

Article XXIV.—THE CRETACEOUS OJO ALAMO BEDS OF NEW MEXICO WITH DESCRIPTION OF THE NEW DINOSAUR GENUS *KRITOSAURUS*.

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PLATES XXVII-XXIX.

A new locality for dinosaurs near Ojo Alamo, in northern New Mexico, was reported to the American Museum by Mr. George H. Pepper, of the Hyde Exploring Expedition in 1902.

The bones submitted at that time were indeterminate but were said to be so numerous that it was thought advisable to investigate the locality. Accordingly, in 1904, the writer was detailed to that region for a preliminary reconnaissance, during which a small but interesting collection of fossils was secured.

This collection is of especial interest, as it represents a fauna that is distinctly older than that of the "Lance Creek Beds or Ceratops Zone" and "Hell Creek beds" of the Laramie Cretaceous. I am unable to definitely correlate the horizon in which these bones occur but the faunal facies appears to be even older than that of Black Buttes, Wyoming, and probably represents a period synchronous with the lower part of the Edmonton series of Alberta, Canada. *The lower Edmonton series has previously been considered equivalent to the Laramie but its fauna, as determined by the writer, is intermediate in age between the Judith River and the Laramie.*

Ojo Alamo is an Indian trading post in Chaco Cañon, about ninety-five miles northwest of Gallup, New Mexico, and twenty miles west of the old Indian pueblo, Bonito, now known as Putnam. It is situated in the eastern edge of the bad land exposures that extend west and south to the Chaco Cañon. On the east and north these bad lands flank a mesa that is dissected on the east by Coal Creek. The escarpments near the head of Coal Creek have furnished a large part of the lower Puerco or basal Eocene fossils of the southwest and may be considered Cope's typical Puerco of 1874. The known fossil-bearing Puerco from which many of Cope's types were obtained, was traced by the writer southwest from Coal Creek and identified with the unfossiliferous bad lands at the head of Ojo Alamo Creek where the strata are weathered into a great amphitheater of open terraces. A careful search through these upper clays failed to reveal either vertebrate or invertebrate

remains, not even fragments. Near their base sandstones predominate and are characterized by quantities of petrified wood with large logs often forming the cap-rock of isolated clay monuments.

Less than a mile south of the store at Ojo Alamo the Puerco formation rests *unconformably* on a conglomerate that is composed of red, gray, yellow, and white pebbles. The position of these beds below what may be called the type of the Puerco or basal Eocene and their unconformable relation is highly significant. The writer is fully aware that the conditions found here, as indicated by the fauna, are not strictly comparable to those of the northern States, where the Fort Union conformably overlies beds now considered Laramie, but it is a point of contact between the uppermost Mesozoic and the lowermost Tertiary and marks the termination of the principal Mesozoic life, the dinosaurs, before the beginning of the Eocene in which no dinosaurs have as yet been found.

Below the conglomerate there is a series of shales and sandstones evenly stratified and usually horizontal, in which there is much less cross-bedding than commonly occurs in the Laramie formation of the northern United States.

The shales below the conglomerate that contain numerous dinosaur and turtle remains I shall designate as the *Ojo Alamo Beds*. They were estimated to be about 200 feet thick, but owing to lack of time I was unable to determine their relation to the underlying formations.

The vertebrate remains were numerous in several places from thirty to one hundred feet below the conglomerate. They consisted chiefly of limb bones, usually lacking the ends, isolated vertebræ and a few skull fragments. Most of this material was chalcedonized, a condition common in the Judith River but never observed in the Laramie. Carnivorous dinosaurs were far more numerous than in the Laramie of the northern United States. The family Trachodontidæ is also well represented, but only a few fragments of ceratopsian remains were found.

The ceratopsian fragments were small sections of characteristic squamosal bones, not collected, and part of a supraorbital horn, No. 5798 of the American Museum collection. Both ends of this specimen are broken but very little is gone from the upper end. It is 120 mm. long, 180 mm. in circumference at the base, and 90 mm. in circumference at the upper end; subovate in cross-section and strongly decurved near the upper end, having a greater curve on the convex than on the concave surface. It is much smaller and lacks the vascular grooves that characterize the horns of the genus *Triceratops* and, judging by the form and size, approaches nearest *Monoclonius recurvicornis* of the Judith River formation from which, however, it is distinct. *M. recurvicornis* is proportionately shorter and more

robust. The squamosal fragments of another individual observed in the field were much thinner than that bone in the genus *Triceratops* but similarly marked by deep vascular grooves. The horn and other skull fragments were apparently from a mature animal representing a ceratopsian genus smaller than either *Triceratops* or *Torosaurus*, but the remains are too fragmentary for characterization.

Little can be said of the carnivorous dinosaurs. The remains were numerous; chiefly disassociated limb bones, lacking articular ends but characterized by hollow shafts, and vertebræ representing a dinosaur as large as *A. bertosaurus* of the lower Edmonton series. The single tooth preserved in the collection is not diagnostic.

In the Cope collection obtained from this region, there are several carnivorous dinosaur teeth and a few separate upper teeth of a large Trachodont dinosaur. As these lower Puerco fossils were collected largely from the Coal Creek locality the dinosaur teeth probably came from the Ojo Alamo beds.

Turtle bones were frequently found with those of dinosaurs. They were especially numerous just below the conglomerate. A new species, *Thescelus repiens* Hay, No. 6066, American Museum collection, is founded on the greater part of a carapace closely related to *T. insiliens* Hay, from the Lance Creek beds of Converse County, Wyoming. The genus is nearly related to the *Bænidæ*.

The most important fossil from this locality is a skull, lower jaws, and atlas, of a hitherto undescribed genus of the family Trachodontidæ:

***Kritosaurus navajovius* gen. et sp. nov.**

Type of species No. 5799, American Museum collection.

Generic characters. Skull deep; muzzle narrow; frontals short, orbital portion reduced, barely coming to the border of the orbit; nasals and premaxillaries very long, quadrate elongate; quadrato-jugal short antero-posteriorly, completely separating quadrate and quadrato-jugal. Mandibular rami massive; edentulous portion decurved. Teeth spatulate in lower jaw.

Specific characters. Maxillary teeth smooth on borders. Mandibular teeth papillate on borders, median carina low, prementary deep and massive. Free edentulous portion of dentary not covered by prementary, short.

The skull is that of an old individual and most of the sutures are obliterated.

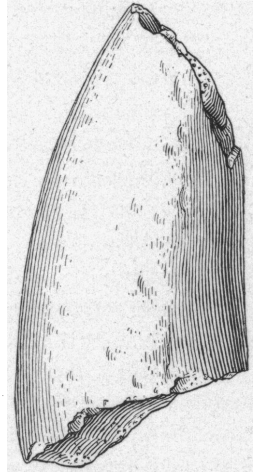


Fig. 1. Ceratopsian horn, No. 5798 A. M. N. H. $\times \frac{1}{2}$.

ated by exfoliation. When found it was almost completely weathered out and the anterior end was in a very fragmentary condition. It was impossible to place many of these fragments in the restoration and where there was no contact the bones were left out. The dentary and prementary were perfectly preserved, thus determining the length of the skull. The nasals were restored after the skull of *Trachodon (Diclonius)* Cope and the premaxillaries according to the relative size between the prementary and premaxillary in that species which necessarily made the rostrum much deeper.

SKULL.

The skull is very deep and more massive than in any heretofore described species of the family and its elements in general follow the *Trachodon* form, but with the following distinct modifications.

Premaxillaries and rostrum proportionately shorter than in *Trachodon (Diclonius) mirabilis* or *Claosaurus annectens* Marsh. Frontal short antero-posteriorly, prefrontal and postfrontal almost excluding it from the border of the orbit. Paroccipital process of exoccipital actually and relatively longer than in *Trachodon*. Orbital opening proportionately smaller and laterotemporal fenestra proportionately larger than in *Trachodon*. Quadrate and jugal completely separated by quadrato-jugal, the exposed part of which is short antero-posteriorly and vertically high. Ectopterygoid extending forward to the union of the maxillary and the jugal.

LOWER JAW.

The lower jaw in form resembles more closely Judith River than Laramie species. Its edentulous portion not covered by prementary is shorter than in any Laramie form.

Prementary. The two prementaries are firmly coössified forming a single element but clearly show their union in the median line. Its lateral borders are massive and nearly vertical, forming a powerful clipping instrument, whereas in all Laramie forms they are delicate and conform to the shape of the rostral bones. The anterior upper border is very rugose and is perforated by two parallel series of vascular foramina, resembling alveoli but which pass obliquely downward and open on the outer surface. Each arm of the \cap terminates in a short rounded inner and a longer outer process. On the posterior lower border in the center there are two processes, an inner short, free, tongue-like process which separates the upper anterior ends of the dentaries and a longer, wider process which underlies the symphysis. The latter process is broken near its origin and shows no indication of bifurcation.

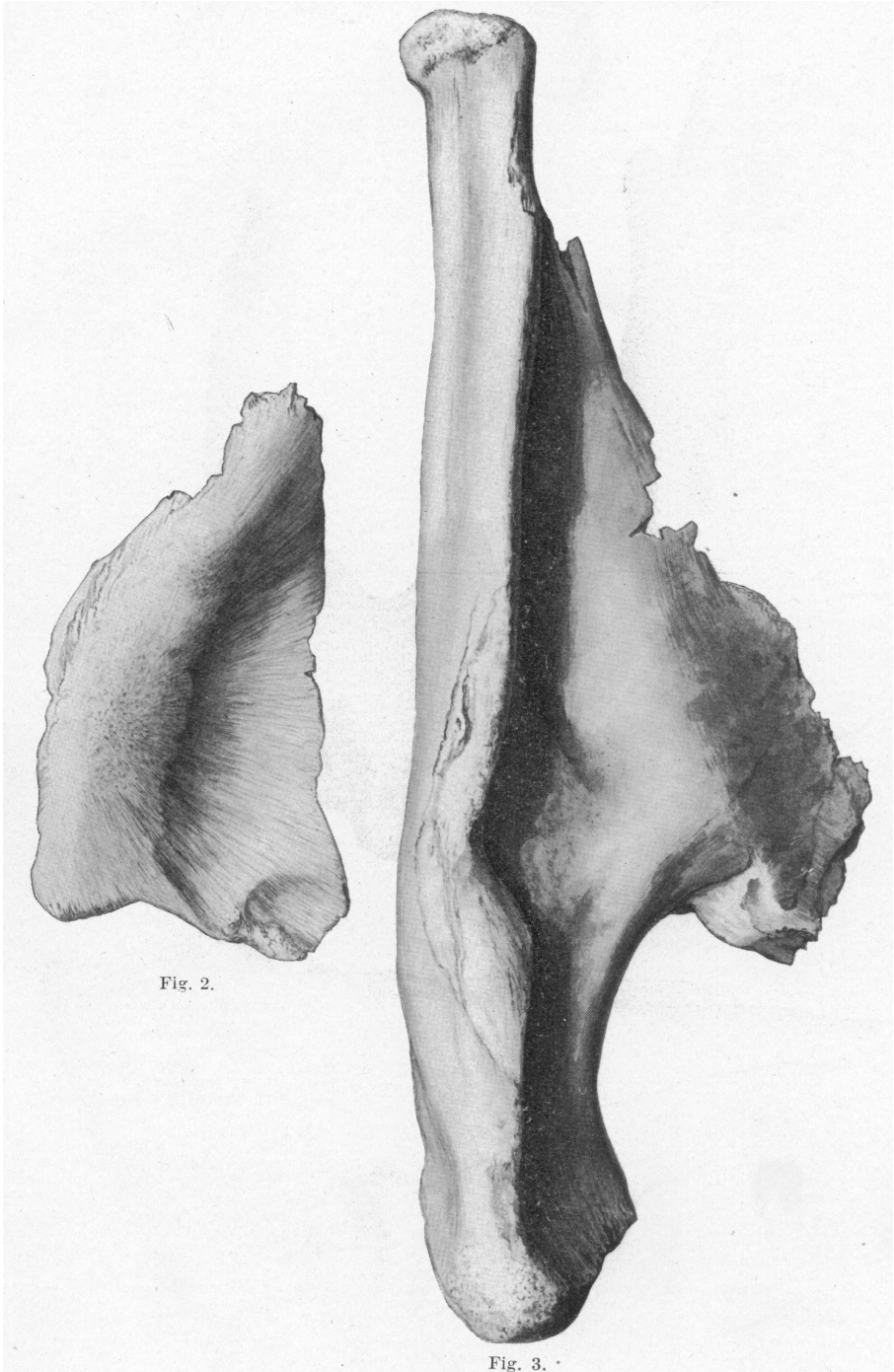


Fig. 2.

Fig. 3.

Fig. 2. Left quadrato-jugal of *Kritosaurus navajovius*. $\times \frac{1}{2}$.
Fig. 3. Left quadrate of *Kritosaurus navajovius*, type. Rear view. $\times \frac{1}{2}$.

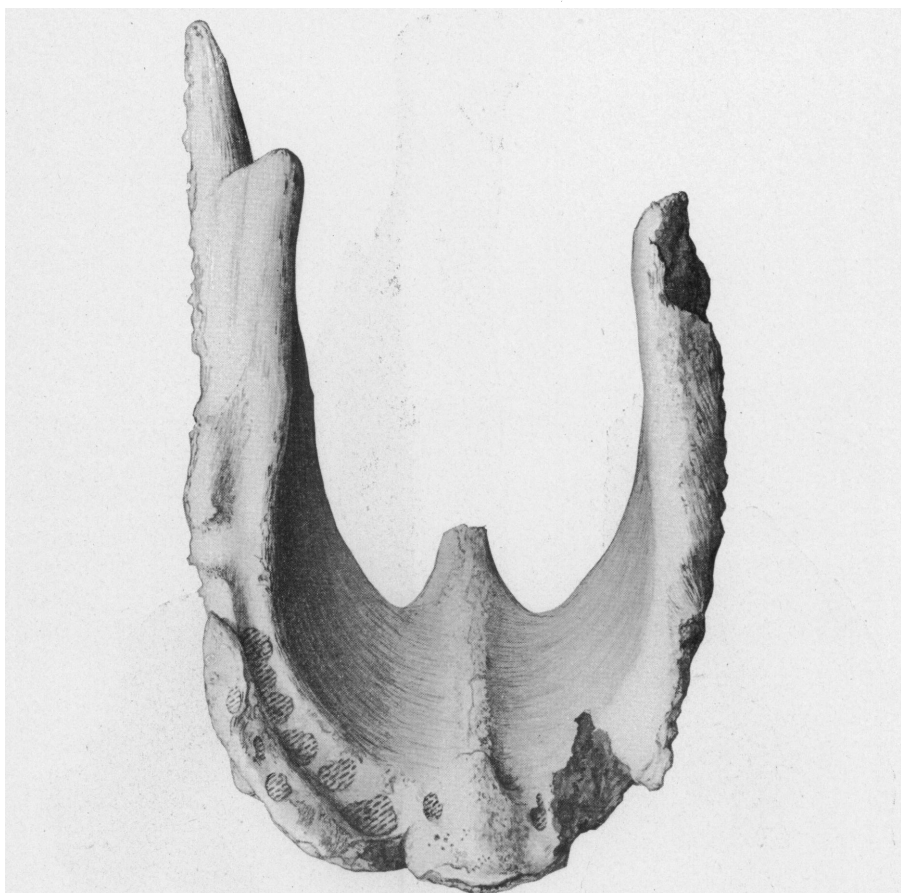


Fig. 4.

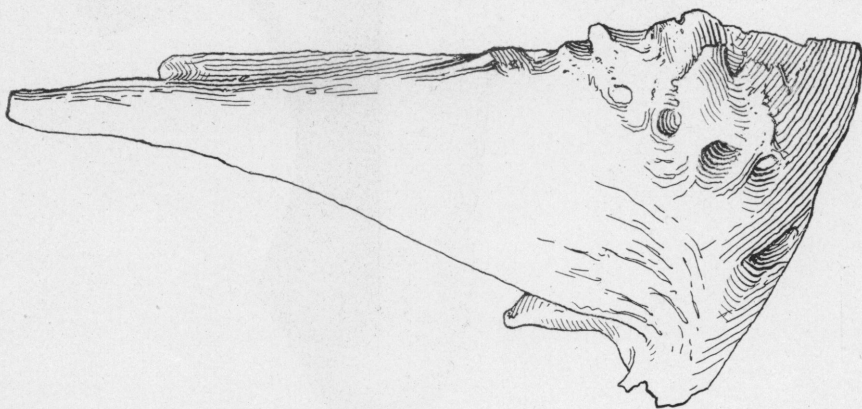
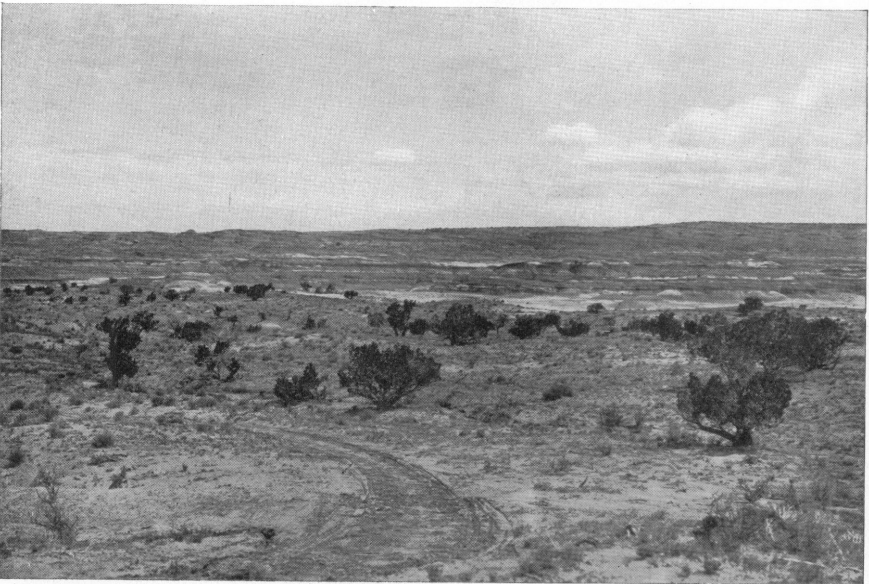


Fig. 5.

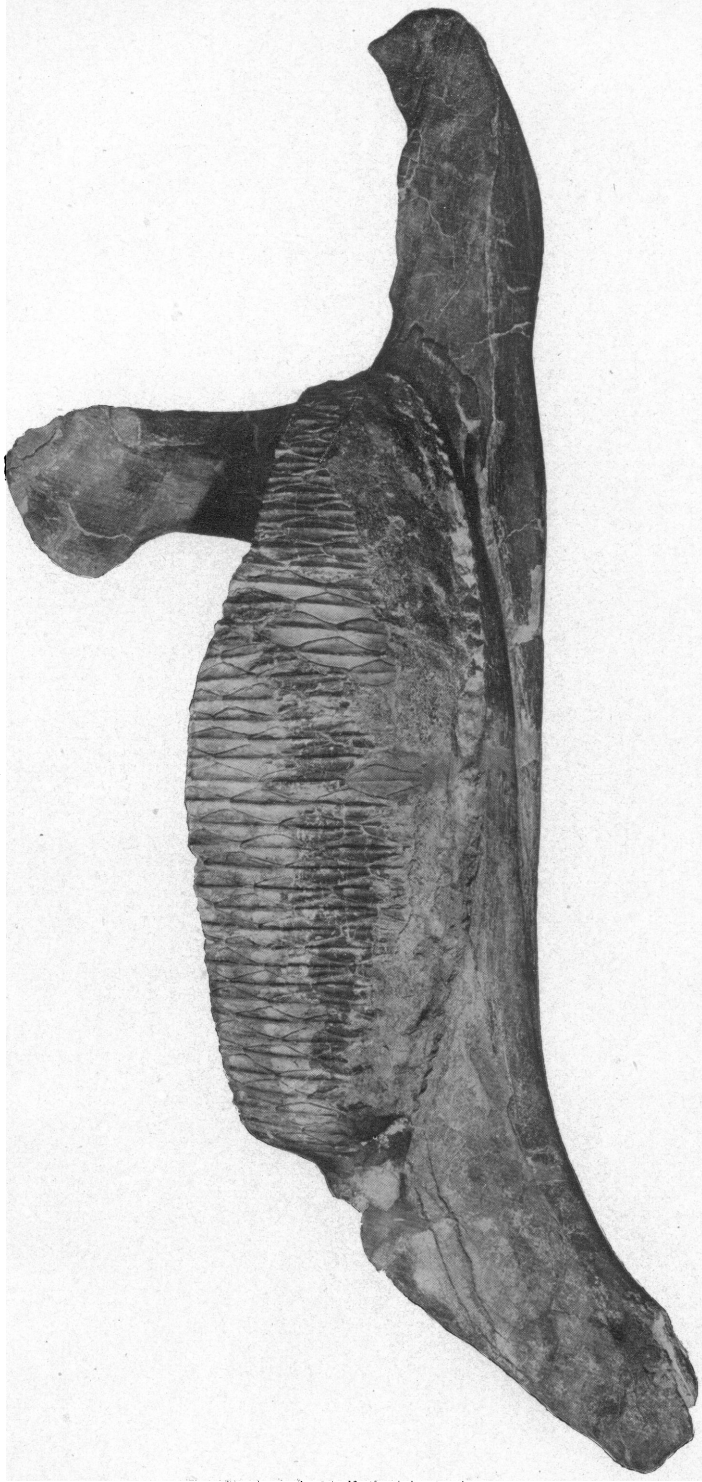
Fig. 4. Premaxillary of *Kritosaurus navajovius*, type. Top view. About $\frac{1}{2}$ nat. size.
Fig. 5. Premaxillary of *Kritosaurus navajovius*, type. Side view. About $\frac{1}{2}$ nat. size.



Cretaceous, near Ojo Alamo, New Mexico.



Type skull of *Kritosaurus navajovius*. About $\frac{1}{4}$ nat. size



Inner view of lower jaw of *Kritosaurus navajovius*. About $\frac{1}{4}$ nat. size.

Dentary. This element is very massive. The edentulous portion is about one fourth of its entire length, is strongly decurved and near the symphysis curves inward. The coronoid process rises opposite the last row

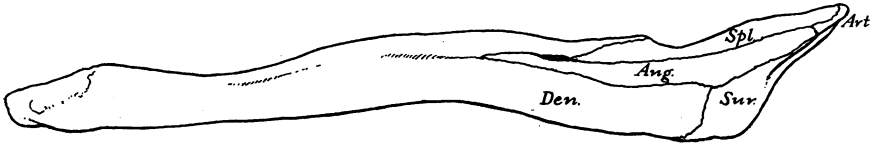


Fig. 6. Inferior view of lower jaw of *Kritosaurus navajovius*.

of teeth as in the genus *Trachodon*, but the backward prolongation of the surangular gives it the appearance of being further forward. It is intermediate in position, in relation to the complete mandible, between *Trachodon* and the European genus *Hecatasaurus*.¹

Surangular. The surangular is proportionately longer than in *Trachodon*. Its anterior vertical process is truncated obliquely and expanded to continue the posterior lower border of the coronoid process. Posteriorly it broadens and furnishes four fifths of the articular surface for the quadrate.

Articular. The articular forms the extreme end of the jaw and is wedged in between the posterior ends of the surangular, angular and splenial. It furnishes about one fifth of the articular surface for the quadrate, in front of which it contracts to a thin wedge but does not reach forward to the end of the dentary process.

Splenial. The splenial follows the usual *Trachodon* form.

Angular. The angular is very long and narrow. Posteriorly its lower border is visible on the outside of the jaw. Anteriorly it forms the lower border of the Meckelian groove and extends nearly to the middle of the dentary.

TEETH.

Two distinct types of teeth appear in the family Trachodontidæ. In the earliest representatives known, *Claosaurus agilis* Marsh from the Niobrara, and species from the Judith River beds that have been referred to *Trachodon*, the enamel face of mandibular teeth is spatulate in form and papillate on the borders. In the later Laramie Cretaceous species the enamel face of mandibular teeth is diamond-shaped with smooth borders.

¹To replace *Limnosaurus* Nopcsa, 1900; preoccupied by *Limnosaurus ziphodon* Marsh, 1871, Proc. Acad. Nat. Sci. Phila., Vol. XXIII, p. 104.

Type, *Limnosaurus transsylvanicus* Nopcsa, Denk. Ak. Wien, Vol. LXVIII, 1900, pp. 555-591.

The teeth of *K. navajovius* are of the primitive form. Both upper and lower series respectively are larger than in any described species of the family.

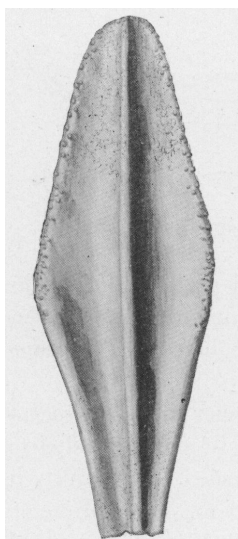


Fig. 7. Lingual surface of a lower tooth of *Kritosaurus navajovius*, type. $\times 3$.

In the mandibular series there are 42 vertical rows of teeth. On the triturating surface one tooth, enamel bearing, a half worn tooth, and an indefinite number of worn roots appear in each row. The enamel face of each tooth is spatulate and rather sharply pointed at the summit; median carina low; lateral surface flat; borders not raised above the flat surface and sparsely studded with enamel papillæ that apparently lack definite arrangement.

In the maxillary series there are 47 vertical rows, and never more than two enamel bearing teeth appear on the triturating surface in each row. They are smooth on the borders, and strongly curved transversely; median carina very high.

Measurements.

SKULL.		mm.
Length, as restored	. . . . .	995
Width across frontal above orbits	. . . . .	220
Width across proximal ends of quadrate	. . . . .	350
Width across distal ends of quadrate	. . . . .	490
Frontal, length antero-posteriorly	. . . . .	198
Parietal, length	. . . . .	113
Supratemporal vacuity, length	. . . . .	140
Supratemporal vacuity, width	. . . . .	100
Quadrate, height	. . . . .	516
Quadrato-jugal, exposed, length anteroposteriorly	. . . . .	42
Quadrato-jugal, exposed, height	. . . . .	160
Ectopterygoid, length	. . . . .	100
LOWER JAW		
Length without predentary	. . . . .	775
Predentary, length	. . . . .	240
Angular, length	. . . . .	250
Splénial, length	. . . . .	260
Articular, length	. . . . .	95
TEETH		
Dental series, upper jaw, length	. . . . .	410
Tooth, mid-section lower jaw, length	. . . . .	45
Tooth, mid-section lower jaw, width	. . . . .	15