

On a Gigantic Saurian from the Dakota epoch of Colorado.

BY E. D. COPE.

Not long since I was informed by the Superintendent of Public Schools of Fremont County, Colorado, Mr. O. W. Lucas, that he had discovered the bones of an enormous saurian at an outcrop of the rocks of the Dakota group, not far from Canyon City. I encouraged him to proceed with the exploration, and asked him to send some specimens which should explain the character of his discovery. One of the first objects sent is a fragmentary lower jaw of a carnivorous dinosaurian, which he found on the surface of the ground. This fossil was found to belong to a species heretofore unknown, which I referred to the genus *Laelaps* under the name of *Laelaps trihedron*.* The second sending included a number of vertebræ, which apparently represent a much more gigantic animal, and I believe the largest or most bulky animal capable of progression on land, of which we have any account.

The vertebræ comprise a cervical, three dorsal and four caudal vertebræ. The dimensions of the animal to which they belonged may be inferred from the fact that the first is twenty inches in length, and twelve in transverse diameter; and that one of the dorsals measures three and a half feet in the spread of its diapophyses, two and a half feet in elevation, and the centrum thirteen inches in transverse diameter. Another dorsal is two feet ten inches in elevation.

The centra of these vertebræ have a ball and socket articulation of the opisthocælian type, the cups and balls being well pronounced. Just beneath the diapophysis is situated a huge foramen. A broken centrum from which Mr. Lucas removed the matrix, shows that this foramen communicates with a huge internal sinus, which occupies almost the entire half of the body of the vertebra. Those of opposite sides are separated by a septum which is thin medially. Thus the centra of the dorsals are hollow. The neural arches are remarkable for their great elevation, and the great expanse of the zygapophyses. They are more remarkable for the form of the neural spines, which are transverse to the long axis of the centrum. That of one of the vertebræ is strongly emarginate so as to be bifurcate. The widely extended diapophyses support the rib-articulations, and there are no capitular articular facets on the centra, but such are found on the basal region of the diapophyses in some vertebræ.

The supposed cervical vertebra is depressed, the anterior or convex extremity of the centrum the most so. It is remarkable for its elongate form exceeding the proportions found in known *Dinosauria* and *Crocodylia*, and resembling that seen in some fluviatile tortoises. Near the anterior extremity a short, robust parapophysis has its origin, from which it extends outwards and downwards, and soon terminates in a truncate extremity which presents downwards. A deep fossa occupies its upper base, and above

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this a deep linear foramen extends throughout the greater part of the length of the centrum. If this vertebra possesses a diapophysis it is rudimental. The caudal vertebræ are amphicælian, but not deeply so. They are subquadrate in section and not so short as the corresponding ones of *Hydro-saurus*. The most anterior one of the series has short robust diapophyses, and is more concave anteriorly than posteriorly. The other caudals are more equally bi-concave, but the cavity is very shallow on the most distal of them. The centrum is also relatively more elongate and compressed than those of the others. None of them display the lateral pneumatic fossa which exists in the dorsals, and, where broken so as to permit a view of the internal structure, the latter appears to consist of rather finely spongy tissue. The chevron facets are not very well defined, and the neural spines are of usual forms, and on the anterior two vertebræ, elongate.

Several genera have been described which possess some of the features presented by the one to which the present animal belongs. The following are characterized by the presence of the lateral sinuses of the vertebral centra: *Megadactylus* Hitch., *Cetiosaurus* Owen., *Ornithopsis* Seeley, *Bothrospondylus* Ow., and *Pneumatosteus* Cope. The first of these may be dismissed with the remark that its caudal vertebræ possess the sinuses as well as the dorsals, which we have seen is not the case with the Colorado animal. The centra of *Cetiosaurus*, according to Owen, and those of *Pneumatosteus* do not exhibit the cavernous structure above described, but are uniformly spongy interiorly. *Ornithopsis*, of Seeley, which Owen refers to his subsequently described *Bothrospondylus*, possesses a cavernous cellular internal structure, which I have not found in the reptile from Canyon City, Colorado, but which occurs in another huge saurian discovered by Prof. Lakes near Golden, Colorado, in the same stratigraphical horizon. Another name (*Chondrosteosaurus*) has been introduced by Prof. Owen, but he specifies no generic characters, nor points out how it differs from *Ornithopsis*, which it resembles in its cellular structure.

Prior to the reception of the present specimen, I was negotiating with Prof. Arthur Lakes, of Golden, Colorado, for the acquisition of another fossil skeleton of a gigantic saurian which he had discovered in that region. This gentleman sent for my inspection two vertebral centra with other fragments. Anticipating their purchase I made some remarks on their characters before a meeting of the American Philosophical Society held on July 20th of the present year. Before my arrangements with Prof. Lakes were completed, the bones which he had found were purchased by Prof. O. C. Marsh, of Yale College. The specimens in my possession were thereupon sent to Prof. Marsh, and my proposed article withdrawn from the hands of the printer. A short time previous to this, a portion of a sacrum of a saurian found by Prof. Lakes had been noticed by Prof. Marsh in the July number of the *American Journal of Science and Arts*, and he had given names generic and specific to the animal to which it belongs. That of the genus not being accompanied by any specific diagnosis nor specific reference to its characters, has no claim to adoption according to

the rules of nomenclature, nor can the genus be distinguished from some of those above enumerated from the few characters of mixed significance which are mentioned. Especially is there nothing to indicate that it differs from *Ornithopsis* or *Bothrospodylus*.

The opportunity of studying the dorsal and caudal vertebræ of the saurian discovered by Professor Lakes, enables me to point out the characters in which the animal from Canyon City differs from it. The centrum of the dorsal vertebra from near Golden is concave posteriorly and plane anteriorly, instead of being convex anteriorly. The supposed caudal is larger than the dorsal vertebra, while that of my specimen is smaller than that of the dorsal centra. The articular faces are nearly plane, not bi-concave, and the antero-posterior diameter of the centrum is disproportionately small, as in *Hadrosaurus*. It has a lateral fossa, and its interior is cavernous. A detached neural spine of this saurian has a form not widely different from what is usual in these reptiles, and totally unlike the extraordinary shape of the present genus.

On such grounds I regard the present species as representing a genus hitherto unknown, which may be called *Camarasaurus* and the species :

CAMARASAURUS SUPREMUS.

Many peculiarities are exhibited by the vertebræ of this species, which are not described in saurians known up to the present time. Many of these would have been lost in less careful hands than those of Mr. Lucas, and science is much indebted to him for the preservation of many thin osseous walls and buttresses. In general, the external walls of the centra are thin, and the processes are composed of laminae, united by narrow margins. The vertebræ are lighter in proportion to their bulk than in any air-breathing vertebrate.

The anterior extremity of the centrum of the cervical vertebra is prominently convex, and much depressed. The posterior and concave extremity is wider, and of rather greater vertical diameter. The base of the neural arch only occupies half of the length of the centrum, an equal extent of the superior surface extending freely beyond it at its anterior and posterior extremities.

The linear lateral foramen commences a little behind the anterior base of the neural arch, and descending somewhat in its direction, terminates beneath the posterior extremity of the base of the neural arch. The base of the latter overhangs the foramen and the base of the transverse process. The inferior surface of the centrum is concave, the concavity being bounded in front by the inferior convex thickening of the extremity. Behind the middle the surface becomes plane, and is, near the posterior extremity, bounded on each side by a short, angular ridge.

| <i>Measurements.</i> | M. |
|---------------------------------------------------------------------|------|
| Length of centrum between anterior convexity and posterior lip..... | .565 |
| Depth of posterior cup..... | .090 |

| | |
|---------------------------------|------|
| | M. |
| Diameter of cup { vertical..... | .310 |
| { transverse..... | .160 |
| Length of parapophysis | .095 |
| Width of neural canal..... | .063 |

The dorsal vertebra which I suppose to be the anterior one of those received is characterized by its undivided transverse neural spine. The entire neural arch is of enormous elevation, but as the zygapophyses are above its middle, the neural spine is not as long relatively as in various other genera, or as in the caudals of this one. The sides of the centrum are strongly concave, and the borders of the cup flaring. The neural arch is everywhere excavated, so as to reduce the bulk, and produce lightness so far as consistent with strength. The diapophyses rise from a point above the neural canal, and are directed upwards as well as outwards. It sends a narrow ridge down to the sides of the centrum, on each side of which its shaft and base are deeply excavated. The posterior of these fossæ is overlooked by the wide zygapophysis; and the roof of the anterior one supports the anterior zygapophysis. The former are separated by another and vertical septum, which bifurcates below, forming two prominent borders of the neural canal. At each side of the base of the neural canal there are two trilateral fossæ, of which the anterior is much the larger, and extends higher up on the lateral edge of the spine. They are separated by a lamina. The diapophysis is not very long, and is subtriangular in section near the extremity. The neural spine is thickened at the extremity as though for the attachment of a huge ligament. At the summit of its posterior basal fossa, at the middle of its height, is an outwardly curved process with a smooth, extero-superior face.

| | | |
|------------------------------------------------------|----------------------|------|
| | <i>Measurements.</i> | M. |
| Length of centrum..... | | .275 |
| Total elevation of vertebra..... | | .830 |
| Elevation to posterior zygapophyses..... | | .550 |
| “ of superior edge of diapophyses above centrum..... | | .350 |
| “ of neural spine above posterior zygapophyses..... | | .295 |
| Length of diapophysis behind..... | | .215 |
| Depth of extremity of do. (restored)..... | | .075 |
| Transverse extent of summit of neural spine..... | | .215 |
| “ “ neural spine at middle..... | | .330 |

Another dorsal vertebra is better preserved than the last described. It is distinguished by the lack of the median portion of the neural spine and the extension outwards, of the median lateral processes described above. The diapophyses are much larger, and the zygapophyses more extended transversely. The centrum is constricted at the middle, and especially just behind the convex articular extremity, whose circumference forms a prominent rim. The edges of the lip are flared outwards, forming a deep basin, much wider than deep. The fossæ described in the last vertebra

are present in this one, but differ in proportions, owing to the greater size and expanse of the superior parts of the neural arch. The fossa posterior to the base of the diapophysis is nearly plane, while that at the anterior base is deeply excavated, is narrower, and extends so far along the inferior side of the process as to give it a semi-circular section near the middle. Distally the diapophysis has a trialate section owing to its three longitudinal ridges, and the articular extremity is large and antero-posterior in direction. The process differs from that of the vertebra already described, in the possession of a facet near the middle of its anterior inferior bounding ridge, which is probably costal, as in the vertebræ of *Crocodylia*. The lateral foramen of the centrum is subround. The general surface is smooth.

| <i>Measurements.</i> | <i>M.</i> |
|-----------------------------------------------------------|-----------|
| Total elevation of vertebra..... | .770 |
| Total transverse extent of diapophyses..... | 1.010 |
| Diameter of centrum { longitudinal..... | .300 |
| { vertical of cup | .250 |
| { transverse " | .340 |
| { " at middle..... | .205 |
| Elevation of zygapophyses above centrum..... | .310 |
| Diameter of zygapophysis { transverse..... | .170 |
| { antero-posterior..... | .090 |
| Width of neural canal..... | .085 |
| Transverse extent of neural spine..... | .440 |
| Length of diapophysis from posterior zygapophysis..... | .320 |
| Antero-posterior width of end of diapophysis..... | .135 |
| Diameter of centrum of anterior caudal { fore and aft.... | .170 |
| { vertical | .245 |
| { transverse | .245 |
| Total elevation of do..... | .545 |
| Elevation of neural canal..... | .040 |
| Antero-posterior width of neural spine..... | .075 |
| Diameter of median caudal { fore and aft . | .180 |
| { vertical . | .200 |
| { transverse..... | .192 |
| Diameter of posterior caudal { fore and aft .. | .155 |
| { vertical | .175 |
| { transverse | .145 |

Besides the characters above-mentioned under the head of the genus, in which the vertebræ of this species differ from those found by Professor Lakes, I may add that they also differ in general proportion. Those of the *Camarasaurus*, are relatively shorter and wider, and more depressed, with deeper cup, and less elongate lateral foramen or fossa. The proportions of the caudals differ totally. The dorsal vertebræ are larger than those of the Golden City saurian.

What the total dimensions of this saurian are, is not readily estimated

without further data. Six cervical vertebræ of the length of the one described would give a neck of ten feet in length. The femur, which I have not yet received, is stated by Mr. Lucas, to be six feet in length. I hope ere long to be able to give a fuller account of this remarkable creature, which exceeds in its proportions any other land animal hitherto discovered, including the one found near Golden City by Professor Lakes.

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