2. VERTEBRATE FAUNAS OF THE OJO ALAMO, KIRTLAND, AND FRUITLAND FORMATIONS.

By CHARLES W. GILMORE.

INTRODUCTION.

The presence of dinosaurian fossil remains near Ojo Alamo, in the northwestern part of the San Juan Basin, N. Mex., was first reported by George Pepper, of the Hyde Exploring Expedition, in 1902. Dinosaurian fossils from the San Juan Basin were known, however, as early as 1885. Cope [1] identified, in collections made by David Baldwin, teeth pertaining to the genera Dysganus, Lælaps, and Diclonius. None of these are now recognized as valid genera. In 1904 Barnum Brown, of the American Museum of Natural History, New York, made a short reconnaissance trip into this region and procured a small but interesting collection of vertebrate fossils, including specimens that were later made the types of *Kritosaurus navajovius* Brown, *Thescelus rapiens* Hay, *Aspideretes fontanus* Hay, *A. vorax* Hay, and *A. austerus* Hay. In 1908 James H. Gardner, while engaged in field work for the United States Geological Survey, made a small collection of fragmentary vertebrate remains, and the next summer, 1909, accompanied by J. W. Gidley, of the United States National Museum, he obtained a second small collection. Two of the turtle specimens collected by Mr. Gardner were selected by O. P. Hay as the types of the species *Adocus vigoratus* Hay and *Basilemys nobilis* Hay.

In 1912 Walter Granger and W. J. Sinclair visited this region and as an incidental part of their work in the overlying Puerco and Torrejon deposits made a small collection of reptilian fossils from the Ojo Alamo sandstone, in which a second specimen of *Kritosaurus navajovius* was recognized and bones of Monoclonius and Deinodon were noted for the first time.

During the field season of 1915 a party under the leadership of C. Max Bauer, assisted by J. B. Reeside, jr., made the most extensive and best collection of fossil vertebrate remains yet procured from this area.

[1] Cope, E. D., The relations of the Puerco and Laramie deposits: Am. Naturalist, vol. 19, pp. 985-986, 1885.

In the present paper I have brought together all the information obtainable relating to the extinct vertebrate fauna of the Ojo Alamo sandstone and of the deposits that immediately underlie that formation. A considerable number of genera and species have now been described in widely scattered publications, and these descriptions are here compiled as an aid to future students.

O. P. Hay and Barnum Brown have been the chief contributors to our knowledge of this fauna, and I have made free use of their articles. The original descriptions of such genera or species as have been established on specimens from these deposits are given in full, followed by such comments and emendations as more recent discoveries and additional material render possible.

I wish here to acknowledge my indebtedness to Dr. L. M. Lambe, of the Geological Survey of Canada, and Dr. W. D. Matthew, of the American Museum of Natural History, New York, for furnishing me with excellent photographs of the skulls of Gryposaurus and Kritosaurus, here reproduced; and to Mr. Barnum Brown, also of the American Museum of Natural History, for valuable assistance in identifying specimens.

THE VERTEBRATE FAUNA.

The known vertebrate fauna of the dinosaur-bearing beds in the San Juan Basin in northern New Mexico consists of a considerable number of genera and species, but many of them have been identified from material so insufficient and fragmentary that it is quite impossible to define them properly. A few, however, are fairly diagnostic, so that comparison with related forms of other geologic formations serves to give some clue as to the age of the deposits from which these specimens were obtained.

In the preceding paper of this series Mr. Bauer has subdivided the dinosaur-bearing deposits into three formations—(1) the upper-

most, or Ojo Alamo, as named by Brown,[1] now restricted to include only the upper sandstone, conglomerates, and interbedded shale lenses, (2) the Kirtland, and (3) the Fruitland. Vertebrate fossils are found throughout these deposits, though they appear to occur most abundantly in the Ojo Alamo and the upper part of the Kirtland, sparsely in and below the Farmington sandstone member of the Kirtland, and more abundantly in the Fruitland.

Material is not yet available for determining whether these formations can be said to carry distinctive vertebrate faunas. The faunas as now known are as follows:

Ojo Alamo sandstone:
- Dinosauria:
  - Kritosaurus navajovius Brown.
  - Monoclonius sp.
  - Deinodon?
- Chelonia:
  - Basilemys nobilis Hay.
  - Adocus? vigoratus Hay.
  - Aspideretes vorax Hay.
  - Aspideretes fontanus Hay.
  - Aspideretes austerus Hay.
  - Thescelus rapiens Hay.
  - Compsemys sp.
- Crocodilia:
  - Crocodiles.
- Pisces:
  - Lepisosteus sp.

Kirtland shale:
- Dinosauria:
  - Kritosaurus navajovius Brown.
  - Carnivorous dinosaurs.
  - Ceratopsian dinosaurs.
  - Armored dinosaur (Ankylosauridæ).
- Chelonia:
  - Baena nodosa n. sp.
  - Neurankylus baueri n. sp.
  - Aspideretes sp.
  - Adocus sp.
  - Plastomenus sp.
- Crocodilia:
  - Crocodiles.
  - Brachachampsa sp.
- Pisces:
  - Lepisosteus sp.
  - Myledaphus sp.

Fruitland formation:
- Dinosauria:
  - Monoclonius?
  - Carnivorous dinosaurs.
- Chelonia:
  - Adocus? lineolatus Cope.
  - Aspideretes austerus Hay.
- Pisces:
  - Lepisosteus sp.

[1] Brown, Barnum, The Cretaceous Ojo Alamo beds of New Mexico, with description of the new dinosaur genus Kritosaurus: Am. Mus. Nat. Hist. Bull., vol. 28, pp. 267–268, 1910.

No mammal, bird, or amphibian remains have yet been recorded from these formations. The fishes are represented by two genera, Lepisosteus and Myledaphus, neither of which have any value in correlation. The same may be said of the Crocodilia. The Chelonia are the best represented, nine genera and eight species having been recognized, and systematic collecting would doubtless add several more. Unfortunately, more than half of the described species have been founded upon fragmentary material, and it is with difficulty that they are compared with better-preserved specimens of other geologic horizons. With the exception of *Adocus? lineolatus* Cope all the recognized species have been based on specimens collected from these formations, so that they offer but little aid in correlation. The discovery in the Kirtland shale of the genus Neurankylus is significant, as previously it has been known by a single specimen from the Belly River formation. *Basilemys nobilis* Hay, from the Ojo Alamo, has its closest affinities in an undescribed specimen from the Two Medicine formation, of Montana, a formation that is in part equivalent to the Judith River. According to Hay, *Thescelus rapiens* appears to approach *Thescelus insiliens* from the lower Lance, but *Baena nodosa* offers no close comparisons.

The dinosaurs were apparently the predominating vertebrates of these times, and they afford the best basis for a comparison with forms found elsewhere. The Trachodontidæ and Ceratopsidæ give the most information relative to the age of these deposits. The finding of the genus Kritosaurus, known elsewhere only from the Belly River; the presence of trachodont teeth with papillate borders, a condition heretofore found only in forms from the Niobrara, Judith River, Belly River, Two Medicine, and Edmonton formations; and the finding of maxillæ having 42 rows of teeth, whereas none of the known specimens from the Lance formation have less than 52 vertical rows, all constitute a combination of evidence showing a greater antiquity than Lance time for the beds from which these specimens were obtained.

The Ceratopsia give corroborative evidence of this conclusion, as shown by specimens found in the Ojo Alamo and Fruitland formations which are provisionally identified as pertaining to the genus Monoclonius. Regardless of the uncertainty of the generic designation of these

specimens, they unquestionably represent the so-called primitive ceratopsians, none of which are found in beds younger than the Edmonton.

Brown [1] has recently said, in regard to the age of the Ojo Alamo formation:

> The vertebrate fauna is distinctly older than that of the Lance. I have expressed the opinion that it was comparable to the Edmonton, but from the recent discovery of Kritosaurus in the Belly River formation and the primitive structure of the contemporary dinosaurs the Ojo Alamo beds appear to be synchronous with the Judith (Belly River) formation.

These conclusions were based by Brown on specimens collected in the upper 200 feet of deposits that immediately underlie the Puerco, and it is quite likely that some of these forms came from beds now included in the Kirtland shale. However that may be, Brown has now established the geologic position of the type of *Kritosaurus navajovius* as below the lower conglomerate and therefore in the Kirtland shale, but the subsequent discovery of a second specimen of the same species above the lower conglomerate shows that the basis for his original contention is not altered by this later subdivision of the deposits. In the Bauer collection of 1915 was a ceratopsian ischium from the Ojo Alamo sandstone identified as pertaining to Monoclonius, a Judith River and Belly River genus. This occurrence and the presence in the same formation of the turtle *Basilemys nobilis* Hay, which has its closest affinities with a Two Medicine form, both support Brown's contention.

Although much is needed in the way of better material before it will be possible to determine even approximately the vertebrate faunas of the Ojo Alamo and underlying formations, enough is already known to indicate their diversity. The discovery of two new species of turtle, *Neurankylus baueri* and *Baena nodosa*, seems to indicate that a careful and systematic search of these areas for vertebrate remains would be well rewarded.

After a study of the material in the United States National Museum collections from this area, and after reviewing the literature in which specimens from these formations have been described, I conclude that the vertebrate remains from the Ojo Alamo, Kirtland, and Fruitland formations show beyond all question that they pertain to a fauna or faunas distinctly older than that of the Lance, and that such evidence as there is contributes to the support of Brown's contention that the Ojo Alamo sandstone is synchronous with the Judith River and Belly River formations as found in areas to the north.

Class REPTILIA.

Order DINOSAURIA.

That the deposits in the San Juan Basin contain a rich dinosaurian fauna is clearly indicated by the discovery of numerous fragmentary remains at many localities. In the collection made by Mr. Bauer in 1915 specimens sufficiently perfect to be identified as dinosaurian were found in no less than 35 localities and at several horizons. These specimens consist chiefly of limb bones, vertebræ, skull fragments, and detached teeth. The greater number of them were chalcedonized, a condition common in the Two Medicine formation of northwestern Montana and, as Brown [2] has pointed out, also "in the Judith River, but never observed in the Laramie." (By "Laramie" I take it he means the Lance.) Only two of the three suborders into which the Dinosauria are subdivided have yet been recognized. The Predentata are represented by trachodont and ceratopsian remains, and the Theropoda, or flesh-eating dinosaurs, by numerous detached teeth and fragmentary bones. Specimens representing the Ornithopoda, or "bird-footed" dinosaurs, have not yet been found, but it may be confidently expected that larger collections will contain representatives of this group also.

Suborder PREDENTATA.

Family TRACHODONTIDÆ Marsh.

Kritosaurus navajovius Brown.

Plate LXXII, *A;* Plate LXXIII, figures 3 and 5.

Kritosaurus navajovius Brown, Am. Mus. Nat. Hist. Bull., vol. 28, pp. 269–274, pls. 28, 29, text figs. 2–7, 1910.
Sinclair and Granger, Am. Mus. Nat. Hist. Bull., vol. 33, pp. 301, 303, 1914.
Brown, Geol. Soc. America Bull., vol. 25, p. 380, 1914.

The present genus and species were founded upon a weathered skull, lower jaws, and atlas, of

[1] Brown, Barnum, Cretaceous-Eocene correlation in New Mexico, Wyoming, Montana, and Alberta: Geol. Soc. America Bull., vol. 25, p. 380, 1914.

[2] Brown, Barnum, The Cretaceous Ojo Alamo beds of New Mexico, with description of the new dinosaur genus Kritosaurus: Am. Mus. Nat. Hist. Bull., vol. 28, p. 268, 1910.

which the skull and jaws are shown in Plates LXXII, *A*, and LXXIII, figure 5. It was described by Brown as follows:

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; quadratojugal short anteroposteriorly, completely separating quadrate and quadratojugal. 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, predentary deep and massive. Free edentulous portion of dentary not covered by predentary, short.

The skull is that of an old individual, and most of the sutures are obliterated 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 predentary 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 predentary 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 anteroposteriorly, 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 quadratojugal, the exposed part of which is short anteroposteriorly 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 [Lance] species. Its edentulous portion not covered by predentary is shorter than in any Laramie [Lance] form.

Predentary.—The two predentaries are firmly coossified, 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 [Lance] 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 ∩ 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 tonguelike 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.

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 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 larger Laramie [Lance] Cretaceous species the enamel face of the mandibular teeth is diamond-shaped, with smooth borders.

The teeth of *K. navajovius* are of the primitive form. [See Pl. LXXIII, fig. 3.] Both upper and lower series, respectively, are larger than in any described species of the family. 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 very strongly curved transversely; median carina very high.

[1] To replace Limnosaurus Nopcsa, 1900; preoccupied by *Limnosaurus ziphodon* Marsh, 1871, Acad. Nat. Sci. Philadelphia Proc., vol. 23, p. 104. Type, *Limnosaurus transsylvanicus* Nopcsa, Akad. Wien Denkschr., vol. 68, pp. 555–591, 1900.

MEASUREMENTS.

Skull.

	Millimeters.
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 anteroposteriorly	198
Parietal, length	113
Supratemporal vacuity, length	140
Supratemporal vacuity, width	100
Quadrate, height	516
Quadratojugal, exposed, length anteroposteriorly	42
Quadratojugal, exposed height	160
Ectopterygoid, length	190

Lower jaw.

Length without predentary	775
Predentary, length	240
Angular, length	250
Splenial, 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

Four years later Lambe [1] described the new genus and species *Gryposaurus notabilis*, from the Belly River formation of Canada, based on a beautifully preserved skull (see Pl. LXXII, *B*), with which was associated a considerable part of the skeleton, including some areas of skin impressions. In a report made to Sinclair and Granger and included in their paper on the Paleocene deposits of the San Juan Basin [2] Brown calls attention to the description of *Gryposaurus notabilis* Lambe, and remarks: "In all respects, including the remarkable development of the nasals, premaxillaries, and predentary and reduction of the orbital portion of the frontal, this skull agrees with the type of Kritosaurus, and there is no doubt of their identity."

In this conclusion Brown is undoubtedly correct, but in justice to Lambe it should be explained that, although Brown had one of the characteristic nasal bones, it was not inserted in the restored skull as figured by him (see Pl. LXXII, *A*), because there was no contact with contiguous parts, and the absence of this portion undoubtedly led Lambe into the unfortunate error of establishing a genus which now proves to be a synonym of the earlier described Kritosaurus.

As has been pointed out by Brown, the discovery of Kritosaurus in the Kirtland and Ojo Alamo beds has an important bearing on the relative age of these formations and would appear to indicate that they are synchronous with the Judith River formation.

In his original paper Brown failed to state the geologic level where the type specimen was found, but in a letter to me dated February 26, 1916, he says: "*Kritosaurus navajovius* came from the upper part of what is designated by Bauer as the Kirtland formation." At the time he wrote the original description of this dinosaur Brown considered the Ojo Alamo formation as extending downward at least 200 feet below the Puerco-Torrejon contact, so that he assigned this specimen to that formation.

Although the type specimen was found in the Kirtland shale, a trachodont maxillary, with fragments of the skull, collected by Sinclair and Granger "a few feet above the conglomerate separating the two horizons at which dinosaur bones were found," has been identified by Brown as pertaining to *Kritosaurus navajovius*, thus demonstrating the occurrence of this genus and species in the Ojo Alamo sandstone, as now defined by Bauer.

In addition to the papillate borders of the mandibular teeth, which indicate a greater antiquity than Lance for Kritosaurus, the smaller number of vertical rows in the dental magazines also points to the same conclusion. Lambe [3] from excellent material defines the genus as follows:

> Skull large, narrow, and very deep, with highly arched nasals. The lower anterior border of the premaxillæ expanded laterally. Orbit much smaller than the lateral temporal fossa. Quadrate high, partially separated from the jugal by a small quadratojugal. Mandible robust. Predentary expanded laterally and deflected in the hinder half, and posteriorly bifurcated below at the midline. Neural spines of the anterior dorsal vertebræ long. Ischia not expanded distally. Body covered with small, polygonal, nonimbricating, tuberculate scales of rather uniform size.

In figure 28 is shown a lateral view of an anterior dorsal vertebra of a large trachodont dinosaur, provisionally identified as pertaining to the genus Kritosaurus. The great height

[1] Lambe, L. M., On *Gryposaurus notabilis*, a new genus and species of trachodont dinosaur from the Belly River formation of Alberta, with a description of the skull of *Chasmosaurus belli:* Ottawa Naturalist, vol. 27, pp. 145–149, pl. 18, February, 1914.

[2] Am. Mus. Nat. Hist. Bull., vol. 33, pp. 297–316, June, 1914.

[3] Op. cit., pp. 145–146.

of the neural spine, the relatively small size of the centrum, the weakness of the neural arch, with broad, oval neural canal, and the anterior zygapophyses close together and lower than the posterior zygapophyses, are all features in close accord with the anterior dorsals of the type specimen of Hypacrosaurus, from the Edmonton and Two Medicine formations. The above-stated combination of characters at once distinguishes this vertebra from all known Lance trachodonts, but as both Lambe and Brown have described Kritosaurus as having tall spines on the anterior dorsals, it can with greater propriety be referred to that genus until such time as the discovery of undoubted remains of Hypacrosaurus show its presence in the Kirtland shale.

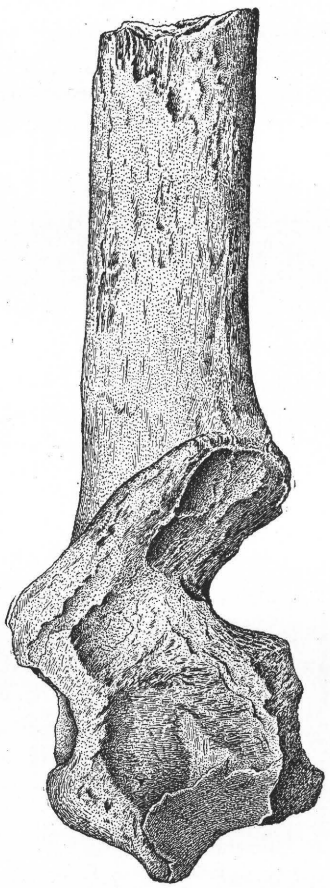


FIGURE 28.—Anterior dorsal vertebra of Kritosaurus? sp., No. 8354, U. S. N. M. About one-fourth natural size.

The only important character wherein this vertebra differs from the type of Hypacrosaurus is the lack of an opening in the thin plate which descends from a point between the posterior zygapophyses to the upper median border of the neural canal. This vertebra was associated with a number of dorsal and caudal vertebral centra, a scapula (see Pl. LXXIII, fig. 2), the proximal half of a femur, portions of two ribs, and fragmentary portions of other bones. A small trachodont femur in this same lot shows that more than one individual is represented by this collection, so it can not be positively asserted that all the bones enumerated above pertain to a single individual.

These bones were collected by Messrs. Bauer and Reeside "2 miles northwest of Ojo Alamo store, in an arroyo north of Ojo Alamo Arroyo, at a horizon 25 feet below the upper conglomerate of Sinclair and Granger [that is, in the Kirtland shale]. There is no lower conglomerate here." (See locality 60, section F, Pl. LXIV.)

Other trachodont remains.

Specimens sufficiently characteristic to be identified as pertaining to the Trachodontidæ were found by the Bauer party in the localities described in the following paragraphs. The localities are indicated by numbers on the map (Pl. LXIV).

"Canyon Ojo Amarillo, 2 miles east of Chaco River, 10 miles south of San Juan River" (locality 14, section B). Fruitland formation. A pair of maxillæ containing badly shattered teeth. In the better-preserved maxillary there are 42 vertical rows of teeth, a feature that would of itself serve to distinguish this specimen from all known Lance trachodonts, which, as shown by specimens in the United States National Museum collections, have from 52 to 57 vertical rows. The borders of the teeth are smooth, as in the upper jaw of Kritosaurus, but in the type of that genus there are 47 vertical rows, so that until the range of variation in the number of rows is determined it would be unsafe to refer the present specimen to the genus Kritosaurus. The length of the dental series is 367 millimeters, whereas in the type of *Kritosaurus navajovius* Brown it measures 410 millimeters.

"View Point, 5 miles northwest of Pina Veta China" (locality 35, section C). Kirtland shale. Small portion of the dentary of a trachodont dinosaur.

"View Point, 5 miles northwest of Pina Veta China" (locality 34, section C). Farmington sandstone member of the Kirtland shale. Dis-

tal end of a humerus and centrum of a caudal vertebra.

"About 23 miles south of Farmington, near the reservation line, 1 mile north of Brimhall Store" (locality 46, section D). Uppermost part of the Kirtland shale. Two anterior caudal vertebræ of a large individual.

"About 30 miles south of Farmington and 4 miles east of reservation line" (locality 80, section E). Lowermost part of the Kirtland shale. Phalanges and cervical vertebræ.

"About 4½ miles northwest of Ojo Alamo store, on head of Hunter Wash; 25 feet below Ojo Alamo" (locality 53, section E). Uppermost part of the Kirtland shale. Right femur of very large individual.

"About 2 miles south of Fruitland, 100 feet above the top of the Pictured Cliffs sandstone" (locality 6, section A). Fruitland formation. Centrum of a caudal vertebra.

"One mile north of west of Ojo Alamo store; 25 feet below the upper conglomerate of Sinclair and Granger. There is no lower conglomerate at this point; it is apparently consolidated with the upper" (locality 62, section F). Uppermost part of the Kirtland shale. Portion of the dentary.

"About 1½ miles southwest of Ojo Alamo store, half a mile west of wagon road; 8 feet above base of lower conglomerate of Sinclair and Granger" (locality 65, section F). Ojo Alamo sandstone. Axis with fused odontoid process. This specimen was submitted to Barnum Brown, of the American Museum of Natural History, New York, who reports: "The axis with fused odontoid process is probably trachodont, possibly Kritosaurus, but it does not agree with any of the material we have in our collections."

"One mile north of west of Ojo Alamo store, in small basin north of Ojo Alamo Arroyo; 20 feet below the conglomerate of Sinclair and Granger, lower and upper combined" (locality 62, section F). Uppermost part of the Kirtland shale. Two caudal vertebræ and portions of a pelvic bone.

"Three miles northwest of Ojo Alamo store; 40 feet below the lower conglomerate" (locality 56, section E). Uppermost part of the Kirtland shale. Portion of the right dentary.

"North side of Barrel Springs Arroyo, half a mile west of wagon road from Ojo Alamo; 10 feet above lower conglomerate" (locality 63, section F). Ojo Alamo sandstone. Fragmentary teeth.

"North side of Barrel Spring Arroyo, about 1¼ miles southwest of Ojo Alamo store; 20 feet below the lower conglomerate" (locality 66, section F). Uppermost part of the Kirtland shale. Considerable part of the dentary with fragments of teeth. The teeth have papillate borders, and it appears likely that this specimen pertains to the genus Kritosaurus.

"One mile east of Pina Vita China, about 20 feet below the conglomerate" (locality 42, section C). Upper part of the Kirtland shale. Portion of a left dentary.

Family CERATOPSIDÆ Marsh.

Monoclonius? sp.

The first Monoclonius-like remains from the Ojo Alamo sandstone were reported by Brown [1] in 1910. He says:

> 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 millimeters long, 180 millimeters in circumference at the base, and 90 millimeters 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.

The Bauer collection contains fragmentary ceratopsian remains from no less than seven localities. The better-preserved specimen (catalogue No. 7347, U. S. N. M.), from Amarillo Canyon, "10 miles south of San Juan River and 2½ miles east of Chaco River" (locality 18, section B, Pl. LXIV), "150 feet above the base of Fruitland formation," consists of the coossified atlas, axis, third and fourth cervical

[1] Brown, Barnum, The Cretaceous Ojo Alamo beds of New Mexico, with description of the new dinosaur genus Kritosaurus: Am. Mus. Nat. Hist. Bull., vol. 28, pp. 268–269, 1910.

vertebræ, considerable portions of several dorsal and caudal vertebræ, parts of two pubes, and fragments of other bones. All this material apparently pertains to one individual.

In figure 29 are shown comparative views of the anterior cervicals of *Triceratops prorsus*, *Monoclonius crassus*, and the specimen here discussed. The distinctness of the latter two from Triceratops is at once apparent, and while in a general way the anterior cervicals of the present specimen approach those of *M. crassus*, quite possible that if more perfect material were available it might be found referable to some of the other genera now known from the Judith River, Belly River, and Edmonton formations, but regardless of the uncertainty of the generic disposition of this specimen, it represents one of the primitive ceratopsians, none of which are found in deposits younger than the Edmonton.

Specimens sufficiently characteristic to be identified as pertaining to ceratopsian dinosaurs

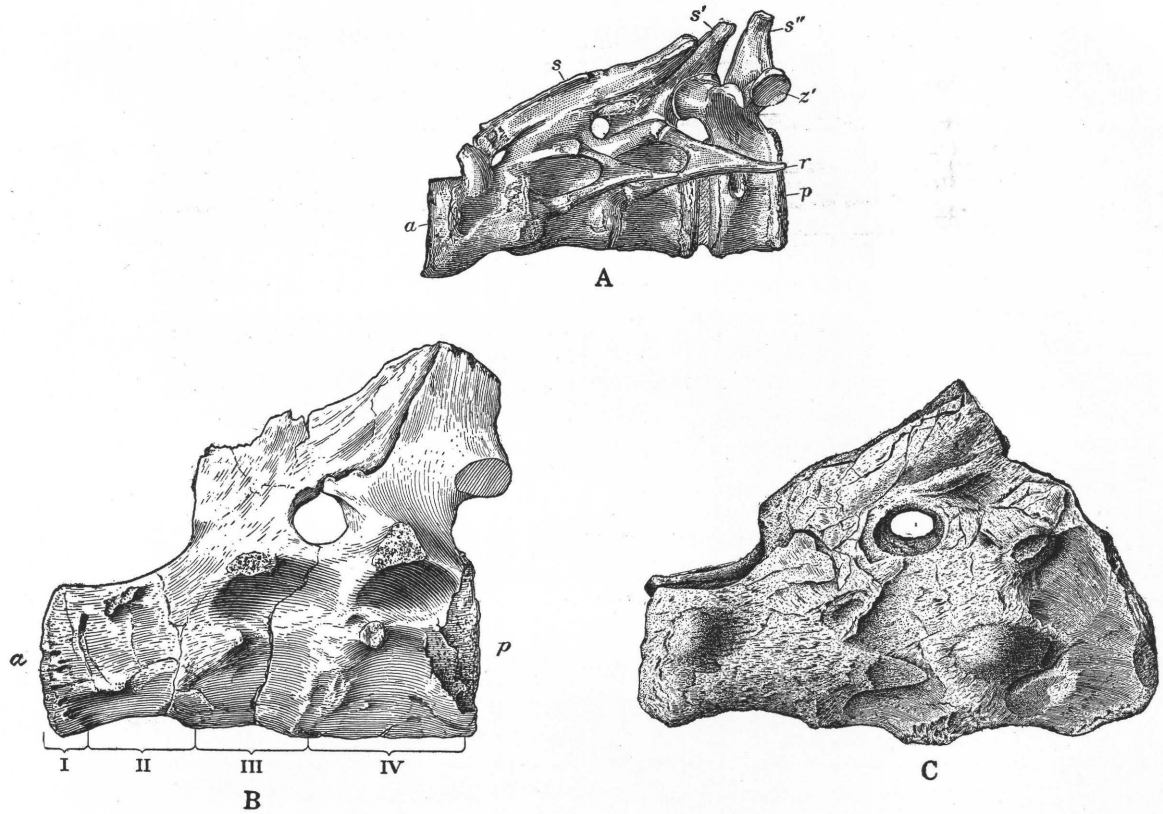


FIGURE 29.—A, Anterior cervical vertebræ of *Triceratops prorsus* Marsh, type, No. 1822, Yale Mus., one-eighth natural size. *a*, Anterior face of atlas; *p*, posterior face of fifth vertebra; *r*, rib; *s*, neural spine of axis; *s'*, neural spine of fourth cervical; *s''*, neural spine of fifth cervical; *z'*, posterior zygapophyses. (After Marsh.) B, Atlas, axis, and third and fourth cervical vertebræ of *Monoclonius crassus* Cope, No. 3998, Am. Mus. Nat. Hist., as seen from the left side, type, one-fourth natural size. *a*, Anterior end; *p*, posterior end; I, II, III, IV, cervicals. (After Hatcher.) C, Atlas, axis, and third and fourth cervical vertebræ of Monoclonius?, No. 3347, U. S. N. M., one-fifth natural size.

a detailed comparison shows many minor differences, sufficient to indicate at least their specific distinctness. The dorsals shown in figure 30 also indicate the close resemblance of this specimen to Monoclonius.

On account of the close resemblance of these bones I now refer the material provisionally to the genus Monoclonius. That it represents one of the so-called primitive ceratopsians there can be no question, for its relatively small size would of itself distinguish it from all known ceratopsians of the Lance formation. It is

were found by the United States Geological Survey expedition of 1915 at the following localities (shown on Pl. LXIV):

"North side of Barrel Spring Arroyo, about 1 mile south of Ojo Alamo store, 1,000 feet west of wagon road; 11 feet above base of lower conglomerate of Sinclair and Granger" (locality 67, section F). Ojo Alamo sandstone. Fragments of ceratopsian teeth.

"About 4 miles west of Farmington, a quarter of a mile east of Mesa Point, and 1 mile south of San Juan River; 40 feet below the Wasatch

conglomerate" (locality 8, section A). Uppermost part of the Kirtland shale. Proximal portion of an ischium (No. 8359, U. S. N. M.) of a ceratopsian dinosaur. This bone can be clearly distinguished from the ischia of Triceratops, but I am unable to identify it with any of the other ceratopsian genera, though its small size shows it to pertain to some of the smaller members of the group.[1]

"North side of Barrel Spring Arroyo, about 1½ miles southwest of Ojo Alamo store; 1 foot above base of lower conglomerate of Sinclair and Granger" (locality 69, section F) Ojo Alamo sandstone. Fragments of the frill of a ceratopsian dinosaur, not determinable.

"North side of Barrel Spring Arroyo, 1¼ miles southeast of Ojo Alamo store; 15 feet above base of Ojo Alamo" (locality 68, section F). Ojo Alamo sandstone. Fragments of the frill of a ceratopsian dinosaur. The deep radiating vascular impressions on the upper surfaces of these fragments are very similar to those found in the genus Triceratops. Brown[2] has evidently found similarly grooved bones. He says:

> The squamosal fragments of another individual observed in the field were much thinner than that bone in 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.

Similar fragments discovered in 1908 by James H. Gardner, of the United States Geological Survey, near the head of Coal Creek, 1 mile southeast of Ojo Alamo, were identified by me as pertaining to the genus Triceratops. It would now appear that this identification was in error.

"North side of Barrel Spring Arroyo, half a mile west of wagon road from Ojo Alamo; 10 feet above 'lower' conglomerate" (locality 63, section F). Ojo Alamo sandstone. Teeth of a ceratopsian dinosaur, not determinable.

[1] Since the above observations were written this specimen was sent to Mr. Barnum Brown, of the American Museum of Natural History, and he reports as follows: "The ischium is undoubtedly that of Monoclonius. It agrees in form and size with that of a skeleton collected last year from the Belly River of Alberta—*Monoclonius flexus*."

[2] Am. Mus. Nat. Hist. Bull., vol. 28, p. 269, 1910.

Family ANKYLOSAURIDÆ Brown.

The presence of armored dinosaurs in the deposits of the San Juan Basin is now shown by the discovery of a right humerus (No. 8360, U. S. N. M.) collected by J. B. Reeside, jr., "2 miles northwest of Ojo Alamo store, 20 feet below the conglomerate" (locality 59, section E). Kirtland shale.

This specimen was placed in the hands of Mr. Barnum Brown, of the American Museum of Natural History, who reports as follows:

> The humerus is that of a genus of the Ankylosauridæ. It agrees in size and form with one of our specimens from the Belly River of Alberta. I have not yet named this genus but am working on it. This genus is typical of the Belly River of Alberta and not found in the Edmonton or Lance formations.

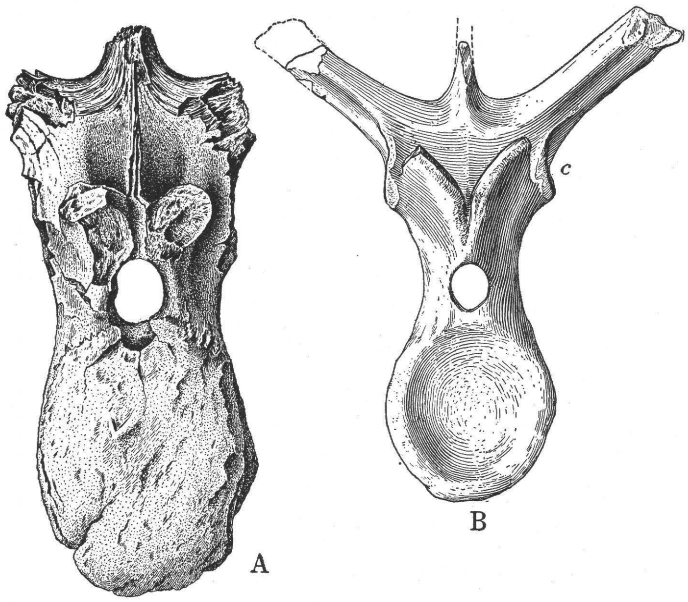


FIGURE 30.—Median dorsal vertebræ, anterior view: A, Monoclonius, No. 8347, U. S. N. M., one-fourth natural size. B, *Monoclonius crassus* Cope, No. 3998, Am. Mus. Nat. Hist., one-fourth natural size. *c*, Capitular. (After Hatcher.)

Suborder THEROPODA.

Family MEGALOSAURIDÆ.

Deinodon?

Plate LXXIII, figures 1 and 4.

In the collection made by Sinclair and Granger in 1913 were separate teeth which Brown[3] has provisionally identified as pertaining to the genus Deinodon.

The Bauer collection also contains detached teeth that are identical in every way with those

[3] Sinclair, W. J., and Granger, Walter, Paleocene deposits of the San Juan Basin, N. Mex.: Am. Mus. Nat. Hist. Bull., vol. 33, p. 303, 1914.

figured by Leidy[1] as *Deinodon horridus* (see Pl. LXXIII, fig. 4), but in view of the paucity of our knowledge concerning the complete dentition of the several genera of carnivorous dinosaurs now named, and especially as the few dentitions known show so considerable a degree of differentiation of the teeth in different parts of the jaws, the provisional reference of detached teeth to a genus based on such material is in the highest degree conjectural and can serve no useful purpose. If such material were discussed under the heading "carnivorous dinosaurs" quite as much information would be conveyed to the reader and the discussion would perhaps be less misleading.

Specimens like these have no value for correlation, as similar teeth are found in the Judith River, Belly River, Two Medicine, and Lance formations.

A list of localities and horizons where detached teeth of carnivorous dinosaurs were found is given below:

Five miles west of Pina Veta China; in Farmington sandstone member of Kirtland shale, 100 feet above its base (locality 47, section D, Pl. LXIV).

A single tooth (Pl. LXXIII, fig. 4; No. 8355, U. S. N. M.) resembling in nearly every detail the D-shaped tooth figured by Leidy.[2]

"One mile south of camp No. 6, 30 miles south of Farmington, 1 mile east of reservation; upper part of coal-bearing beds, 10 feet above highest coal" (locality 76, section E). Fruitland formation. Tooth fragments of carnivorous dinosaur.

"About 39 miles south of Farmington and 4 miles east of reservation line" (locality 80, section E). Lower part of Kirtland shale, 350 feet above base. Fragmentary teeth of carnivorous dinosaurs.

"North side of Barrel Spring Arroyo, about a mile south of Ojo Alamo store, 1,000 feet west of wagon road; about 11 feet above base of 'lower conglomerate' of Sinclair and Granger" (locality 67, section F). Ojo Alamo sandstone. Tooth of large carnivorous dinosaur.

"One mile north of west of Ojo Alamo store; 25 feet below the upper conglomerate of Sinclair and Granger. There is no lower conglomerate at this point; it is apparently consolidated with the upper" (locality 62, section F). Kirtland shale. Tooth of carnivorous dinosaur.

"Two miles northwest of Ojo Alamo store; 20 feet below the conglomerate of Sinclair and Granger" (locality 59, section E). Upper part of Kirtland shale. Median phalange of small carnivorous dinosaur; tooth of large carnivorous dinosaur.

"North side of Barrel Spring Arroyo, half a mile west of wagon road from Ojo Alamo; 10 feet above 'lower' conglomerate" (locality 63, section F). Ojo Alamo sandstone. Teeth of carnivorous dinosaurs.

In Plate LXXIII, figure 1, is shown a left dentary (No. 8346, U. S. N. M.) of a carnivorous dinosaur collected by J. B. Reeside, jr., "28 miles south of San Juan River and about 12 miles east of the Navajo Reservation line at the head of Hunter Wash" (locality 60, section F, Pl. LXIV), from the upper part of the Kirtland shale. In this bone are sockets for 13 large teeth, but except a germ tooth in the ninth alveolus from the front all the others have been lost. This germ tooth is compressed laterally, lenticular in section in the upper portion, and serrate on both borders. It is indistinguishable from some of the detached teeth found at other localities by the Bauer party. The 13 alveoli occupy a space about 354 millimeters long. At the third alveolus the dentary on the external side had a depth of 93 millimeters; at the eleventh alveolus it is 110 millimeters deep. As in the other Cretaceous Theropoda, the alveolar partitions expand internally into interdental rugosæ.

In the number of tooth sockets this jaw agrees with *Dynamosaurus imperosus* Osborn,[3] but in the general form of the dentary, particularly the contour of the anterior end, it approaches Albertosaurus[4] (Dryptosaurus) most nearly, but as the dentary of Albertosaurus has sockets for 15 teeth the presence of 13 in this individual would appear to show its distinctness.

It is quite possible that this dentary pertains to the genus Deinodon, but that can not be determined at this time because the dentary of that genus is unknown. The identification of this specimen must therefore await the discovery of additional material.

[1] Leidy, Joseph, Extinct Vertebrata from the Judith River and Great Lignite formation of Nebraska: Am. Philos. Soc. Trans., vol. 11, pl. 9, figs. 41–45, 1859.

[2] Idem, figs. 41, 42.

[3] Osborn, H. F., Tyrannosaurus and other Cretaceous carnivorous dinosaurs: Am. Mus. Nat. Hist. Bull., vol. 21, p. 263, 1905.

[4] Idem, p. 265.

Order CROCODILIA.

The presence of crocodiles in the San Juan Basin is shown by numerous shed teeth in the collection made by the Bauer party in 1915. Differences observed in these teeth would appear to indicate the presence of two or more species, but it is quite impossible to identify species or even genera from these simple conical teeth. Similar teeth have been frequently found in the Judith River, Belly River, Two Medicine, and Lance formations, and until identifiable specimens are found these detached teeth can have no value for correlative purposes.

Crocodile remains were collected at the localities shown in Plate LXIV and described below.

"One mile south of camp No. 6, 30 miles south of Farmington, 1 mile east of reservation" (locality 76, section E). Fruitland formation. Teeth.

"About 30 miles south of Farmington and 4 miles east of reservation line" (locality 80, section E). Lower part of Kirtland shale. Teeth and limb bone.

"North side of Barrel Spring Arroyo, about a mile south of Ojo Alamo store" (locality 67, section F). Ojo Alamo sandstone. Teeth and dermal scute.

"One mile north of west of Ojo Alamo store" (locality 63, section F). Ojo Alamo sandstone. Tooth.

Family ALLIGATORIDÆ.

Brachychampsa sp.

The genus Brachychampsa[1] is based on a well-preserved skull containing teeth, from the Lance formation as exposed on Hell Creek, Mont.

In the Bauer collection are detached teeth which I am unable to distinguish from those of the type specimen of Brachychampsa and which in all probability should be referred to that genus. The United States National Museum collections contain similar teeth from the Judith River and Lance formations, so that in the present state of our knowledge these detached teeth have no value as formation indicators.

Brachychampsa teeth have been found in two localities in the San Juan Basin, both in the Kirtland shale—"30 miles south of Farmington and 4 miles east of the reservation line," and "30 miles south of San Juan River and 5½ miles east of the reservation line, on a trail up Hunter Arroyo" (locality 72, section E, Pl. LXIV).

Order CHELONIA.

Altogether eight genera and nine species of fossil turtles are now recognized from the Ojo Alamo sandstone and the immediately underlying formations. Of the eight recognized species only one has been found elsewhere, the others being based on specimens obtained from these deposits. Unfortunately, at least half of these species are founded on very fragmentary specimens, for the most part fragments of the carapace.

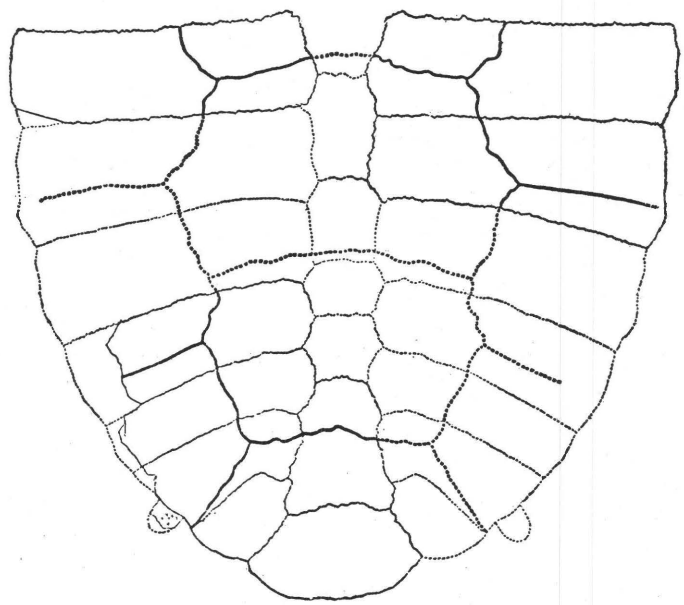


FIGURE 31.—Carapace of *Neurankylus eximius* Lambe. Type. Museum of the Canada Geological Survey, Ottawa. One-third natural size. (After Lambe.)

Family PLEUROSTERNIDÆ Cope.

Genus NEURANKYLUS Lambe.

The genus Neurankylus was established by Lambe[2] in 1902 upon a somewhat fragmentary specimen from the Belly River formation as exposed on Red Deer River in the Province of Alberta, Canada. The type consists of the posterior two-thirds of a carapace, from which all the peripheral bones are missing. (See fig. 31.)

[1] Gilmore, C. W., A new fossil alligator from the Hell Creek beds of Montana: U. S. Nat. Mus. Proc., vol. 41, pp. 297–302, pls. 26–27, 1911.

[2] Lambe, L. M., On the vertebrata of the Mid-Cretaceous of the Northwest Territory: Contr. Canadian Paleontology, vol. 3, pt. 2, pp. 42, 43, text fig. 7, 1902.

The great width of the vertebral scutes, the presence of a ninth pair of costals, and a greatly enlarged eighth neural were considered a combination of characters sufficient to separate it generically from all described forms. Its family affinities were thought by Lambe to be with the Chelydridæ.

In 1908 Hay[1] removed this genus to the Baenidæ and defined the genus Neurankylus as follows:

> A genus of uncertain position and known only from a portion of the carapace of the type species. Eighth neural large, followed by an expanded suprapygal. In the type a ninth pair of costal bones. The vertebral scutes nearly twice as wide as long.

The presence of an extra pair of costals in the type of *Neurankylus eximius* is considered by Hay an individual variation and therefore not of classificatory value. The large size of the eighth neural, as suggested by Lambe and as now shown by the type of *Neurankylus baueri*, was brought about by the coalescence of the last neural with the suprapygal and on that account can not be considered a diagnostic character. It will thus be observed that so far as the type species is concerned the great width of the vertebral scutes constitutes the principal character for distinguishing this genus.

The specimen discussed below is, on account of the close resemblance of its vertebrals to those of *Neurankylus eximius*, provisionally referred to the genus Neurankylus. The discovery of better-preserved specimens in the Belly River formation may possibly show the generic distinctness of these individuals, but in the light of our present knowledge the evidence points to their being congeneric.

The genus Neurankylus may now be defined as follows: Carapace depressed; neurals with interrupted, obtuse, dorsal carina; mesoplastrals meeting narrow on the midline; inguinal buttresses barely reaching borders of fifth and sixth costals; vertebrals very broad as compared to their length.

The close resemblance of the present specimen to the genus Glyptops shows it to be a true member of the Pleurosternidæ, so that now this family is represented in North America by the genera Glyptops and Neurankylus.

[1] Hay, O. P., The fossil turtles of North America: Carnegie Inst. Washington Pub. 75, pp. 93, 94, text fig. 90, 1908.

Neurankylus baueri Gilmore, n. sp.

Plates LXXIV, LXXV; text figures 32 and 33.

Type: No. 8344, U. S. N. M., consisting of a complete carapace and plastron. Collected by C. Max Bauer and J. B. Reeside, jr., 1915.

Locality: "About 30 miles south of Farmington and 4 miles east of reservation line," San Juan Basin, San Juan County, N. Mex. (Locality 80, section E, Pl. LXIV.)

Horizon: Lower part of the Kirtland shale.

The specimen on which this species is founded is a beautifully preserved shell, lacking only some minor fragments. Dorsoventrally it is considerably depressed, but the outlines of the carapace and plastron are little distorted and give a good idea of the form of the living animal. In its general form the carapace is broadly oval, broad behind, with scalloped borders posterior to the inguinal notches, and regularly rounded in front with the exception of a slight median emargination. Even aside from effect of the vertical crushing the shell was still depressed.

At the center the carapace has a greatest length of 560 millimeters. Its greatest width is 480 millimeters. The entire border anterior to the inguinal notches is thickened and rounded, but posteriorly it thins out to an acute edge. All the peripheral bones flare upward. This upward inclination is most pronounced along the sides, where it forms a wide, shallow gutter, much as in *Glyptops plicatulus* (Cope). (See fig. 32.)

Delicate striations cross the sutures at right angles, and faint scutal growth markings on the marginals constitute the ornamentation of the carapace.

On the median line, within the third, fourth, and fifth vertebrals, are short, obtuse elevations, but elsewhere there is no indication of any carina. The sulci are narrow and moderately impressed. The sutures have all coalesced, but by means of the transverse lines mentioned above the courses of nearly all of them can be accurately traced.

There are eight neural plates. All except the sixth, which is octagonal, and the seventh, which is subrectangular, are hexagonal, with the widest end forward. Their principal dimensions are as follows:

Dimensions of neurals in Neurankylus baueri, in millimeters.

No.	Length.	Width.	No.	Length.	Width.
1.....	60	46	5.....	50	40
2.....	48	40	6.....	55	52
3.....	55.5	42	7.....	26	30
4.....	56	45	8.....	30	43

The pygal has a greatest length at the center of 40 millimeters, and a greatest width on the free border of 60 millimeters.

There are eight pairs of costals, there being no evidence of a ninth pair, as found by Lambe[1] in the type specimen of *Neurankylus eximius*. They gradually decrease in width from front to back, only the eighth being relatively wider than the one immediately preceding it.

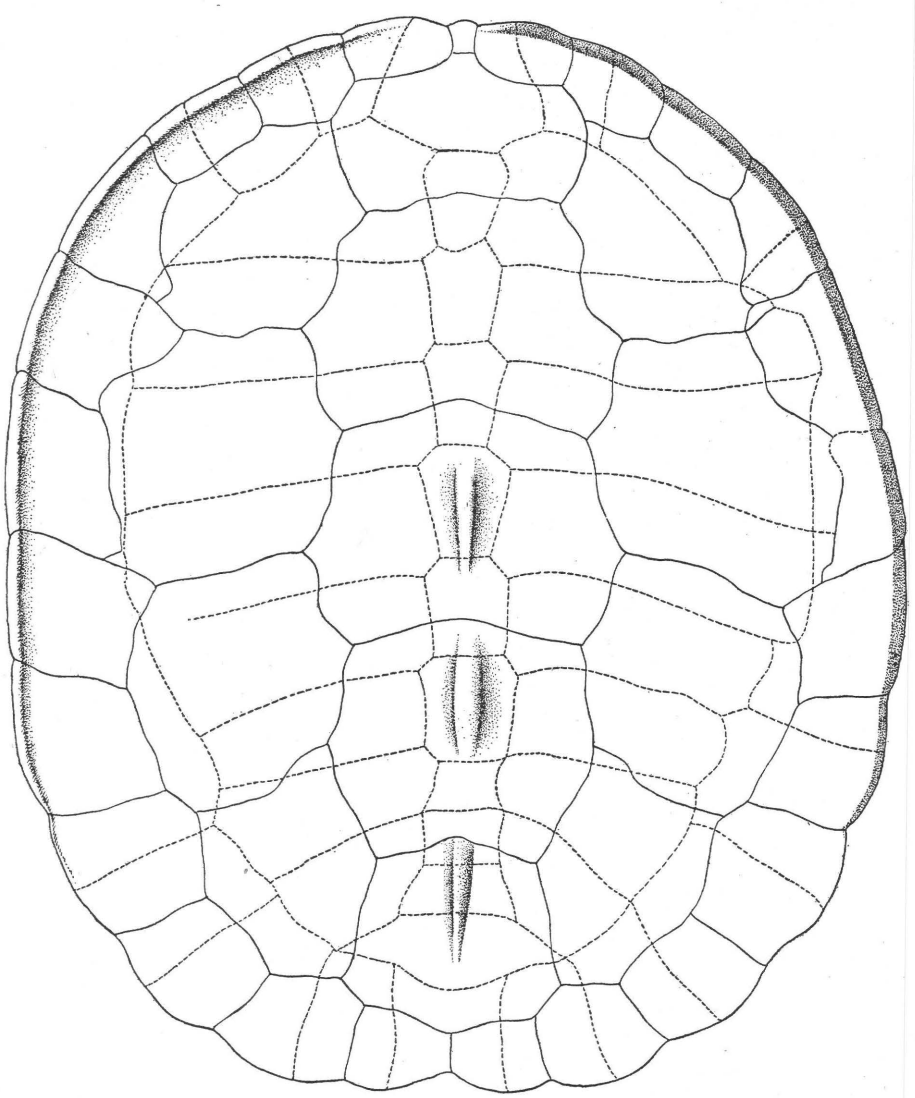


FIGURE 32.—Carapace of *Neurankylus baueri* Gilmore, n. sp. Type, No. 8344, U. S. N. M. One-fourth natural size.

The nuchal is 73 millimeters long, 52 millimeters wide on the free border, and has a maximum width of 92 millimeters.

The first suprapygal has the form of a trapezoid, being 27 millimeters long and 64 millimeters wide. The second suprapygal is lozenge-shaped, 40 millimeters long and 120 millimeters wide.

The border of the carapace is made up of 11 pairs of peripheral bones, and all excepting the third, fourth, and sixth extend entirely mesiad of the costoperipheral sulcus. The first has a height of 60 millimeters; the third, 59 millimeters; the fifth 64 millimeters; the

[1] Lambe, L. M., On Vertebrata of the Mid-Cretaceous of the Northwest Territory, pt. 2: Contr. Canadian Paleontology, vol. 3, p. 42, fig. 7, 1902.

seventh, 71 millimeters; the ninth 84 millimeters; the eleventh, 70 millimeters.

The vertebral scutes are very broad compared to their length, as in *Neurankylus eximius* Lambe. These scutes, however, are relatively longer than in the species just mentioned. Their sides are strongly bracket shaped.

The nuchal scute is small and subrectangular in outline, and its greatest diameter is anteroposterior. Its length is 19 millimeters; its width on the free border 14 millimeters. The supracaudal scute is divided, as in Hadrianus.

On account of the great breadth of the vertebrals and the considerable mesiad extension of the inguinals the costal scutes have the rather unusual proportion of being as broad as long.

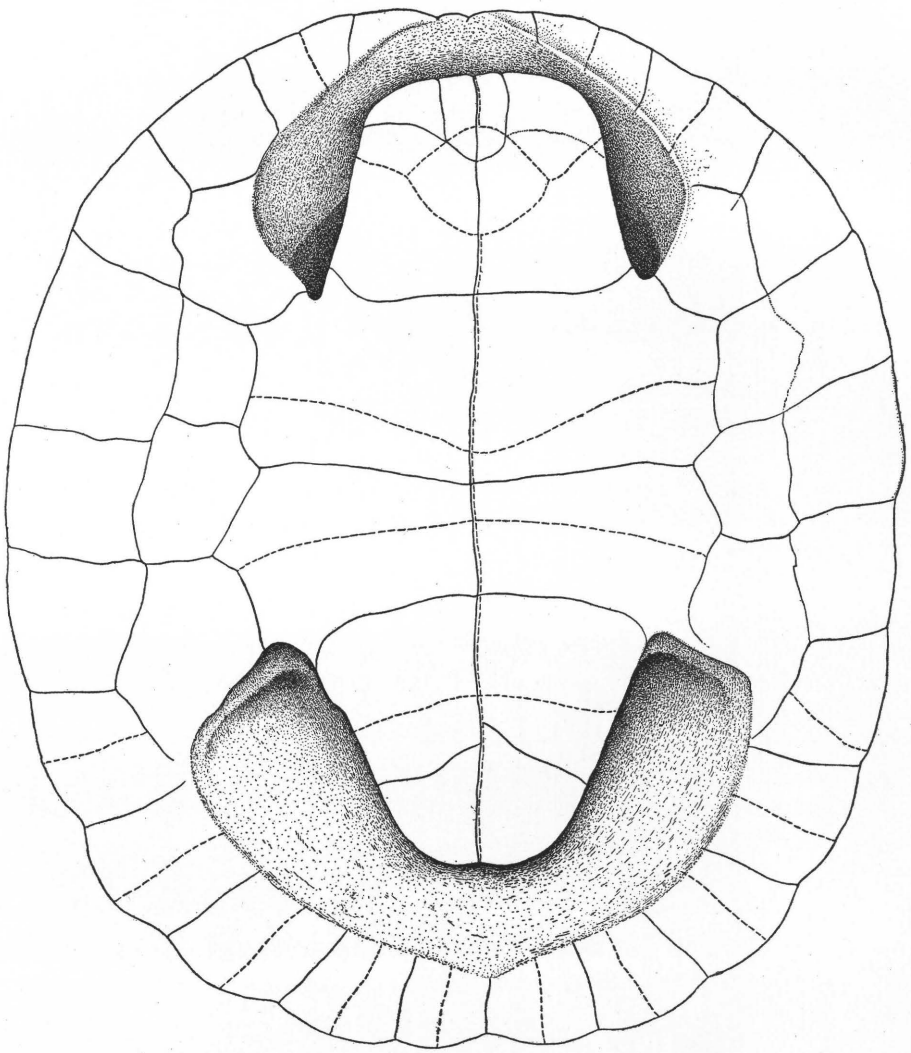


FIGURE 33.—Plastron of *Neurankylus baueri* Gilmore, n. sp. Type, No. 8344, U. S. N. M. One-fourth natural size.

The principal measurements of these scutes are given below.

Dimensions of scutes of Neurankylus baueri, in millimeters.

No.	Length.	Width in front.	Greatest width.
1	81	110	133
2	106	93	165
3	110	125	167
4	114	117	140
5	108	82	117

The marginal scutes alternate with the peripheral bones. The fourth, fifth, and seventh extend inward across the costoperipheral suture, but all the others are external to this suture.

The plastron (Pl. LXXV; text fig. 33) has a total length of 416 millimeters. It is broad in front, as in other members of the Pleuro-

sternidæ. The posterior lobe is tapering; the narrowed end truncated, with a very slight median emargination. The concavity of the plastron would indicate this individual to be a male.

The anterior lobe is 111 millimeters long and at the base 168 millimeters wide. At the gular-humeral sulcus it measures 123 millimeters in width. The front of the lobe has a thickened, rounded margin. At the center it measures 12 millimeters in thickness. The posterior lobe at the center is 122 millimeters long and 185 millimeters wide at the base. The lateral borders converge rapidly from the inguinal notch backward to the truncated posterior end.

The bridge has a width of 195 millimeters.

The epiplastra meet on the midline by a suture 30 millimeters long; the hypoplastra for 120 millimeters, the mesoplastra for 30 millimeters, the hypoplastra for 95 millimeters, and the xiphiplastra for 88 millimeters.

The buttresses are rather narrow, as in other Pleurosternidæ. The axillary extends well upward toward the vertebræ on the under side of the first costal. The inguinal buttress rises little if at all above the costoperipheral suture.

The intergular scutes meet on the midline for 40 millimeters, and they overlap the entoplastron. The gulars do not meet on the midline or overlap the entoplastron. The humerals meet on the midline for a distance of 79 millimeters, the pectorals for 100 millimeters, the abdominals for 60 millimeters, the femorals for 58 millimeters, and the anals for 64 millimeters.

There are four inframarginal scutes.

Family BAENIDÆ Cope.

Baena nodosa Gilmore, n. sp.

Plate LXXVI; text figures 34 and 35.

Type: No. 8345, U. S. N. M.; consists of a nearly complete carapace and plastron. The principal parts missing are portions of the posterior border at either side of the middle. Collected by J. B. Reeside, jr., and John Brittain, September 8, 1915.

Locality: "Two miles northwest of Ojo Alamo store," San Juan County, N. Mex. (See locality 60, section F, Pl. LXIV.)

Horizon: Kirtland shale.

The very rough surface ornamentation of the carapace of the type specimen is especially characteristic of this species, and this feature alone will serve to distinguish it from all other described forms. The ornamentation consists of a series of rounded nodelike elevations of irregular shapes and unequal sizes placed without definite arrangement. Along the central portion of the carapace these node swellings are elongate anteroposteriorly, with narrow longitudinal grooves between. Interspersed here and there among the elongate nodes are short, rounded elevations. Lateral to the vertebral areas the nodes are more widely scattered, and the valleys between them are wider and deeper. The peripheral surfaces are comparatively smooth.

In form the anterior end of the carapace is obtusely pointed. Proceeding posteriorly the lateral borders are divergent to a point posterior to the inguinal notches, where they round into the wide, truncated posterior end. This end has a decided median emargination, at each side of which the border is scalloped. The number of these scallops can not be determined in the present specimen. The sulci are narrow and shallowly impressed, but most of those of the carapace can be clearly traced. The sutures, however, have been obliterated through coossification, and are to be observed only between a few of the costals. (See fig. 34.)

The greatest length of the carapace at the center is 354 millimeters; the greatest width, which is posterior to the inguinal notches, is 344 millimeters. The depth of the shell at the center is 80 millimeters, but in life this measurement was considerably greater.

The nuchal scute, relatively of large size, has a length of 23 millimeters and a width on the free border of 19 millimeters; its greatest width is 27 millimeters.

The vertebral scutes when compared with those of other species of the genus are relatively narrow. As in *Baena hatcheri* Hay, from the Lance formation, an accessory lateral scute is cut off from each side of the first vertebral, thus greatly reducing it in size. But *B. nodosa* differs from *B. hatcheri* Hay in having a large nuchal scute that takes the place of the extremely small first vertebral and forms scutellæ as in *B. hatcheri*.

The sides of the vertebrals are but little enlarged laterally at their centers. Their principal dimensions are given in the table.

Dimensions of vertebrals of Baena nodosa, in millimeters.

Number.	Length.	Width in front.	Greatest width.
1	50	24	62
2	82	54	74
3	81	66	80
4	76	61	71
5	54	49	93

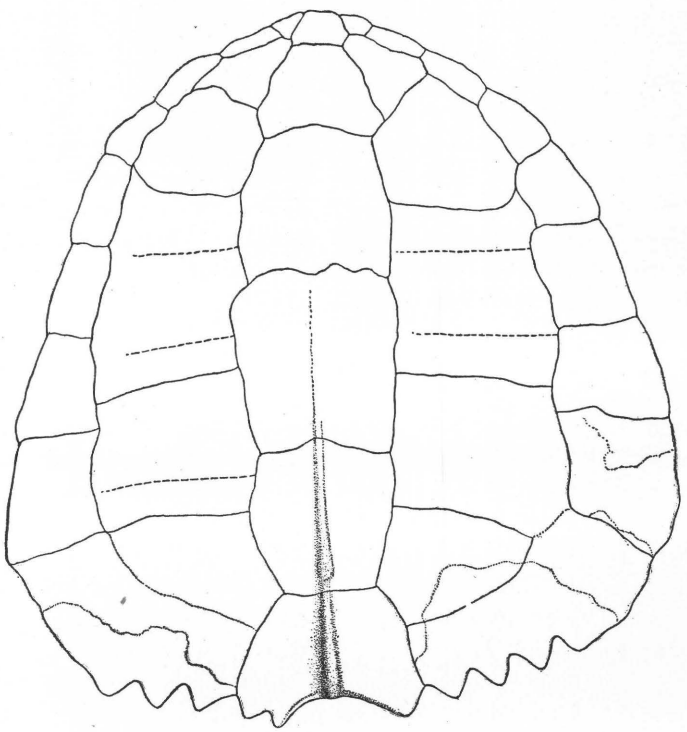


FIGURE 34.—Carapace of *Baena nodosa* Gilmore, n. sp. Type, No. 8345, U. S. N. M. About one-fourth natural size.

The triangular supernumerary lateral scutes are each 44 millimeters anteroposteriorly and 54 millimeters transversely. The nuchal has on each side a small triangular marginal scute with a free border 16 millimeters in length. The second marginal is extremely narrow fore and aft (11 millimeters) but has a length on the free border of 27 millimeters. The third marginal extends back from the border 18 millimeters; the fourth 26 millimeters; the seventh 62 millimeters; the eighth 59 millimeters. The number of marginals can not be determined in this specimen. As in other species of this genus there is no supracaudal scute, the fifth vertebral coming to the posterior margin.

The emargination on the posterior border is 59 millimeters wide. At its center the bone is thickened to 12 millimeters, thus forming an obtuse median ridge that continues well forward toward the middle of the fifth vertebral scute.

The plastron (fig. 35) is comparatively smooth, having only a finely granulated surface. The concave nature of the plastron would indicate this individual to be a male.

The plastron has a greatest length of 323 millimeters. The sides of the plastron, beginning with the bridges, rise upward and outward clear to the margin of the shell, so that the margin stands considerably above the level of the plastron.

The anterior lobe is 81 millimeters long and 113 millimeters wide at the base. The width diminishes gradually to the gular-humeral sulcus, where it measures 71 millimeters transversely. It is slightly notched at this point and again where the gular-intergular sulcus crosses the margin. The anterior border is slightly emarginate.

The limits of the entoplastron can not be traced. The bridge is 149 millimeters wide.

The posterior lobe is 89 millimeters long and 132 millimeters wide at the base. The posterior end is truncated and has a shallow but broad emarginated border. At the femeroanal sulcus the sides of the lobe are slightly constricted.

By means of the striations on the bones the limits of the mesoplastrals can be accurately determined. They meet rather broadly on the midline for a distance of 36 millimeters and expand toward the outer margins of the shell. All the other sutures are largely obliterated on account of the complete coossification or fusion of the bones.

There are distinct gulars and intergulars, all of about the same shape and size, as in *Baena hatcheri* Hay. These scutes all start from a common point at the midline. The intergulars meet at the midline for a distance of 29 millimeters; the humerals for 61 millimeters; the

pectorals for 61 millimeters; the anals for 47 millimeters. The median longitudinal sulcus appears to follow a tortuous course, as in several other species of the genus.

On the bridge there are four large inframarginal scutes. These appear to lie principally on the plastral bones, though extending over on to the peripherals.

This species is distinguished from all others in the rough, nodelike ornamentation of the carapace, in the triangular shape of the shell, and in having the greatest breadth posterior to the inguinal notches.

Dimensions of vertebrals of Thescelus rapiens, in millimeters.

No.	Length.	Width.
1	50±	82±
2	75	92
3	81	92
4	61	92
5	.....	86

On the left side there is a supernumerary costal scute. This has been cut off, mostly from the first costal proper but to some extent from the second marginal. The fourth marginal shown on the left side has a height of 57 millimeters, rising somewhat on the costals.

Thescelus rapiens Hay.

Text figure 36.

Thescelus rapiens Hay, The fossil turtles of North America: Carnegie Inst. Washington Pub. 75, pp. 97–98, text figs. 91–92, 1908.

Sinclair and Granger, Am. Mus. Nat. Hist. Bull., vol. 33, p. 303, 1914.

The original description is as follows:

This species is represented by a single shell, which was collected from "Laramie" deposits [1] at Ojo Alamo, San Juan County, N. Mex., in 1904, by Mr. Barnum Brown, of the American Museum of Natural History. The catalogue number of the specimen is 6066. The shell has been damaged considerably by weathering and lacks a portion of the carapace in the nuchal region, some portions of the right costals, most of the peripherals, the front of the plastron, and the rear of the xiphiplastrals.

The length of the carapace must have been close to 400 millimeters; the width about 375 millimeters. Apparently the shell was considerably depressed. The front of the carapace over the neck was excavated, but not so deeply as in *T. insiliens*. The area occupied by the vertebral scutes presents a broad, shallow, longitudinal channel; but in this, over the neural bones, there is a low ridge. The free borders of the anterior peripherals are rather obtuse.

The sutures of the shell are obliterated, but a few of them may be traced by the fine striations which cross them. So far as they can be made out, they are shown in the diagrammatic figures. The scutal areas are distinctly marked on the shell. They present various irregularities. The vertebrals [fig. 36, A] are broader than long; their dimensions are shown in the table below:

[1] In a letter to me dated February 26, 1916, Mr. Brown says: "*Thescelus rapiens* came from the lower conglomerate just below the old Indian trading store in Ojo Alamo," or from the Ojo Alamo sandstone.—C. W. G.

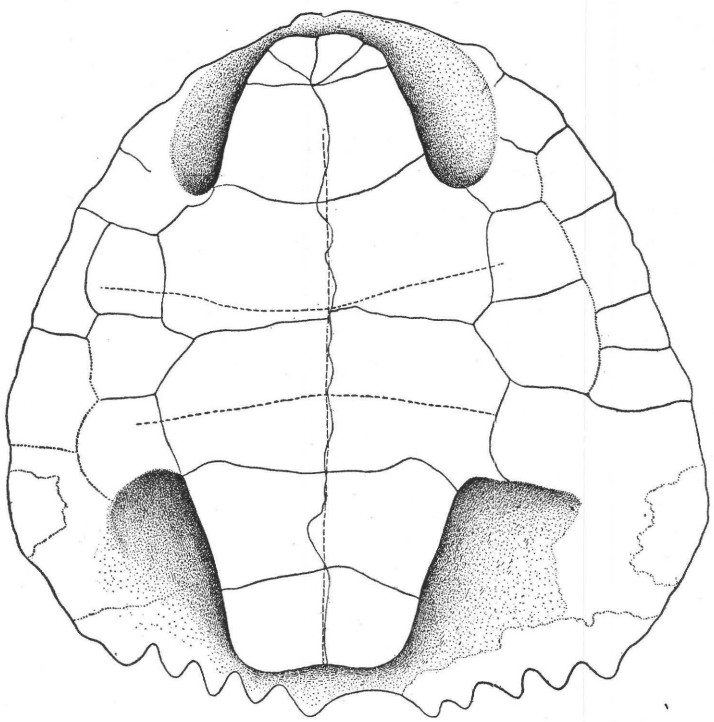


FIGURE 35.—Plastron of *Baena nodosa* Gilmore, n. sp. Type, No. 8345. U. S. N. M. About one-fourth natural size.

The plastron [fig. 36, B] is large. From a low ridge which joins the free border of the front lobe with that of the hinder lobe the bridges ascend at an angle with the remainder of the plastron. The axillary notch is far forward, falling about 55 millimeters behind the front of the carapace. The opening for the head and legs is thus considerably restricted. The front lobe extended evidently much beyond the front of the carapace. Its length can not be determined. The width ot the base is 150 millimeters. The bridge is 167 millimeters wide. The length of the hinder lobe was approximately 100 millimeters; the width at the base is 165 millimeters. It narrows rather rapidly backward, so that at the femoro-anal sulcus the width is 104 millimeters.

There are at present large mesoplastra, the boundaries of which can be pretty satisfactorily determined. These

are about 35 millimeters wide at the midline, but they expand to about 85 millimeters at the peripherals.

The median longitudinal sulcus runs a very irregular course, and across the femorals it can not be distinguished with certainty. The humerals occupy 70 millimeters of the midline; the pectorals, about 90 millimeters; the abdominals, about 35 millimeters; the femorals, about 52 millimeters. The femoroanal sulcus runs far forward from its starting point on the border of the plastron. Probably on account of weathering the sculpture of the carapace is nearly obliterated, appearing only in a few spots. On the plastron it is more distinct. It appears to have resembled that of *T. insiliens* and consists of narrow and low ridges and tubercules. Some traces are observed of the ridges due to the growth of the scutes.

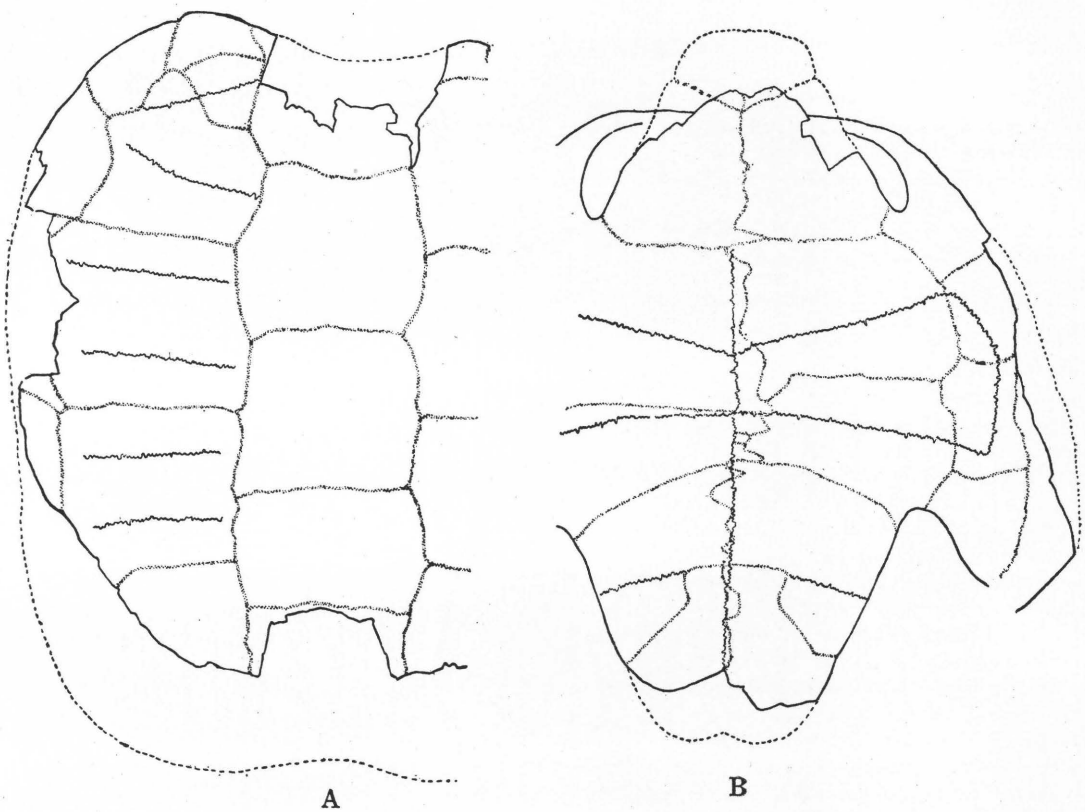


FIGURE 36.—*Thescelus rapiens* Hay. A, Carapace; B, plastron. Type, No. 6066, Am. Mus. Nat. Hist. About one-sixth natural size. (After Hay.)

This species differs from *T. insiliens* in having the nuchal less deeply excavated, in having a median depression along the back, and in having the hinder lobe of the plastron more rapidly reduced in width backward. In *T. insiliens* the bridges are considerably wider than the base of the hinder lobe.

It should be added that the type of *T. insiliens* mentioned above is from the Lance formation of Wyoming.

At the present time *T. rapiens* Hay is known only from the type specimen.

Family DERMATEMYIDÆ Gray.

Basilemys nobilis Hay.

Text figure 37.

Basilemys nobilis Hay, U. S. Nat. Mus. Proc., vol. 38, pp. 316–317, text figs. 12, 13, 1910.

The type specimen of this species, No. 6555, U. S. N. M., was collected by J. H. Gardner and J. W. Gidley at Ojo Alamo, N. Mex., in 1909. It was found below the upper conglomerate in the dinosaur-bearing deposits and "about 50 feet above the lower conglomerate"—therefore in the Ojo Alamo sandstone.

The specimen consists of many fragmentary parts of both the carapace and plastron. The best-preserved part is the border of the right side of the posterior lobe of the plastron, including a portion of the hypoplastron and a part of the xiphiplastron.

Hay's original description follows:

The right extremity of the fragment of hypoplastron reaches out to the suture with the eighth peripheral. From this suture to that between the hypoplastron and

the xiphiplastron, following the curve, is 102 millimeters. Near the former suture the bone is 52 millimeters thick. From the border of the inguinal notch a wall extends backward along the border of the hinder lobe. At the hypoxiphiplastral suture this wall arises 40 millimeters above the lower surface of the plastron. From the summit of the wall the bone slopes downward rapidly and about equally on the outside and the inside of the wall. Where the slope ceases on the inner side of the wall the xiphiplastron is about 17 millimeters thick. Passing backward 40 millimeters the wall is somewhat higher, slightly steeper on the outside and overhanging on the inner side [fig. 37, A]. At a distance of 60 millimeters behind the hypoxiphiplastral suture the wall is 36 millimeters high and still more overhanging on the inner side. At the base of the wall here the thickness of the xiphiplastron is 21 millimeters. As the rear of the xiphiplastron is approached the wall becomes lower, only 25 millimeters where the fragment ends [fig. 37, B]. On the upper surface of the xiphiplastron there is a large oval scar which was occupied by the pubis.

On the lower surface of the outer extremity of the hypoplastron are seen the narrow threadlike sulci which bound the inguinal scute. This is only 25 millimeters

FIGURE 37.—*Basilemys nobilis* Hay. Type, No. 6555, U. S. N. M. A, Section across free border of xiphiplastron 40 millimeters behind hypoplastron; B, section across free border of xiphiplastron 115 millimeters behind hypoplastron. Both figures one-half natural size. (After Hay.)

wide, and it is thrown well out on the extremity of the bone. In *B. variolosa* this scute is much wider and extends medially to the free border of the hinder lobe. On the sloping outer face of the xiphiplastral wall, near the hinder end of the specimen, is seen a part of the femoroanal sulcus.

From *B. præclara*, described above, this species differs in at least one important respect, the inner slope of the wall around the border of the hinder lobe of the plastron. * * * It differs from *B. sinuosa* in about the same way, for in the latter the upper surface of the xiphiplastron slopes rapidly downward toward the central portion of the lobe. The writer has not at hand information regarding the same region in *B. variolosa*, but it probably does not differ in any important respect from that of *B. sinuosa*.

Hay considers the type specimen to represent an individual of "nearly the size of the type of *Basilemys variolosa* (Cope), the type of the genus, the plastron of which was about 670 millimeters long."

In the concluding paragraph of the citation given above, Hay points out wherein the present form differs from all other species of the genus, though it is at once apparent that its distinctness from the single Judith River species, *Basilemys variolosa* (Cope), has not been satisfactorily demonstrated. That it may pertain to a distinct species is quite possible, though it is perhaps significant that a fragmentary specimen of Basilemys sp. (No. 8024, U. S. N. M.) from the Two Medicine formation, which is in part equivalent to the Judith River, most closely resembles *B. nobilis* Hay. The lateral ridge on the hinder lobe of the plastron in this specimen, while not quite so prominent as in *B. nobilis*, nevertheless forms a distinct wall, as in that species, and constitutes a character which distinguishes both of these specimens from all other described forms with the possible exception of *B. variolosa*.

Adocus? lineolatus Cope.

Plate LXXVIII, figure 4.

Adocus? lineolatus Cope, U. S. Geol. and Geog. Survey Terr. Bull. [1st ser.], No. 2, p, 30, 1874; The Vertebrata of the Cretaceous formations of the West: U. S. Geol. Survey Terr. Rept., vol. 2, p. 263, pl. 6, figs. 11, 12, 1875.

Hay, Bibliography and catalogue of the fossil Vertebrata of North America: U. S. Geol. Survey Bull. 179, p. 437, 1902; The fossil turtles of North America: Carnegie Inst. Washington Pub. 75, pp. 247, 248, figs. 308, 309, 1908.

Bowen, The stratigraphy of the Montana group: U. S. Geol. Survey Prof. Paper 90, pp. 122, 123, 1915.

In the collection made by Mr. Bauer from the San Juan Basin is a fragmentary turtle (No. 8348, U. S. N. M.), consisting of the seventh peripheral from the left side, associated with a few other fragments, collected in the Fruitland formation, "1 mile south of Fruitland" (locality 4, section A, Pl. LXIV). Fortunately it can be accurately compared with the type of *Adocus vigoratus* Hay, from the same region, which also has the left seventh peripheral. The finer sculpture of the Bauer specimen, which has four to five rows of pits in a line 5 millimeters long, separates it at once from *A. vigoratus*, which has only three rows in a 5-millimeter line. This difference in sculpture is clearly shown in Plate LXXVIII, figures 3 and 4. This finer sculpture resembles closely that of *Adocus? lineolatus* Cope, to which, for the present at least, this specimen is referred.

The type of *A. lineolatus* was obtained on Bijou Creek, 40 miles east of Denver, Colo., in beds believed to be of Arapahoe age.

Knowlton[1] has stated:

Fragments that have been identified as pertaining to this species have been found by Lambe in Belly River beds of Red Deer River, Alberta, by Barnum Brown in the Lance formation on Hell Creek, Mont., and by others in the "Ceratops beds" [Lance formation] of Converse County, Wyo.

According to Hay, "Fragments of costals scarcely, if at all, to be distinguished from them [*A. lineolatus*] are found in the collection made in the Judith River region for Prof. Cope by C. H. Sternberg, in 1870."

Hatcher[2] has expressed the opinion that the reference of Lambe's specimen "may be incorrect." Hay[3] says:

It is unsafe to identify as belonging to *Adocus? lineolatus* specimens from the Judith River and Laramie beds before far better materials of the species have been collected from the type locality. It is improbable that the same species continued from the Judith River epoch to the Arapahoe epoch.

The specimen now before me shows a type of sculpture which at once distinguishes it from *Adocus vigoratus* Hay, found in the same region, a sculpture which agrees in all particulars with the description and figures of the type of *Adocus? lineolatus* Cope, so that disregarding all preconceived opinions as to what its geologic range should be, I conclude that turtles having a similar surface ornamentation of the shell lived in the Judith River, Ojo Alamo, Belly River, Arapahoe, and Lance epochs.

It is quite probable that more than one species is represented by these fragments, but until better material is found I can do no better than refer them to the described species, inadequate though that may be.

Adocus vigoratus Hay.

Plate LXXVII, figure 2; Plate LXXVIII, figure 3; text figure 38.

Adocus vigoratus Hay, U. S. Nat. Mus. Proc., vol. 38, pp. 317–318, pl. 11, fig. 3, text figs. 14–18, 1910.

The original description is given below:

The fragmentary remains which are described under the above-given name were collected September 3, 1909, by Messrs. Gardner and Gidley, at Ojo Alamo, San Juan County, New Mexico. The bones were secured below the upper bed of conglomerate [Ojo Alamo sandstone], in those beds which furnished remains of dinosaurs. The specimen bears the number 6554 of the catalogue of the U. S. National Museum.

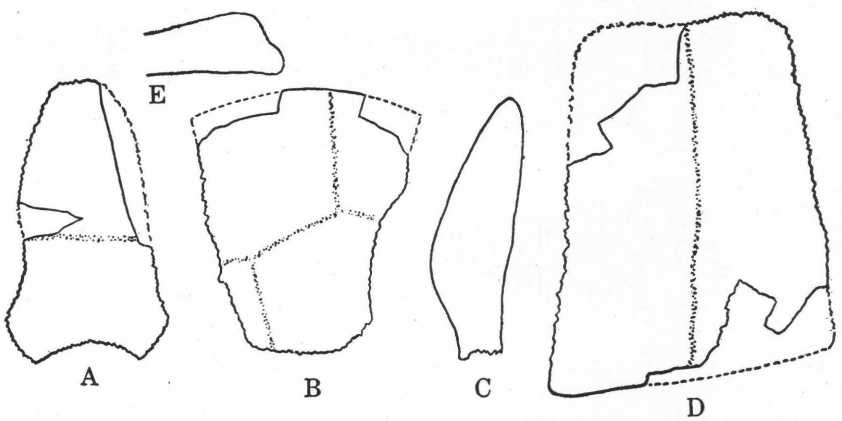


FIGURE 38.—*Adocus vigoratus* Hay. Type, No. 6554, U. S. N. M. A, First neural; B, first left peripheral; C, section across first left peripheral, the upper surface toward right; D, left seventh peripheral; E, section across free border of base of hinder lobe. All figures about one-half natural size. (After Hay.)

The individual was one of considerable size, the length of the carapace having been probably 500 millimeters. One neural [fig. 38, A] present is probably the most anterior one. It is narrowed in front, notched behind, and crossed by the sulcus that passed probably between the first and the second vertebral scutes. The length is 68 millimeters along the midline; the width is 40 millimeters. The anterior end was about 6 millimeters thick; the posterior, 10 millimeters. Figure 38, B, represents the form of the first left peripheral, while figure 38, C, presents a section from the free border to the border that articulated with the first costal. The bone is about 53 millimeters wide along the anterior border and 67 millimeters high. Its greatest thickness is 19 millimeters, and this is the same where the bone joined the nuchal and where it joined the second peripheral. The free border is obtuse. On the upper surface are seen part of the first vertebral scute, a part of the first costal scute, and parts of the first and the second marginal scutes. The ascending plate of one of the bridge peripherals is penetrated by the extremity of a rib.

[1] Knowlton, F. H., Remarks on the fossil turtles accredited to the Judith River formation: Washington Acad. Sci. Proc., vol. 13, p. 57, 1911.

[2] Stanton, T. W., and Hatcher, J. B., Geology and paleontology of the Judith River beds: U. S. Geol. Survey Bull. 257, p. 76, 1905.

[3] Hay, O. P., The fossil turtles of North America: Carnegie Inst. Washington Pub. 75, p. 248, 1908.

Figure 38, D, presents a view of the left seventh peripheral. Its length near the free border is 73 millimeters; its height is 96 millimeters. The free border is subacute. The border is greatly thickened, to form a shoulder to receive the inguinal buttress of the plastron. This buttress did not rise to the lower borders of the costals. On the upper part of the inner face of the bone is a shallow groove in which lay the end of the rib of the fifth costal plate. Farther down this rib enters the bone and descends a distance of 44 millimeters from the upper border.

Of the plastron there are present a fragment of the right xiphiplastron and the portion of the hypoplastron that sends up the right inguinal buttress. Figure 38, E, represents a section taken just behind this buttress. It shows the thickness of the bone and the form of the free border at the base of the hinder lobe. The underside of the fragment shows the outer end of the abdominofemoral sulcus. The xiphiplastron is quite thin, the thickness just behind the femoroanal sulcus being only 6 millimeters. The free edge is acute. The sulcus just named is directed forward as it moves toward the midline.

The outer surfaces of all the bones, those of the plastron as well as those of the carapace, are ornamented with shallow pits arranged in more or less regular rows. The rows are directed obliquely to the sutural borders of most of the bones [Pl. LXXVII, fig. 2; Pl. LXXVIII, fig. 3]. There are three rows of pits in a line 5 millimeters long. The ridges between the pits are rounded on their summits and the cross ridges are feeble.

This species is evidently different from all of those described from the eastern region of the United States. From *A. lineolatus*, the type of which came from Colorado, the present species differs in having a coarser sculpture, three rows of pits in a 5-millimeter line, instead of four or five.

Compsemys sp.

Plate LXXVIII, figure 2.

A number of broken fragments (No. 8349, U. S. N. M.) of the upper shell of a small turtle were found by Mr. Reeside "on the north side of Barrel Spring Arroyo, half a mile west of the wagon road from Ojo Alamo, in the Ojo Alamo sandstone, 10 feet above the lower conglomerate" (locality 63, section F, Pl. LXIV). These bones are covered with small, rounded pustules that form an ornamentation very close to that of *Compsemys vafer* Hay, but as other species of this genus have a somewhat similar sculpture it would not be safe to attempt a specific determination on materials so scanty.

The discovery of these specimens is of importance, however, as recording for the first time the presence of the genus Compsemys in the Ojo Alamo sandstone.

Family PLASTOMENIDÆ Hay.

Plastomenus sp.

Plate LXXVIII, figure 1.

The genus Plastomenus is represented in the Bauer collection by the complete hypoplastral bone (No. 8350, U. S. N. M.) from the left side shown in Plate LXXVIII, figure 1. I am unable at this time to identify the bone with any described species, and on account of its very large size am inclined to the opinion that it represents a new form but do not feel justified in establishing a new species on such meager material. Its chief importance here is in being the first recognizable specimen of the genus Plastomenus found in the San Juan basin.

The specimen was collected by Mr. Bauer "5 miles northwest of Pina Veta China," in the Farmington sandstone member of the Kirtland shale (locality 33, section C, Pl. LXIV).

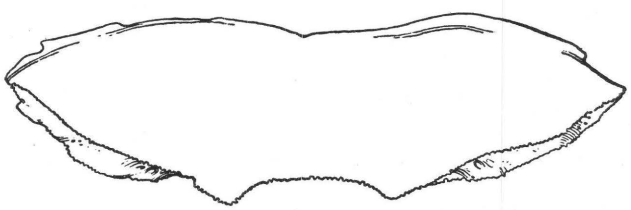


FIGURE 39.—Nuchal bone of *Aspideretes vorax* Hay. Type, No. 6140, Am. Mus. Nat. Hist. About two-fifths natural size. (After Hay.)

Family TRIONYCHIDÆ Hay.

Aspideretes vorax Hay.

Plate LXXVII, figure 3; text figure 39.

Aspideretes vorax Hay, The fossil turtles of North America: Carnegie Inst. Washington Pub. 75, pp. 496-497, text fig. 651, 1908.

The original description follows:

This species was collected from the Laramie deposits[1] near Ojo Alamo, San Juan County, N. Mex., in 1904, by Mr. Barnum Brown. The type is in the American Museum of Natural History and has the catalogue number 6140. The species is represented, as far as known, by only the nuchal bone; but this is complete. The length of the bone from side to side is 200 millimeters in a straight line, 215 millimeters over the curve. The lateral convexity is considerable and appears to have been somewhat greater than that of either *A. austerus* or *A. fontanus*, both from

[1] In response to my inquiry as to the exact geologic position of the type specimens of *Aspideretes vorax*, *A. fontanus*, and *A. austerus* Barnum Brown, in a letter of February 26, 1916, writes as follows: "The three species of Aspideretes came from clays interbedded in the sandstone of the upper part of the Ojo Alamo formation." It should be added that this determination is based on Bauer's columnar section, which Brown had before him.—C. W. G.

the same locality as this species. The width at the midline is 45 millimeters; the greatest width 55 millimeters. The greatest thickness is 15 millimeters. There is a moderate median sinus in the anterior border. This border is not clipped off at a nearly right angle with the upper surface, as in the two other species mentioned above, but is beveled down on the upper surface of the bone to a sharp edge. This beveled surface is not sculptured. The hinder border of the bone presents a median excavation, for the preneural bone. The latter bone was evidently unusually broad, the excavation having a width of at least 55 millimeters. The preneural border is thicker than that of *A. fontanus*, the thickness being 7 millimeters.

The sculpture of the bone is obscured by a layer of hard matrix; but so far as can be determined it was intermediate between *A. fontanus* and *A. austerus*, approaching more closely the latter.

Certain fragments of costals present probably belong to this species but possibly to *A. fontanus*. One of these, apparently the right sixth, is 35 millimeters wide at the neural border, 30 millimeters wide more distally, and has a thickness of 8 millimeters.

This species differs from *A. fontanus* in having the free anterior border of the nuchal beveled, the bone thicker at the preneural border, and a coarser sculpture. From *A. austerus* it differs in having a nuchal with greater anteroposterior width, the bone not so thick, and with the free anterior border beveled off instead of being clipped off at a right angle with the upper surface.

A specimen in the United States National Museum (No. 6550) has been questionably identified by Hay as pertaining to the above-named species. It consists of a portion of the nuchal and other parts of the carapace and plastral bones. In Plate LXXVII, figure 3, are shown portions of two costal plates, selected to show the character of the ornamentation.

This specimen was collected in 1909 by Messrs. Gardner and Gidley in San Juan Basin "75 feet below the Ojo Alamo sandstone, in dinosaur beds." Mr. Gidley tells me that the position as stated above was an estimate of the distance, and he is of the opinion that the specimen came from above the lower conglomerate and therefore from the Ojo Alamo sandstone.

Aspideretes austerus Hay.

Plate LXXVII, figure 1; text figures 40 and 41.

Aspideretes austerus Hay, The fossil turtles of North America: Carnegie Inst. Washington Pub. 75, pp. 495–496, text figs. 649–650, 1908.

The original description is as follows:

The fragmentary specimen on which the present species is based was collected in 1904 by Mr. Barnum Brown, from Laramie deposits [see footnote, p. 295] at Ojo Alamo, San Juan County, N. Mex. The catalogue number of the specimen is 6068. The remains, belonging apparently to a single individual, consist of the nuchal except the central portion, part of both first costals, the greater part of a right posterior costal, probably the sixth, various fragments of costals, a piece furnishing parts of two neurals, and a considerable portion of the right hypoplastron.

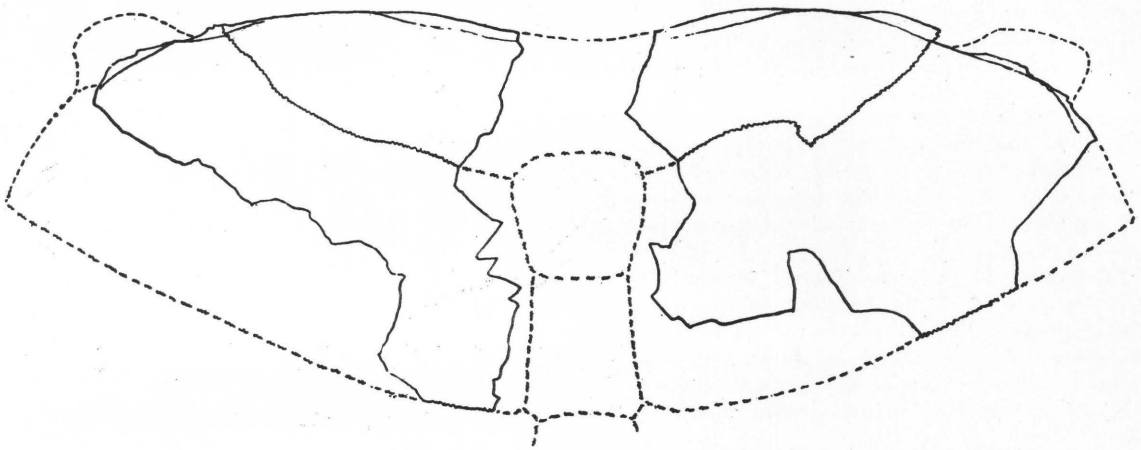


FIGURE 40.—Parts of nuchal and first costals of *Aspideretes austerus* Hay. Type, No. 6068, Am. Mus. Nat. Hist. About two-fifths natural size. (After Hay.)

The species is characterized by the very thick bones and the coarse sculpture of both the carapace and plastron.

On account of the missing middle region of the nuchal, the exact lateral extent of this bone can not be determined. It was, however, not far from 230 millimeters, being thus somewhat less than that of *A. fontanus*, just described. The greatest width is 45 millimeters, a fourth less than that of *A. fontanus*. The greatest thickness of the bone is 21 millimeters. The free anterior border is not beveled but is cut off at nearly right angles with the upper surface, like that of the species just mentioned. The thickness of this border varies from 10 millimeters toward the midline to 15 millimeters near the outer end.

The first costal is about 72 millimeters wide near the neural border, and it increases to 80 millimeters near the distal end. The free border is cut off at a nearly right

angle to the upper surface. The thickness of this border is 10 millimeters or more. The hinder border of this bone is 10 millimeters thick.

The posterior, probably the sixth, costal is 25 millimeters wide 110 millimeters from the distal end, but it widens rapidly to 55 millimeters. The free border is like that of the first costal. There must have been a considerable notch between this costal and the one next behind. In thickness this costal ranges between 9 millimeters near the proximal end and 10 millimeters at the distal end.

The sculpture of the carapace is best displayed toward the free borders. It consists of abruptly sunken pits, of which there are usually five in a line 20 millimeters long. Closer to the free borders the pits are smaller. Nowhere does there appear any tendency for the formation of straight rows of pits, such as are seen on the costals of *Amyda cariosa*, of the New Mexico Wasatch. On the portions of the carapace near the midline the pits are less conspicuous. They appear to be as large, but the walls appear worn down.

The hypoplastron [fig. 41] is thick and heavy. At the suture with the hypoplastron, not far from the midline, the thickness is 13 millimeters. One border of the notch for the process of the xiphiplastron remains. This bone was articulated with the hypoplastron by a jagged suture, and it must have extended anteriorly near the midline. The outer end of the hypoplastron, near the bases of the lateral processes, is 16 millimeters thick. Evidently nearly the whole lower surface of the plastron was covered by the sculptured layer. The pits are smaller than those of the carapace, there being about seven pits in a line 20 millimeters long. Many of them coalesce to form winding furrows.

This species differs from *A. fontanus* in having a narrower nuchal, much thicker bones, and a considerably coarser sculpture. It is referred to Aspideretes provisionally.

The fragment of a costal plate (No. 8351) shown in Plate LXXVII, figure 1, is identified provisionally as pertaining to the present species. It agrees with the type specimen in being thick and heavy and especially in the character of the surface ornamentation, which is made up of abruptly sunken pits without definite arrangement in rows. It was collected by Mr. Bauer 28 miles south of San Juan River (see locality 51, section D, Pl. LXIV), "about 250 feet above the Pictured Cliffs sandstone," in the Fruitland formation.

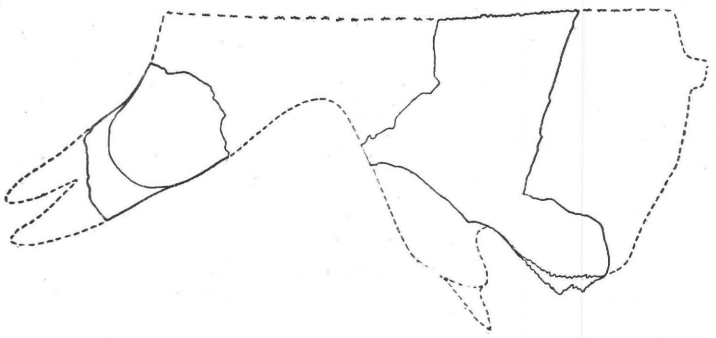


FIGURE 41.—Right hypoplastron of *Aspideretes austerus* Hay. Type, No. 6068, Am. Mus. Nat. Hist. About two-fifths natural size. (After Hay.)

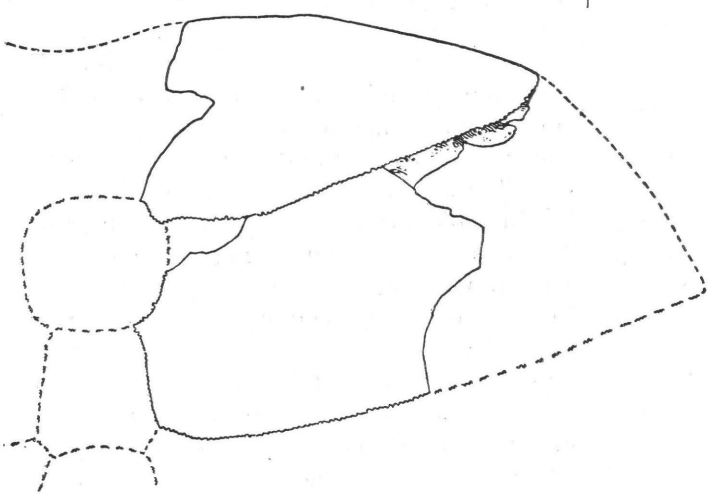


FIGURE 42.—Parts of nuchal and first right costal of *Aspideretes fontanus* Hay. Type, No 6070, A.m. Mus. Nat. Hist. About two-fifths natural size. (After Hay.)

Aspideretes fontanus Hay.

Text figure 42.

Aspideretes fontanus Hay, The fossil turtles of North America: Carnegie Inst. Washington Pub. 75, pp. 494–495, text fig. 648, 1908.

The original description follows:

From the Laramie beds [see footnote, p. 295] at Ojo Alamo, San Juan County, N. Mex., Mr. Barnum Brown, of the American Museum of Natural History, in 1904 brought materials belonging apparently to three species of the genus Aspideretes. Of these the present is represented by nearly the whole of the right half of the nuchal and a considerable part of the right first costal. The number of the specimen is 6070.

At no point does this piece of nuchal come to the midline; hence we can not determine the exact extent of the bone laterally. It was, however, not far from 260 millimeters. The animal was therefore one of considerable size. The inner hinder angle of the bone presents a part of the sutural border for the preneural, and from this to the outer end of the nuchal is 125 millimeters. The width of the bone where it came in contact with the preneural is 60 millimeters. The anterior border is not beveled but is cut off nearly at right angles with the upper surface.

The greatest thickness, through the ridge on the lower surface, is 16 millimeters. Where it made contact with the preneural the thickness is only 4 millimeters.

The portion of the costal, the proximal half, almost certainly belongs to the same individual. At its proximal end it presents the sutural borders for the preneural and the first neural. Evidently the preneural was somewhat wider than the neural. Its length was at least 40 millimeters. The border of the costal for union with the neural is 7 millimeters thick. About the middle of the length of the hinder border of the costal the thickness is 7 millimeters.

The upper surface of the bone is incrusted with a layer of iron oxide, but so far as can be discovered the sculpture was finer than in the other two species found in that region, *A. austerus* and *A. vorax*. The few pits observed appear to be about 2.5 millimeters in diameter.

The respects in which this species differs from those just named are mentioned under their respective descriptions.

Class PISCES.

Two genera of fishes have been provisionally identified from the deposits in San Juan Basin. On account of the close similarity between them and the fish remains found in the Judith River, Belly River, Two Medicine, and Lance formations, they are of little value for correlation, although they give some indication of the character of the fish that inhabited the waters at the time these deposits were laid down.

Myledaphus sp.

Plate LXXVII, figure 4.

Myledaphus bipartitus Cope, Acad. Nat. Sci. Philadelphia Proc., 1876, p. 260.

This genus of pavement-toothed fish is represented by a considerable number of detached teeth (No. 8356, U. S. N. M.) found by Mr. Bauer's party "30 miles south of Farmington and 4 miles east of the reservation line," in the lower part of the Kirtland shale (locality 80, section E, Pl. LXIV). Teeth of this pattern are found in the Lance, Judith River, and Belly River deposits. The teeth found by the Bauer party can not be distinguished from teeth from the Judith River described by Cope as *Myledaphus bipartitus*, but it would be quite impossible to identify species from teeth of such simple pattern.

Lepisosteus sp.

Plate LXXVII, figure 5.

The genus Lepisosteus was founded on lozenge-shaped scales. Similar scales occur in the Lance, Two Medicine, Judith River, and Belly River formations, and the present specimens probably represent more than one species, but the material is too inadequate to identify species. These scales have been found in the San Juan Basin in the localities named below:

"One mile south of camp No. 6, 30 miles south of Farmington, 1 mile east of reservation; 10 feet above highest coal" (locality 76, section E, Pl. LXIV). Fruitland formation.

"About 30 miles south of Farmington and 4 miles east of reservation (locality 80, section E). Kirtland shale.

"North side of Barrel Spring Arroyo, about 1 mile south of Ojo Alamo store, 1,000 feet west of wagon road; 11 feet above base of lower conglomerate of Sinclair and Granger" (locality 67, section F). Ojo Alamo sandstone.

"About 30 miles south of San Juan River and 5½ miles east of the reservation line, on trail up Hunter Arroyo" (locality 72, section E). Kirtland shale.

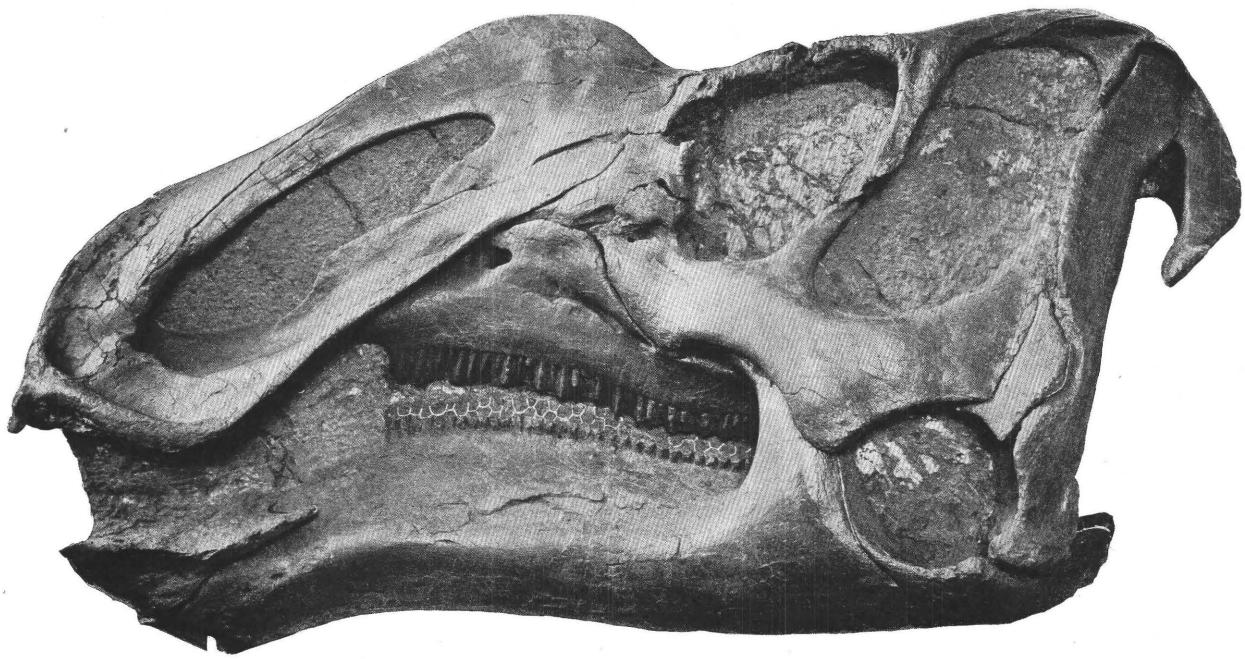
"One mile north of west of Ojo Alamo store; 25 feet below the upper conglomerate of Sinclair and Granger [locality 62, section F]. There is no lower conglomerate at this point; it is apparently consolidated with the upper." Upper part of Kirtland shale.

"North side of Barrel Spring Arroyo, half a mile west of wagon road from Ojo Alamo; 10 feet above lower conglomerate" (locality 63, section F). Ojo Alamo sandstone.

PLATES LXXII–LXXVIII.

A. SKULL OF KRITOSAURUS NAVAJOVIUS BROWN.

Type. No. 5799, Am. Mus. Nat. Hist. About one-sixth natural size. A comparison with *B* shows that the nasal bones have not been properly restored. (After Brown.)



B. SKULL OF KRITOSAURUS NOTABILIS (LAMBE).

In the museum of the Geological Survey of Canada, Ottawa. Originally described as the type of Gryposaurus notabilis. About one-sixth natural size. (After Lambe.)

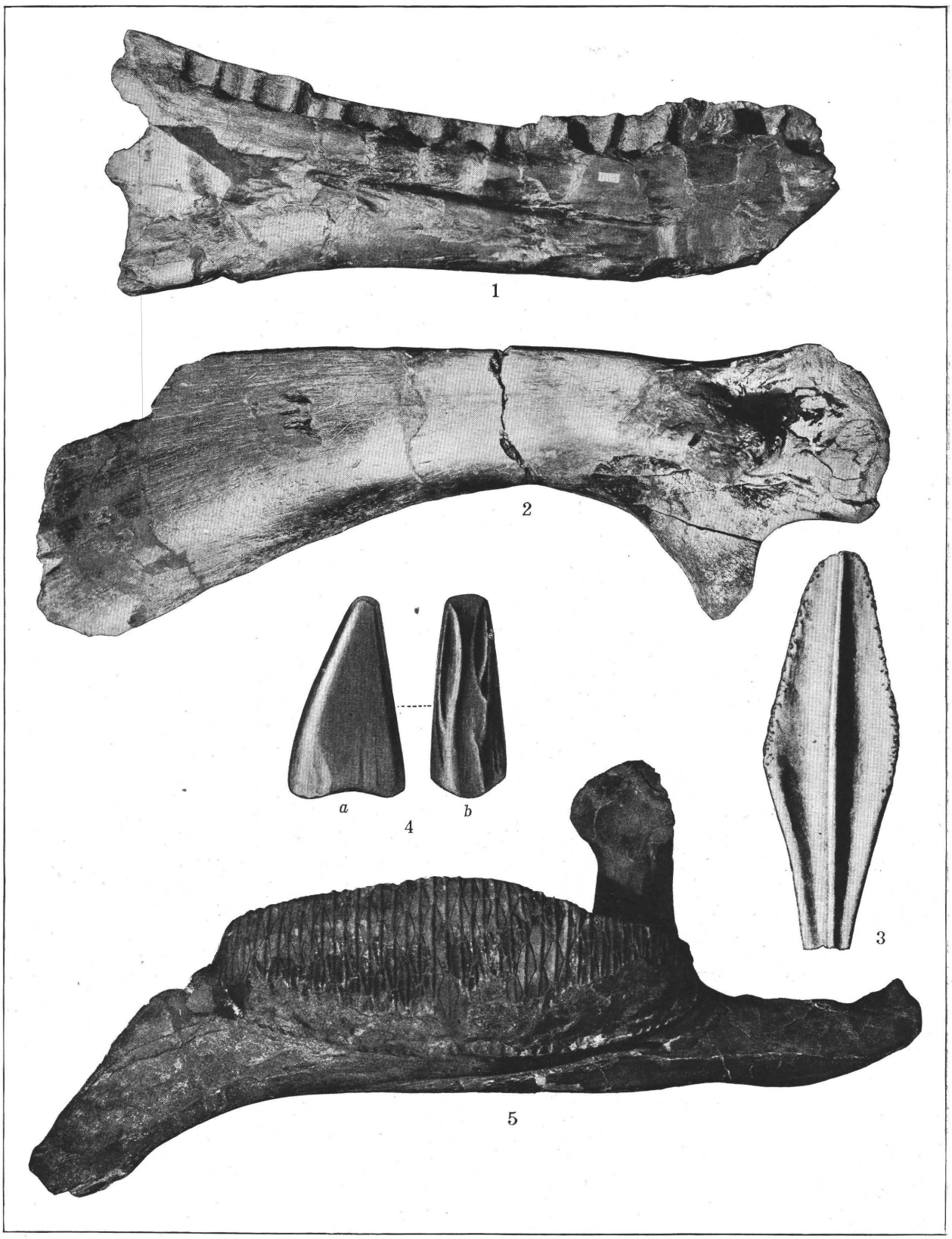

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PLATE LXXIII.

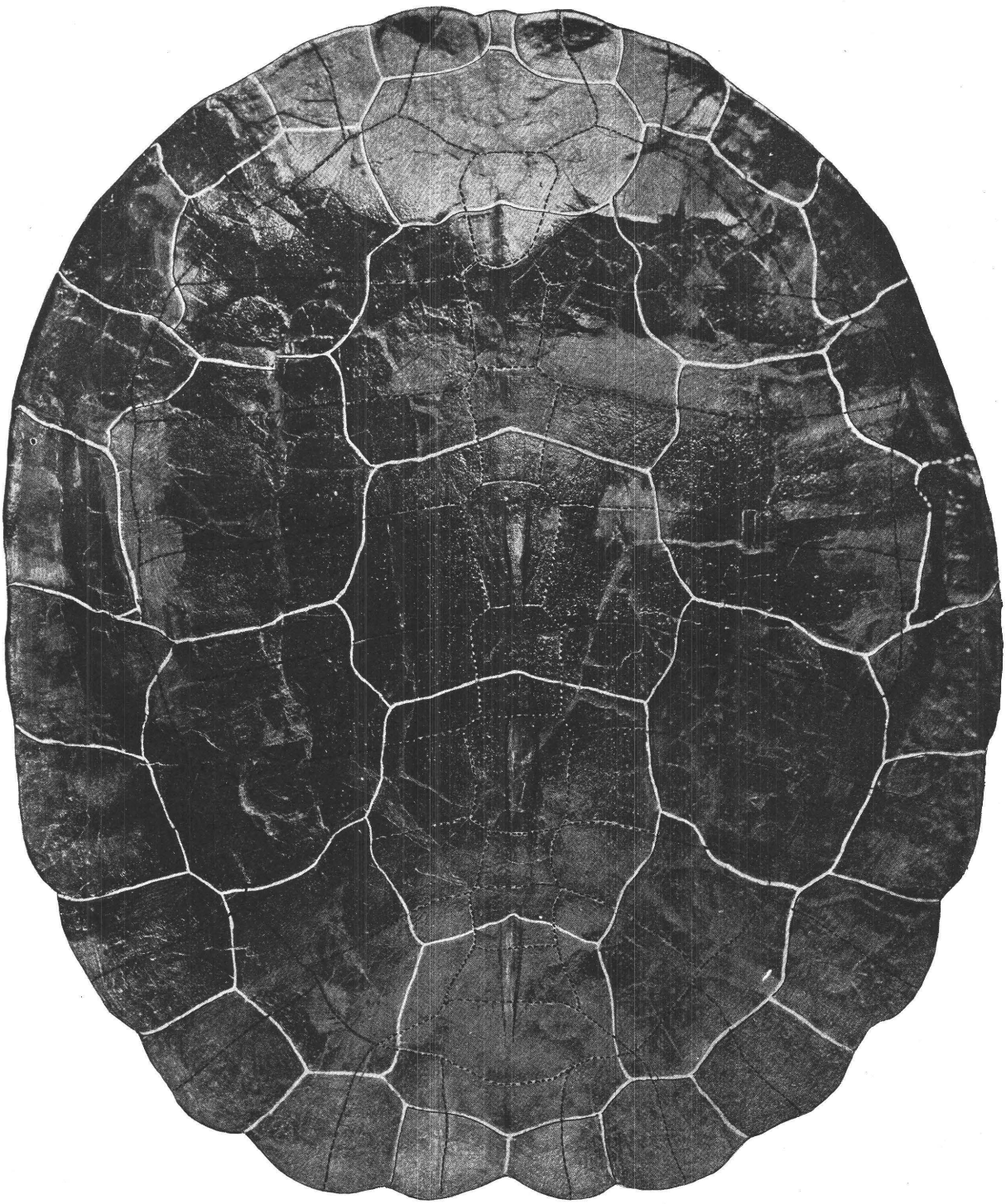
FIGURE 1. Left dentary of carnivorous dinosaur, possibly pertaining to the genus Deinodon. No. 8346, U. S. N. M. About one-third natural size.

FIGURE 2. Right scapula of Kritosaurus? sp. No. 8354, U. S. N. M. About one-fourth natural size.

FIGURE 3. Lower tooth of *Kritosaurus navajovius* Brown. Type. No. 5799, Am. Mus. Nat. Hist. Internal view. Enlarged 1½ diameters. (After Brown.)

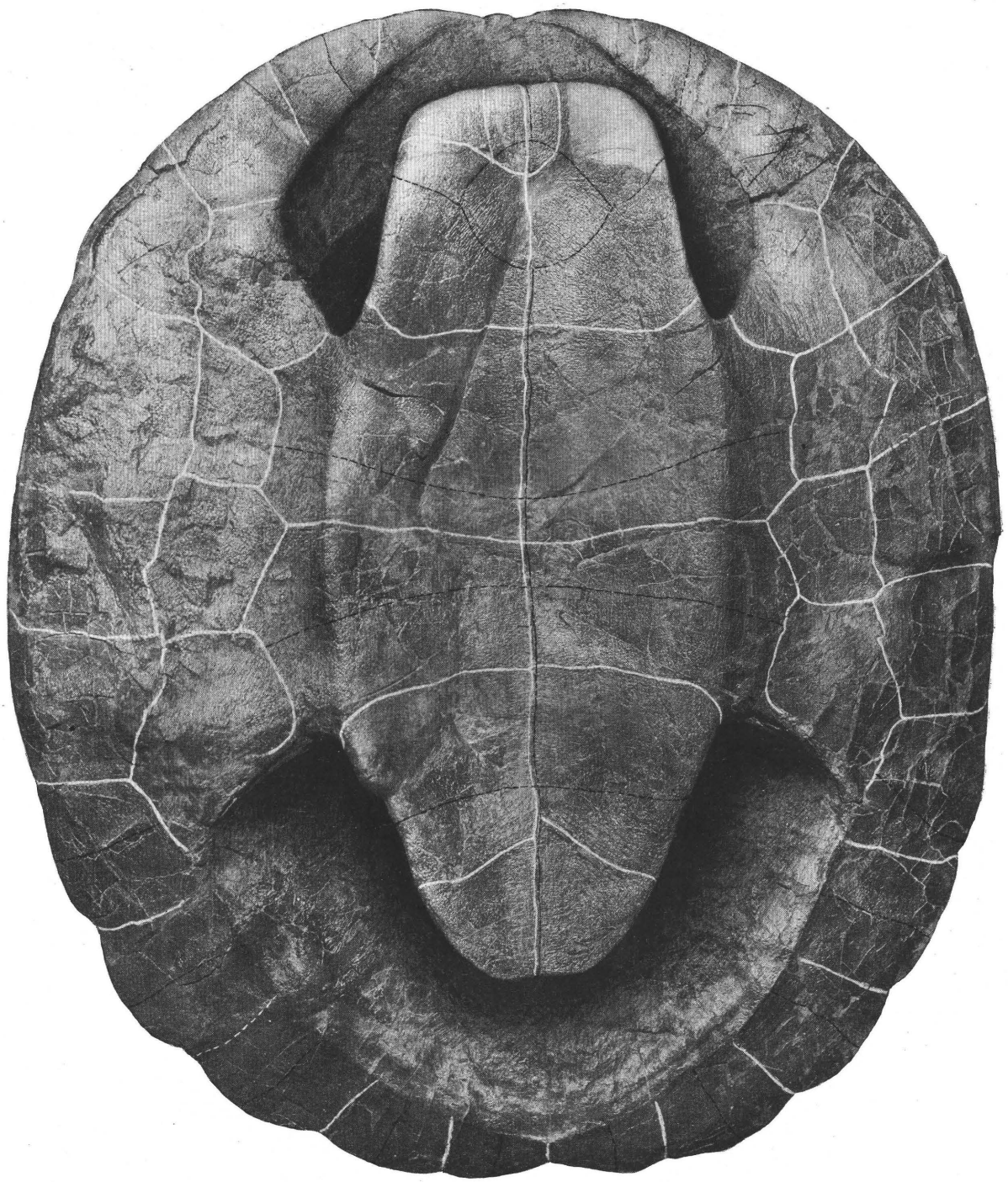
FIGURE 4. Tooth of carnivorous dinosaur. No. 8355, U. S. N. M. *a*, Lateral view; *b*, end view. Enlarged 2 diameters. This tooth resembles closely one figured and described by Leidy as pertaining to *Deinodon horridus*.

FIGURE 5. Right dentary of *Kritosaurus navajovius* Brown. Viewed from the internal side. Type. No. 5799, Am. Mus. Nat. Hist. About one-fifth natural size. (After Brown.)



CARAPACE OF NEURANKYLUS BAUERI.

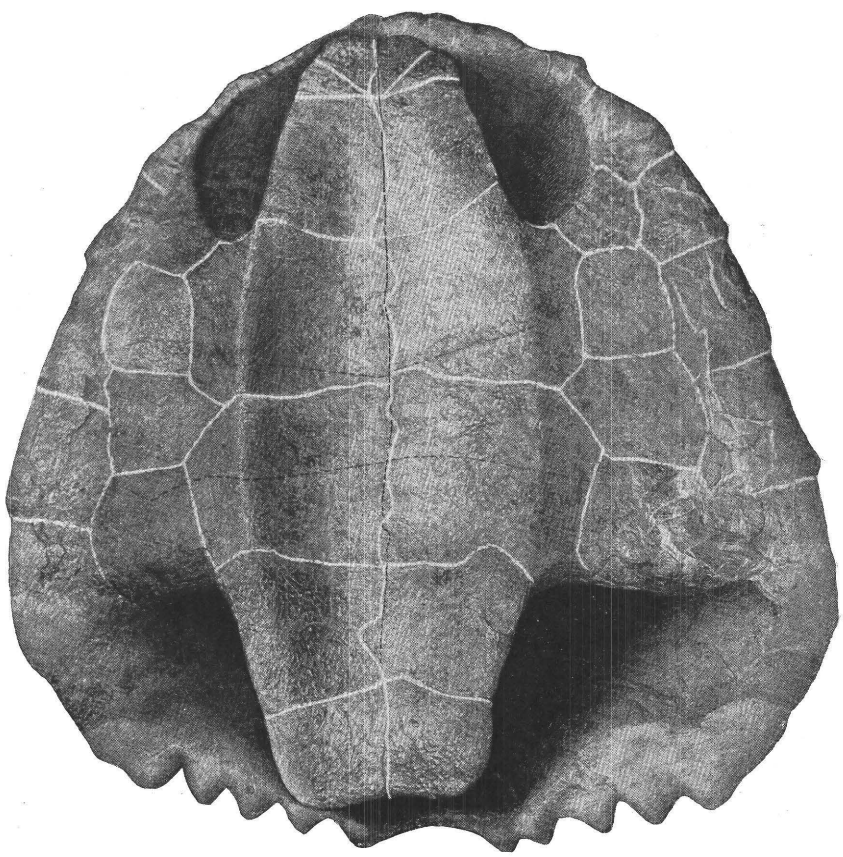
Type. No. 8344, U. S. N. M. Dorsal view. One-third natural size.



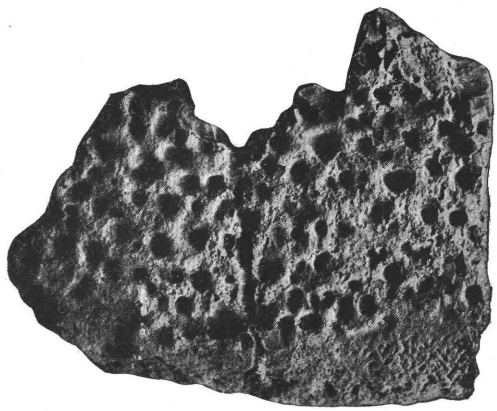
PLASTRON OF NEURANKYLUS BAUERI.

Type. No. 8344, U. S. N. M. Ventral view. One-third natural size.

A. CARAPACE OF BAENA NODOSA.
Type. No. 8345, U. S. N. M. Dorsal view. One-fourth natural size.



B. PLASTRON OF THE SAME SPECIMEN.
Ventral view. One-fourth natural size.



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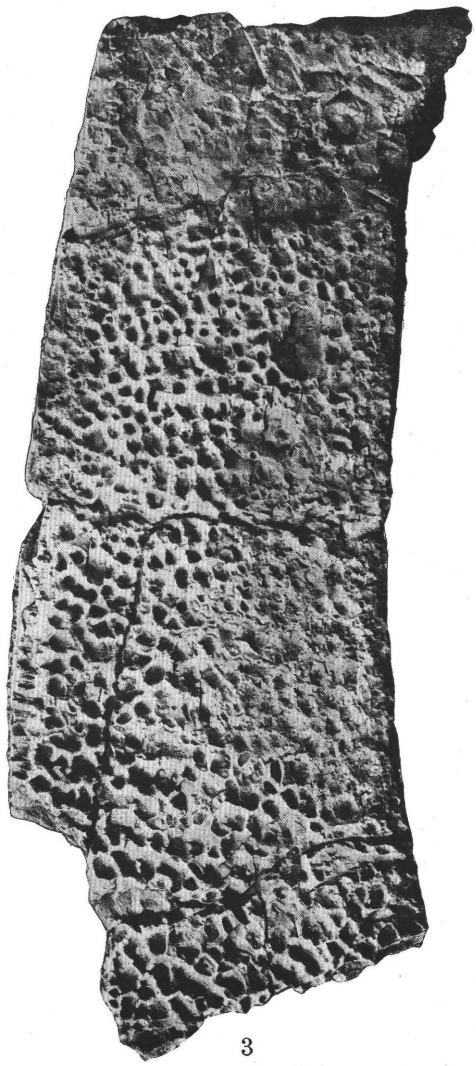

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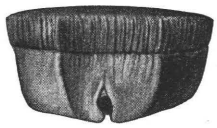

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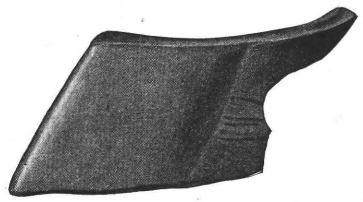

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3a

PLATE LXXVII.

FIGURE 1. *Aspideretes austerus* Hay. Distal end of costal plate. No. 8351, U. S. N. M. Natural size. Shows the abruptly sunken pits which form the characteristic ornamentation of the carapace.

FIGURE 2. *Adocus vigoratus* Hay. Type. No. 6554, U. S. N. M. A part of a peripheral above the bridge to show the ornamentation. The upper border of the bone is toward the left. Natural size. (After Hay.)

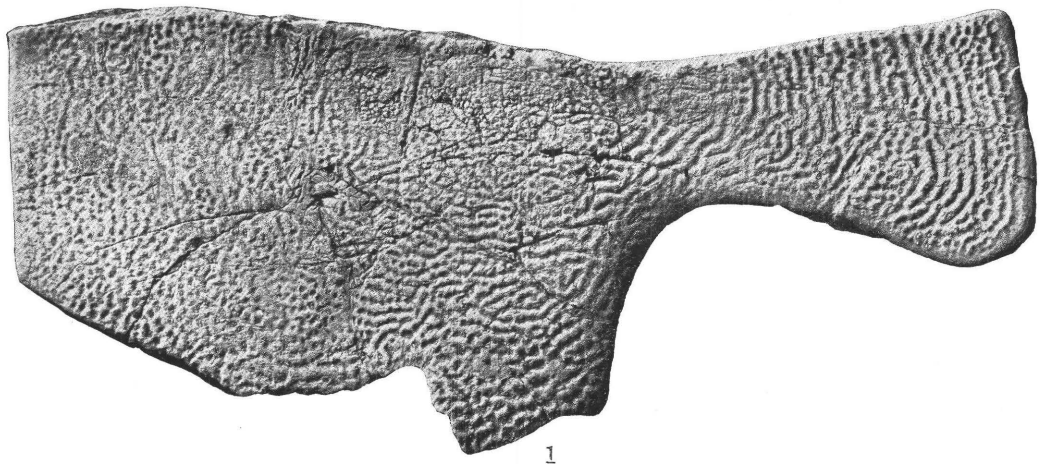
FIGURES 3, 3a. *Aspideretes vorax* Hay. Costal plates to show the ornamentation. No. 6550, U. S. N. M. Natural size.

FIGURE 4. Myledaphus sp. Tooth. No. 8356, U. S. N. M. Enlarged 2 diameters.

FIGURE 5. Lepisosteus sp. Scale from the side of the body. No. 8357, U. S. N. M. Enlarged 2 diameters.

PLATE LXXVIII.

FIGURE 1. Plastomenus sp. Left hypoplastral bone. No. 8350, U. S. N. M. About three-fourths natural size.
FIGURE 2. Compsemys sp. Portion of a costal scute. No. 8349, U. S. N. M. Enlarged 2 diameters.
FIGURE 3. *Adocus vigoratus* Hay. Seventh peripheral, left side. No. 6554, U. S. N. M. Natural size.
FIGURE 4. *Adocus? lineolatus* Cope. Seventh peripheral, left side. No. 8348, U. S. N. M. Natural size.



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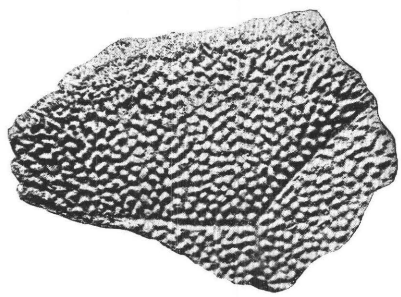

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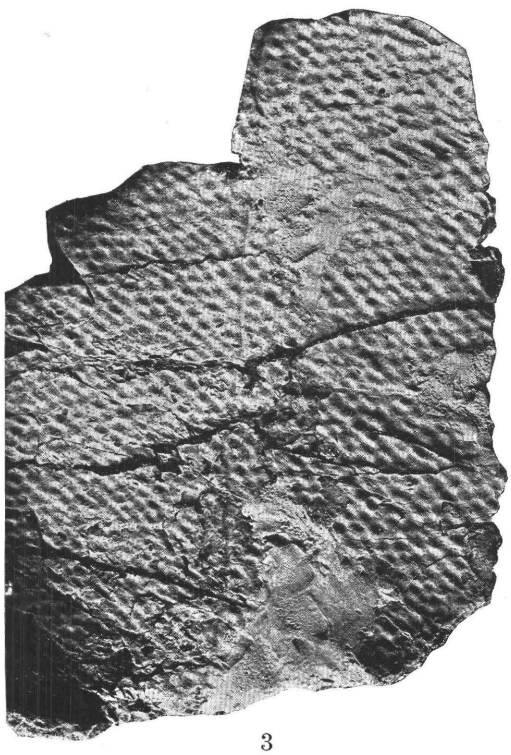

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