

- Fig. 19.* *D. intortus*, sp. nov. 19 *a*, 19 *b*, nat. size; 19 *d*, proximal portion, magn. Glenkiln Shales, Glenkiln Burn and Wanlockhead.
- Fig. 20.* *D. divaricatus*, Hall, sp., var. *rigidus*. 20 *a*, nat. size; 20 *b*, magn. Glenkiln Shales, Birnock Water, Leadhills district.
- Fig. 21.* *Bryograptus Callavei*, sp. nov. 21 *a*, nat. size; 21 *b*, magn.; 21 *c*, branch, magn. Shineton Shales, Shineton, Salop. Collection, Dr. Callaway.
- Fig. 22.* *B. Kjerulfi*, sp. nov. 22 *a*, nat. size; 22 *b*, magn. After Prof. Kjerulf (Veiviser, fig. 6, *a*, &c. p. 3).
- Fig. 23.* *Diplograptus* (*Idiograptus*) *aculeatus*, sp. nov. 23 *a*, normal aspect, nat. size; 23 *d*, ditto, magn.; 23 *b*, 23 *c*, deprived of test, lateral views, nat. size; 23 *e*, 23 *f*, ditto, magn. Lower Girvan Rocks, Myoch Bay, Girvan, Ayrshire.
- Fig. 24.* *Lasiograptus retusus*, sp. nov. 24 *a*, nat. size; 24 *b*, magn. 2; 24 *c*, distal portion, magn. 5; 24 *d*, proximal portion, magn. 5. Upper Llandeilo, Llandrindod Wells, Radnorshire.
- Fig. 25.* *Diplograptus perexcavatus*, Lapworth. 25 *a*, complete, partly restored, nat. size; 25 *b*, 25 *c*, fragments in relief, nat. size; 25 *e*, proximal portion, magn.; 25 *d*, distal portion, magn., showing overlapping bases of the hydrothecæ; 25 *f*, ditto, magn. Lower Hartfell Shale (*Wilsoni* zone), Dobb's Linn.
- Fig. 26.* *D. physophora*, Nicholson. 26 *a*, complete specimen, nat. size; 26 *b*, proximal portion, magn., showing form and mode of attachment of proximal "vesicle."
- Fig. 27.* *Cryptograptus tricornis*, Carr., sp. 27 *a*, complete specimen, showing normal appearance of polypary (Hartfell Spa); 27 *c*, ventral aspect, magn. (the lower portion is an impression only); 27 *b*, reverse aspect, magn.; 27 *d*, ditto; 27 *e*, profile, partly restored, magn. Balcletchie beds, Laggan, near Girvan, Ayrshire.
- Fig. 28 a.* *C. tricornis*, var. *Schæferi*: *a*, nat. size; *b*, proximal portion magn. Upper Llandeilo, Llandrindod Wells, Radnorshire.

XV.—On the Occurrence in North America of rare Extinct Vertebrates found fragmentarily in England.—No. 3. By Prof. R. OWEN, C.B., F.R.S., &c.

[Plate VIII.]

[Continued from ser. 5, vol. iv. p. 61.]

Part IV. SUPPLEMENTS TO RESTORATION OF *LEIODON ANCEPS*.

I HAVE been favoured by Prof. O. C. Marsh, of Yale College, New Haven, Mass., with a copy of his paper "On the new Characters of Mosasauroid Reptiles," based on an examination of "remains of not less than 1400 distinct individuals"*. Knowing the riches of the Professor's collection, I have looked with much interest for the results of his examination as bearing upon and probably dissipating any remaining doubts as to the affinities and place in the Reptilian series of the huge

* From the 'American Journal of Science,' vol. xix. (January 1880). p. 83.

extinct marine cold-blooded air-breathers typified by the *Mosasaurus Hoffmanni* of Conybeare and Cuvier.

At the date of the last two papers, quoted below*, no evidence had been obtained, or been noticed in Prof. Cope's extensive illustrations of American Cretaceous Mosasauroids†, of a sternal bone or apparatus. This most important element in the question, as between the Ophidian and Lacertian nature of those reptiles, has been fully and satisfactorily demonstrated by the collection at Prof. Marsh's command; and as he thereby feels himself justified in inferring "the presence of a sternum in the entire group"‡, I do not hesitate in accepting this welcome addition to the complete restoration of our Leiodont modification of the Mosasaurian type; and I beg leave to offer such addition, with a few supplementary observations, to the paper admitted into 'Annals and Magazine of Natural History' for July 1879.

The following is Prof. Marsh's description of these long-missing parts of the skeleton:—

"THE STERNUM.

"The absence of a sternum has been asserted by Cope to be one of the important characters of the Mosasauroid Reptiles§; and this statement has been accepted by some authors||. Several specimens, however, in the Yale Museum, one of which is figured in plate i. fig. 1, prove the contrary." ... "The most perfect specimens of the Mosasauroid sternum preserved pertain to the genus *Edestosaurus*, and are of the true Lacertian type. The sternum in this genus is narrow and elongate in form, nearly or quite symmetrical, as shown in plate i. fig. 1 [st]. [This figure is given in Pl. VIII. fig. 1 of the present paper.] It is thin, slightly concave above and convex below. Its antero-lateral margins are short and rounded, and have distinct grooves for the coracoids. The costal margins are much longer and converge posteriorly. Each has facets for five sternal ribs; and, behind these, false ribs were supported by a partially ossified pedicle, which joined the end of the sternum. In the other genera of Mosa-

* Quart. Journ. Geol. Soc. of London for November 1877, p. 682, and for August 1878, p. 748.

† 'The Vertebrata of the Cretaceous Formations of the West,' 4to, 1875.

‡ *Mem. cit.* p. 83.

§ 'Vertebrata of the Cretaceous,' p. 114 (1875); also 'Bulletin of Survey of Territories,' p. 309 (1878).

|| As the allegation rested on the somewhat treacherous basis of "non-finding" in commonly fragmentary and more or less incomplete skeletons represented by fossil remains, I limited myself to stating:—"Sternal or episternal elements of the scapular arch seem not to have been recognized in the American series of fossils" (*loc. cit.* p. 710, 1877).

sauroid reptiles the sternum has not yet been found so well preserved as in *Edestosaurus*; but there can be no reasonable doubt of its presence. In *Holosaurus* there appears to have been a partially ossified mesosternum" *.

Thus to the restoration of *Leiodon anceps* in plate viii. of vol. iv. 5th series of the Annals and Magazine Nat. Hist., there may now be added not only the sternum, but also some pairs of sternal ribs.

A bone is described and figured as belonging to the hyoid arch†, of proportions rather Cetacean than Lacertian; it is still more remote, in form, from any hyoid element of the Ophidian type.

Sclerotic plates "like those in *Ichthyosaurus* and a few birds," forming a ring "composed of only a single row of plates, which, in position, overlapped each other"‡, further attest Saurian as against Ophidian affinities. I have accordingly added such circle of ossicles to the orbit in the restoration of *Leiodon* above cited.

When I prepared the paper on the affinities of the Mosasauroids (1877), the homologue of the ectopterygoid in Ophidia was not present in the specimens at my command, and had not been noticed in any of Prof. Cope's examples. I could only contrast with the palatal view of a Python's skull (ib. fig. 17) the mutilated portion of the same surface of the skull in *Mosasaurus Hoffmanni* (ib. fig. 16). The ectopterygoid has now been recognized by Prof. Marsh in three American genera of Mosasauroids (*Tylosaurus*, *Lestosaurus*, and *Edestosaurus*)§. In *Python* the ectopterygoid is a long, slender, narrow bone, having an oblique overlapping junction with the otherwise free hind end of the maxillary, and a similar but more extended junction with the outer surface of the middle expanded part of the pterygoid. In the Mosasauroids, as exemplified by *Tylosaurus*, the ectopterygoid "is an L-shaped bone, thin and somewhat twisted. One ramus unites by suture with the corresponding process of the pterygoid; and the other extends forward, nearly at a right angle, to join the maxillary"||.

In the paper on the affinities of the Mosasauroids, it was inferred from Prof. Cope's figures that the dentigerous palatal bones, which he determined to be the true "palatines," were the homologues of the bones described by Cuvier as the pterygoids in *Mosasaurus*¶. Prof. Marsh confirms this homology and consequent affinity to the Iguanidæ. Various specimens

* Marsh, *ut supra*, p. 83.

† *Ibid.* p. 85, fig. 1.

‡ *Ibid.* figs. 2, 3, 4 (*Lestosaurus simus*, Marsh).

§ *Ibid.* p. 86.

|| *Ibid.*

¶ Owen, Quart. Journ. Geol. Soc. 1877, p. 698.

in the Yale Museum show conclusively that the dentigerous bones of the palate in various genera of Mosasauroids were attached posteriorly to the tympanics and to the pterapophyses by ligament, to the maxillaries by the medium of the ectopterygoids, and to the true palatines by suture. "Cope has called these dentigerous bones 'palatines,' and has stated that they were separated from the quadrates by intervening bones* ; but on both points he was in error. The true palatines are small edentulous bones in front and outside of the pterygoids" †.

In regard to the vertebræ in Mosasauroids, the rich collection in "Yale Museum" does not appear to affect or add to the characters of the several divisions of the backbone, as defined by Cuvier and his successors, and as summarized in the 'Annals' for July 1879, p. 57, pl. viii. The best-preserved specimen of the vertebral column appears to be of an individual of the proportionally shortest form of Mosasauroid (*Holosaurus abruptus*, Marsh). This skeleton shows 98 vertebræ ; but the tail is incomplete, and the preserved caudals are of the tenth type in the above "summary."

With the important additions to a knowledge of the framework of the pectoral arch and its appendages, Prof. Marsh has materials for the restoration of the bones of the fore fin in both *Edestosaurus* (Pl. VIII. fig. 1) and *Lestosaurus* (fig. 2). Neither of these genera supports the restoration figured by Prof. Snow in the *Leiodon* of the Kansas chalk ‡. They correspond more closely with that of a *Lestosaur* described and figured by Marsh in the 'American Journal of Science and Arts' for June 1872 §. The digital formula in *Edestosaurus dispar* is I. 3, II. 5, III. 5, IV. 4, V. 3 (Pl. VIII. fig. 1[¶]) ||. The same formula is repeated in the pectoral fin of *Lestosaurus simus* ¶. The fin is relatively broader in *Edestosaurus* ; and in the specimen figured of *E. dispar* seven carpal bones (four in the proximal, three in the distal row) intervene between the five metacarpals and the two antibrachial bones. In the figured specimen of *Lestosaurus* (Pl. VIII. fig. 2) two carpals are shown at the ulnar end of the distal row, and the same number at the same part of the proximal row.

With regard to the antibrachial bones, I may observe that in the *Crocodilia*** , the *Lacertilia* ††, the *Chelonina* ‡‡, and the

* 'Vertebrata of the Cretaceous,' p. 118. † Marsh, *loc. cit.* p. 86.

‡ Copied in plate viii. fig. 13, of Ann. & Mag. Nat. Hist. for July 1879.

§ See also Owen "On the Affinities of the Mosasauridæ, as exemplified by the Bony Structure of the Fore Fin," Quart. Journ. Geol. Soc., August 1878.

|| Marsh, *loc. cit.* pl. i. fig. 1.

¶ *Ibid.* fig. 2.

** Cuvier, Ossem. Foss. 4to, t. v. 2^e partie, p. 111, pl. iv. fig. 13.

†† *Ibid.* pl. xvii. fig. 45.

‡‡ *Ibid.* pl. xii. figs. 11-15.

Sauropterygia*, the ulna, ⁵⁵, is broader than the radius, ⁵⁴ (Pl. VIII. fig. 1); and I would submit whether the antibrachial bones have not been transposed in Prof. Marsh's figures, and the ulna (marked *r*) placed at the radial side of the forearm. In the copy of his fig. 1, in Pl. VIII. fig. 1, I have indicated the several bones and digits by the symbols used in my 'Archetype of the Vertebrate Skeleton,' pl. i., as also in the figures 1-4 of the fore fin in the Quart. Journ. Geol. Soc. for August 1878, p. 749. In the copy of Prof. Marsh's fig. 2 in my Pl. VIII. I have transposed the position of the radius and ulna, agreeably with the analogies above referred to. To the restoration of the pelvic arch and appendages (Pl. VIII. fig. 3) I have nothing to object.

The sum of Prof. Marsh's observations on his rich series of American generic or subgeneric forms of Mosasaurians is as follows:—"The new characters above presented are all Lacertian rather than Ophidian. The important characters of the Mosasaurians now known indicate that they form a sub-order of the Lacertilia, which should be called *Mosasauria*"†. In this conclusion I entirely concur: it is that to which I was led after comparison of the evidences of the extinct group at my command in 1877 ‡.

EXPLANATION OF PLATE VIII.

- Fig. 1. Sternum, scapular arch, and bones of the pectoral fins. (*Edestosaurus*.)
 Fig. 2. Bones of the pectoral fin, with Marsh's position of the antibrachial bones reversed. (*Lestosaurus*.)
 Fig. 3. Pelvic arch and bones of the pelvic fins. (*Lestosaurus*.)

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 19, 1879.—Henry Clifton Sorby, Esq., F.R.S.,
 President, in the Chair.

The following communication was read:—

"Supplementary Note on the Vertebræ of *Ornithopsis*, Seeley (= *Eucamerotus*, Hulke)." By J. W. Hulke, Esq., F.R.S., F.G.S.

The author in this communication describes several cervical and trunk vertebræ of this remarkable Dinosaur. The former are cha-

* 'Monograph on the Fossil Reptilia of the Liassic Formations.' 4to. In the Palæontographical volume, issued 1865, pl. i. *Plesiosaurus dolichodeirus*; pl. ix. *P. rostratus*; pl. xiv. fig. 4. *P. macrocephalus*, fig. 6. *P. Hawkinsii*.

† *Op. cit.* p. 87 (1880).

‡ *Loc. cit.*



Owen, Richard. 1880. "XV.—On the occurrence in North America of rare extinct vertebrates found fragmentarily in England.—No. 3." *The Annals and magazine of natural history; zoology, botany, and geology* 5, 177–181.

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