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XXIV.—*On the Occurrence in North America of rare Extinct Vertebrates found fragmentarily in England.* By Prof. R. Owen, C.B., F.R.S., &c.

[Plates X. & XI.]

Part I. Restoration of *Chondrosteosaurus*.

Of such species, one of the most, if not the most, extraordinary which has come under my observation is the extinct reptile on certain vertebræ of which I founded, in 1876, the genus *Chondrosteosaurus* and the species *Ch. gigas**.

The centrum of an "anterior trunk-vertebra," the position of which, by characters continued, in *Crocodilus*, from the posterior cervicals to the anterior dorsals, I would not more precisely define, presented a length of 1 foot 3 inches (375 millims.). Another and more posterior vertebral centrum, and a third more mutilated one, of which I made a section showing its imperfectly ossified structure, were, and still are, all the evidences of *Chondrosteosaurus* which have reached me from British Wealden strata: the locality was the submerged bed on the south coast of the Isle of Wight.

I am of opinion, however, that our knowledge of this huge and singular Saurian has been extended by discoveries, in 1877, of fossil remains in the Mesozoic formations of Fremont County, Colorado, U. S., due to the persevering researches of the Superintendent of Public Schools in that county, Mr. O. W. Lucas.

* "Monograph on the Fossil Reptilia of the Wealden Formations," in the Palæontographical Society's volume issued in 1876, p. 5, pls. ii.–v.

This opinion is grounded on the following concordancies of the characters which I assigned to the genus with those noted by Prof. E. D. Cope in a seemingly homologous vertebra, which he terms "cervical," and which was submitted to his examination by Mr. Lucas.

1. *Terminal Articulations of Centrum.*

The first character which I assigned to *Chondrosteosaurus* was founded on the form of the terminal articular surfaces of the centrum. "The hemispheroid convexity of the anterior end (*a*)" was proved to be such, notwithstanding some abrasion of the fossil, "by the more perfect preservation of that surface in the opposite concave articular end, *b* (plate iii.)"*.

The vertebræ, at least at the fore part of the trunk, were thus of the type which I have characterized as "opisthocœlian"†.

Prof. Cope states that "a cervical and three dorsal vertebræ" of the Saurian here compared "have a ball-and-socket articulation of the opisthocœlian type"‡. This character, however, in parts of the vertebral column is common to other genera (*Streptospondylus*, *Cetiosaurus*, *Iguanodon*, e. g.)§.

2. *Osseous Structure.*

The next character of *Chondrosteosaurus* is taken from the osseous structure of the vertebræ. It was yielded by "the large cancelli obvious at every fractured surface of the vertebra," and was further tested and exemplified by "a vertical longitudinal section of a rolled and worn centrum of a second anterior trunk-vertebra, figured three fourths of the natural size in plate v. fig. 2"‖. Of these cancelli it is remarked, "I deem it much more probable that they were occupied in the living reptile by unossified cartilage or chondrine than by air from the lungs"¶. They might be termed, from their size, huge internal sinuses.

So Prof. Cope writes, "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 centrum. Those [sinuses]

* Monogr. cited, p. 5.

† Reports on British Fossil Reptilia, *passim*; Anat. of Vertebrates, 8vo, vol. i. p. 59; and 'Palæontology,' 8vo, p. 300.

‡ "On a gigantic Saurian from the Dakota Epoch of Colorado," in the Palæontological Bulletin, no. 25, 8vo, p. 5, published August 23, 1877.

§ Report on British Fossil Reptiles, pt. ii. 1841, pp. 88–102.

‖ Monogr. cited, pp. 6, 7.

¶ Ibid. p. 6.

of opposite sides are separated by a [bony] septum which is thin medially"*. In the 'Palæontological Bulletin,' no. 28, the author writes, "the centra of the dorsal vertebræ are hollow, including two large chambers which are separated by a longitudinal wall"†.

In regard to the "cervical vertebra," Prof. Cope speaks of "the interior chambers"‡ as differentiating them from the "dorsal centra," in which "there are but two chambers, which are separated by a longitudinal median septum"§. Such is the difference indicated in the more anterior and the less anterior of the trunk-vertebræ from the Isle of Wight in regard to my second character of *Chondrosteosaurus*. It does not appear, however, that this largely cancellous structure was investigated or exposed in the Colorado vertebræ, as in the British Wealden ones, by special sections; allusion is only made by Prof. Cope to the "broken centrum from which Mr. Lucas had removed the matrix"‖.

I believe myself justified nevertheless in concluding that the characters, from internal structure as from terminal articulations and lateral fossæ, on which the genus *Chondrosteosaurus* was founded, equally denote the "gigantic Saurian from the Dakota epoch of Colorado."

3. *Costal Articulations.*

A third character, if an extinct reptile be indicated solely by cervical or anterior dorsal vertebræ, is to be derived from the processes or surfaces which such vertebræ afford for the articulation of the ribs. In modern Reptilia such processes are single on each side in lizards, double in crocodiles. For the needs of intelligible description of the numerous and varied fossil vertebræ submitted to or observed by me in the course of preparing my 'Report on British Fossil Reptiles' (1840 and 1841), I proposed to call, in the vertebræ showing the double joint, the lower or capitular articular costal process "parapophysis," the upper or tubercular one "diapophysis."

In characterizing the Wealden fossils in question it is written:—"That the vertebra is from the fore part of the trunk may be inferred from the presence, on each side, of both a parapophysis (plate ii. *p*) and a diapophysis (ib. *d*), indica-

* *Loc. cit.* p. 5.

† 'Proceedings of the American Philosophical Society,' vol. xvii. no. 100, May to December, 1877, p. 233.

‡ *Loc. cit.* p. 334. § *Loc. cit.* p. 235.

‖ Pal. Bull. no. 25, p. 5, August 23, 1877.

tive of the bifurcation of the proximal end of the rib into a a capitular and a tubercular articulating process" *.

Of "the supposed cervical vertebra" from Dakota, Prof. Cope writes:—"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 this a deep linear foramen extends throughout the greater part of the length of the centrum."

Of the dorsal vertebræ Prof. Cope writes:—"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" †.

So, likewise, in a vertebra of *Chondrosteosaurus* which had "come from a more posterior part of the column," I note that "the parapophysis" (or "capitular articular facet") "had disappeared, at least from the position from which it projects in the subject of plate ii." ‡

Thus there is correspondence of the fossils compared in characters of the rib-joints, as in those of the terminal articulations and of the osseous texture.

4. *Parapophysis.*

But this correspondence is further carried out in the shape, direction, and position of the parapophyses of the cervical or anterior trunk-vertebræ. In *Chondrosteosaurus* "the fore part of the base of the process occupies the lower vertical half of the centrum, commencing at some distance from the hind end, and terminating very near the beginning of the anterior articular ball" §.

The close similarity in proportion and position of the parapophyses (*p*) is exemplified in Pl. X. fig. 1, from the reduced view given in my 'Monograph' of 1876, pl. ii. fig. 2—and in that (Pl. X. fig. 3) copied from fig. *a*, pl. i., appended by Prof. Cope to the paper "On the Vertebrata of the Dakota Epoch of Colorado," in the 'Proceedings of the American Philosophical Society,' no. 100, vol. xvii. 1877.

5. *Fossæ of Centrum.*

To come to minor characters. In *Chondrosteosaurus* "the whole side of the centrum is occupied by a deep oblong de-

* Monogr. cited, p. 5.
† Pal. Bull. no. 25, 1877, p. 7.
‡ Monogr. cited, p. 7.
§ Ibid. p. 7.

pression, which probably lodged a corresponding saccular process of the lung. On one side this depression was partially divided by a thin oblique plate (pl. v. fig. 1, *f*, *f*); its relative position beneath the base of the diapophysis is shown at *d*"*.

So also in the "enormous Saurian of the Dakota group," "just beneath the diapophysis is situated a huge foramen"†. And in Prof. Cope's subsequent and fuller description, "the centra of the cervicals and dorsals are hollow, and the interior chambers communicate with the cavity of the body by a large foramen on each side, which is below the base of the diapophysis. In the cervical region it is very elongate, and extends between the bases of the parapophysis and diapophysis"‡.

6. *General Proportions and Shape.*

The centrum of the anterior trunk-vertebræ of *Chondrosteosaurus*, the subject of plates ii., iv., and v. fig. 1, is notable for its great longitudinal and small vertical diameter and the flatness of the under surface (Pl. X. fig. 1).

So likewise with the Dakota Saurian, "The supposed cervical vertebra is depressed; the anterior or convex extremity is the most so. It is remarkable for its elongate form, exceeding the proportions found in known *Dinosauria* and *Crocodilia*"§. In truth the only known vertebra of considerable proportions was the subject described and figured, under the heading "Order DINOSAURIA (?); Genus *Chondrosteosaurus*; species *Chondrosteosaurus gigas*, Owen," in the Monograph of 1876.

7. *Size.*

But, huge as were the fossil vertebræ from the Wealden, which suggested the *nomen triviale*, they are surpassed by the subjects of Prof. Cope's description.

The length of my specimen was 1 foot 3 inches; and I ventured to state, with respect to this dimension, that the vertebra equalled "in length the largest one of any Cetacean recent or fossil"‖.

Of the Dakota monster Prof. Cope states, "the dimensions of the animal to which they belonged may be inferred from the fact that the first [cervical vertebra] is twenty inches

* Monogr., Pal. Soc. vol. 1876, p. 6.
† Pal. Bull. no. 25, 1877, p. 5.
‡ Proc. of Amer. Phil. Soc. 1877, p. 236.
§ Pal. Bull. no. 25, 1877, p. 5.
‖ Monogr. 1876, p. 6.

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" *.

From the numerous and close agreements demonstrable between my "anterior trunk-vertebra" and Prof. Cope's "supposed cervical vertebra," I am quite prepared to receive from our submerged Wealden deposits of the Isle of Wight a dorsal vertebra rivalling the dimensions of the Dakota one, in the ratio of 1 foot 3 inches to 1 foot 8 inches, which differentiates the dimensions of the more advanced vertebræ compared. But that so rich an accession of illustrations of this probably "largest or most bulky animal capable of progression on land" † as the Dakota rocks have revealed at their outcrop, should be extracted from the resting-place of the British giant, would be an event that I cannot flatter myself that I shall contemplate during the brief remnant of my working days.

Concluding, from the seven characters assigned in the monograph of 1876 to *Chondrosteosaurus*, that the remains from Dakota, affording their describer the same seven characters, are of that genus and probably of the same species, the additional elements toward its reconstruction brought to light by Mr. Lucas and described by Prof. Cope constitute a most acceptable and interesting accession to the knowledge of extinct Reptilia.

In Prof. Cope's 'Palæontological Bulletin,' no. 25, he reports, "The vertebræ comprise a cervical, three dorsal, and four caudal vertebræ" ‡.

The characters of the first two kinds are quoted above.

"The caudal vertebræ are amphicœlian, but not deeply so; they are subquadrate in section." "The most anterior one of the series has short robust diapophyses, and is more concave anteriorly than posteriorly. The other caudals are more equally biconcave; 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 the usual forms, and on the anterior two vertebræ elongate.

"The dorsal vertebra which I suppose to be the anterior

* Pal. Bull. no. 25, 1877, p. 5. † Ibid. ‡ Ibid.

one of those received, is characterized by its undivided transverse neural spine. The entire neural arch is of enormous elevation; but as the zygapophyses" (Pl. X. fig. 4, *z*, *z'*; the letters indicative of parts are added to my copy, not being given in the original) "are above its middle, the neural spine [ib. *ns*] is not as long relatively as in various other genera, or as in the caudals of this one. The sides of the centrum [*c*] are strongly concave, and the borders of the cup [*c'*] flaring. The neural arch is everywhere excavated, so as to reduce the bulk and produce lightness so far as consistent with strength. The diapophyses [*d*] 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 [*z'*]; and the roof of the anterior one supports the anterior zygapophysis [*z*]. The former are separated by another and vertical septum, which bifurcates below, forming two prominent borders [*n*, *n'*] of the neural canal. At each side of the base of the neural canal there are two trilateral fossæ, of which the anterior [*p*] is much larger and extends higher up on the lateral edge of the spine. They are separated by a lamina. The diapophysis [*d*] 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.

"*Measurements.*

	m.
"Length of centrum	·275
Total elevation of vertebra	·830*
Elevation to posterior zygapophyses	·550
Elevation of superior edge of diapophyses above centrum	·350
Elevation of neural spine above posterior zygapophyses	·295
Length of diapophysis behind	·215
Depth of extremity of ditto (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

* [= 2 feet 8½ inches.]

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 semicircular 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 *Crocodilia*. The lateral foramen of the centrum is subround. The general surface is smooth" *.

The neural arch is confluent with the centrum.

In a later account of the gigantic Saurian † the dorsal vertebræ are again stated to be "remarkable for the enormous elevation of the superior arches and diapophyses, the result of which is to give the ribs an unusually elevated basis, and the cavity of the body much space above the vertebral axis on each side. On the other hand the bones of the tail and limbs are solid or nearly so, in great contrast with some of the Dinosauria of later geological periods. Another peculiarity is the probable great length of the anterior limbs. The scapula is enormous as compared with the pelvic bones. The sacrum is also small and short, showing that the weight was not borne on the hinder limbs." It appears also that *Chondrosteosaurus* resembled *Cetiosaurus* in the "pitted surface of the articular end of the limb-bones."

Reverting to character 2, common to *Chondrosteosaurus* and the Dakota monster, it will be seen that there is a difference of opinion between Prof. Cope and myself as to the contents, in the living giants, of the "huge internal sinuses" of their vertebral centrums. In the Wealden fossils, and, I suppose, also in the Dakota ones, they are occupied by mineral matter derived from the matrix. When Prof. Cops, states

* Pal. Bull. pp. 8, 9.

† 'Proceedings of the American Philosophical Society,' vol. xvii. no. 100, May to December, 1877, p. 233.

"thus the centra of the dorsals are hollow" *, I infer him to mean that, in the recent state, the vertebral sinuses of his reptile, like those in the pneumatic vertebræ of a bird, were filled with air; and he states that "they communicated with the cavity of the body by a foramen on each side" †—meaning, I presume, with such parts of that cavity as were continued from the lungs and contained air. This, indeed, is placed beyond doubt by the term "pneumatic" applied to the lateral fossæ in the dorsal and cervical centrums. On this assumption he affirms, "the vertebræ are lighter in proportion to their bulk than in any air-breathing animal," the cancelli being relatively larger than in the vertebral centra of birds. If, as I believe, the cancelli were occupied by unossified gristle, or "chondrine," and supposing the deficiency of the thin layer of bone at the bottom of the lateral fossæ to be natural, there would be no communication of the cancelli with the cavity of the body or of any viscus therein lodged. The vertebral centra would be solid, although constituted of two tissues, as I conclude to have been the case with those of *Poikilopleuron*, in which the centrum is excavated by a large central cavity or sinus (Pl. X. fig. 5, *ih*), although there are no lateral fossæ ‡. On the other hand the lateral fossæ may exist without cancelli or sinuses in the substance of the centrum, as *e. g.* in *Bothriospondylus suffossus* §. In *Bothriospondylus robustus* ‖ the cancelli are small, numerous, longitudinally extended, ill-defined, wholly unlike the pneumatic cancelli in the vertebræ of birds and Pterodactyles. But the lateral fossæ in extent and depth much resemble those in *Chondrosteosaurus*, and retain their lining of thin compact bone unbroken or imperforate.

In *Cetiosaurus longus* ¶ the lateral fossæ coexist with a closer osseous texture of the centrum than in *Bothriospondylus*; the anterior trunk-vertebræ are opisthocœlian, as in *Chondrosteosaurus*. The lateral depressions at the upper part of the sides of the centrum occasion a "singularly compressed upper portion of such centrum underlying the neural canal and forming a vertical medial plate of bone, three or four inches in height and but six or eight lines in thickness" **; but whatever parts in the thoraco-abdominal cavity may

* Pal. Bull. 1877, p. 5.

† Proc. Amer. Phil. Soc. 1877, p. 233.

‡ Monogr. 1876, pl. i. fig. 3, *ch*.

§ Monograph on the genus *Bothriospondylus* in the volume of the Palæontographical Society issued 1875, pp. 17–20, pls. iv. & v.

‖ Ibid. p. 21, pl. vi. ¶ Ibid. p. 29, pl. x. ** Ibid. p. 30.

occupy or line these depressions, they unquestionably do not convey air into the osseous substance of the vertebra.

In *Omosaurus* also there is a depression on each side of the centrum, in the dorsal vertebræ, "beneath the base of the neural arch" *; but the osseous tissue is as in *Cetiosaurus*. There are no cancelli to communicate with the lateral fossæ.

In the comparison of the vertebræ of *Poikilopleuron*, in which the lateral fossæ are wanting, with those of *Cetiosaurus* and *Omosaurus*, it is noted that "ossification is incomplete and large chondrosal vacuities are left in the substance of the centrum, which, in the fossils, become filled with spar" †.

It seemed reasonable therefore to conclude that in a vertebra combining the lateral fossæ of *Bothriospondylus* with the cancellous texture of *Poikilopleuron* the cancelli, filled with spar in the fossils, might have been occupied by chondrine in the living reptile.

8. *Relative Capacity of the Neural Canal.*

I could not, however, be satisfied with this conclusion or opinion so long as there remained any test to which it might be subjected. It may seem strange that the neural canal should offer such test; but I was attracted to this part of the vertebra for the light it might throw on the point at issue.

All existing air-breathing Vertebrates which have the bony tissue of the centrum cancellous, especially so largely and widely cancellous as in *Chondrosteosaurus* (with which, in this character, birds of flight alone can be compared), and which have such cancelli filled with air, are remarkable for the frequency and vigour of their muscular actions; and such actions, in birds and bats, are correlated with powers of flight.

With this vital energy of the muscular system there is a concomitant development of the nervous system, at least of that division of the central chord which gives origin to the motor stimuli; and the size of the myelon affects that of the neural canal.

To this part, therefore, of the vertebræ of *Chondrosteosaurus* my attention was directed, and, as related in my description ‡, and shown in the figure §, that canal was singularly contracted in proportion to the size of the vertebra (Pl. X. fig. 2, *n*).

A similar narrow neural channel is figured in the view of the anterior trunk-vertebra (copied from Prof. Cope's plate i.

* Monograph on *Bothriospondylus*, Pal. Soc. vol. 1875, p. 48, pl. xii. fig. 3, *f*.

† Ibid. p. 28.

‡ Monogr. cited, Pal. Soc. vol. 1876, p. 6.

§ Ibid. pl. iv. *n*.

fig. 1) in Pl. X. fig. 3, illustrating the present communication. This concordance, indeed, between the Wealden Chondrosteosaur and the Dakota gigantic Reptile may be reckoned as an eighth character and evidence of their generic relationship. In further illustration of this significant indication of the sphere and grade of locomotion in my reptile, I added the figure of a corresponding view of a vertebra of an eagle (Pl. X. fig. 6) *.

It was rather hard, after the pleasurable pains which I had taken to make my few vertebræ as useful as possible to future finders, to have my proposed generic name superseded by *Camarosaurus*, Cope, and still harder to read, in the Professor's excellent supplementary notices of the genus, "Another name (*Chondrosteosaurus*) has been introduced by Prof. Owen; but he specifies no generic characters" †.

A name, notwithstanding Linné's estimate ‡, interests me less, in the present case, than the nature and affinities of the gigantic Saurian in question; and towards the latter knowledge Prof. Cope's descriptions give acceptable and valuable aid.

On the limited foundation to this end available in 1876, I was led to refer *Chondrosteosaurus* to the Dinosaurian order, but with a sign of doubt §.

A sacrum, part of a sacrum, perhaps a single sacral vertebra might have dispelled the doubt. Mr. Lucas was so fortunate as to secure the entire sacrum of the Dakota reptile. Its small size and an inference as to its function are noted above. Prof. Cope has added to that notice the following description:—

"It consists of only four vertebral centra, thoroughly coossified. The anterior articular extremity is convex, that of the posterior extremity slightly concave. Its transverse processes are, like those of the other vertebræ, much elevated, although they spring from the centra. The external face of their bases is not prominent; and the spaces between their projecting portions are deeply excavated. The extremities of the adjacent transverse processes are united, thus inclosing large foramina" ‖.

In the Dinosaur of the skeleton of which we have the most complete restoration (i. e. *Scelidosaurus*), the sacrum consists of four coalesced vertebræ; the transverse processes are

* Monogr. 1876, pl. iv. fig. 3.
† Bullet. cit. p. 6.
‡ "Nomina si pereunt, periit et cognitio rerum."
§ Monogr. 1876, p. 5—"Order Dinosauria (?)."
‖ Proceedings of the Amer. Philos. Soc. 1867, p. 235.

expanded at their termination, "and thus touch each other, or nearly so, at their ends" *.

A large foramen so enclosed is shown in the figure cited. This characteristic of the Dinosaurian sacrum is more strikingly exhibited in the 5-jointed one of the Iguanodon, in which there are four such large foramina on each side †.

We have thus ground for testing the inference drawn by Prof. Cope, viz. that, with regard to the bulky Saurian of Dakota, "the weight was not borne on the hind limbs." This statement has a meaning on the assumption that the Professor accepts the notion that the previously known Dinosauria, or some of them, marched on their hind legs like birds. What proportion of the weight of *Chondrosteosaurus* might be so sustained we may infer from the analogy of *Scelidosaurus*. Of this Dinosaur both humerus and femur of the same individual are preserved in the specimen now in the British Museum. The relative size of these bones affords an estimate of the share they respectively took in the sustentation and motion of the Saurian on dry land. The femur ‡ is twice the length and more than twice the thickness, in the shaft, of the humerus §.

It may be that well-ascertained specimens of these bones in *Chondrosteosaurus* will exhibit similar proportions.

Prof. Cope, however, writes, "The bones of the tail and limbs are solid or nearly so, in great contrast with some of the Dinosauria of later geological periods. Another peculiarity, of the genus *Camarosaurus* at least, is the probable great length of the anterior limbs. The scapula is enormous as compared to the pelvic bones" ||. "The great length of the humerus in the probably allied genus *Dystropheus*, from the trias of Utah, adds to the probability that the same bones were large in *Camarosaurus*. This character, taken in connexion with the remarkably long neck possessed by that genus, suggests a resemblance in form and habits between these huge reptiles and the giraffe" ¶.

Until, however, a humerus of *Chondrosteosaurus* be unequivocally discovered, it appears to me that the analogy of the dinosaurian *Scelidosaurus* offers safer guidance than the mammalian genus *Camelopardalis*.

* "Monograph on a Fossil Dinosaur," &c., in the Palæontological Society's volume issued 1862, p. 7, pl. vi. fig. 1.

† Owen, 'History of British Fossil Reptiles,' 4to, pt. vi. (1855) pl. 8.

‡ Monogr. 1855, pl. x. 65.

§ Ibid. pl. iii. 53.

|| Proc. Amer. Philos. Soc. 1877, p. 233.

¶ Ibid. p. 234.

We may assume that the femur of *Chondrosteosaurus* was discovered by Mr. Lucas in such contiguity with the other sufficiently characteristic and previously characterized bones of that genus as to justify the following description of such bone by Prof. Cope:—

"The femur is long and without prominent third trochanter, this process being represented by a low ridge. The condyles have an extensive posterior sweep, and are separated by a shallow trochlear groove in front"*.

In *Scelidosaurus* also the process called "third trochanter" in *Iguanodon* is reduced to, or represented by, a ridge from near the middle of the inner side of the shaft†; and "the condyles are but feebly indicated by a shallow notch on the fore part, but more distinctly behind, where they are produced backward"‡.

In the absence of a figure of the femur of *Chondrosteosaurus*, we may infer that, amongst known Dinosaurs, it most resembled that of *Scelidosaurus*. The main difference is in size. The femur of *Chondrosteosaurus* is, in length, 1820 millims., that of *Scelidosaurus* is 403 millims.

"The tibia of *Chondrosteosaurus*," like that of *Scelidosaurus*, "is much shorter than the femur"§; and "the astragalus is evidently distinct from it"‖, as it is, likewise, in *Scelidosaurus*¶, in which, however, I consider the naviculare and the ento- and mesocuneiform tarsals, in mammals, to have coalesced with the astragalus.

Prof. Cope figures the right scapula of *Chondrosteosaurus*, and gives the following description:—"The scapula is relatively of large size. It is rather elongate, and the superior extremity is expanded. There is a very large mesoscapular process, which is wanting in *Cetiosaurus*, according to Phillips's figures. It appears to resemble the scapula in *Dystropheus*. (See Report of Lieut. Wheeler, vol. iv. pl. lxxxiii. p. 31). The two proximal faces, the glenoid and the coracoid, are well distinguished; and their surfaces are, like the corresponding faces of other bones, pitted coarsely"**.

Besides the scapula of *Cetiosaurus*††, that of *Iguanodon*‡‡ and of *Scelidosaurus* are sufficiently entire to be comparable

* Proc. Amer. Philos. Soc. 1877, p. 236.
† Monogr. 1855, pl. x. 63, *t*.
‡ Ibid. p. 15.
§ Cope, Proc. Amer. Phil. Soc. 1877, p. 236.
‖ Id. ibid.
¶ Monogr. 1855, pl. x. *a*.
** Proc. Amer. Philos. Soc. 1877, p. 235.
†† Monogr. 1875, p. 32, fig. 2.
‡‡ Hist. of Brit. Fossil Reptiles, pt. vi. 1855, pl. 19. fig. 1.

with that of *Chondrosteosaurus*. In *Iguanodon* the breadth of the humeral end is two sevenths the length of the scapula; in *Cetiosaurus* it is not quite one half that length; in *Scelidosaurus* it is one half that length; in *Chondrosteosaurus* it is two thirds that length. In the degree of expansion of the humeral end of the scapula the *Scelidosaurus*, amongst the Dinosauria as known to me, makes the nearest approach to *Chondrosteosaurus*. The part called "mesoscapular process" is not indicated in Prof. Cope's figure. On the supposition that it may be the low ridge there shown, a similar ridge from the middle of the anterior border of the bone is indicated in the scapula of *Scelidosaurus*.

The coarse pitting of the articular surfaces of the limb-bones and arches are most common and best marked in the marine Reptilia (*Ichthyo-* and *Sauro-pterygia*); the degree in which the same character is marked and prevails in the limb-bones of other Saurians points to the predominance of the sea over the land as the theatres of their life-acting. This inference I have drawn and applied to the *Cetiosauri*; it is as legitimate an application in considerations of the way and medium of life of *Chondrosteosaurus*. Not that I deem the Cetiosaurs or any form of Dinosauria to be as exclusively aquatic as the Plesiosaurs; but the degree or proportion of their time passed in water may be inferred from such a character as that noted by Prof. Cope in the articular surfaces of the scapula and in those of the acquired long bones and limb-bones of *Chondrosteosaurus*.

On the pneumatic hypothesis of the cancellous structure of the vertebræ, the conclusion drawn by Prof. Seeley would be equally just and legitimate, viz. that such huge Dinosaurs were "constructed after the lightest and airiest plan, such as is only seen in Pterodactyles and in birds," that the species is "therefore clearly ornithic" and entitled to the designation of *Ornithopsis**.

Prof. Cope, indeed, accepts the consequent inference, viz. that *Chondrosteosaurus* "carried its neck erect after the manner of birds;" but he prefers to compare the reptile, on the assumed concomitant length of a hypothetical humerus, to the giraffe.

As, however, I find the closest resemblance of the parts of the framework of *Chondrosteosaurus*, of which such acceptable additions have been brought to our cognizance through the praiseworthy labours of Prof. Cope and Mr. Lucas†, to those of previously known Dinosauria, it is in that order that I find

* Ann. & Mag. Nat. Hist. 1870, 4th ser. vol. v. p. 279.

† To the latter gentleman the Professor bears the following testimony:—"Credit is due to Superintendent O. W. Lucas for this discovery, and

the most trustworthy and acceptable guides to the true nature and way of life of the stupendous Saurian of the Dakota horizon. As a Bothriospondylian genus the side-pits may have received, as I have suggested, saccular portions of the lung; and the service derived therefrom might be such as the *Gadus navaga* receives by the extension of sacculi of the air-bladder into the excavations of the parapophyses of its abdominal vertebræ—a diminution, viz., of specific gravity facilitating natation.

To the functions with which the further extension of air into the osseous tissue is related, the degree of solidity ascribed to the limbs of *Condrosteosaurus* would be adverse. In that limb-character I see the affinity of the genus to *Cetiosaurus*. In that genus, in *Iguanodon*, and in *Scelidosaurus* the fore limbs manifest the proportions which least impede the faculty of swimming exercised by the powerful hind limbs and tail. From the quantity of unossified tissue in the vertebral column, and from the restriction, as a Dinosaur, of the number of sacral vertebræ, I infer that *Chondrosteosaurus* was more aquatic, less terrestrial, in its life and movements than were the *Iguanodon* and *Megalosaurus*.

It is as interesting as it was unexpected to possess the knowledge of the extensive geographical range of the hugest of the hitherto characterized extinct Reptilia.

As to the geological position of the American representative of our Wealden *Chondrosteosaurus*, Prof. Marsh sees grounds for identifying what is, according to Prof. Mudge, the same horizon as the Dakota with the Wealden of England. But Prof. Cope remarks:—"Specimens from the northern locality which I have examined render it certain that the horizon is that of Mr. Lucas's excavations. Of this I may say that there is no palæontological evidence of its identity with the Wealden. The resemblance of the vertebrate fossils to those of the English Oolite is much greater, but not sufficient as yet for identification. The discovery of Vertebrata in the strata of the Dakota epoch is an important addition to the geology and palæontology of North America"*.

If, however, the legitimate inference from the above detailed conformity of characters between *Chondrosteosaurus* and *Camarosaurus* be accepted, it will supply an evidence of the accuracy of Prof. Marsh's inference as to the Wealden age of the Dakota formation.

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also in an especial manner for the skill and care he has exercised in taking out and shipping the ponderous specimens" (Proc. Amer. Philos. Soc. 1877, p. 234).

* Proc. Amer. Phil. Soc. 1877, p. 234.

Part II. Restoration of *Coryphodon*.

If I were restricted to a single specimen on which to deduce the nature of an extinct animal, I should choose a vertebra to work out a reptile, and a tooth in the case of a mammal.

The characters, seven or eight in number, that may be deduced from a reptilian vertebra have been pointed out in the summary of the subsequent evidences which have contributed towards the reconstruction of the *Chondrosteosaurus*. The dental characters are fewer, yet still, as it has proved, sufficiently significative of the genus founded thereon to guide subsequent discoverers of fossils to a right reference of them.

In the year 1844 a petrified fragment of lower jaw with one entire tooth was dredged up from the sea-bed between St. Osyth and Harwich, off the Essex coast. It came into the possession of John Brown, Esq., F.G.S., by whom it was transmitted to me for determination; and it is now, with the rest of his collections, according to his liberal bequest, in the British Museum. The characters on which the genus of hoofed quadruped was proposed, with the name *Coryphodon*, are detailed in the undercited work*. From the mineral characters of the fossil I inferred that it had been originally imbedded in an Eocene deposit of the Essex coast.

This inference was supported by a second tooth, from a different part of the jaw, which had been brought up in the following year from a depth of 160 feet, out of the plastic clay, in the operations of sinking a well in the neighbourhood of Camberwell. It was submitted to me by Mr. Alport, author of the 'Antiquities and Natural History of the Town of Maidstone in Kent'†.

In the year 1876 Prof. O. C. Marsh, of Yale College, Newhaven, United States, published an account of his discovery, in a formation of the Rocky-Mountain region the horizon of which he determined to be that of the "plastic clay" or lower Eocene of England, of the following remains of a large hoofed quadruped.

The skull lacking the lower jaw, but with the maxillary teeth so preserved as to determine the dental formula to be:—

"Incisors $\frac{3}{3}$, canines $\frac{1}{1}$, premolars $\frac{4}{4}$, molars $\frac{3}{3}$, $\times 2 = 44$"‡.

The last molar and the canine proved the animal to

* 'History of British Fossil Mammals and Birds,' 8vo, 1846, p. 299, figs. 103, 104, 107.

† *Op. cit.* p. 306, fig. 105.

‡ The first notice of this interesting discovery appeared in 'The American Journal of Science and Arts,' vol. xi. May 1876; the more detailed account from which I quote is given in vol. xiv. of the same 'Journal,' July 1877, p. 81.

belong to the same genus as that founded on those teeth in 1846. Other parts of the skeleton included cervical, dorsal, and caudal vertebræ, and, what is still more important and suggestive, the bones of both fore and hind limbs, permitting a restoration of the feet, as in the figures copied in Pl. XI. figs. 1 & 2, from Marsh's memoir *.

In the Section vii. of the undercited work†, containing an attempt to develop Cuvier's idea of the classification of Pachyderms by the number of their toes‡, I referred the genus *Coryphodon* to the Perissodactyle series. The first confirmation from the limb-bones supplied by the North-American fossils is derived from the femur. I had noted that "the trochanters of the femur are two in the Artiodactyles, but three in the Perissodactyles" §; but at that date I could not apply this proposition to the genus in question. Prof. Marsh writes (1877), "the femur of *Coryphodon* is of the perissodactyl type, and has a distinct third trochanter" ||.

In my work above cited, when treating of digital characters, I referred to *Coryphodon*, together with *Lophiodon*, *Palæotherium*, *Acerotherium*, and *Hippotherium*, "as links filling up the now broken series of perissodactyle or odd-toed Ungulates represented by the existing genera *Rhinoceros*, *Hyrax*, *Tapirus*, *Equus*" ¶.

But the importance of the link supplied by *Coryphodon* could not have been divined before Prof. Marsh's discovery. This genus, older in time, earlier in date, than *Palæotherium* or *Lophiodon*, retained the digits which they had lost. They are present in what may be termed the mammalian typical number, 5, on both fore (Pl. XI. fig. 1) and hind (ib. fig. 2) feet.

A form of hoofed limb may yet be discovered (and I should expect it in the predecessors of the Hyracotherioids) of a more generalized type than that in *Coryphodon*—one, viz., in which the perisso- or the artio-dactyle characters will be less distinctively marked.

It is not that the greater robustness of the third metapodial indicates the tendency to perissodactylism; for such is the character of that bone in the artiodactyle *Hyopotamus*. The third metatarsal (second through loss of the first) differs both by breadth and length from the fourth metatarsal, to which it

* *Tom. cit.* pl. iv.

† 'Contributions to the History of the British Fossil Mammals,' 4to, 1848, p. 30.

‡ See 'Ossemens Fossiles,' tom. iii. ed. 1822, 4to, p. 72.

§ Contributions &c. p. 59.

|| *Loc. cit.* p. 83.

¶ *Loc. cit.* p. 55.

becomes equal and similar in later Artiodactyles. But in *Coryphodon* a superior size of the third digit coexists with a three-trochantered femur. I therefore limit myself to tracing the subsequent simplifications of the foot in the Perissodactyle series.

As these Ungulates approach the present time the feet gain in length but lose in breadth; and the latter loss is due not only to proportions of the constituent bones of the fore and hind feet, but to disappearance of digits.

The first or innermost is always the first to go.

Two series, however, may be traced, in which the tendency to length over breadth of foot is more marked in one than in the other. The broader type is represented in the still living series by the rhinoceros, the narrower type by the horse.

The earliest, now extinct, form of *Rhinoceros*, called, from the non-development of the defensive weapon, *Acerotherium*, exhibits the type of fore foot shown in fig. 4.

Its diminutive congener (*Hyrax*), which escapes an enemy by hiding in the cavities of rocks, is also hornless, like the old Tertiary Acerothere, and retains a similar type of four-toed fore foot. With the coming in of enemies in the later Miocene and Pliocene periods the formidable horn is developed in the larger beasts, single or two in number, and these one behind the other, never in a pair; although elevations of the outer table of the skull, simulating horns, do occur, in a symmetrical pair, in some species of Acerothere. The contemporaries of the tiger in India, and of the lion in Africa, superadd to their weapon of attack defensive armour, in the thickness of their folded hide. The foot of the modern rhinoceros is reduced, as in Pl. XI. fig. 5, to the tridactyle type; but a rudiment of the fifth metapodial (ib. v) is still retained. The divergence from the pentadactyle type in the longer and narrower form of foot can now be traced through a rich series of gradations*, of which three are selected for the present illustration. In Pl. XI., fig. 6 represents the fore foot of the *Orohippus*, in which the first digit alone is wanting. The relative size of the third indicates the superior share it takes in station and progression. The persistence of the fifth digit, though slender, adds to the power which *Orohippus* possessed to pass over swamps, in which the foot of the modern horse would sink.

In the Miocene Hippothere (ib. fig. 7) the fifth digit has gone, and the second and fourth are reduced, while the third is enlarged. It is a form of foot better adapted than that of *Orohippus*

* For a knowledge of which we are chiefly indebted to Prof. Marsh, "Notice of new Equine Mammals from the Tertiary Formation," in Amer. Journal of Arts and Sciences, vol. vii. March 1874.

for swiftness. In the Pliocene and existing Equines (horse, ass, zebra) the phalanges of the second and fourth have ceased to be developed, and their metapodials (ib. fig. 8, II & IV) are reduced to the farrier's "splint-bones;" growth has been concentrated on the third digit. With this simplified form of foot speed is maximized and escape from enemies best assured. The safety of no antecedent Perissodactyle was so provided for. The strategy of Equines is retreat rather than combat; if driven to defence, the single hoof on the hind foot is launched out at the assailant.

As a general rule, it may be remarked that no Eocene hoofed mammal bears weapons; the canines are small when recognizable, so small in some as to have suggested to their discoverer the name "*Anoplotherium*," or weaponless. Partial elevations of the outer table of the skull, analogous to the nasal pair in an old Miocene hornless *Rhinoceros**, are developed in pairs on other parts of the skull, even on the mandible (*Dinoceras* e. g.). It is most probable that these large and low obtuse prominences, like the pair in *Acerotherium pleuroceros*, Duv., and the median one in *Camelopardalis*, were covered with hairy or callous tegument, not capped with horn: they cannot be cited as "weapons." One of these singular mammals, the *Dinoceras mirabile* of Marsh, from the "Eocene of Wyoming," offers the exceptional instance of a pair of upper canines descending, like those of *Machairodus* and *Trichechus*, outside and beyond the lower border of the mandible.

But the character which is exceptional in the oldest Tertiary Ungulates becomes the rule in the newest ones and in existing species. The Rhinoceroses, *e. g.*, have their mesial horns, the Ruminants their parial ones, the Boars their horn-like tusks; and this better-weaponed condition of herbivorous objects of prey seems to be correlated with concomitant increase in number, size, and force of their carnivorous enemies.

At the Eocene period Carnivores appear to have been but few and not large. The *Hyænodon* of Hordwell and of the Eocène supérieure du Gard, the *Pterodon* and *Cynodon* of the Lignites of Débruge, the *Arctocyon* of the Eocène inférieure à la Vère, the *Galethylax* of the Paris Gyps, the *Rhagatherium* of the Eocene of Mauremont did not acquire the size of a panther. The species of *Amphicyon* and *Hyænarctos* make their appearance at the Miocene period, but are mostly inferior

* "C'est du *Rhinoceros minutus*, G. Cuv., qu'il faut rapprocher un rhinocéros du Bourbonnais que M. Duvernoy supposait avoir deux cornes placées l'une à côté du nez et l'autre de l'autre côté" (Ossem. Foss., ed. posthum., 8vo).

in size to the later bears, lions, and tigers. The acquisition of the most perfect and distinctive carnassial organization, as exemplified in *Felis* proper, has not been manifested with certainty by fossils from formations older than those of Miocene age; and there they are rare and do not exceed the Jaguar in size (e. g. *Machairodus*, Kaup; *Felis cristata*, Cautley and Falc.). As Pictet well observes of the Carnassiers, "Ils ont, pendant les premiers âges du développement des mammifères, été précédés par des espèces plus faibles, plus lentes et plus omnivores"*.

The modifications at present traceable in the Perissodactyle division of hoofed mammals pass, as we have seen, in two directions—one supplying the species with means of defence and combat by thick hides and true horns, the other perfecting their means of escape by increased speed.

In connexion with the elephantine proportions, feet, and excessive development of an upper pair of tusks of *Dinoceras*, new interest is attached to the partial risings of the outer table of the skull in certain Miocene Proboscidians. In *Elephas hysudricus* the frontal pair, with their broader bases, are divided by a channel; in *E. namadicus* the coalesced bases of the frontal risings project forward. One cannot call these developments "horns," any more than the pair of bosses which modify the lower contour of the mandibular rami of the *Megatherium*, like the similar developments in *Dinoceras*. True horns, or keratose weapons, are pointed, whether they consist of bone only or of both osseous and corneous substances; and when branched, as a rule, the snags are pointed.

Cuvier first noted the relative inferiority of size and simplicity of surface of the brain in a large herbivore of the Eocene period (*Anoplotherium commune*), whence he deduced the inference that it must have been but poorly endowed with intelligence. The probable or possible conditions of such relative stupidity are not entered upon. In a beast of the size of an ordinary ass, the brain was hardly so large as that of a roebuck†.

Gratiolet‡ noted a similar simplicity of cerebral structure in the *Cainotherium* of the lower Miocene of Allier, France.

* Traité de Paléontologie, 8vo, 1853, vol. i. p. 226.

† "Un hasard heureux m'a aussi procuré quelque idée de la forme du cerveau dans l'*Anoplotherium*—il étoit peu volumineux à proportion, aplati horizontalement: ses hémisphères ne montroient pas des circonvolutions, mais on voyoit seulement un enfoncement longitudinal peu profond sur chacun. Toutes les lois de l'analogie nous autorisent à conclure que notre animal étoit fort dépourvu d'intelligence."—*Ossemens Fossiles*, 4to, ed. 1822, tom. iii. p. 44, pl. vii. fig. 3.

‡ Bullet. de la Société Philomathique, Février 1858.

In the fossil skull of a herbivore from an older division of the Eocene ("l'éocène à Lophiodons" d'Issel), Ed. Lartet* found the brain, as represented by the cast in matrix, to be still less, relatively, than in the Anoplothere and Cainothere. The hemispheres extended neither upon the rhinencephalon in front nor upon the cerebellum behind. He also notes the lower development of the brain in the Miocene *Hipparion* as compared with that of a modern *Equus* of similar bulk. Referring to the size of the much-convoluted cerebral hemispheres of the brain in the elephant, and assuming the natural duration of life of that animal to be 150 years, associating also the longevity of Man with his large brain †, Lartet infers that the older the mammal in geological time the briefer was the life of the individual and the smaller the amount of its intellectual faculties ‡.

When, however, we consider the small size of brain and the great length of life of a gigantic tortoise, the correlation supporting the induction of the briefer life-periods of the individual herbivores of the Miocene and Eocene periods is far from commending itself to credence. As to the limitation of intelligence associated by Gratiolet and Lartet, as by Cuvier, with the low development of brain, that is the obvious physiological inference.

The question, which is here left untouched, is, What were the conditions of existence in the older tertiary times which rendered better brains and concomitant intelligence uncalled for in the peaceful Herbivora of those periods?

To the attempt to solve this question I was led by observing that an Eocene marine mammal showed the same inferiority of development of its cerebral hemispheres, compared with its modern congeners, as did the terrestrial forms §. And the

* Comptes Rendus de l'Acad. des Sciences, Juin 1868.

† "L'éléphant, qui vit un siècle et demi, a le cerveau plus grand qu'aucun autre mammifère terrestre; après l'éléphant viendrait l'homme qui, par le volume absolu du cerveau, comme par la longévité, parait l'emporter sur les autres mammifères terrestres."—*Loc. cit.*

‡ "Il en ressortirait comme hypothèse explicative des faits observés, que, dans certains divisions de la classe des mammifères, il y aurait eu, depuis leur apparition sur le globe, accroissement graduel d'énergie vitale et d'intelligence; en termes plus explicites, que la durée de vie et le développement des facultés intellectuelles auraient été moindres chez les espèces fossiles remontant aux premiers temps de la période tertiaire que leurs analogues ou leurs congénères de l'époque actuelle."—*Loc. cit.*

§ "Viewing fig. 2 (brain of *Eotherium*) in contrast with fig. 5 (brain of *Manatus*), one is led to speculate on the circumstances influencing increase of brain-mass in marine mammals of simple, sluggish, Sirenian habits, either obtaining their food from seaweed at no great depth, or shuffling along to browse the grassy shore of a river or estuary. Certain it is that since the good old Eocene times 'new foes have arisen;' and any

explanation which I hazarded I believed might apply to analogous instances in time-series of other and terrestrial herbivorous mammals.

The Coryphodons may have roamed over the regions of Utah, Wyoming, and New Mexico in vast herds; but they were not harried and disturbed by the enemies that now persecute the bisons of North America. The instincts which such unintermitting persecution have developed in the wild Herbivora of that and other continents, and which call for the utmost skill and wood-craft of the sportsman to circumvent, were little, if at all, excited in the oldest Eocene period, so far as the evidences of contemporary enemies of *Coryphodon* have come to light.

"The brain-cavity in *Coryphodon*" (Pl. XI. fig. 3, *e*, *p*, *r*), writes Prof. Marsh, "is, perhaps, the most remarkable feature in the genus, and indicates that the brain itself was of a very inferior type; but its most striking modifications are the small size of the hemispheres [*p*] compared with the expanded cerebellum [*e*]. The olfactory lobes [*r*] were large and entirely in advance of the hemispheres" *.

Thus the parts of the brain which experimental physiology has associated with the locomotive function and the testing of food, were present in due proportion to the bulk of the extinct Herbivore. The quest of favourite foliage and delicate herbage by the exercise of an acute sense of smell, and the migrations from pasture to pasture or from grove to grove, were both provided for in their relations to the cerebral organization. But the superadded mass which converts the sensations into ideas, and retains the impressions as memories, remained at that low stage of development which suited a blissful condition of existence untroubled by the necessity of taking cognizance of, and contriving escapes from, the attacks and wiles of creatures concerned in killing Coryphodons.

To the close and careful comparisons of the conscientious palæontologist of Yale College we are indebted for the above interesting and unexpected additions to our knowledge of the rare and ancient Tertiary mammal, fragmentarily indicated

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increase in the number of creatures and their lethal powers concerned in killing sea-cows would add to the number of phenomena which such sea-cows were concerned in noting, with concomitant reaction of such perceptions, or neural vibrations, resulting in a change of cerebral into muscular force, exercised to put themselves into depths of safety. With such augmentation of ideas the thinking-organ has grown." ("On *Eotherium ægyptiacum*," Quarterly Journal of the Geological Society, 1875, vol. xxxi. p. 105.)

* Marsh, *loc. cit.* p. 82.

in the "plastic clay" of England (1845), and in the "conglomérate de l'argile plastique" at Meudon, France (1856)*, of the elements toward a restoration of which we might have long remained in doubt had they continued to be made known to us as parts of a *Bathmodon* or *Loxolophodon* †.

EXPLANATION OF THE PLATES.

Plate X.

Fig. 1. Under view of anterior trunk-vertebra (one fifth nat. size) of *Chondrosteosaurus.*
Fig. 2. Upper view of the same vertebra (one fifth nat. size) of ditto.
Fig. 3. Upper view of a similar, but more mutilated, vertebra (much reduced) of ditto (after Cope).
Fig. 4. Side view of a dorsal vertebra (after Cope), much reduced, of ditto.
Fig. 5. Longitudinal vertical section of a dorsal vertebra of a *Poikilopleuron.*
Fig. 6. Longitudinal horizontal section of a cervical vertebra of an eagle (*Haliæetus albicilla*).

Plate XI.

Fig. 1. Bones of the left fore foot, *Coryphodon* (after Marsh, much reduced).
Fig. 2. Bones of the left hind foot, *Coryphodon* (ditto, ditto).
Fig. 3. Outline of skull and cerebral cavity, *Coryphodon* (ditto, ditto).
Fig. 4. Bones of the fore foot, *Acerotherium* (reduced).
Fig. 5. Ditto, *Rhinoceros* (reduced).
Fig. 6. Ditto, *Orohippus* (ditto).
Fig. 7. Ditto, *Hipparion* (ditto).
Fig. 8. Ditto, *Equus* (ditto).

XXV.—*Characters of undescribed Species of* Halticinæ.

By Joseph S. Baly, F.L.S.

[Continued from ser. 5, vol. i. p. 322.]

Œdionychis bitæniata, Clark, MS.

Œ. subelongato-ovata, postice paullo ampliata, convexa, pallide flava, femoribus posticis apice, scutello elytrisque (his basi exceptis) nigris; elytris crebre, sat fortiter punctatis, cyaneis, limbo

* Hébert, 'Annales des Sciences Nat.' t. vi. p. 87, pls. iii. and iv. (1856).

† "The Museum of Yale College contains a large collection of *Coryphodon* remains from Utah, Wyoming, and New Mexico; and this material is amply sufficient to indicate all the more important characters of the group. Among these specimens are portions of the same individuals described by Cope under the names *Bathmodon* and *Loxolophodon*, both of which are synonyms of *Coryphodon*" (Marsh, American Journal of Science and Arts, vol. xiv. July 1877, p. 81).