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On Generic Characters in the Order Sauropterygia

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Notes

9. On GENERIC CHARACTERS in the ORDER SAUROPTERYGIA. By
Prof. OWEN, C.B., F.R.S., F.G.S., &c. (Read December 20,
1882.)

THE progress of knowledge of the species of Reptilia associated by De la Beche under the collective name Enaliosauria, led to the subdivision of that maritime group into the orders Ichthyopterygia and Sauropterygia*, these terms being significative of their characters of resemblance respectively to Fishes and to Saurians.

Large accessions of species have since been made known in both orders. With regard to the first, I have not deemed the modifications in the dentition, in the shape and structure of the sterno-coraco-scapular frame, in those of the fins, or the gradations of general bulk, sufficient, as satisfactory characters, for generic subdivision.

In the Sauropterygia, besides gradations of size, ranging, for example, from *Plesiosaurus Hawkinsii* to *Ples. Cramptoni*, there is a difference in the proportional length of the neck and number of its vertebræ relating to the size of the head it supports. In *Plesiosaurus homalospondylus*, for example, the cervical vertebræ are thirty-eight in number; in *Ples. rostratus* they are twenty-four. This character alone would not have obtained a generic separation: but a shortening of the neck, due not only to decreasing number but to altered proportions of the cervical vertebræ, when associated with a well-marked modification of the teeth, of the sterno-coraco-scapular frame, and of the paddle-bones, called for a separation of the Sauropterygia into *Plesiosaurus* proper and a distinct genus, for which the name *Pliosaurus* was proposed†, indicative of the nearer approach which its species made to a generalized Saurian type.

In the Crocodilia, for example, a common character of the teeth is to have the usually simple conical crown, whether finely ridged or not, provided with a pair of enamel-ridges stronger than the rest, and placed on opposite sides of the crown.

In the genus *Plesiosaurus* the coronal ridges of the teeth are uniform or subequal, and the transverse section of the crown is circular or subcircular‡.

In the genus *Pliosaurus*, besides the shortness of the neck concomitant with hugeness of the head, a step towards the fresh-water Saurians is made by the presence of a pair of coronal ridges, longer and rather stronger than the rest, and rendered the more distinct by the characters of the parts of the tooth-crown so defined; the shorter enamel-ridges being limited to one division, and this portion moreover

* Owen's 'Palæontology,' 8vo, 1860, pp. 198, 209.

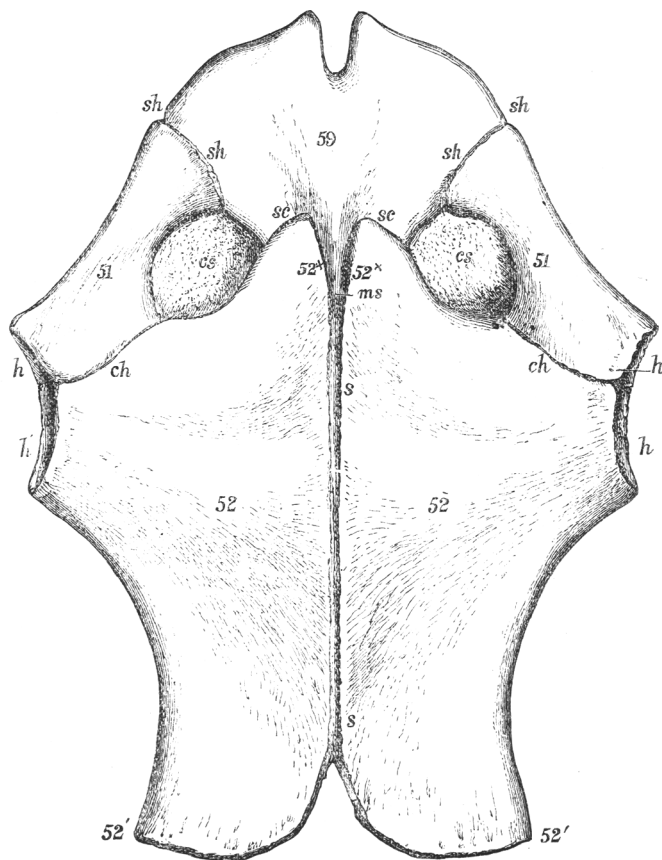
† "Report on British Fossil Reptilia," part ii. in 'Reports of the British Association for the Advancement of Science,' 1841.

‡ "Monograph on the Sauropterygia," volume of the Palæontographical Society, issued 1865, pl. ix. figs. 3-9.

being strongly convex; while the opposite portion is but slightly convex and is unridged. A single tooth, like some other fossilizable parts, serves unequivocally to indicate its belonging to a Pliosaur*.

I will not dwell on the distinctive characters manifested by the fin-skeleton†, but proceed to detail those shown by the sterno-

Fig. 1.—Diagram of Sterno-coraco-scapular mass in Plesiosaurus.



coraco-scapular frame, premising a more detailed description of the characters of that part of the skeleton of *Plesiosaurus* than has elsewhere, so far as I can find, been given.

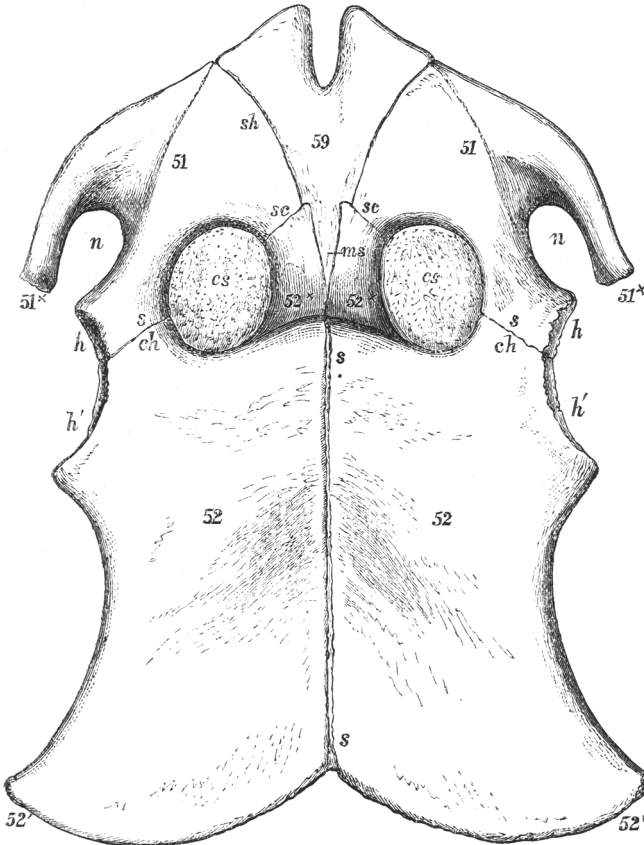
In Sauropterygia the place and function of a sternum are mainly supplied by the pair of coracoids (figs. 1 & 2, 52) which meet and

* Id. ib. issued 1861, pl. vii., and 1862, pl. xii.

† Id. ib. issued 1862, pp. 9-11, pl. iv.

join by a longitudinally extended suture (*ib. ib.*, *s*, *s*) below the thoracic part of the abdominal cavity. Posteriorly to ('sacrad of') this mesial suture, the coracoids diverge and terminate freely by a broad margin, each with an angle (*ib. ib. 52'*) inclining "laterad." Anteriorly ("atlantally") the sutural portions slightly diverge (*ib.*

Fig. 2.—Diagram of *Sterno-coraco-scapular mass* in *Pliosaurus*.



ib. 52') and expose the hinder ("sacral") end (*ib. ib.*, *ms*) of the mesial plate, *59*, representing an episternum. Laterally, each coracoid contracts in length, becomes thickened, and presents two syndesmotic or roughened articular surfaces: the hinder one (*ib. ib. h'*) contributes the corresponding portion of the articular cavity for the humerus, the fore one joins the scapula (*ib. ib.*, *51*) by the suture, *ch*, laterad of which the scapula contributes the fore portion, *h*, of

the glenoid cavity. In *Plesiosaurus* the hinder end of the scapula, which is the thickest part of the bone, is thus divided pretty equally between its coracoidal (*ch*) and humeral (*h*) articular surfaces, both being rough or "syndesmosal." In advance of the surfaces *h*, *ch*, the scapula thins and contracts, chiefly by a strong margino-mesial concavity, contributing the outer border of the "coraco-scapular vacuity" (*ib. ib.*, *cs*). The outer or lateral and thicker border of the scapula is nearly straight; and the bone extending forward and slightly mesiad, expands to unite with the episternum, *se*, by the suture, *sh*.

The episternum, *se*, presents anteriorly a mesial notch, from each angle of which the bone extends outward and backward to its sutural union, *sh*, with the fore end of the scapula. At this union the episternum contracts, and is continued backward to join the coracoids, passing a short way internal to ("centrad" of) them, and appearing outwardly as a terminally pointed portion, *ms*, at the fore part of the narrow mesial interspace of the coracoids, *sz**, which interspace interrupts anteriorly their extensive mesial suture with each other.

Thus the sterno-coraco-scapular frame, or mass, presents an anterior and a posterior emargination and a pair of subcircular vacuities. The above-defined characters of this portion of the skeleton, save that of the scapular element, are common moreover to both the generic groups of the Sauropterygia.

The chief and suggestive modification of the mass in the Pliosaurian genus is the retention of a typical character of the scapula which is lost in the more modified or specialized Plesiosaurian forms, viz. the production of the part of the blade-bone (fig. 2, *si**), laterad and dorsad, where it terminates freely †. This portion represents the main body of the scapula in the higher Vertebrates, but, as in the "Allantoic group" (Reptilia and Aves) ‡, without expanding.

The portion of the scapula, *si*, common to both genera, which contributes its share (figs. 1 & 2, *h*) to the glenoid cavity, is separated in *Pliosaurus* from the free portion, *si**, by the notch, *n*. In advance of this the Pliosaurian differs from the Plesiosaurian scapula by its greater relative breadth, extending its sutural border, *sh*, mesiad, so as to touch or join the fore end of the coracoid, *sz**.

The coracoids retain their large proportional size, but have a less even or flattened outer surface; mesially they bulge to their common suture, *s*, giving more room to the ventral or visceral cavity; and, at the transverse margin parallel with the hind border which they contribute to the vacuities, *cs*, *cs*, they bend dorsad, suddenly contract,

† This character I added to the generalized illustration of the Sauropterygian skeleton in my 'Palæontology,' p. 227, fig. 71.

‡ "In their generation and development modern Batrachians differ from other cold-blooded air-breathers and agree with fishes. Birds, by genetic and developmental characters, as well as by the general plan of their organization, are more intimately and naturally allied to the oviparous Saurians than to the viviparous Mammals."—*Anat. of Vertebrates*, vol. i. 1866, pp. 6 and 7.

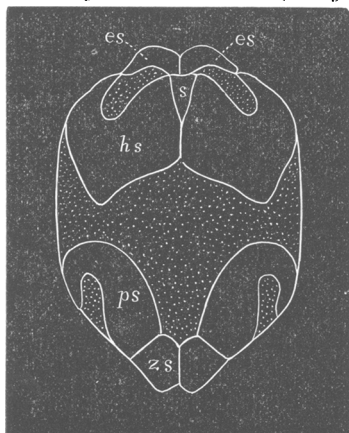
52', but contribute, as in *Plesiosaurus*, the mesial border of those vacuities, and articulate, underlapping it, with the hinder end of the episternum, 59. The proportional characters of this element are given in figs. 1 & 2.

In thus determining the homologies of the constituents of the complex bony buckler in Sauropterygia, I have exhausted every subject of comparison at my command, derivable from fossil remains of the group and from other Reptilian forms both fossil and recent, and in the latter have had recourse to modes and stages of development of the constituents of the answerable part of the frame.

The degree in which the abdominal surface is defended by bone in Sauropterygia resembles that in Chelonia. But the homology of the defensive parts can be safely predicated of but a small proportion only of the elements of the plastron. The episternum (figs. 1 & 2, 59) may answer to three of the Chelonian elements, viz. to the pair of bones so named, and marked *es* in fig. 3, and to the mesial piece, *s*, continued backward in a pointed form, and called "entosternum." But such constituents have coalesced into one bone in Sauropterygia, and I have no evidence, as in Chelonia*, of its development from several centres.

One might be tempted by the size and shape of the parial elements of the plastron, *hs* (hyosternals), in the immature tortoise (fig. 3),

Fig. 3.—*Development of Plastron, young Tortoise.*



to regard the broad coracoids, 52, in figs. 1 & 2, as homologues, especially in the Chelonian half-developed state, when the fore and outer angle is produced in direction and degree like the scapular process, 51*, in *Plesiosaurus*. But the process in the plastron of the Tortoise expands as it grows, and ultimately articulates with the dermo-marginal pieces of the carapace; it is, like them, a "dermal

* "On the Development and Homologies of the Carapace and Plastron of the Chelonia" (Philosophical Transactions, 1849).

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bone." The true homology of the constituents of the sterno-coracoscapular frame is yielded by the endo-skeleton of *Chelonia*, in which the true coracoid is the largest and broadest of the elements of the shoulder-arch, the mesial margins almost meeting beneath the fore part of the thoracic-abdominal cavity.

Recalling the impression made on the mind of Cuvier * by the first account of the *Plesiosaurus dolichodeirus*, we can appreciate the advantage and reward of continued researches, in the blotting-out of seeming anomalies, and in the addition of features of affinity linking on the strange extinct form (brought to light by Conybeare) to the general Reptilian type, and diminishing the intervals which seemed to exist in the series.

The few and short cervical vertebræ in *Pliosaurus* manifest, with these Ichthyosaurian proportions, by their amphicælian, almost flattened, articular surfaces, characters of contemporary Crocodilia, of which Reptiles we are also reminded by the short and thick neck, the large head, and the powerful jaws of the later-found Sauropterygian genus. The teeth, moreover, are now implanted in distinct sockets; and the blade-bone resumes its normal character.

It is interesting to note that the species tending to diminish the interval that seemed to separate Conybeare's *Plesiosaurus* from the typical Reptilia have been hitherto obtained from Mesozoic deposits less ancient than the Lias. All my evidences of *Pliosaurus* have been derived from Kimmeridgian and Portlandian beds.

A third generic modification of the Sauropterygia is indicated by teeth and a portion of the skull from a part of the Cretaceous series; but I wait for further acquisition of its remains before submitting to the Society the differential characters of the genus *Polyptychodon*.

DISCUSSION.

The PRESIDENT stated that great differences of opinion existed as to the form of the scapular arch in *Plesiosaurus*. He himself believed that there is evidence that in *Pliosaurus* there was a dorsal prolongation of the scapula similar to that found in the higher vertebrates.

* "C'est par cet habitant de l'ancien monde, peut-être le plus hétéroclite, et celui de tous qui paroit le plus mériter le nom de monstre, que je terminerai cette histoire des animaux perdus."—*Ossem. Foss.* tom. v. pt. 2, p. 476, 1824.