ART. XXXIX.—*Preliminary Description of New Tertiary Reptiles*; by O. C. MARSH. PART I.

THE remains described in this paper are from the early Tertiary deposits of the Rocky Mountain region, and were discovered by the Yale College party during their explorations in the summer and autumn of last year. The localities are nearly

* Darwinism in Morals, in *Theological Review*, April, 1871.

all in the Eocene beds of the Green River basin, first examined by the Yale party, in 1870, and found to contain so many new and interesting forms of vertebrate life.* In this extinct fauna, Reptiles were particularly abundant, and among them were numerous Lizards, several species of which are here described.

Thinosaurus paucidens, gen. et sp. nov.

This genus includes a number of large carnivorous Lizards, which resemble, in some respects, the Varanidæ, or Monitors. The vertebræ are similar in form to those of *Varanus*, but differ in being joined together, especially in the dorsal region, by a peculiar modification of the zygosphenal articulation. This is essentially a repetition of the anterior zygapophyses by an intermediate and diminutive pair of wedge-shaped processes, which replace the usual zygosphenæ seen in the vertebræ of Iguanas and Serpents. In the caudal vertebræ, this articulation gradually subsides to a low roof, projecting in front over the neural canal. The zygantral cavities are distinct, but not so deep as in the Iguana. They are separated in the anterior vertebræ by a median ridge, the sides of which fit against the articular faces of the small intermediate zygapophyses. Some of the cervical vertebræ had free articulated hypapophyses, as in the Mosasauroid Reptiles. The bones of the skull are smooth, and were evidently without osseous dermal scutes, which was doubtless the case also with the rest of the body. There was a parietal foramen. The teeth are pleurodont, and, in the specimens at present known, have broad expanded bases. All the species appear to have had a long tail, and were probably good swimmers. This genus may be readily distinguished from *Glyptosaurus* Marsh, by the absence of the ornamented dermal plates, which protected all the species of that group. The genus *Saniva* of Leidy is probably more nearly related, but so far as now known the vertebræ appear to have been united only by the usual articulation.

The present species is based upon the greater part of a skeleton found, by the writer, in place. Portions of several other skeletons were discovered in the same region by other members of the Yale party. In the former specimen, the teeth were not numerous, but appear to have been long and sharp. The bases of the crowns attached to the inner wall of the jaw are much expanded, and their sides furrowed, as in *Heloderma*. The dorsal vertebræ have the articular ball and cup transversely elliptical, and much inclined. The centra have their inferior surface very slightly concave longitudinally, and convex transversely. The articular faces for attachment of the ribs have

* This Journal, vol. i, 1871, pp. 192, 322, and 447.

a round tubercle on their upper portion. The sacral vertebræ are short, and are quite concave below longitudinally. They have no ridge between the zygantral cavities, as in the anterior vertebræ. The anterior and medial caudals are elongated, but less so than the dorsals. The distal caudal vertebræ are slender, but not materially compressed. The limb bones preserved resemble those of the Iguanas. The remains preserved of this species indicate an animal about four feet in length.

Measurements.

Space occupied by three lower teeth,.....	13· mm.
Length of dorsal vertebra from edge of cup to end of ball, 16·	
Width of articular cup,.....	11·
Width of ball,.....	10·2
Expanse of anterior zygapophyses,.....	19·
Expanse of posterior zygapophyses,.....	17·
Expanse of small intermediate processes,.....	4·5
Length of first sacral vertebra,.....	13·
Width of cup,.....	8·6
Length of first caudal,.....	13·2

The type specimen of this species was found by the writer, last September, at Grizzly Buttes, Wyoming. The geological horizon is Eocene, or possibly Upper Miocene.

Thinosaurus leptodus, sp. nov.

This species, which was somewhat smaller than the one above described, is indicated by the more important parts of two skeletons, and some isolated remains of other individuals. The teeth preserved are of unequal size, with the crowns slender, compressed, and pointed; and curving backward and inward. The grooves at the base are deep, and pass upward over the lower half, at least, of the crown. There is a distinct cutting edge in front, but none behind on the lower part of the teeth observed. The vertebræ are very similar to those of *T. paucidens*. The articular cup is transversely elliptical, and is faintly depressed above for the neural canal. The two sacral vertebræ are *ankylosed*. Both are short, and have a deep groove on the lower surface of the expanded diapophyses. The pelvic arch is very similar to that in the Iguanas, but the ilium is pointed at its upper extremity. The caudal vertebræ have the chevrons situated about one-third the length of the centrum from the end of the articular ball. The tail was long and slender.

Measurements.

Space occupied by three lower teeth,.....	11· mm.
Antero-posterior diameter of crown of lower tooth,	2·5
Transverse diameter,	1·5

Length of dorsal vertebra on lower surface,.....	13·6 ^{mm} ·
Width of cup,.....	9·
Expanse of anterior zygapophyses,.....	16·
Length of two united sacral vertebræ,.....	18·6
Length of ilium,.....	42·7

The skeleton on which this description is mainly based was found in September last, at Grizzly Buttes, Wyoming, by Mr. J. F. Quigley. Another fine specimen was found at the same locality by Mr. G. G. Lobdell, Jr.

Thinosaurus crassus, sp. nov.

A third and still larger species of the same genus is represented in our Wyoming collections by a number of dorsal vertebræ, and a few other less characteristic remains, all parts of one skeleton. The vertebræ preserved differ considerably from those of the preceding species, in being much more massive in proportion to their length, which is about the same as in *T. paucidens*. Those of the dorsal series have the inferior surface of the centrum nearly straight longitudinally, and flat or slightly concave transversely. The unarticular surface of the vertebræ is everywhere irregularly striated. The known remains of this species indicate a reptile about five feet in length.

Measurements.

Length of dorsal vertebra on lower surface,.....	16· mm·
Transverse diameter of articular cup,.....	11·2
Transverse diameter of ball,.....	11·
Vertical diameter,.....	5·5
Expanse of anterior zygapophyses,.....	22·
Expanse of posterior zygapophyses,	20·2

The specimen on which the present species is based was found by the writer, last September, in the Tertiary shale near Henry's Fork, Wyoming.

Thinosaurus grandis, sp. nov.

A gigantic Lizard, the largest yet discovered in the Green River basin, and exceeding in size any living species, is indicated by fragmentary portions of several individuals. These remains agree so nearly with those of the species above described that they may be referred, provisionally at least, to the genus *Thinosaurus*. The vertebræ, so far as known, resemble in their proportions those of *T. crassus*, but the dorsals have the centra convex transversely on the inferior surface. The rudimentary zygosphenæ, moreover, in the type specimen of the present species, has its sides inflected, forming a shelf beneath the cavities thus enclosed, a peculiarity not seen in the vertebræ of the other species of the genus. The posterior sacral

vertebra has a groove on the lower side of its diapophyses. This species was probably not less than seven feet in length, and three or four times the bulk of *Iguana tuberculata*.

Measurements.

Transverse diameter of cup of dorsal vertebra,.....	13 [•] mm.
Transverse diameter of same vertebra between articular faces of diapophyses,.....	29 [•]
Transverse diameter of neural arch between zygapophyses,.....	16 [•]
Expanse of posterior zygapophyses,.....	22 [•]
Length of posterior sacral vertebra,.....	18 [•]
Transverse diameter of ball,.....	11 [•] 5
Length of first caudal vertebra,.....	18 [•] 1
Antero-posterior diameter of acetabular cavity,.....	21 [•]

The type specimen of this species was found, in September, 1870, at Grizzly Buttes, Wyoming, by Mr. C. W. Betts, of the Yale party of that year.

Thinosaurus agilis, sp. nov.

The smallest species of the genus yet discovered is represented in our collections by some characteristic parts of one skeleton, in perfect preservation, and by several isolated vertebrae from the same locality. In the former specimen, the lower teeth are very similar to those of *T. leptodus*, the next larger species, but the basal grooves on the inner side do not extend up so far on the crown. The two species may be readily distinguished, also, aside from the great difference in size, by the anterior caudal vertebrae, which in the present specimen have the articular cup much more depressed. In the dorsal vertebrae, the neural spine is quite short. The middle and distal caudals are much elongated. The remains preserved indicate an animal about two feet long.

Measurements.

Length of dorsal vertebra on lower surface,.....	10 [•] 3 mm.
Width of articular cup,.....	5 [•] 5
Width of ball,.....	5 [•]
Expanse of anterior zygapophyses,.....	9 [•]
Expanse of posterior zygapophyses,.....	8 [•] 2
Length of first caudal vertebra,.....	7 [•] 3
Width of articular cup,.....	5 [•]
Vertical diameter of cup,.....	2 [•] 8
Transverse diameter of distal end of femur,.....	8 [•]

The specimens on which this description is based were found, last autumn, near Henry's Fork, by Mr. G. G. Lobdell, jr.

Glyptosaurus princeps, sp. nov.

In addition to the characters given when the genus *Glyptosaurus* was proposed,* the following, derived from a study of

* This Journal, vol. i, p. 456, June, 1871.

more complete specimens, may be mentioned. The entire body and tail was covered with ornamented osseous plates, most of them united by suture. The rami of the lower jaw were but loosely attached at the symphysis. There were numerous small teeth, "*dents en cardes*," on the pterygoids. The malar arch was complete. The parietals were thick, and there was a parietal foramen. The pelvic arch and the limb bones resemble those in the Iguanas, but the posterior limbs were proportionally smaller. The caudal vertebræ, in some species at least, were divided transversely by a thin unossified septum, so that the centra break there readily, as in many recent lizards. This genus and its allies evidently represent a distinct family, which may be called *Glyptosauridae*.

The present species exceeds in size any of the genus hitherto discovered. It is represented at present by the more important parts of a skull, with some portions of a skeleton and numerous scutes of one individual, and by a few other fragmentary remains. The lower jaws have their rami curved in front, like those of *Heloderma*. The lower teeth were close together, and had their bases deeply fluted. The frontal bones are very massive, and the longitudinal groove on their lower surface is proportionally narrow. The pterygoid teeth are numerous, and are closely and irregularly crowded together. They are tubercular, and collectively resemble the pattern of some of the dermal plates. The cranial scutes preserved have their tubercles more irregular in size and arrangement than in the other species of the genus. The remains indicate a reptile fully six feet in length.

Measurements.

Space occupied by anterior twelve lower teeth,	23• mm•
Width of frontals at posterior edge of nasal suture,	15•6
Width at posterior edge of prefrontal suture,	19•
Greatest thickness of frontals on median line,	5•
Width of cotylus of lower jaw,	12•
Longitudinal diameter,	8•

The type specimen of this species was found by the writer, in September last, in the Eocene shale at Grizzly Buttes, Wyoming.

Oreosaurus vagans, gen. et sp. nov.

This genus may be distinguished from *Glyptosaurus*, apparently its nearest ally, by the frontal bones, which are proportionally much narrower at their posterior margin, and broader between the orbits. The superior surface of these bones is, moreover, rough and granular, which would indicate that they were not covered with osseous scutes. The body was thus protected, but the dermal plates preserved, even those evidently

from the dorsal region, were united together by beveled edges. The teeth were pleurodont. The pterygoid bones supported minute tubercular teeth, resembling those of *Glyptosaurus*.

In the species here described the teeth are rodlike, with small bases, and obtuse striated summits, which are crowned by a low longitudinal ridge. The frontals are thick, and loosely united by suture. Between the orbits, their sides are nearly parallel. Their upper surface is evenly marked by small irregular tubercles. The dermal scutes preserved have a similar pattern, and some of them are carinate. The species was about three feet in length.

Measurements.

Space occupied by eight teeth near middle of lower jaw,.....	11.2 mm.
Space occupied by four anterior teeth of upper jaw,.....	5.
Width of band of small teeth on pterygoid,.....	4.6
Width of frontals at posterior margin,.....	13.
Width between orbits,.....	11.

The known remains of this species were found by the writer, last autumn, at Grizzly Buttes, Wyoming.

Tinosaurus stenodon, gen. et sp. nov.

A small carnivorous Lizard is indicated among our Wyoming fossils, by part of a lower jaw, with two teeth, in excellent preservation, and by some other fragmentary specimens. The teeth preserved are from near the middle of the lower jaw. Their crowns are short, much compressed, pointed, and curved backward. They are separated from each other about half the diameter of the crown. The anterior tooth is the larger, and has on its front edge a small cusp. The posterior tooth is tricuspid. On the outside of the jaw, in front of each tooth, is a groove cut by the opposing upper tooth, which was likewise compressed and pointed. The bases of the lower teeth are smooth and swollen. The animal thus represented was probably less than two feet in length.

Measurements.

Space occupied by three lower teeth,.....	4.5 mm.
Height of crown of lower tooth above jaw,.....	1.
Antero-posterior diameter at base,.....	1.8
Transverse diameter of jaw below teeth,.....	2.

The remains which can now with certainty be referred to this species are from Henry's Fork, Wyoming, and were found by Mr. J. F. Page, in September last.

PART II.

Glyptosaurus brevidens, sp. nov.

The present species is well represented by the greater portion of a skeleton in remarkable preservation. The reptile appears to have been covered up, soon after death, in the soft mud of the lake, and thus the bones, and even many of the dermal scutes, were preserved in their natural position. The remains indicate a species about as large as *Glyptosaurus ocellatus* Marsh, and probably a nearly related species. The frontals are proportionally thicker than in *G. sylvestris* Marsh, but are covered with similar scutes. The malar arch was massive. The teeth are rod-like, close together, and unusually short, projecting but slightly beyond the jaw. The summits are obtuse, and marked by irregular striæ. The pterygoid teeth are minute, and arranged in a narrow band. The dermal scutes on the malar region are very thick, and have their tubercles in concentric rows, forming an ocellated pattern. The dorsal plates are large, quadrilateral in form, with the lateral margins united by suture, and the ends imbricate. The exposed parts of these scutes are covered with small tubercles, arranged near the margin in rows. The center is more or less carinate longitudinally. The cervical vertebræ have a keel below, which gradually subsides in the dorsal region. The articular ball is surrounded by a deep groove.

Measurements.

Width of frontals between orbits,.....	19· mm.
Space occupied by five posterior upper teeth,.....	7·5
Width of occipital condyle,	8·
Depth of lower jaw at cotylus,.....	12·
Length of centrum of anterior dorsal vertebra,.....	11·
Width of articular cup,.....	6·8
Expanse of anterior zygapophyses,.....	15·
Length of dorsal scute,.....	13·5
Width of same,.....	8·

This specimen was found by the writer, last September, at Grizzly Buttes, Wyoming.

Glyptosaurus rugosus, sp. nov.

This species may be readily distinguished from *Glyptosaurus sylvestris*, and other allied forms, by the osseous scutes on the frontals, which are smaller than in any known species of the genus. These plates are prominently convex, and have their tubercles nearly all of equal size, and without definite arrangement. The prefrontal and postfrontal bones, moreover, approach each other, above the orbit, much more nearly than in

the species hitherto described. The remains preserved of this species indicate an animal about three or four feet in length.

Measurements.

Width of both frontals at posterior margin,.....	31. mm.
Width between orbits,.....	22.
Extent of postfrontal suture on frontal,.....	13.5
Distance between prefrontal and postfrontal,.....	3.2
Thickness of frontals on median line between orbits,.....	3.4

The only known remains of the present species were found, in September last, at Grizzly Buttes, by Mr. T. G. Peck, of the Yale party.

Glyptosaurus sphenodon, sp. nov.

A smaller species, probably belonging to the genus *Glyptosaurus*, is indicated in our collections by some fragmentary remains, among which the most characteristic specimen is a portion of an upper jaw with several teeth. These are peculiar, and differ essentially from any yet discovered in the Green River basin. The crowns are long, cylindrical, separated slightly from each other, and directed obliquely backward. The summits are compressed, and very sharp. The bases of the teeth are rugose, and the crowns smooth. This species was about two or three feet in length.

Measurements.

Space occupied by four upper teeth,.....	6. mm.
Height of upper tooth on inner side,.....	4.5
Extent beyond jaw,.....	2.
Antero-posterior diameter of crown,.....	1.2

The specimens at present representing this species were discovered last autumn, near Henry's Fork, Wyoming, by Mr. T. G. Peck.

Glyptosaurus ocellatus Marsh.

This Journal, vol. i, p. 458, June, 1871.

Among our Eocene fossils are several specimens which evidently belong to *Glyptosaurus ocellatus*, and fortunately afford additional specific characters. One of these specimens has the frontal bones perfect, one postfrontal, and a number of other important parts of the same skull and skeleton. The frontals are slightly sigmoid longitudinally, the posterior margin and the interorbital region being elevated. They are closely covered with thick osseous scutes, which have their tubercles so arranged as to form an ocellated pattern. The plates of the middle row on each frontal between the orbits have their length and width nearly equal. The pterygoid bones have a narrow band of teeth near their inner margin, and exterior to this in front a second short band. This species was rather larger than the type specimen of *G. sylvestris*.

Measurements.

Length of frontals on median line,	38· mm.
Width between orbits,	19·5
Width at posterior margin,	32·4
Transverse diameter of distal end of humerus,	18·4

The specimen here described is from Grizzly Buttes, Wyoming, and was found by Mr. J. F. Page.

Oreosaurus lentus, sp. nov.

Another species of lizard, which may be placed provisionally in the genus *Oreosaurus*, is indicated by a number of caudal vertebræ, widely different from any hitherto known. These vertebræ are short, and have the lower surface of the centra deeply excavated, longitudinally, by a broad groove, which makes the inferior border of the articular cup and ball emarginate. The chevrons are thus attached on either side to a prominent ridge, their position being a little behind the middle of the centrum. The reptile represented by the remains preserved was apparently about two or three feet long.

Measurements.

Length of anterior caudal vertebra on lower surface,	7· mm.
Transverse diameter of articular cup,	4·4
Vertical diameter,	2·
Distance from chevrons to end of ball,	3·5

The known remains of this species were found by the writer, in September last, near Henry's Fork, Wyoming.

Oreosaurus gracilis, sp. nov.

A somewhat smaller lizard, which may for the present be likewise referred to the genus *Oreosaurus*, is represented by several specimens, nearly all pertaining to different individuals. The most characteristic of these is the greater portion of a right lower jaw in perfect preservation. The teeth in this specimen are numerous, and close together. They are conical in form, with small bases, and smooth sharp summits, slightly compressed. The jaws were slender, and but loosely attached to each other by a small symphysis. The groove for Meckel's cartilage is narrow, and very short. The specimens preserved indicate a reptile about two feet in length.

Measurements.

Space occupied by the fourteen anterior teeth of lower jaw,	10·2 mm.
Depth of jaw below fourteenth tooth,	3·5
Thickness of jaw at this point,	2·4
Length of symphysis,	2·

The remains on which this species is based were found, last autumn, by the writer, near Henry's Fork, Wyoming. The geological horizon is Eocene.

Oreosaurus microdus, sp. nov.

Another species, apparently belonging to the genus *Oreosaurus*, and about as large as *O. gracilis*, may be established on some isolated remains which are quite characteristic. One of these is part of a lower jaw with the teeth in excellent preservation. The latter are unusually small and slender, and curve gently outward. The crowns are nearly round; the summits obtuse, somewhat compressed, and marked by irregular striæ. The jaw is stout, and the groove for Meckel's cartilage large.

Measurements.

Space occupied by four teeth from near middle of lower jaw,	2.4 mm.
Depth of jaw near middle,.....	3.5
Width of jaw near middle,.....	2.
Length of lower tooth including base,.....	2.

The only remains that can now with certainty be referred to this species are from the Eocene beds, near Henry's Fork, where they were found by the writer, last September.

Oreosaurus minutus, sp. nov.

A very diminutive lizard, with teeth closely resembling those of *Oreosaurus*, is indicated among our Wyoming fossils by some fragments of jaws and other less characteristic remains, belonging to several individuals, which differed somewhat in size, but agreed in their more important characters. The teeth in these specimens are cylindrical, slender, with small bases, and sharp summits. They are near together, and curve slightly inward. The rami of the lower jaw were quite slender, and apparently united together only by cartilage. Several vertebræ were obtained by our party, which probably pertain to this species. The remains preserved indicate reptiles not more than six or eight inches in length.

Measurements.

Space occupied by eight anterior teeth of lower jaw,.....	2.2 mm.
Depth of jaw below eighth lower tooth,.....	1.5
Thickness of jaw at this point,.....	.8
Space occupied by four upper teeth of larger specimen,...	2.

The type specimens of this species were discovered by the writer, last autumn, near Henry's Fork, Wyoming.

Tinosaurus lepidus, sp. nov.

A species of very small lizards, apparently belonging to the genus *Tinosaurus*, may be established on some fragmentary remains among our Wyoming fossils. One of these is the anterior half of a lower jaw in good condition. The teeth in this specimen are compressed, and closely resemble those in the chameleon. The rami of the lower jaw were stout, and not

deep, and met each other at a considerable angle. The symphysis is short, and its surface nearly smooth, showing that the rami were but slightly attached. The groove for Meckel's cartilage is unusually large. The animal represented by the remains preserved was probably not more than a foot in length.

Measurements.

Space occupied by four anterior lower teeth,	4· mm.
Depth of jaw below fourth tooth,	2·
Width of jaw at this point,	1·6
Length of symphysis,	2·

The specimen here described was found by Mr. O. Harger, in September last, near Henry's Fork, Wyoming.

Iguanavus exilis, gen. et sp. nov.

A new and interesting genus of extinct lizards, very different from those already described, may be predicated upon a number of vertebræ, and a few other isolated specimens which were brought to light during our explorations last year in the Eocene of Wyoming. The caudal vertebræ preserved are slender, and much elongated. The articular ball is but little depressed, only slightly inclined, and very convex. The chevrons are attached at the posterior end of the centrum, as in the Iguanas, to which the present species appears to be clearly related. The centra of the caudals, however, are less compressed than in that genus, and also want the unossified transverse septum. The vertebræ appear to have had only a rudimentary zygosphenal articulation. The specimens that can now be placed in this species belonged to animals about two feet in length.

Measurements.

Length of twelfth caudal vertebra on lower surface,	7· mm.
Transverse diameter of articular cup,	2·2
Vertical diameter,	1·8
Transverse diameter of articular ball,	2·

The remains above described were found last September, by the writer, near Henry's Fork, Wyoming.

Limnosaurus ziphodon, gen. nov.

Crocodylus ziphodon Marsh. This Jour., vol. i, p. 453, June, 1871.

Additional remains of this species, since obtained by the Yale party at the same locality as the type specimen, clearly show that it belongs to a genus quite distinct from the modern *Crocodylus*. The sharp, compressed teeth, with both edges serrated, differ widely from those of any known *Crocodylians*, and alone afford a good distinctive character. Others will be given in the full description.

Yale College, New Haven, Sept. 21st, 1872.