"    "    "    orbits . . . . .	.086
"    "    at orbits . . . . .	.294
"    "    between nares . . . . .	.085
Diameter of orbits { antero-posterior . . . . .	.048
{ transverse . . . . .	.057
Length of premaxillary tooth . . . . .	.025
Diameter " " . . . . .	.007
Length of posterior maxillary tooth . . . . .	.010
Diameter of median " " . . . . .	.007
Length of a dorsal centrum . . . . .	.024
Vertical diameter of do. . . . .	.025
Elevation of neural spine of do. . . . .	.050
Length of rib on curve . . . . .	.080



This interesting fossil was found in the Triassic formation of Texas by my friend Jacob Boll. The cranium and vertebræ were discovered in such relation as render it evident that they were parts of one animal.

STRIGILINA GURLEIANA, Cope, sp. nov.

This species is known by a single jaw or tooth in complete preservation, which was found, like the type of the genus *S. linguæformis*\* near Danville, Ill., by Mr. Gurley.

The tooth is quite small, its length only equaling the width of the known tooth of *S. linguæformis*. It is also narrower in proportion to the length. The root and the cutting edge are turned in opposite directions as in the other species. The principal difference between the two is seen in the character of the transverse ridges or crests of the oval face. There are two crests less, or five, with a delicate basal fold, making six, while, counting the fold there are eight in *S. linguæformis*. The anterior ridge is transverse; the others slightly convex backwards, and all are equidistant and uninterrupted, which is not the case in the older species. They are also of different form, being distinct ridges with anterior and posterior faces similar. In *S. linguæformis* the anterior face only is vertical, the posterior descending very gradually, the whole forming a series of steps. Length of ridged face .0060; width anteriorly .0035; width posteriorly .0020.

This species is dedicated to William Gurley, of Danville, Illinois, to whose zeal science is indebted for the species from that locality described in this and other papers.

Twenty species have now been obtained from the Clepsydrops shales, the exact geological position of which remains to be accurately determined. Dr. Winslow informed me that they are the bed No. 15 of Prof. Bradley's section of the Carboniferous rocks of Vermilion county, Illinois. This places them near the summit of the Carboniferous series, below two thin beds of coal (which word is misprinted "coral" in my last paper, Proceed. Amer. Philos. Soc. 1877, p. 63). I am now informed that this portion of Prof. Bradley's scale is not correct, and that No. 15 occupies a much higher position than he assigns to it. It lies unconformably above the merom sandstone of Mr. Collett, which deposit is above the coal measures and unconformable to them. The stratigraphical evidence is thus confirmatory of that derived from paleontology, that the *Clepsydrops* shale occupies a position in the scale above the coal measures.

CTENODUS PUSILLUS, Cope, sp. nov.

Form narrow, the width of the base about equal to the depth. The coronal portion is narrower than the base, because the inner face is oblique, forming an acute angle with the inferior plane. There are but four crests, of which the two longer are directed in one direction, and the two shorter in another. The interior ones of both pairs form a continuous

\*Proceedings Amer. Philos. Soc. 1877, p. 52.

crest which is convex inwards. The crests are straight, elevated and acute; each one supports two or three denticles, which are rectangular and little elevated. The longer ones project beyond the general outline; the shorter ones are less prominent at the extremities; all are obtuse in the vertical direction. The superior surface is smooth. The inferior is slightly concave in the transverse sense. The tooth on which this species is found is the smallest yet obtained from the formation. Length, .007; width, .003; depth at inner crest, .003.

Two specimens were found by Wm. Gurley, in Vermilion Co., Illinois, in the *Clepsydrops* shale.

I have referred two species from this formation to the genus *Ceratodus*, under the names of *C. vinslovi* and *C. paucicristatus*. While the form of these teeth is that of the genus named, the structure of the superficial layer differs in wanting the punctæ which are characteristic of *Ceratodus*, but is, on the contrary, uniformly dense, although frequently irregular. I therefore refer the two species above mentioned to another and allied genus, under the name *Ptyonodus*, with *C. vinslovi* as type.

#### ORTHACANTHUS QUADRISERIATUS, Cope, sp. nov.

Represented by an incomplete radial spine. With it occur several fragmentary spines which resemble very closely one belonging to *O. gracilis*, Newb. (Geolog. Survey of Ohio, Pl. lxix, fig. 7), and which only differ in having the denticles shorter. As teeth of a *Diplodus* near to or identical with *D. compressus* are common in the shale, the two may belong to the same fish. Dr. Newberry has already suggested that *Orthacanthus* and *Diplodus* are identical.

The *O. quadriseriatus* is quite different from the other species. The spine is wider than deep, and the series of denticles are widely separated. The surface between them is gently convex and smooth. The anterior face is strongly convex and presents at each side two shallow furrows. The external groove is divided by a series of thin longitudinal denticles which are smaller than those of the principal row, and which are sometimes somewhat confluent at the base. The principle denticles are closely placed, stout, acute, and recurved. Transverse diameter of shaft .0035; antero-posterior diameter .0025. The portion of the shaft preserved is straight.

#### ARCHÆOBELUS VELLICATUS, gen. et sp. nov.

"Species No. 4," Cope, Proceed. Amer. Philos. Soc. 1877, p. 55.

Several other specimens of the body described as above have been obtained by Messrs Winslow and Gurley. In every instance it is a tooth-like process attached to a solid base by ankylosis in the manner of the teeth of fishes. From the appearance it presents I am led to suppose that it is the only one of its series, and there are none of the numerous teeth of the collections which can be associated with it. I therefore distinguish the genus by a name and the following diagnosis.

The form is conical, and the surface is not grooved nor furnished with

prominent ridges. The interior is hollow, and the walls are composed of a few concentric layers without external enamel or cementum. The solid base to which it is attached is shallow, presenting smooth surface on the opposite side, which is deeply impressed by a longitudinal groove at one end.

The characters of this species are pointed out at the place above quoted. The measurements of a large specimen are : length .015 ; diameter of base, long .008 ; short .005.

I am not sure as to the part of the skeleton to which this body should be referred.

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*On Reptilian remains from the Dakota Beds of Colorado.*

BY E. D. COPE.

(*Meeting of American Philosophical Society, November 2, 1877.*)

Since the discovery of the huge saurian *Comarasaurus supremus* (Cope, Paleontological Bulletin, No. 25, p. 5), Superintendent Lucas has explored the horizon of the Dakota of the Eastern Rocky Mountains near the Arkansas River for other indications of extinct life. His search has been rewarded by the finding of several species of reptiles of interesting character, which it is the object of the present paper to describe.

CAULODON DIVERSIDENS gen. et. sp. nov.

This large saurian is represented by ten teeth found together, but separated from the cranial bones, and in a more or less broken condition. I select four of these exhibiting the characters most clearly.

*Char. gen.* Fang of the tooth of great length and hollow, and contracted at the base. It is without excavation for successional tooth. Crowns of the teeth of different forms in different portions of the jaw ; the posterior are like the bowl of a spoon ; others have a similar form but are more compressed, having double lateral ridges, while the crown of another, supposed to be an incisor, is little wider than the root, and has the section an oval with one side less convex than the other. All are coated with an enamel-like layer of considerable thickness which extends on the fang in some of the teeth. None of the crowns present cutting edges.

The characters presented by these teeth are quite distinct from anything hitherto found in North American Saurians. The absence of indication of the successional teeth is remarkable, and in connection with the contraction of the base of the root, suggests that the mode of succession of teeth approximated that exhibited by the *Mammalia*.

*Char. specif.*—The roots of all the teeth are cylindrical. The crown of the posterior tooth is convex on one (the external) side, and concave on the other. The convexity is increased by a contraction of the external surface near and parallel to each border. The concavity is divided by a longitudinal rib which disappears at the base. This edge of the



tebræ preserved, and the surface is smooth excepting some delicate longitudinal ridges extending to the border of the expanded extremity. The narrower extremity of a dorsal vertebra is nearly round and presents a slight median tuberosity; the opposite end is wider than deep, and its surface is uniform. The smaller extremity of a lumbar vertebra is slightly concave.

	<i>Measurements.</i>	M.	
Diameter of dorsal centrum	}	longitudinal . . . . .	.023
		vertical . . . . .	.020
		transverse . . . . .	.025
Width of base of neural arch with diapophysis . . . . .		.010	

This species is dedicated to its discoverer, O. W. Lucas, of Canyon City, Colorado, the Superintendent of the Public Schools of the surrounding region. Through the scientific interest and energy of this gentleman the extinct vertebrata of the Dakota division of the Cretaceous Period hitherto unknown to science are being brought to light. The care and skill exercised by Mr. Lucas in the preservation of remains, which are often bulky, and always fragile, deserve the thanks of all students of this department of science.

#### COMPSEMYS PLICATULUS, sp. nov.

Although tortoises have been discovered in older formations in Europe, the present species is the earliest yet obtained in North America. Its characters appear to coincide in important respects with those of the Lignitic formation which I have referred to *Compsemys* Leidy. This name I have proposed to retain for tortoises with marginal bones completely united with solid plastron, and the usual dermal scuta, and which differ from *Emys* in their *Trionyx*-like sculpture.

The *C. plicatulus* is represented by portions of both carapace and plastron of several individuals. While the distal extremities of the costal bones display the suture for the marginals, they also possess an inferior true costal prolongation, as in *Trionyx*. The proximal part is not preserved in any marginal bone, but the adjacent portions were united by fine suture. The proximal extremity of the costals exhibit the usual two directions, the shorter being posterior, and relating to the anterior part of the succeeding vertebral bone. The sternal sutures are fine; that between the hyo- and hyposternal bone is transverse; while that between the latter and the post-abdominal is oblique, and at the margin quite squamosal. At that point the hyposternal overlaps the post-abdominal for a considerable distance, and the suture of the inferior side of the plastron, after bending forwards, is abruptly recurved, running along the edge of the posterior lobe.

The scutal sutures are not wide nor deeply impressed, but the abdomino-femoral, and the femoro-anal are distinct. The median, longitudinal, sternal, and the costo-marginal sutures are irregular and serpentine. The sculpture is rather fine, and consists of rather closely placed tubercles and ridges. The borders of the elements of both carapace and plastron are marked

with ridges at right angles to the sutures, which are not short. The middle parts of the costal bones are marked by short interrupted or inosculating vermicular ridges closely placed. On the middle portions of the sternal bones the ridges are in places more broken, forming tubercles.

The surface of the bridge is angularly oblique to that of the plastron. The buttresses are not produced inwards. The free marginal bones are rather thin, and are not recurved.

<i>Measurements.</i>	M.
Length of a costal bone.....	.110
Width of the same.....	.032
Thickness “.....	.005
Length of hyposternal bone.....	.066
Width of the same at inguinal notch.....	.048
Thickness of the same in front.....	.007

Found by Superintendent Lucas with the foregoing species.

#### CLEPSYDROPS LIMBATUS sp. nov.

The discovery of a species of the genus *Clepsydrops* in Texas, in a formation hitherto regarded as Triassic, adds weight to the view above expressed, that the *Clepsydrops* shales of Illinois belong either to the Triassic or Permian formations. As typical of the new species I select a vertebra, which may be exactly compared with corresponding one of *C. collettii*. The centrum is about as wide as long, and its sides are very concave, much more so than in *C. collettii*, and the rim-like borders of the articular extremities are connected by a straight compressed hypopophysial keel. The sides of the foramen chordæ dorsalis are convex in the longitudinal section, thus contracting the opening, as compared with the very wide flare of the border of one of the extremities of the centrum. This flare receives the wide recurved border of the opposite extremity of the adjoining centrum, forming a kind of ball and socket articulation. This reflected surface forms a ridge with the funnel of the foramen at this extremity of the vertebra. The concave extremity is produced downwards, so that the foramen is considerably above the middle point. The diapophysis and parapophysis are not distinct nor elongate, but are represented by a projecting scar on the superior part of the centrum, which is directed downwards and forwards towards the rim of the articular face.

Besides the great contraction of the centrum, its relatively shorter form distinguishes it from that of *C. collettii*. It is also much larger than that species and the *C. pedunculatus*, being the largest of the genus.

<i>Measurements.</i>	M.
Length of centrum.....	.031
Diameter of centrum { vertical.....	.039
{ transverse.....	.033
Width of neural canal.....	.006

Discovered by Jacob Boll.

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