

ART. III.—*The Protostegan Plastron*; by GEORGE R. WIELAND. (With Plate II.)

OWING to the fact that the bones of the plastron of the turtles from the older formations are usually fragile and are made up of many parts, we have but few restorations of this portion of the testudinate skeleton from pre-Tertiary species. And so far as the gigantic turtles of the American Cretaceous are concerned we lack a complete restoration entirely, though Hay has given a partial restoration of *Protostega gigas* Cope.*

The present contribution may in some degree fill up this gap. It is based on two specimens of the turtle closely related to *Protostega*, which I have described as *Archelon ischyros*,* both of which I collected near the Cheyenne River in South Dakota from the very uppermost Fort Pierre Cretaceous.

As these plastrs, though fairly well preserved, were broken into hundreds of pieces while yet in place, it has not been thought advisable to indicate fractures. Nor has it been deemed necessary to indicate in the illustrations that the external spines of the left hyo- and hypo-plastron have been in part determined from those of the corresponding elements of the right side. The fact that all the figures given are from a single specimen, as confirmed by a second, adds to their value.

General Description.

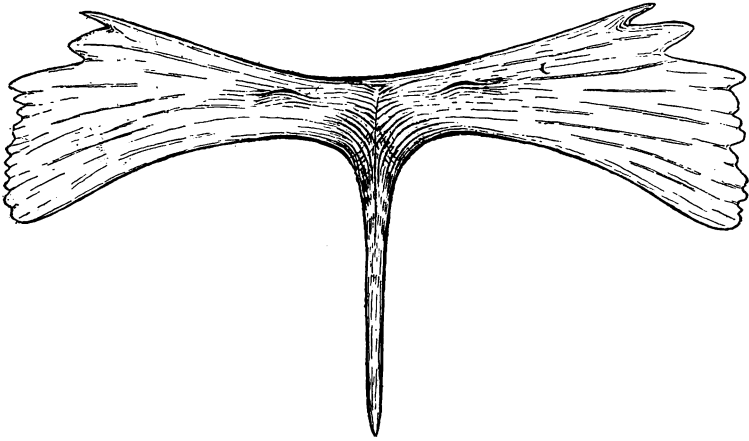
The Entepiplastron (see measurements, p. 19).—The most striking feature of the protostegan plastron is the distinct fusion or lack of separation of the three anterior plastral elements,—that is, of the entropastron and the two epiplastrs. This single element is a feature hitherto unobserved in the Testudinata and may be described as the *entepiplastron* or *paraplastron*. It is a rather heavy and a very shapely bilaterally symmetrical T-shaped bone, gracefully curving outward into two broad alæ which slowly thin out to no more than the thickness of cardboard along their posterior edges. Anteriorly the edge is rounded except in the central portions, where there is a distinct downward and outward-looking external chamfer. At each forward extremity of the alæ there is one distinct spine followed by a second which is flat and thin. The remainder of the outer edge tends toward termination in thin spines. While the outer surface is somewhat convex in general relief, the inner is slightly concave and flat except for two lateral longitudinal bosses about six centimeters long, one centimeter high and twenty centimeters apart, anterior to which are

* Field Columbian Museum Publication 7, Chicago.

† See this Journal for December, 1896.

small furrows. The long medial posterior or entoplastral process is, however, distinctly triangular for the first third of its length, and for the remainder quite round. The entire surface of this bone is striated like the remainder of the plastron, and not like the carapace.

1.



Entoplastron. Upper or internal side. One-tenth natural size.

That we have in this bone a true plastral element was decided from the following reasons and facts :

1. Its size and particularly its form will permit the supposition that it represents the entoplastron and epiplastra.

2. There is the possibility that the epiplastra or their homologue could lie athwart the anterior extension of the hyoplastræ, as is distinctly the tendency in *Sphargis*.

3. I have twice seen this bone in place, and each time it rested directly upon the anterior portions of the hyoplastra and beneath numerous other skeletal parts, while the angular edge of the entoplastral process faced upwards, and therefore inwards as would be expected. Rounded edges and flat faces would probably be exterior.

4. The chances were in favor of the preservation of other plastral elements, rather than of such a free nuchal as this bone would have constituted, had they existed. Especially was this the case in specimen No. II, where the anterior parts were quite undisturbed.

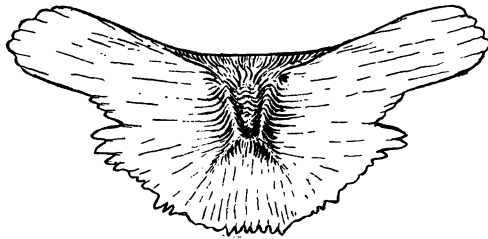
5. There is no process for articulation with the last cervical vertebra as in all living marine testudinales.

6. Were this bone to be regarded as the nuchal, and the remainder of the plastron then to be added to proportionally for

anterior plastral elements as in *Tholassochelys*, etc., the plastron would probably have had a greater length than the carapace.

7. There is an element which I figure and think must be the nuchal. It resembles markedly the nuchal of *Sphargis* and corresponds closely to the bone which Cope believed to be the nuchal of *Protostega gigas*, (Cretaceous Vertebrata of the West, plate XII, fig. 11.) The figure and description is given herewith. The *nuchal* (see meas.) is a flat fan-shaped bone distinctly incurved anteriorly, and spreading out into two broad alæ projecting well forward. These must have con-

2.



Nuchal. Under or internal side. One-tenth natural size.

nected with the marginalia, the anterior pair of which were quite thin, fragments having been recovered. It should be remarked that the thickness laterally and also of the thin posterior fan, the edge of which is slightly notched as if for sutural union with the first neural, as well as striation, all favor the nuchal position for this bone. The latter is especially true of a small dorsal pitting from which radiate several distinct surface striations corresponding to those radiating from the median neural groove* of the carapace. The inferior side is marked by a prominent centrally-placed elevation two centimeters in height, having the shape of an isosceles trapezoid distinctly buttressed at the four corners. The long and anterior base of this trapezoidal ridge has twice the length of the shorter, and a slight central elevation is enclosed. This elevation must have formed a surface for articulation with the last cervical vertebra. This element evidently formed no part of the plastron, and as I have previously described the pygal I can suggest no other than the nuchal position. (See Figure 2.)

Hay, in his publication previously mentioned, figures a portion of the entepiplastron which he says must be regarded as the nuchal. He mentions the grooves of the [upper] surface as internal, that is, facing downward, and presumably representing contact with transverse processes of the last cervical

* See description of carapace, this Journal, Dec. 1896, page 400.

vertebra. But, whether or not it shall transpire that my contention is correct, it must be borne in mind that these markings *faced upwards*. If this element had been the nuchal, whence came they? They were never in contact with any vertebral processes unless such projected downwards.

The Hyoplastron (see measurement).—This element of the plastron is traversed by and marks the end of a continuous heavy ridge beginning with the heavy outer edge of the comparatively narrow xiphiplastron and continuing through the hypoplastron. Considered in its general outline, this ridge strongly suggests the beginning of a reduction resulting in a plastron like that of *Sphargis*.

From its central ridge the hyoplastron, which is broadly elliptical in general outline with the exception of the large brachial notch, grows steadily thinner on both sides until it consists simply of flat ridges marking the emergence of the spines which beset it on every side except the brachial, the edges being no thicker than cardboard.

These spines narrow and thicken toward their middle portions. Those of the inner edge may be roughly divided into an anterior, a medial and a posterior group. The spines of the anterior group, seven to nine in number, are very heavy and rather short and incline to or are distinctly triangular in section with the flat surface beneath. Those of the medial group, six in number, are very long and slender. For their last third they are crescentic in cross section, the concave faces facing in pairs. The last or inferior group consists of rather flat spines. There are nineteen spines in all on the right interior and twenty-one on the left. Where two take the place of one the general symmetry is preserved by a diminution in size.

On the outer edge following the brachial angle there are three broad, heavy and rather short spines, followed by three longer and more slender; the remainder of the outer hyoplastral series being rather broad and flat.

There is absolutely no marginal or surface marking whatever suggesting contact with an *epiplastron*. (See Plate II.)

The Hypoplastron (see measurements).—This bone strongly resembles the hyoplastron in general appearance, though the spines are more numerous and less divided into regions, with the exception of the two long posterior extensions which receive the xiphiplastron between them. The right and left inner series overlap considerably. Inner series of spines, right side, 20; left, 17; outer series, 17 in number.

The Xiphiplastron (see measurements).—Except for the slightly dactylated connection between the posterior ends of the xiphiplastrals there are no spiny processes. The outer edge

thickens into a rounded and heavy ridge previously mentioned, while the inner edge thins out as it passes beneath the posterior extension of the hypoplastron. Anteriorly there are two lateral grooves for the reception of the two posterior hypoplastral continuations. This dovetailing makes a very firm joint between these two elements.

Concluding Remarks.—From the further study involved in the reconstruction given herewith I conclude that the genus *Archelon* which I have proposed is unnecessary. *Archelon ischyros* therefore becomes *Protostega ischyra*. Certain differences I pointed out in the processes of the humerus and procoracoscapular together with unusually robust form and increase of size are of distinct specific but not generic value. I may mention that Cope represented the ribs of *Protostega* as free and that Hay with additional material considered this possible. The rib expansions unquestionably united in *gigas* by suture as in *ischyra*, as Professor Cope has since assured me must have been the case.

Cope regarded *Protostega* as the type of a new family which he did not name, but with the idea that the plastral elements were dorsal—an error much more easily made than one might at first think—especially since some of the marginalia do actually develop into thin dorsal spine set extensions.

Of the generic and family relations of these important forms I shall have more to say at a subsequent time.

MEASUREMENTS.

The Entepiplastron.

	M.
Extreme length (lateral)	·94
Antero-posterior length	·45 ±
Greatest breadth of alæ	·28
Least breadth of alæ	·10
Least circumference of alæ	·21
Thickness at least circumference	·05
Greatest thickness in medial line	·06
Length of entoplastral process	·36 ±

The Hyoplastron.

Greatest antero-posterior length inclusive of spines...	1·03 ±
Greatest oblique length inclusive of spines	1·20 ±
Greatest width inclusive of spines	1·10 ±
Greatest antero posterior length exclusive of spines..	·92
Greatest width exclusive of spines	·70
Greatest thickness	·048
Length of interior spines	·15—·25
Length of exterior spines	·15—·20

The Hypoplastron.

Greatest length inclusive of spines.....	1.00
Greatest width inclusive of spines.....	1.00±
Greatest length exclusive of the posterior extension..	.65
Greatest width exclusive of spines	.65
Greatest thickness	.041
Length of interior spines.....	.15—.25
Length of exterior spines	.10—.20

The Xiphiplastron.

Greatest length.....	.50
Greatest width	.17
Greatest thickness.....	.036
Thickness near terminus.....	.025

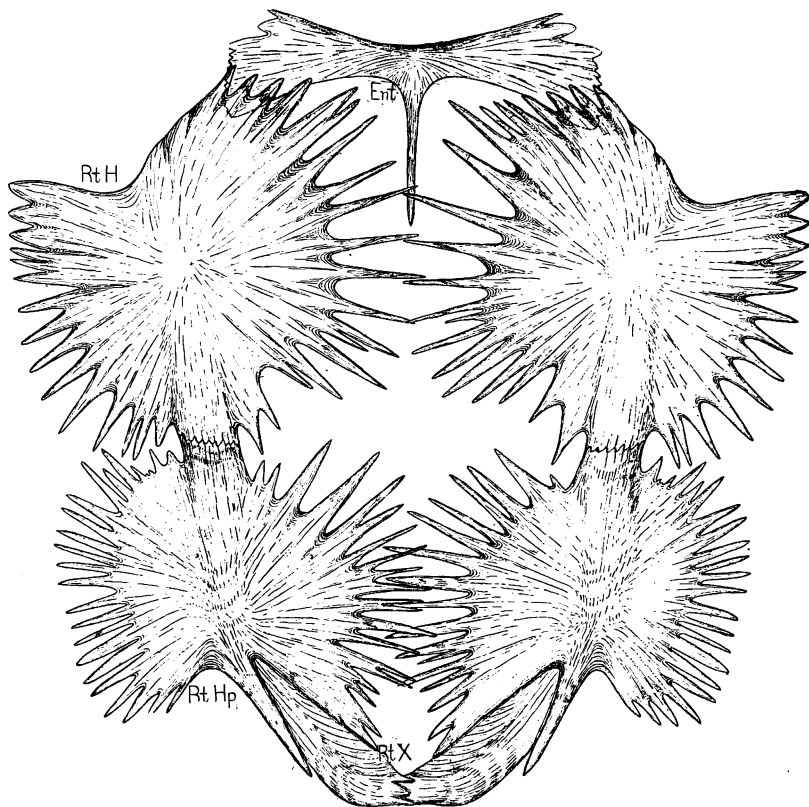
The Plastron.

Total width across the hyoplastron.....	2.00 +
Total width across the hypoplastron.....	1.86
Total length	2.00 +

The Nuchal.

Greatest lateral width.....	.64
Antero-posterior length	.25
Elevation of articulating surface for the last cervical vertebra	.02
Greatest thickness including the process for the cer- vical	.035
Width of alæ	.09
Thickness of alæ.....	.01—.015

Chester, Pa., Dec. 11, 1897.



THE PLASTRON OF *PROTOSTEGA ISCHYRA* (Wieland).

The under or external view of a series of elements, all of which were found in contact relatively in the above position and beneath all other skeletal parts present.

One-twentieth natural size.

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|---|---------|---|-------------------------|
| { | Rt. H | = | Right Hyoplastron. |
| { | Rt. Hp. | = | " Hypoplastron. |
| { | Rt. X. | = | " Xiphiplastron. |
| { | Ent. | = | The Entepiplastron (?). |