

# Range and Distribution of the Mosasaurs, With Remarks on Synonymy.

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With Plate XX.

The Mosasaurs are at present known from four remote regions of the world—North and South America, Europe and New Zealand. Doubtless they lived over the greater part of the earth and may be expected to be found wherever the deposits in which they occur are found. Their geological range is confined exclusively to the Upper Cretaceous, from the time corresponding to the upper part of the Dakota to that of the lower part of the Laramie, or from Upper Cenomanian to the Lower Danian. The correlation of the American Cretaceous deposits with those of Europe, or even with each other is by no means exact, or even approximately exact. Nevertheless the equivalency of the different strata and epochs is sufficiently well determined to admit of approximate results, and it is one of the purposes of this paper to bring what evidence the Mosasaurs—typical Cretaceous reptiles—may present, bearing upon the subject.

The oldest Mosasaurs are apparently those described by Hector from New Zealand, which he referred to the genera *Liodon* and *Taniwhasaurus* Hector.\* The genus *Liodon* Owen, Dollo has recently shown to be a synonym of *Mosasaurus*.† Whether or not Hector's species is congeneric with those placed under *Liodon* by Cope is not certain, though it is evident that it is closely allied. *Taniwhasaurus* is as clearly of the *Platecarpus* type, and may possibly belong to that genus.

The most recent form is the historical *Mosasaurus giganteus* Soemmering (*M. Camperi*, *M. Hoffmani*) from the Mæstricht beds in the Lower Danian. These three forms, *Tylosaurus*, *Platecarpus* and *Mosasaurus* represent three distinct and divergent types, which I will call the Tylosaurinæ, Platecarpinæ, and Mosasaurinæ, cor-

\*On the Fossil Reptilia of New Zealand, Trans. and Proc., New Zealand Institute, vi, 338, 1873.

†Bull. Soc. Belg. Geol., vii, 79, 1892.



responding to the megarhynchous, microrhynchous and mesorhynchous types of Dollo.\*

The Tylosaurinæ begin with *Liodon* (*Tylosaurus?*) *Haumurensis* Hector in the Cenomanian of New Zealand and continue to the Upper Senonian of Belgium as found in the genus *Hainosaurus* Dollo, from the Brown Phosphatic Chalk of Mesvin Ciple. In the interior of North America the type, so far as known, begins near the lower part of the Niobrara and terminates at its close or in the beginning of the Ft. Pierre, that is, to use the European time periods, with the close of the Turonian or the beginning of the Senonian. Forms ascribed to this genus, the *Liodon* of Cope, are from the Lower Greensand or Lower Marl of New Jersey, but their positive identification is yet uncertain, if not doubtful, since the only characteristic parts, the rostrum, quadrate and limb bones have never yet been found. There is nothing improbable in its occurrence in these beds, but hitherto nothing decisively characteristic of *Tylosaurus* has been found there. The genus *Hainosaurus* is clearly of the *Tylosaurus* type. In fact the two genera are so nearly related that decisive distinctional characters are not yet forthcoming, unless they be found in the paddles.

The Platecarpinæ have a very similar distribution. Beginning in the Cenomanian of New Zealand, in *Taniwhasaurus*, if the deposits of New Zealand are really cotemporaneous with this epoch in Europe, they terminate in the closely allied *Plioplatecarpus* Dollo from the Lower Mæstrichtian of Belgium. In North America the species upon which the genus *Platecarpus* has been chiefly based are known nowhere outside of Kansas and Colorado, and are here restricted exclusively to the Niobrara. The type species of this genus, *P. tympaniticus* Cope, is from Mississippi and is in all probability congeneric with the Kansas species, but this has not yet been satisfactorily proven, though it certainly belongs in the Platecarpinæ.

From the Ft. Pierre only one species can be referred to this group, and this with doubt. *Brachysaurus* described by myself in the last number of this QUARTERLY may belong here, but I believe that its affinities are more close with the Mosasaurinæ. It is certainly closely related to *Prognathosaurus* Dollo,† from the Upper Senonian of Belgium, and I should have had little hesitancy in identifying it with that genus had not Dollo stated that the chevrons are free in *Prognathosaurus*.‡

\*Mem. Soc. Belg. de Geol., iv, 163, 1890.

†Mem. Soc. Belg. de Geol., iii, 193, 1889.

‡Mem. Soc. Belg. de Geol., iv, 163, 1890.



Of the Mosasaurinæ, including the two genera *Mosasaurus* and *Clidastes*, the lowest horizon is the upper part of the Niobrara in Kansas. *Clidastes* ranges into the Ft. Pierre, as previously stated by myself. In the eastern Atlantic region his genus is represented by forms closely allied to those from Kansas. Its range then, is from the upper part of the Turonian through the larger part of the Senonian.

The typical *Mosasaurus* is confined exclusively to the Senonian and Danian. Its distribution in North America is reputed to be from New Jersey, Alabama and Dakota, but some of the determinations may be incorrect. The species from the Ft. Pierre are, however, clearly congeneric with one or more from New Jersey. In Europe *Mosasaurus* is known only from the Upper Senonian and the Danian (Upper Chalk and Mæstrichtian), that is, apparently, from later horizons than those in which the genus occurs in America.

The two genera *Mosasaurus* and *Clidastes* are nearly related, though sufficiently different to justify their independent existence.

From the known distribution of the Mosasaurs, Dollo has concluded, "Que la Nouvelle-Zéland (ou, mieux, les terres australes) est le centre d'irradiation des Mosasauriens, qui en seraient partis à la fin de l'époque cénomanienne, auraient vécu uniquement en Amérique durant l'époque turonienne, auraient émigré en Europe à l'époque sénonienne et s'y seraient éteints avec l'époque mæstrichtienne." The fact that Mosasaurs are reported from the Amazonian Purus, corresponding to the Mæstrichtian, would certainly indicate that they had not become at all restricted in distribution in the latter part of their existence.

The distribution of the Mosasaurs, so far as now known, seems to be of little value in the correlation of the Cretaceous epochs. Only a single genus seems to be of wide distribution, and the nearly related ones may be widely separated in geological range. Two, perhaps three distinct types appear suddenly in the Cenomanian and have continued side by side in the same waters throughout the greater part of the time during which the group has been in existence. Some minor divergent forms have appeared, such as the singular *Phosphorosaurus* Dollo, *Prognathosaurus* and *Brachysaurus* and, perhaps, *Baptosaurus* Marsh, which, by the way, is one of the latest American forms, from the Upper Greensand or Marl of New Jersey, and occurring also, if Merriam's determination is correct, in the Niobrara of Kansas.

The common aquatic ancestor of the three types must be sought for in a much earlier period, certainly in the Lower Cretaceous.



The rudimentary or possibly functional zygosphene among the Platecarpinæ, or some members of it and the complete zygosphene in *Clidastes*; together with the shortened muzzle and more fully ossified paddles, indicates a much closer relationship between the Platecarpinæ and Mosasaurinæ than between either and the Tylosaurinæ. In the last we find, in some forms at least, that the fifth finger is actually longer than the fourth, with as many phalanges, and that the carpus and tarsus are almost wholly unossified. If we assume with Dollo that the zygosphene is a primitive character, and it must be unless it had an independent origin among the Mosasaurs, then *Clidastes* would be the most generalized and *Tylosaurus* the most specialized of the Mosasaurs. In the paddles and skull, *Tylosaurus* is with hardly a doubt, more specialized than any other genus. However, although *Clidastes* may retain some of its primitive characters, it certainly shows in many other respects a high degree of specialization.

In the accompanying plate are shown the side views of skulls of two of these types, the Tylosaurinæ and Platecarpinæ. The third type, the Mosasaurinæ, may be seen by reference to plate XV, in Vol. III, of this QUARTERLY.

I give below a tabular review of the known genera of the Mosasaurinæ arranged in systematic sequence, using the European time-epochs for comparison's sake. Of course it is understood that the exact equivalency of these time-periods is yet a matter of uncertainty.

#### TYLOSAURINÆ.

Hind feet functionally pentadactylate. Trunk short, the tail proportionally long, not dilated distally. Tarsus and carpus almost wholly unossified, the phalanges numerous. Vertebrae wholly without zygosphene. Premaxillary projecting into a long rostrum in front of the teeth. Quadrate with a short suprastapedial process.

#### *Tylosaurus* Marsh

- Cenomanian of New Zealand (*Liodon Haamuriensis* Hector).
- Upper Turonian of Kansas and New Mexico (Niobrara).
- ? Senonian of New Jersey (Greensand).

#### *Hainsosaurus* Dollo

- Upper Senonian of Belgium (Brown Phosphatic Chalk of Ciple).

\*Mem. Soc. Belg. Geol., iv, 168.

\*Ueber the Pythonomorphen der Kansas Kreide, Paleontographica, xli, 36.



**PLATECARPINÆ.**

Hind feet functionally pentadactylate. Trunk short, the tail proportionally long, not dilated distally. Carpus and tarsus imperfectly ossified. Vertebrae with rudimentary or functional zygosphene. Premaxillary not projecting beyond the teeth, very obtuse. Quadrate large, with long suprastapedial process.

**Platecarpus** Cope.

Upper Turonian of Kansas and Colorado (Niobrara).  
? Senonian of Mississippi.

**Plioplatecarpus** Dollo.

Lower Mæstrichtian of Belgium (Danian).

**Prognathosaurus** Dollo.

Upper Senonian of Belgium (Brown Phosphate of Copley).

? **Brachysaurus** Williston

Senonian of Dakota (Ft. Pierre).

**Sironectes** Cope and Holosaurus Marsh

Upper Turonian of Kansas (Niobrara).

**Taniwhasaurus** Hector

Upper Cenomanian of New Zealand.

**MOSASAURINÆ.**

Hind feet tetradactylate. Carpus and tarsus fully ossified, and with not more than six phalanges in any digit. Trunk relatively long, the thorax short, the tail much compressed distally, the chevrons co-ossified with the centra. Zygosphenes rudimentary or functional. Humerus with a strong radial process at distal end. Prefrontal more or less dilated into a horizontal plate posteriorly. Coronoid large. Rostrum short, obtusely conical. Quadrate small, with a suprastapedial process of moderate length.

**Mosasaurus** Conybeare

Lower Danian of Belgium and England (Upper and Lower Mæstrichtian and Upper Chalk).  
Upper Senonian of Belgium (Brown Phosphate of Copley).  
Senonian of New Jersey and Dakota (Greensand and Ft. Pierre).  
? Senonian of Alabama and North Carolina.

**Olidastes** Cope.

Uppermost Turonian or Lowermost Senonian of Kansas and Colorado (Niobrara and Ft. Pierre).  
Senonian of New Jersey, Alabama and Mississippi.



**INCERTÆ SEDIS.****Baptosaurus** Marsh.

Upper Senonian of New Jersey (Upper Greensand).

Upper Turonian of Kansas (Niobrara).

**Phosphorosaurus** Dollo.

Upper Senonian of Belgium (Brown Phosphatic Chalk of Cipley).

**TYLOSAURUS.**

? *Macrosaurus* Owen, Journ. Geol. Soc. Lond., 1859, 380.

? *Lesticodus* Leidy, Proc. Amer. Phil. Soc., 1859, vii, 10.

? *Nectoportheus* Cope, Proc. Amer. Phil. Soc., 1868, 181.

*Liodon* Cope et alia, nec Owen.

*Rhinosaurus* Marsh, Amer. Journ. Sci., June, iii, 461, 1872 (preoc.).

*Rhamphosaurus* Cope, Proc. Acad. Nat. Sci. Phil., 1872, 141 (preoc.).

*Tylosaurus* Marsh, Amer. Journ. Sci., iv, 1872, 147.

Moderate to very large sized species. Rostrum much produced, the nares situated far back. Facial surface of the parietal produced to the posterior part in the middle, the sides nearly parallel. Post-frontal and prefrontal meeting on the superior orbital border. Prefrontal not expanded on the facial plane over the orbit. Quadrate with a short suprastapedial process. Humerus slender, the proximal end angular, the distal end without radial process. Ulna and radius slender. A single carpal or tarsal bone present, not articulating with adjacent bones. Phalanges very numerous, the fifth finger not reduced. Hind limb as large as the anterior. Spines of caudal vertebræ not elongated. Thoracic vertebræ twelve to fourteen in number, the lumbo-dorsals about ten, the pygal caudals five; whole number of vertebræ not exceeding one hundred and twenty; no zygosphene. Coracoid not emarginate.

As in *Platecarpus* the rightful name of this genus can not be determined until more is known about the forms described from incomplete material from New Jersey. It seems very probable that the name *Tylosaurus* will eventually have to be abandoned. It is altogether likely that *Nectoportheus* is the same, while *Macrosaurus* and *Lesticodus* possibly are. In this uncertainty *Tylosaurus* may be retained for the present.

*Macrosaurus levis* Owen, the type of the genus, was proposed for a species represented by two dorsal vertebræ from the Greensand of New Jersey. Leidy (Cretaceous Reptilia, 75) referred other remains to the same species, but with the remark, "I cannot



avoid the suspicion that both the specimens in question and those described by the high authority just mentioned (Owen) really appertain to the dorsal series of *Mosasaurus*." The vertebræ figured by Leidy seem to be congeneric with the Kansas forms referred to *Tylosaurus*, but, inasmuch the genus is distinguished with difficulty by the vertebræ alone, it would be hazardous to say with any degree of certainty that they are really the same. Cope, in 1870 (Extinct Batrachia, etc.), referred certain bones to this same species under the name *Liodon*. In the plates of the same work he figured two or three vertebræ over the name of *L. validus*, referred to *L. lævis* in the text, and to *Clidastes antivalidus* in the explanation of the plates! The bone figured in the text certainly does not belong with *Tylosaurus*, and, if Cope is correct in his determination, *Macrosaurus* is not the same as *Tylosaurus*. The different names that he used, however, are sufficient evidence of his uncertainty.

*Lesticodus* was given by Leidy to a species (*L. impar*) represented by teeth and portions of the jaws, and was afterwards abandoned by him. Cope apparently believed that the genus was the same as *Liodon* Cope.

*Nectoportheus* Cope was based upon *Liodon validus* (olim *Macrosaurus*) and was characterized by him as follows: (Extinct Batrachia, etc., 208) "The posterior dorsals are so much more depressed than in *Liodon lævis*, that future discovery may justify the generic separation of the genus *Nectoportheus*, which I originally applied to this animal." In his "Cretaceous Vertebrata" (p. 160) he says: "The typical species of this genus (*Liodon anceps* Owen) is very little known, but few remains having been obtained from the English chalk, its locality and horizon. Numerous North American species resemble it in the forms of the crown of the teeth, and it is probable, though uncertain, that they agree in other respects also. Several names have been proposed for our species, the earliest of which is *Macrosaurus* Owen. This name applies to species with compressed dorsal vertebræ, as *L. lævis* and *L. Mitchelli*, both from the New Jersey Greensand. For species with the depressed dorsal vertebræ, as *L. validus* from New Jersey, *L. perlatus* from New Jersey, and *L. proriger* from Kansas, the name *Nectoportheus* was proposed and briefly characterized."

The definition of *Tylosaurus* (*Rhinosaurus*) was explicit and exact, leaving no doubt of the genus to which it was intended to apply.

#### PLATECARPUS.

? *Holcodus* Gibbes, Smithsonian Contributions, ii, p. 9, 1850.

*Platecarpus* Cope, Boston Soc. Nat. Hist., 1869, p. 164.



*Lestosaurus* Marsh, Amer. Journ. Sci., June, 1872.

Medium sized Mosasaurs. Premaxillary short and obtuse, projecting very slightly beyond the teeth. Teeth slender, and recurved, faceted upon the outer side and striate on the inner. Nares much dilated anteriorly, situated forward. Frontal emarginated in the middle behind; pineal foramen large, situated near the frontal suture. Facial surface of parietal small, triangular in shape, the apex not extending beyond the middle of the bone. Prosplenial with a dilated wing-like process above. Quadrate large with a large suprastapedial process, reaching below the middle of the bone. Expanded portion of palatine short. Coronoid short and not prominent. Zygosphenes of vertebræ rudimentary. Cervical vertebræ seven in number. Thoracic vertebræ not more than fifteen in number, lumbo-dorsals nine or ten; pygial caudals five or six; chevrons large, articulated, spines of caudals regular in length. Limbs relatively large; arm and leg bones short and expanded; three or four carpal or tarsal bones present, closely articulating; pollex and hallux shorter than the fourth digit, divaricated. Coracoid with a deep emargination. Pelvic bones large; ischium much expanded distally; pubis without antero-proximal process.

The genus *Holcodus* Gibbes was proposed for the reception of a species supposed by him to be represented by three teeth from Alabama, South Carolina and New Jersey. Two of these were figured in his work cited (pl. iii, ff. 6-9), with the following description: "They are solid, and resemble in their pyramidal form those of *Mosasaurus hoffmani* antero-posteriorly, the dividing ridges making the anterior and posterior surfaces equal, and they are both convex. They are also acutely pointed. In *Mosasaurus* the outer surface is plane or nearly so, and both have longitudinal narrow planes near the base. \* \* In the teeth under notice, on the outer half are many planes, almost grooves, and also on the inner face, which is peculiarly striated toward the base. As the striated character is a structural distinction, the name *Holcodus* is given to the genus, and that of *acutidens* to the species." Professor Leidy afterward\* showed that only those teeth from Alabama belonged to a Mosasauroid, the ones from New Jersey being those of a crocodile (*Hyposaurus*). He describes Gibbes' type as follows: (op. cit.) "The specimen has the enameled crown three-fourths of an inch in length. The base is elliptical in transverse section, and measures five lines antero-posteriorly, and four lines transversely. The crown is nearly equally divided by acute ridges, which are im-

\*Cret. Reptiles of the United States, p. 32, foot note.

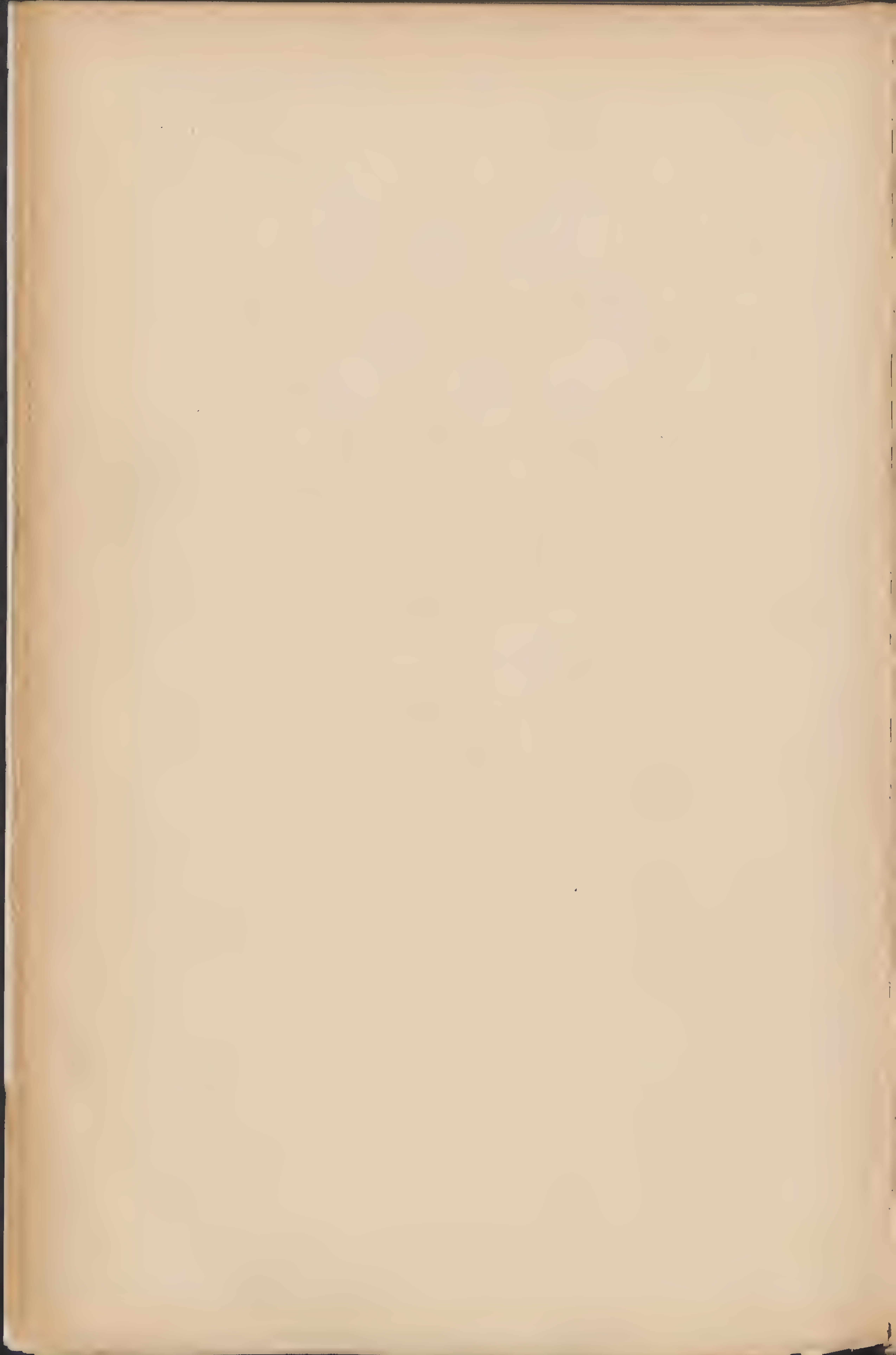


perfect in the specimen, but appear not to have been denticulated. The surfaces are subdivided into narrow, slightly depressed planes, and the inner one is strongly striate at the base." He is inclined to refer the tooth to *Mosasaurus*, a view in which Marsh coincides after examination of the type.\*

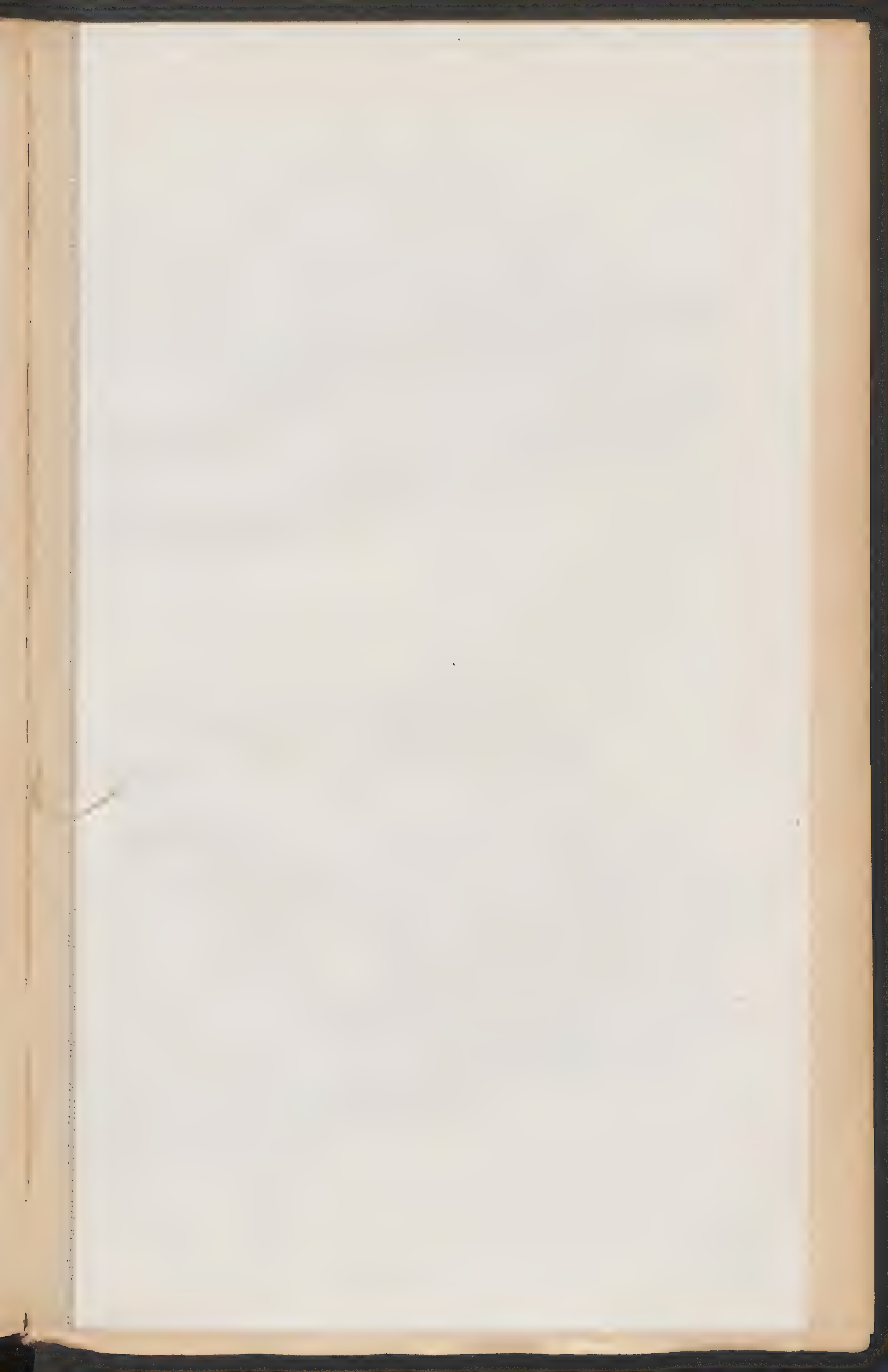
I cannot agree with these authors. Whatever the tooth may be it is not that of a *Mosasaurus*. Professor Cope erected the genus *Platecarpus* for a species which Leidy had previously referred to *Holcodus*, under the name *tympaniticus*. The specimen which he described was from Mississippi. Later Cope applied the name *Holcodus* to two species from Kansas (*H. coryphæus* and *H. ictericus*), but which he later placed in *Platecarpus* after the name *Lestosaurus* had been given to the genus represented by them. Cope in his *Cretaceous Vertebrata* (p. 141) says: "The teeth of the Kansas species referred to it are somewhat similar in character to those described by Gibbes; but it is evident that the latter belonged to a different animal more nearly allied to the true *Mosasaurus*." Of *Platecarpus tympaniticus* very little of the skeleton has been described, and the tail is not yet known. At one time, Cope stated that the tail vertebræ of *Platecarpus* had co-ossified chevrons, upon what authority I can not learn. Marsh based the distinction of *Lestosaurus* largely upon that character, apparently following Cope. The quadrate of *P. tympaniticus*, as figured by Cope certainly looks very much like that bone of the Kansas species, and the quadrate in this genus is a very characteristic bone. These questions then, are to be settled before the name *Platecarpus* can be finally accepted for the Kansas forms: First, Is the typical *Platecarpus* identical with *Holcodus*? I believe that it is. The teeth of the Kansas forms agree perfectly with Leidy's description and figure of the type specimen of *Holcodus*. Second, Is *Platecarpus tympaniticus* congeneric with the Kansas species placed in this genus. This also appears to be true, but it is by no means yet proven. If both propositions are true, our species must be known as *Holcodus*. If the latter only is true, *Platecarpus* will be retained; while if the former is alone true, the name *Lestosaurus* will take precedence. It is a pity that little or nothing has been added to our knowledge of the southern and eastern species of this group within the last twenty years. Perhaps we may expect more definite knowledge concerning them in the immediate future. There is no inherent improbability that the Alabama or Mississippi species are not congeneric with the western ones, inasmuch as we know positively that one genus at least, *Clidastes*, does occur in all these regions, and it does not seem at all unlikely that all of them are common to the different horizons.

\*Amer. Journ. Sci., June, 1872.

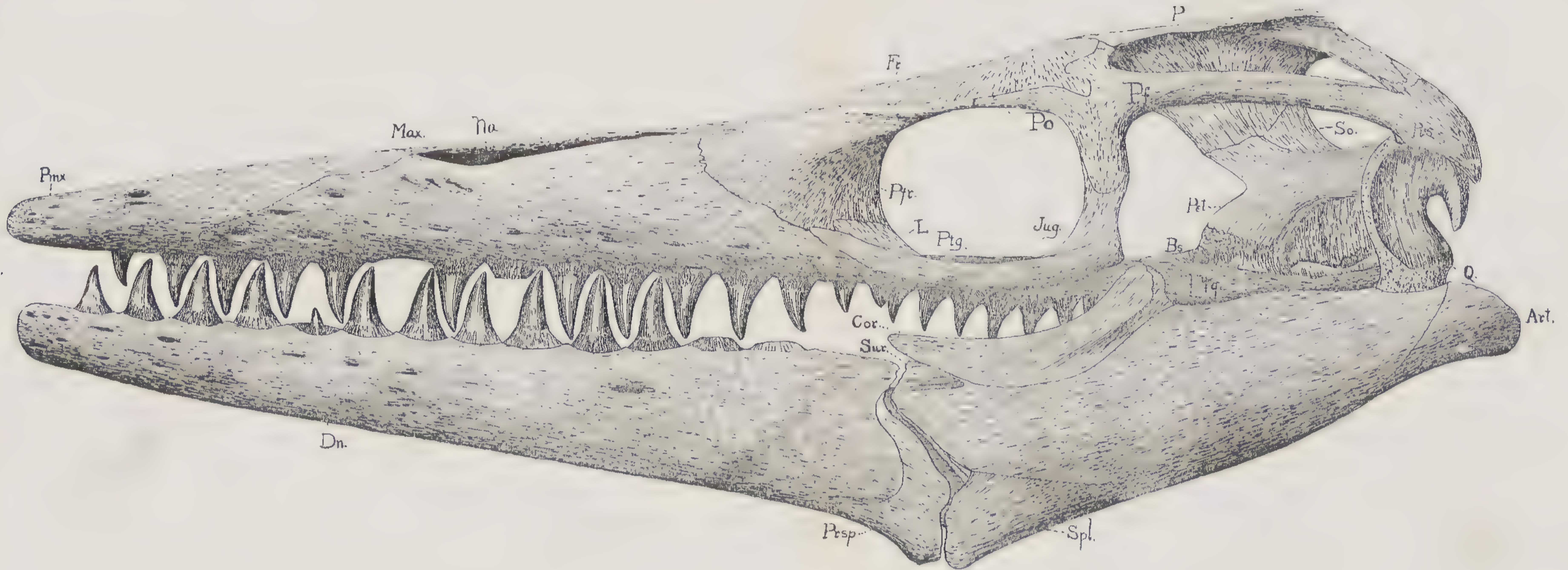




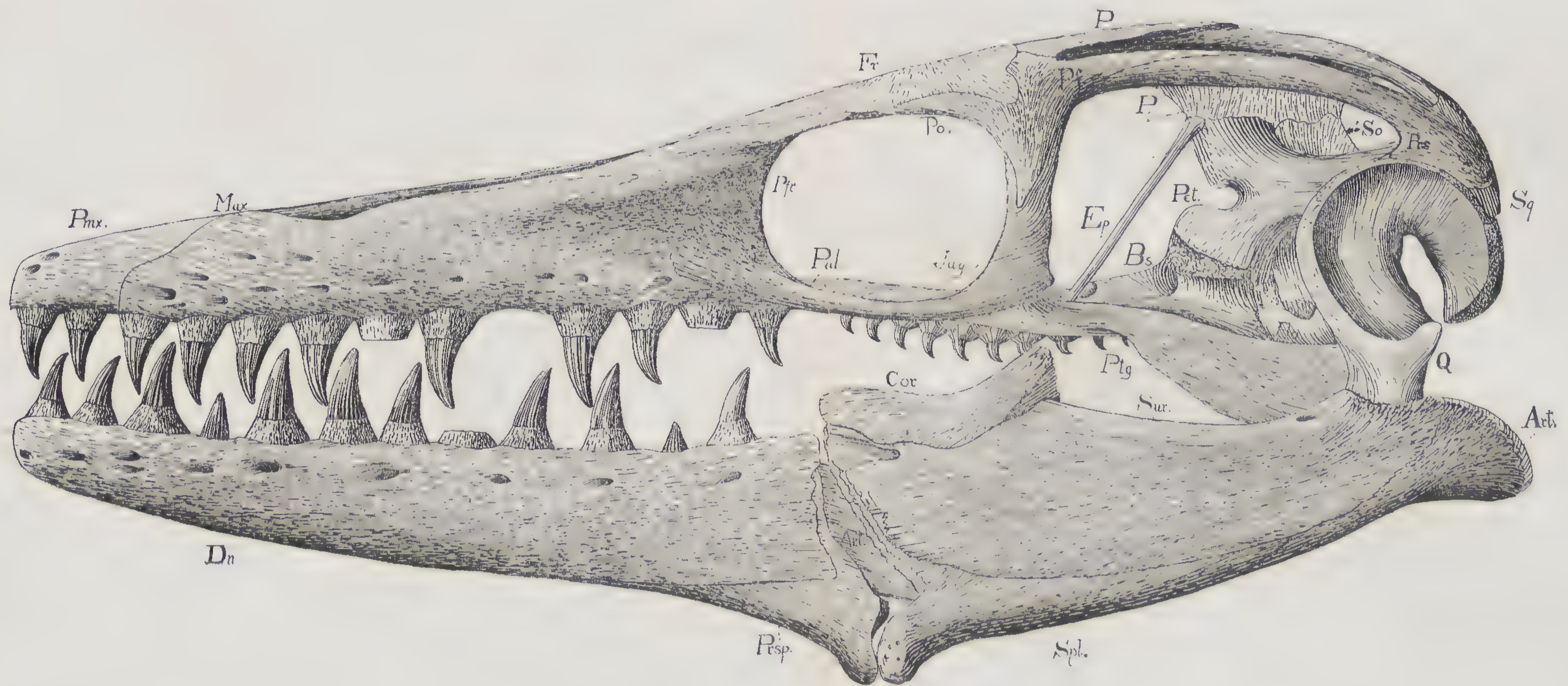








SKULL OF TYLOSaurus PRORIGER COPE.



SKULL OF PLATECARPUS CARYPHÆUS COPE.

S. PRENTICE, del.