CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

(*Continuation of Contributions from the Museum of Geology*)

UNIVERSITY OF MICHIGAN

VOL. III, No. 1, pp. 1–14 (1 pl.) NOVEMBER 10, 1928

INDICATIONS OF A COTYLOSAUR AND OF A NEW FORM OF FISH FROM THE TRIASSIC BEDS OF TEXAS, WITH REMARKS ON THE SHINARUMP CONGLOMERATE

BY

E. C. CASE

UNIVERSITY OF MICHIGAN

ANN ARBOR

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

(Continuation of Contributions from the Museum of Geology)

UNIVERSITY OF MICHIGAN

Editor: EUGENE S. MCCARTNEY

The series of contributions from the Museum of Paleontology was inaugurated to provide a medium for the publication of papers based entirely or principally upon the collections in the Museum. When the number of pages issued is sufficient to make a volume, a title-page and a table of contents will be sent to libraries on the mailing list, and also to individuals upon request. Communications with reference to exchange or purchase of copies should be directed to the Librarian, General Library, University of Michigan.

VOLUME I

The Stratigraphy and Fauna of the Hackberry Stage of the Upper Devonian, by Carroll Lane Fenton and Mildred Adams Fenton. Pages xi + 260, 45 plates, 9 text figures and 1 map. Cloth. $2.75 net.

VOLUME II

1. A Possible Explanation of Fenestration in the Primitive Reptilian Skull, with Notes on the Temporal Region of the Genus *Dimetrodon*, by E. C. Case. Pages 1–12, with 5 illustrations. Price, $.30.
2. Occurrence of the Collingwood Formation in Michigan, by R. Ruedemann and G. M. Ehlers. Pages 13–18. Price, $.15.
3. Silurian Cephalopods of Northern Michigan, by Aug. F. Foerste. Pages 19–104, with 17 plates and 2 text figures. Price, $1.00.
4. A Specimen of *Stylemys nebrascensis* Leidy, with the Skull Preserved, by E. C. Case. Pages 87–91, with 7 text figures. Price, $.20.
5. Note on a New Species of the Eocene Crocodilian *Allognathosuchus, A. wartheni,* by E. C. Case. Pages 93–97, with 1 plate and 1 text figure. Price, $.20.
6. Two New Crinoids from the Devonian of Michigan, by G. M. Ehlers. Pages 99–104, with 1 plate. Price, $.20.
7. New Brachiopods from the Warsaw Formation of Wayne County, Kentucky, by G. M. Ehlers and M. S. Chang. Pages 105–111, with 1 plate. Price, $.20.
8. The Richmond Formation of Michigan, by R. C. Hussey. Pages 113–187 with 11 plates, 12 text figures and 1 map. Price, $.75.

(Continued on inside of back cover)

VOL. III, No. 1, pp. 1–14 (1 pl.) NOVEMBER 10, 1928

INDICATIONS OF A COTYLOSAUR AND OF A NEW FORM OF FISH FROM THE TRIASSIC BEDS OF TEXAS, WITH REMARKS ON THE SHINARUMP CONGLOMERATE

By E. C. CASE

THE expedition from the Museum of Paleontology of the University of Michigan to the Upper Triassic, Dockum, beds of western Texas in 1927 recovered the anterior portion of the lower jaw of a small Cotylosaur belonging in the Family *Procolophonidae,* which includes the genera *Telerpeton, Koïloskiosaurus, Procolophon, Sclerosaurus* and, perhaps, *Thelegnathus.*

This specimen, the first member of the *Cotylosauria* known to occur in the Triassic of North America, was discovered by Mr. W. H. Buettner near Walker's Tank in Crosby County, Texas. It bears the catalogue number 2338 and is the type of the genus and species, *Trilophosaurus buettneri.*

It is possible that Gilmore's *Hypsognathus fenneri,* recently described,[1] is the complement of this member of the Triassic fauna on the eastern side of the continent.

The characters of the specimen are best appreciated from a study of the illustrations, Plate I, Figures 1–5. The teeth are complete and perfect but the bone has suffered somewhat from solution. The anterior end of the bone is broken away, but only a small part of the extremity is lost, which did not, in all probability, carry a tooth. The first tooth is represented by the base only; the tooth was small, cylindrical, and evidently conical.

[1] Gilmore, Chas. G., "A New Fossil Reptile from the Triassic of New Jersey," *Proc. U. S. National Museum,* Vol. 73, Art. 7, 1928.

The second tooth is also represented by the base only, but this, with the remaining teeth, was decidedly different from the anterior one; they are all very wide as compared with their length and set transversely in the jaw as in *Diadectes* and *Telerpeton.* The third, fourth and fifth teeth are complete and perfect. The sixth tooth is represented by the base only and posterior to this there is evidence of a socket for a seventh tooth. All the teeth posterior to the first increase regularly in size from the second to the seventh.

The three perfect teeth are so similar that a description of one will suffice for all. The short base rises sharply from the surface of the bone without change of size to the base of the enameled crown. The crown swells out sharply but slightly and then the anterior and posterior faces incline inwards and upwards to meet in the sharp cutting edge at the top. Each face is marked by two shallow grooves which divide the crown into three parts and the cutting edge into three cusps. The cutting edge is inclined slightly inward and downward; the outer cusp is somewhat higher than the median and inner ones. The bases of the second and sixth teeth and small perforations of the bases of the third and fifth show that there was a large pulp cavity.

The method of attachment of the teeth to the jaw is most puzzling. Viewed from above the teeth are apparently acrodont in their attachment; the fibres of bone passing from the base of the tooth to the adjacent bone are clearly seen under a low magnification, but the bases of the second and sixth teeth, showing the continuation of the root into the bone, and the evident socket for the root of a seventh tooth indicate that the method of attachment was thecodont. The peculiarity of the method of attachment led to an examination of the literature of the members of the *Procolophonidae* and it was discovered that most of the writers upon these forms had been puzzled by the same thing and that the shape of the crowns of the maxillary teeth was for long misunderstood because in most of the specimens the teeth are presented only in lateral profile.

In 1867 Huxley wrote of *Telerpeton elginense:* "I have carefully examined into the mode of implantation of these (maxillary) teeth, and I have been unable to satisfy myself that they are lodged in true alveoli. They appear to be anchylosed to the edges of the jaw bone, as in many modern lizards with an 'acrodont' dentition."

In 1904 Boulenger wrote on the same form correcting some of Huxley's observations. He said: ". . . the exaggerated length of the anterior mandibular tooth is owing to the roots being made to project beyond the bone, the thecodont nature of the Reptile not having been recognized. As to the side teeth, Huxley only described them from the lateral aspect, without mentioning that on the right side of the specimen the fourth maxillary tooth may distinctly be seen, in a transverse section, to have been transversely expanded and molar like." In the same article he said: "Each maxillary bore six large bilobate teeth, the roots hourglass-shaped in horizontal section, the transverse diameter at least double the longitudinal and with large pulp cavities. The teeth are implanted in sockets, not acrodont as believed by Huxley. Three conical teeth were present in each premaxillary, the first the largest. . . .

"The dentition therefore bears a close resemblance to that of *Procolophon,* differing, however, in the molar teeth being wider still, in this respect agreeing with *Diadectes* and *Empedias* as figured by Cope."

In 1917 Huene gave a description of the skull of *Telerpeton elginense* in which he mentions a large conical premaxillary tooth separated by a diastema from a second smaller premaxillary tooth. The maxillary teeth are described as having two conical cusps connected by a somewhat lower cutting edge. The outer cusps of the mandibular teeth are somewhat higher than the inner ones.

In 1876 Owen described the maxillary teeth of *Procolophon* as conical in form with a pulp cavity: "The base of the tooth seems to be confluent with substance of the jaw; there is no appearance of an alveolar cavity."

In 1878 Seeley, describing three species of *Procolophon,* speaks of the maxillary teeth as subcylindrical with a large pulp cavity. He says of the species *cuniceps* that the teeth are "anchylosed to the jaw with no trace of fangs or sockets," and of the species *laticeps*: "The bases of the fangs invested by bone, so as to have the aspect of being in sockets." In 1889, in another paper, he describes the teeth of *Procolophon* as cylindrical, terminating in sharp conical points, and as having "slightly expanded bases, which are in close union with the jaws."

In 1903 Broom gave a catalogue of the specimens of *Procolophon* in the Albany Museum in Grahamstown, South Africa; the following notes are extracted from his descriptions.

Specimen 16.— "The teeth of the maxillary bone are seen to be seven in number; of which the last two are smaller than the others. The teeth which may be regarded as molars have broad flattened crowns."

Specimen 24.— "The cast of the broad tops of the molar teeth are well shown."

Specimen 27.— "In the lower jaw there are seen to have been 9 teeth, the anterior ones pointed, the posterior with broad crowns."

Specimen 30.— "There have been three premaxillary pointed teeth, and six maxillary teeth, of which the first only is somewhat pointed."

Specimen 32.— "There have been only eight teeth in each mandible, of which the first three are pointed."

Specimen 37.— "The molars have broad though fairly sharp crowns."

Specimen 42.— "Left mandible showing the thorough anchylosis of the teeth to the dentary."

In 1905 Broom described the two species of *Thelegnathus* with the teeth "closely resembling those of *Procolophon*," and with "little doubt that the remains belong to a member of the *Procolophonia*." "In the maxilla are six and possibly seven molar teeth, and as in *Procolophon* they are anchylosed to the jaw. In structure and shape the teeth also resemble closely those of *Procolophon*. They differ, however, in becoming steadily larger on passing back." Of a second specimen of the same species, he says: "The crown [in the maxillary teeth] is distinctly constricted antero-posteriorly in the middle, and though worn is fairly sharp."

In 1912 Huene described *Koïloskiosaurus* and said of the maxillary teeth that they are apparently conical, but an exploration of the cast of a tooth with a fine point shows that there was a transverse cutting edge and that the cross-section of the base was not round but oval, with the greatest diameter transverse to the length of the jaw.

In the same paper Huene described the teeth of *Sclerosaurus* as sharply conical in the anterior portions and the maxillary and opposing mandibular teeth as bluntly conical, flattened above and with the base oval and obliquely transverse to the jaw.

It is apparent from these citations that the members of the family *Procolophonidae* had a tendency to the development of teeth set transversely in the jaw, with a transverse cutting edge and the edge divided into cusps. These characters show in varying degree in the various forms and reach their greatest development in *Telerpeton* and the form here described. The peculiar attachment of the teeth is apparently also a common character.

The discussion of fragmentary material is often of doubtful value, but when a fragment indicates the presence of a new form or group previously unknown in a certain geological horizon or locality, the geological and paleogeographical implication transcends in importance the morphological description. The members of the family *Procolophonidae* are all Triassic. *Telerpeton* occurs in the upper Keuper, according to Jukes-Brown, in the middle Triassic, according to Broili (Zittel); *Thelegnathus* occurs in the middle Triassic of South Africa; *Procolophon* in the lower Triassic of the same region; *Sclerosaurus* and *Koïloskiosaurus* occur in the upper Bunter of Germany.

The present form is from the upper Triassic, though Huene has suggested that the beds may be middle Triassic. The advanced stage of specialization of the teeth is confirmatory evidence of the upper Triassic age of the beds in which it was found.

The second specimen, number 7506, Museum of Paleontology, University of Michigan, was figured in outline and briefly described in 1922 by the author. It was then described as a form of unknown relationships. Since that time the author has searched for further light upon the specimen but has been unsuccessful; it is here further described and figured, Plate I, Figures 6, 7, 8, in the hope that some worker may recognize it or may make some helpful suggestion. This specimen was found in the matrix enclosing the skull described by the author as *Leptosuchus crosbiensis* in 1922; it is from the same geological horizon as the other specimens recovered from Crosby County, Texas, but from another layer than the specimen described above and from a locality a few miles away.

The form of the tooth is clearly shown in the figures. The bone is evidently that of a fish and from the shape of the bone and of a depression on the inner side, becoming narrower anteriorly, the broken base is toward the anterior end. The teeth were typically acrodont in attachment. The broken base of the anterior tooth is 5.5 mm. from the anterior end of the fragment; it is separated from the complete tooth by less than 1 mm. and the second tooth is 3.5 mm. from the posterior end. As there is no indication of teeth anterior or posterior to the two and as they are set very close together, it is probable that they were the only teeth in the jaw or were isolated in position. The two teeth have their greatest diameter parallel to the axis of the jaw and the anterior one is much smaller than the second, as indicated by its broken base.

The complete tooth is 10 mm. long and 4.5 mm. in its greatest breadth. The crown is slightly swollen at the base but contracts toward the top from all sides. One side, believed to be the outer, is concave. The top of the tooth is a narrow ridge, probably originally a sharp cutting edge but worn by use into a narrow facet sloping slightly toward the concave side. The facet is 4.8 mm. long. A portion of the crown is broken away from the convex side showing characteristic dentine structure. As the author has sought unsuccessfully for any form to which this may be compared or referred, the name *Xenognathus obscurus* is tentatively proposed.

The exposures of Upper Triassic in northern Arizona have been consistently treated by all workers in the region as revealing the typical section but there has been no consensus of opinion as to the limits of the Triassic, above and below, of the exact horizon of the component beds, or of their areal extent. Gregory [2] and Darton [3] have given résumés of the observations and conclusions of various workers, and recently Lee [4] and Branson [5] have discussed the Red Beds of the whole Rocky Mountain region. Increasing knowledge of the fauna of the Triassic beds in western Texas permits this contribution to an appreciation of the extent of the Shinarump conglomerate member.

A very brief statement of the character of the beds in the type region is:

Chinle. Essentially red sandstone and shale, frequently very massive. *Limestone conglomerate* a characteristic feature.

Shinarump. Cross-bedded, lenticular conglomerate or coarse sandstone, the pebbles chiefly *quartz and quartzite.*

Moenkopie. Chocolate red and banded arenaceous shales and clays, and thin sandstones. Variable in stratification and color.

Gregory correlates the Shinarump with the Dolores of southwestern Colorado, which is characterized by the abundance of "limestone conglomerate" recognizing both types, calcareous and siliceous, of conglomerate as a feature of the Shinarump. The Shinarump, in both its phases, is accompanied by a distinct vertebrate fauna and by this means can be traced from its type occurrence to its final, easternmost, appearance on the east side of the Staked Plains of Texas. Chart I, compiled from the literature and the observations of the author, shows the possible correctness of this suggestion. The chart differs from that of

[2] Gregory, H. E., *Geology of the Navajo Country,* Professional Paper No. 93, U. S. G. S., 1917.

[3] Darton, N. H., *Resumé of Arizona Geology,* Arizona Bureau of Mines, Bulletin No. 119, 1926.

[4] Lee, W. T., *Correlation of Geologic Formations between East Central Colorado, Central Wyoming, and Southern Montana,* Professional Paper No. 149, U. S. G. S., 1927.

[5] Branson, E. B., "Triassic-Jurassic 'Red Beds' of the Rocky Mountain Region," *Journal of Geology,* Vol. XXXV, No. 7, p. 607, 1927.

CHART I

L. Trias. and U. Trias. refer solely to the relation of the beds to the conglomerate. All are Upper Triassic in age. (F) Indicates the position of the vertebrate fauna.

Age	Tanner's Crossing Tucker's Springs Adamana	Ft. Wingate	Abiquiu Chama Rv.	S. W. Colorado	Carthage	Carlsbad Guadaloupe	Santa Rosa Cuervo Tucumcari San Jon Endee	Dickens Spur	Big Springs
Tertiary							Tertiary	Tertiary	Tertiary
Coman-chean							Coman-chean	Coman-chean	Coman-chean
Jurassic	Wingate ss.	Wingate ss.	Jura (?)	La Plata	Wingate ss. (?)	Absent	Wingate ss. (?)	Absent	Absent
Triassic	Chinle (F)	Chinle (F)	U. Trias.	U. Dolores	Absent ?	Absent	U. Trias. Dockum 3	U. Trias. ? Dockum 3	Absent
	Shinarump	Shinarump	Poleo ss.	L. Dolores Ls. Cong.	Cong. (F)	Absent	Cong. Dick-ens Dockum 2	Dickens Dockum 2	Dickens Dockum 2
	Moenkopi	Moenkopi	L. Trias. (F)	L. Dolores	L. Trias. (F)	Absent	L. Trias. (F) Dockum 1	L. Trias. (F) Dockum 1	L. Trias. (F) Dockum 1
Permian	Kaibab	Shale and clay	Shale and sandstone	Cutler	Chupadero (Gypsum at top)	Castile Gyp-sum Rustler dol.		Gypsum Double Mt.	Gypsum Double Mt.
					Chupadero	Delaware ls.		Clear Fork	Clear Fork
			Abo ss.						

CHART II

Stegocephalia are all either Metoposaurus or Buettneria. Desmatosuchus possibly equals Episcoposaurus. It is probable that many of the genera of Parasuchians should be united in the genus Phytosaurus.

Tanner's Crossing Tucker's Springs Adamana	Fort Wingate	Abiquiu Chama River	S. W. Colorado	Carthage	Santa Rosa Cuervo Tucumcari San Jon Endee	Dickens Spur (Walker's Tank and Cedar Mountain)	Big Springs (Otischalk)
Stegocephalia Metoposaurus	Stegoceph. fragments	Stegoceph. fragments	Stegoceph. fragments	Stegoceph. fragments	Stegoceph. fragments	Metoposaurus Buettneria	Stegoceph. fragments
Parasuchia Macheroprosopus Angistorhinus	Accompsosaurus Paleorhinus	Phytosaurus Episcoposaurus	Phytosaur fragments Heterodontosuchus	Phytosaur fragments	Phytosaur fragments	Phytosaurus Episcoposaurus Leptorhinus Desmatosuchus Promystriosuchus	Phytosaurus (?)
Dinosauria		Coelophysis			Dinosaur fragments	Coelophysis Dinosaur indet.	
Forms indet. Placerias		Typothorax				Trilophosaurus	Forms nov.

Branson mainly in that the Dockum beds are considered as equivalent to the Shinarump rather than to the Chinle.

The evidence for the position assigned to the Dockum, other than that of the vertebrate fauna, is the apparent actual continuity and the similarity of association with other beds. The evidence from the contained fossil wood has not yet been evaluated and the known invertebrates are too few to be of great value.

The vertebrate fauna associated with the Shinarump (Chart II) is a highly specialized and characteristic one which bears internal evidence of response to a fixed and peculiar environment. The author has more than once insisted that correlation of beds by the contained fossils is more a correlation of life conditions than a measure of exact time equivalence. In this consideration is to be found an answer to one objection that might be made to the proposed correlation. In the extreme western part the vertebrate fauna is found in the Shinarump and above it, in the Chinle; in the eastern exposures, in western Texas, it is found in the Shinarump and below it, in the Moenkopi or its equivalents. Future discoveries may necessitate alteration of this statement, but as yet there is no evidence to the contrary. The fauna is an easily recognized one of giant Stegocephalians and Phytosaurs of bizarre form, of Cotylosaurs (as reported in this paper), of Dinosaurs, and of Ganoid and Dipnoan fishes.

Chart II shows the location of the better known members of the fauna. It can be traced from Tanner's Crossing north of Winslow and Holbrook, in Arizona, to Fort Wingate, in western New Mexico, and as far east as Carthage, in central New Mexico. It occurs in the exposures on the Chama River, in northwestern New Mexico near Abiquiu, and as abundant fragments in the Dolores Formation of southwestern Colorado. It can be traced across southern Colorado from the San Miguel River to the Purgatory River, Animas County, in extreme southeastern Colorado. It occurs near Folsom, New Mexico, and from there can be traced southward on the western side of the Staked Plains through Endee, San Jon, Tucumcari, Cuervo, Montoya, and Santa Rosa. The beds at Folsom and on the

Purgatory River are the same as those which appear in the valley of the Red River north of Amarillo, Drake's Dockum beds, and these can be traced south with the same fauna, on the eastern side of the Staked Plains from Clarendon to Big Springs, in Texas. The absence of Upper Triassic beds in central New Mexico is due to the elevation of the Chupadero (Permian) in that region; probably thin outliers containing the fauna will be found between Santa Rosa and Carthage.

Branson has very justly remarked upon the uncertainty of identification, generically and specifically, of the few known vertebrates and upon the danger of using the material in exact correlation of the beds, but there can be little doubt that the specimens are all parts of one fauna, perhaps with local geographical differences, and reflect a similar stage of evolution under similar conditions of environment. The fauna as a whole is so closely associated with the Shinarump that it may safely be used as an indication of equivalence of conditions and perhaps of time.

In all the exposures on both sides of the Staked Plains the fauna lies in and below a conglomerate or heavy, coarse sandstone. In the localities directly west of the Plains the conglomerate lies directly beneath the Tertiary cap or within a few feet of it, but at Tucumcari, Montoya, Cuervo, etc., there is a heavy bed of red sandstone, the equivalent of the Chinle, above the conglomerate, which has been repeatedly searched unsuccessfully for the vertebrate fauna. These upper beds extend a long distance southward toward Roswell and westward toward Las Vegas.

On the east side of the Plains the conglomerate lies directly beneath the Tertiary cap. It is typically exposed at Dickens, in Dickens County, and is referred to in the author's notes as the Dickens member of the Dockum; it is probably the same as Gould's Trujillo member and Drake's Santa Rosa member. The author has described this conglomerate from several localities and has published sections. The upper layers of conglomerate, or coarse sandstone, are heavy, brown or red, cross-bedded and siliceous; immediately below this is a bluish or whitish bed of similar material but with many included limestone pebbles and a high calcareous content, a "limestone conglomerate." These beds thin rapidly toward the east and probably did not extend a great distance beyond their present exposure. The clay and sandstone below, the equivalent of the Moenkopi extend farther east and are probably separated from the Permian below by the Quartermaster or Blaine gypsum which Gould has traced from Oklahoma into Texas.

The author does not believe that the fact that the fauna occurs above the conglomerate in the west and below it in the east militates against the proposed correlation for the following reasons:

1. The conglomerate on both sides of the Staked Plains is dominantly siliceous above and dominantly calcareous below; both phases of the Shinarump are present.

2. Water-worn fragments of the fauna are found in the conglomerate wherever the fauna occurs in immediately adjacent beds, either above or below.

3. The occurrence of the remains of the fauna is peculiar. Literally hundreds of square miles of exposure of beds that might be expected to contain the fauna are utterly barren. The bones occur in what are obviously old river channels or in areas of wash of rapid water. It is extremely rare that any association of skeletal parts is found.

It seems probable that great areas of barren, fine-grained Triassic sediment were deposited in immense shallow lakes, of such extent that only locally could anything but the finest sediment reach the major part of their bottom. Bordering the lakes were lands that afforded a most favorable habitat for the aquatic and semi-aquatic vertebrates. The land was covered by a mantle of deeply decayed residual soil, in places red from the effect of alternately high and low water table. Some slight physiographic or meteorologic change, insufficient to affect the life, might permit the unreduced pebbles and fragments to be borne far out into the lakes and deposited as the conglomerate. An equally slight change in the opposite direction would restore the previous conditions. Whatever the process really was, such a succession of events would account for the extent and continuity of the beds over large areas and for the persistence of the fauna. The dominantly siliceous or calcareous content of the beds is easily accounted for by the supposition of different areas of degradation affording the material. The stratigraphic location of the fossils already discovered may very easily be but the accidents of the collectors' fortune or of original deposition.

DESCRIPTION OF PLATE I

FIGURES 1 to 5, *Trilophosaurus buettneri.* All figures $\times$ 1.7

FIG. 1. Inner surface

FIG. 2. Outer surface

FIG. 3. Upper surface

FIG. 4. Posterior surface

FIG. 5. Obliquely from above and in front

FIGURES 6 to 8, *Xenognathus obscurus.* All figures $\times$ 1.8

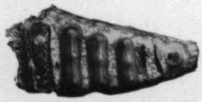
FIG. 6. Outer surface

FIG. 7. Inner surface

FIG. 8. Upper surface

PLATE I


1


3

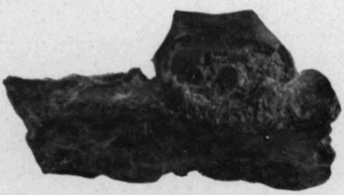

2


4


5


6


8


7

(*Continued from inside of front cover*)

VOLUME III