

ART. XLVIII.—Description of some new Fossil Serpents, from the Tertiary Deposits of Wyoming; by Professor O. C. MARSH, of Yale College.

AMONG the Reptilian fossils discovered by the Yale College party, during their explorations last summer in the Green River Tertiary basin, west of the Rocky Mountains, were the remains of several species of Serpents, which are of peculiar interest, as they are the first extinct Ophidians found in the interior of the continent, and, with the exception of three species from the Eocene marl of New Jersey,\* the only fossil representatives of this order yet detected in this country.

These remains, which are now in the Peabody Museum of Yale College, consist mainly of vertebræ, of various sizes, many of them more or less injured, but in general with the most characteristic parts well preserved. Nearly all the specimens obtained evidently belonged to constricting serpents, closely related to the modern Boas of South America, although considerably smaller, and generically distinct. A few of the specimens indicate snakes of moderate size, with apparently quite different affinities.

In comparing the larger series of these fossil vertebræ, especially those from near the middle of the trunk, with the corresponding vertebræ of the living species of *Boa*, a strong resemblance will be noticed in the more important characters, especially in the transversely elliptical outline of the articular cup and ball; in the obtuse lateral elevation extending from the diapophyses to the articular ball; and in the elongated median ridge on the inferior surface of the centrum. The differences between them, however, are important, and indicate clearly that the fossil specimens represent a separate genus, for which the name *Boavus* † is proposed, in allusion to the not improbable relationship of the two types. In the extinct genus, the articular ball and cup are more nearly vertical, and their outline forms a more full transverse ellipse. The neural arch is proportionally more elevated, and has on either side a low ridge, extending backward from the articular face of the zygosphene, and expanding over the zygantral cavities. The latter are more deeply excavated than in *Boa*. The neural spine is shorter, its antero-posterior extent, in the specimens in which it is preserved, being greater than its height. The diapophyses are convex throughout, while those of *Boa* are more or less concave on the lower part of their articular face. The lateral elevation, extending from the diapophyses to the articular ball, is, in *Boavus*, situated lower on

\* This Journal, vol. xlviii. p. 397, Nov. 1869.

† *Boa*, and *avus*, grandfather.

the centrum, and is less rounded. The hypapophysial ridge, also, is sharper, and extends nearer to the inferior edge of the articular ball.

From the vertebræ of *Dinophis* Marsh, which genus includes the only fossil Ophidians hitherto found in this country, as well as from those of the nearly allied *Palæophis* of Owen, the specimens of *Boavus* here described are widely separated, especially by their greatly inferior size; by the shorter neural spine; by the broader zygosphene, which exceeds in transverse diameter the articular cup, as in most modern serpents; by the elevation extending backward from the zygosphene; by the more expanded diapophyses; and by the well developed lateral and inferior median ridges on the centrum. The vertebræ of *Boavus*, however, resemble those of *Palæophis* and *Dinophis*, and differ from those of *Boa*, *Crotalus*, and many other modern serpents, in having the sides of the neural canal extended forward nearly to the edge of the articular cup.

*Boavus occidentalis*, sp. nov.

This species is established on eight vertebræ, nearly all from the middle dorsal region. They evidently represent several individuals, as they differ considerably in size, and were found at three separate localities. They indicate constricting serpents between six and eight feet in length. The neural arch in this species is elevated and massive. The neural spine is short, and triangular at its base, which rests on the posterior three-fourths of the arch. The zygosphene is convex above, slightly excavated in front, and without a median tubercle. The neural canal has a distinct median epapophysis on its floor, and sharp lateral ridges, which give it a sub-trifoliate outline. The diapophyses are auriform, and project below the inferior margin of the cup. The hypapophysis is a sharp ridge, beginning at the margin of the cup, and ending, just before reaching the ball, in an obtuse projection.

The principal dimensions of one of the largest vertebræ of this species are as follows:—

Length of centrum from edge of cup to convexity of ball,	4.50 lines.
Transverse diameter of cup,.....	2.80 “
Vertical diameter of cup,.....	2.50 “
Transverse diameter of zygosphene at base,.....	3.50 “
Distance from top of zygosphene to lower margin of cup,	5. “
Vertical diameter of ball,.....	2.45 “
Width of neural canal in front,.....	1.75 “
Height of neural canal in front,.....	1.10 “

The various specimens representing this species were found in September last by H. B. Sargent, A. H. Ewing, and the

writer, at Grizzly Buttes, near Fort Bridger, Wyoming Territory. The geological horizon is probably Eocene.\*

*Boavus agilis*, sp. nov.

This species, which was nearly the same in length as the preceding, although apparently much more slender, is indicated by five vertebræ, all from the dorsal region, and representing two or more individuals. They may readily be distinguished from the corresponding vertebræ of *B. occidentalis*, by the proportionally more elongated centrum; by the rounder and more inclined cup; by the more expanded anterior zygapophyses; by the diapophyses, which do not extend below the inferior surface of the centrum; and by the hypapophysial ridge, which is more obtuse, and in its anterior portion expands rapidly until it disappears in the margin of the cup.

The largest vertebra of this series has the following dimensions:—

Length of centrum from edge of cup to convexity of ball,	4.25 lines.
Transverse diameter of cup,.....	2.50 “
Vertical diameter of cup,.....	2.40 “
Vertical diameter of ball,.....	2.35 “
Width of neural canal in front,.....	1.75 “

The specimens on which this species is based were discovered by the writer, near Fort Bridger, in the same formation as the remains above described.

*Boavus brevis*, sp. nov.

The serpents representing this species were considerably smaller than those described above, and evidently much shorter in proportion to their bulk, being probably not more than four or five feet in length. The only remains obtained consist of three dorsal vertebræ, all in good preservation, and evidently belonging to two different individuals. These vertebræ have the centrum unusually short, its extent measured on the inferior surface scarcely exceeding the transverse diameter of the zygosphene. The neural arch is low, and bears on its posterior two-thirds the neural spine, which is quite short, and truncated. The zygosphene is less massive than in the preceding species, and has a slight median swelling on the anterior margin of its base.

The dimensions of the most perfect of these vertebræ are as follows:—

Length of centrum from edge of cup to convexity of ball,	2.20 lines.
Transverse diameter of cup,.....	1.60 “
Vertical diameter of cup,.....	1.25 “
Transverse diameter of zygosphene at base,.....	1.85 “
Distance from top of zygosphene to lower margin of cup,	2.80 “
Width of neural canal in front,.....	1.00 “
Height of neural canal in front,.....	.90 “

\* This Journal, III, vol. i, p. 192, March, 1871.

The specimens here described were found by H. B. Sargent, in the same fresh-water Tertiary deposits, and near the same locality, as the two preceding species.

*Lithophis Sargenti*, gen. et sp. nov.

This species and genus are at present represented by three trunk vertebræ, only one of which, however, is sufficiently well preserved to show all its more important characters. The specimens indicate a small serpent about four feet in length, and probably, like the preceding species, allied to the constrictors. From the vertebræ of *Boavus*, as well as from those of the other fossil Ophidians discovered in this country, the present specimens may be readily distinguished by the more compressed centrum, and especially by the articular cup and ball, which are circular in transverse outline, as in the Arican *Eryx*, and stand nearly at right angles to the axis of the centrum. The anterior zygapophyses, also, are more extended outward, and their articular faces have a greater antero-posterior expansion than in any of the described species. The diapophyses have their articular surfaces divided by a horizontal groove, having a rounded tubercle above, and a pointed projection below, as in the modern *Bascanion*. There is no lateral ridge extending from the diapophyses to the articular ball, as in *Boa* and *Boavus*, the converging sides of the centrum being nearly flat. The hypapophysis is reduced to a wedge-shaped ridge, extending the whole length of the centrum, and having its sharp apex below the inferior margin of the cup. The floor of the neural canal has a prominent, obtuse median ridge throughout its whole length, but no lateral ridges are apparent.

The principal measurements of the best preserved vertebra are as follows :

Length of centrum from edge of cup to convexity of ball,	2.80 lines.
Transverse diameter of cup,.....	1.35 “
Vertical diameter of cup,.....	1.35 “
Vertical diameter of ball,.....	1.30 “
Width of neural canal in front,.....	.90 “
Distance from end of anterior zygapophysis to hypapophysis, .....	3.00 “
Distance between ends of the anterior zygapophyses, -	4.50 “

For the extinct genus manifestly indicated by the fossils here described, the name *Lithophis*\* is proposed, and the species they represent may appropriately be called *Lithophis Sargenti*, after the discoverer, Mr. H. B. Sargent, of the Yale Scientific party, who found the specimens in the Eocene “Mauvaises Terres” beds at Grizzly Buttes, near Fort Bridger.

\* Λίθος, stone, and ὄφις, serpent.

*Limnophis crassus*, gen. et sp. nov.

One of the most interesting of the Ophidian fossils obtained during our explorations in Wyoming was a single anterior dorsal vertebra, very well preserved, and quite unlike any hitherto described. It indicates a moderately sized constricting serpent, perhaps six feet in length, but evidently of a very different type from the species already characterized. On comparing it with the corresponding vertebræ of *Boavus* and *Lithophis*, a striking difference is at once seen in the dimensions of the articular cup, which considerably exceeds in width the parallel diameter of the base of the zygosphenæ, a feature only observed heretofore in a few fossil serpents from the Eocene, and quite unknown in modern species. The cup and ball have a subtriangular, ovate outline, the greatest transverse diameter being above the center: they are also placed nearly at right angles to the axis of the centrum. Another marked peculiarity of this vertebra is the unusual posterior extension of the neurapophyses, which project some distance beyond the articular ball. Their nearly flat sides slope downward and outward like a gable roof, without any indication of the angle so characteristic of the vertebræ of *Palæophis*,\* which in several other respects the present specimen strongly resembles. The neural spine is unfortunately not preserved, but it was evidently short, and confined to the posterior two-thirds of the neural arch. The anterior zygapophyses had only a moderate expansion. The diapophyses have, for the attachment of the rib, a single, rounded, and prominent tubercle, with its lower border above the inferior margin of the cup, and with no indication of a dependant process. There is also no ridge extending from the diapophysis to the articular ball. The hypapophysis consists of a single, compressed, obtuse tubercle, which descends from the middle of the centrum downward and slightly forward; its base occupying rather more than half of the median line.

The more important dimensions of this vertebra are as follows:

Length of centrum from edge of cup to convexity of ball,	3.20 lines.
Transverse diameter of cup,-----	2.30 "
Vertical diameter of cup,-----	1.80 "
Vertical diameter of ball,-----	1.70 "
Distance from posterior summit of neurapophyses to inferior margin of ball,-----	3.50 "
Length of hypapophysis below inferior margin of cup,--	.90 "

This interesting vertebra, although the only one of the kind at present known, is so characteristic, and well preserved, and differs so widely from the corresponding remains of Ophidians

\* Memoirs of Paleontological Society of London, 1850, p. 57.

hitherto described, as to justify establishing for its reception a new genus, which may be called *Limnophis*.\* The species may properly be named *Limnophis crassus*, in reference to the probable proportions of the extinct serpent thus indicated. The specimen was discovered by Mr. A. H. Ewing, a member of the Yale party, in the Eocene fresh-water deposits, near Marsh's Fork, about fifteen miles from Fort Bridger, in Wyoming.

Yale College, New Haven, March 20th, 1871.