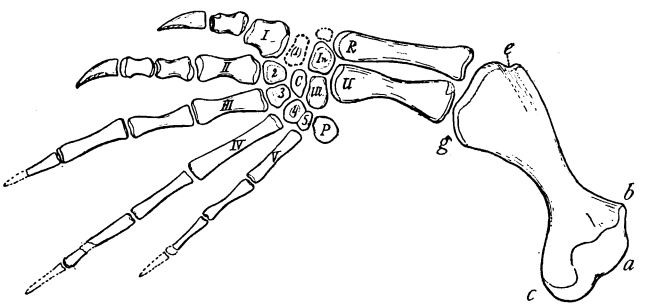
ART. XIV.—*Notes on the Cretaceous Turtles, Toxochelys and Archelon, with a Classification of the Marine Testudinata;* by G. R. WIELAND.

I. *The Front Flipper of Toxochelys latiremis.*

A FINE specimen of *Toxochelys latiremis* Cope* from the Niobrara Cretaceous of Kansas (Accession No. 2491 of the Yale coll.) includes a well preserved skull and lower jaw, six cervical, and several dorsal vertebrae, anterior portions of the carapace and plastron, and two nearly complete front flippers. Although some of these bones are somewhat crushed, their preservation is in all other respects exceedingly good. The

Figure 1. *Toxochelys latiremis* Cope. Dorsal view of the left front flipper, x¼.



a, b, c, e, g, respectively the head, radial and ulnar processes, ectepicondylar groove, and entocondyle of the humerus: R, radius: U, ulna: In, intermedium; Ul, ulnare: P, pisiform; C, centrale; 1–5, first-fifth carpalia; I–V, first-fifth metacarpalia.

left of the front flippers is evidently the more complete, and apparently only lacks the radiale, first carpale, and some distal portions of the terminal phalanges of the third, fourth, and fifth digits. The various elements, with the exception of carpalia 4 and 5, were separated in collecting, or else had originally been more or less scattered. Nevertheless, the arrangement of the parts, as shown in figure 1, is given with considerable confidence as to the correctness of the main facts.

Hitherto our knowledge of the front flipper of *Toxochelys* has been limited to the proximal half of the humerus and two fingers as described by Case,† although the phalanges are men-

* E. D. Cope.—Vertebrata of the Cretaceous Formations of the West, vol. ii, Rep. U. S. Geol. Sur. of the Territories. Washington, 1875.

† E. C. Case.—University Geol. Sur. of Kansas, Paleontology, part iv, *Toxochelys*. Topeka, 1898.

tioned as "flattened" by Cope. Case figures as the first finger what is here denoted as the second, but, as is further mentioned below, there is a striking peculiarity in the strong resemblance of the second metacarpal to the first, which would lead one to err in this respect in the absence of the other digits.

Description. The humerus, rather broader in the fossil than in life as the result of crushing, is, as I have already pointed out on the basis of the proximal portion only, of the *thalassoid* type characteristic of various of the older Chelonidæ.* That is, while the general outline closely approaches that seen in typical oceanic turtles, certain persisting older characters are present, such in particular as the high position of the rather prominent radial crest. The most closely related humeral form is to be seen in *Lytoloma*† and in *Neptunochelys tuberosa* (Leidy, Cope) Wieland.*

The radius is somewhat longer than the ulna as in other Chelonidan forms, and also be it noted as in *Acichelys* (*Eurysternum*) *Wagleri*. (See figure in Zittel's Handbuch.)

The large *intermedium* is also of the same general outline as that of *Acichelys*.‡ The arrangement of the carpals is, however, mainly as in *Chelone*, etc., the first carpale not being excluded from contact with the centrale, while the first metacarpal is set high, and the small and thin *pisiform* is attached to the fifth carpale.

General Observations. The present is probably the first fairly complete restoration of the fore flipper of an ancient marine Chelonian which has been given, and as one might well expect in the case of a Cretaceous turtle presenting various primitive characters, no little light is shed upon the manner in which the evolution of the Testudinate flipper has proceeded. The most striking peculiarity is the flatness of metacarpal II. This bone presents characters distinctly intermediate to those of metacarpals I and III. As flattening is usually only present in the bones of the first finger, there is in *Toxochelys* a very marked use made of this means of adaptation for marine life. *Toxochelys* has two well developed claws, not noticeably differing in this respect from *Eretmochelys*, but the short and robust phalanges of the first and second fingers, all of which are exceedingly well preserved, are decidedly more suggestive of those seen in land forms than in the case of any other known distinctly marine turtle.

* G. R. Wieland.—Some Observations on Certain Well-marked Stages in the Evolution of the Testudinate Humerus. This Journal, fourth series, vol. ix, June 1900.

† L. Dollo.—On the Humerus of *Euclastes*. Geol. Mag., vol. v, pp. 261–267. London, 1888.

‡ Zittel.—Handbuch der Paleontologie.

With respect to the distal phalanges of the fourth and fifth fingers, it should be stated that the present restoration is of necessity more or less generalized. These phalanges being more slender than those of the first and second fingers, have suffered crushing, and having been isolated also, one cannot be wholly sure of their exact order. Nevertheless, it is fully evident that fingers 3–5 are long, and have the structure seen in strictly marine turtles. In the appended table of measurements only those elements are given which may be determined with reasonable certainty, though the estimated lengths of fingers 3–5 are doubtless very near the truth.

At least we are enabled to deduce the principal variants in the evolution of the Testudinate flipper from some generalized type of foot like that of *Chelydra*. The humeral changes in general form I have already outlined at some length. In the case of the remaining elements it would of course be desirable to consider an approximately phyletic series, but in the absence of this, the general trend of change may best be made clear by considering the percentage of length of the elements of the flipper in *Chelydra*, *Toxochelys*, *Eretmochelys* and *Dermochelys*. These are, together with *Acichelys* of the Jurassic, and the known portions of *Archelon*, as follows:

	Humerus.	Radius.	Ulna.	1st finger.	2nd "	3rd "	4th "	5th "	Pisiform.
Dermochelys,	100	43	39	127	180	209	173	86	23
Eretmochelys,	100	53	44	49	89	128	105	44	12
Archelon,	100	54	51	—	—	—	—	—	21
Toxochelys,	100	58	50	51	73	100±	104±	70±	11
Chelydra,	100	52	53	50	72	73	55	50	(small)
Acichelys (=Eurysternum),	100	57	51	40	54	63	66	51	17

Inspection of the above table shows:

1. Strongly marked radial and ulnar decrease in length.

2. Greater or less elongation of the radius as compared with the ulna.

3. Nearly static length of the first finger in the Chelonidan forms, with sharp increase in Dermochelys.

4. Persistent increase in the length of fingers 2–4.

5. More or less variable tendency to increase in length of the fifth finger.

6. Great pisiform increase, which began relatively early.

Measurements of Toxochelys latiremis.

(All are from the same individual.)

The Skull.

	M.
Extreme length from beak to extremity of the supra-occipital process, which is complete	·152
Length from beak to occipital condyle	·114
Extreme width	·11
Width between articular surface of quadrates	·078
Length from beak to anterior border of internal nares	·025
Extreme length of ramus of lower jaw	·11

The Cervicals.

Length of 1st cervical centrum	·014
Length of 2d " "	·025
Length of 3d " "	—
Length of 4th " "	·033
Length of 5th " "	—
Length of 6th " "	·032
Length of 7th " "	·031
Length of 8th " "	·03
Estimated total length of the eight cervicals	·226
Length of 1st dorsal centrum	·023

The Humerus.

	M.
Greatest length	·135
Depression of radial crest beneath proximal extremity	·02
Distance of ectepicondylar groove from distal anterior border	.005

Greatest length of the other elements of the front flipper:

Radius	·075	Metacarpale, III	·039
Ulna	·066	" IV	·055
Intermedium	·018	" V	·037
Ulnare	·017	Phalanx, I–1	·018
Centrale	·015	" I–2 (claw)	·024
Carpale I	—	" II–1	·02
" II	·015	" II–2	·019
" III	·013	" II–3 (claw)	·025
" IV	·013	Phalanx III–1	·034
" V	·011	" III–2	·039
Pisiform	·015	" IV–1	·036
Metacarpale, I	·023	" V–1	·031
" II	·035		

Total length, first finger	·65
" " second finger	·095
Estimated length, third finger	·13
" " fourth finger	·135
" " fifth finger	·09

II. *The Front Flipper of Archelon ischyros.*

In my first description of the gigantic turtle skeleton from the Fort Pierre Cretaceous of South Dakota which constitutes the type of *Archelon ischyros*,* I figured, in addition to other skeletal parts, the humerus, radius, ulna, femur, tibia, and fibula, and mentioned the fact that a number of carpals and tarsals with several phalanges were also present. This was practically the first contribution presenting the main features in the limb organization of the [Protosteginæ]. Hitherto our knowledge of the flippers of these great turtles had been limited solely to that given in Cope's original description of the first member of the group discovered, *Protostega gigas*.† In this form the humerus was described and figured together with the radius and ulna, although the latter were then supposed to be "metapodials" rather than bones of the forearm.

As there was at the time of my first publication an absolute dearth of information concerning the carpal and tarsal structure in marine turtles from the American Cretaceous, not one having been described, the fear that I might make some serious error prevented my publishing the restoration of the carpus which I then made, the various elements having been found only partly in position.

Now, however, Professor Williston‡ has just described the hind flipper of *Protostega*, and this enables me by exclusion to determine with a reasonable assurance of correctness that the elements I originally assigned to the carpus in my study of the closely related *Archelon* truly belong there. I am hence able to add some further facts concerning the skeletal organization and systematic position of these highly interesting Testudinates.

The partial restoration of the left fore flipper shown in figure 2 is based on the radius and ulna, with what are considered to be all of the carpals but two, together with the first and fifth metacarpals. Several phalanges are present, but as finger proportions may vary markedly it is not deemed advisable to attempt a complete restoration. The value to be attached to this preliminary restoration is provisional, as follows:

(a) The radius and ulna are simply drawn in a generalized position, but their orientation is based on that found in a second specimen where these bones were in an approximately normal position with respect to the humerus, only.

* G. R. Wieland.—A New Gigantic Cryptodire Testudinate from the Fort Pierre Cretaceous of South Dakota. This Journal, fourth series, vol. ii, December 1896.

† Loc. cit.

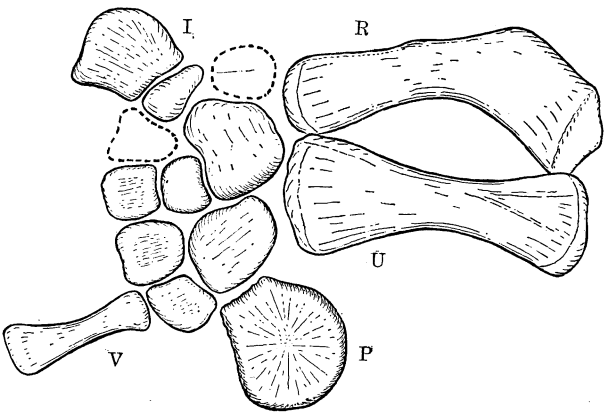
‡ S. W. Williston.—On the Hind Limb of *Protostega*. This Journal, fourth series, vol. xiii, April, 1902.

(b) Carpalia 3–5 were found in succession, and are doubtless correctly placed.

(c) There is little doubt but that the intermedium and ulnare are correctly determined, but their precise orientation is not so certain. Thus it may be that the intermedium should be rotated in a vertical arc of 90°. This, however, would not greatly alter its general contact outline, as it is a very robust and much rounded instead of flattened bone.

(d) Since metacarpal I and the pisiform are beautifully preserved, both as to form and surface markings, the possible remaining margin of error as to the identity of the several parts is slight.

Figure 2. *Archelon ischyros* Wieland. Partial restoration of left front flipper, x1/8.



R, radius; U, ulna; P, pisiform; I, carpale 1; V, carpale 5.

Description. Since the peculiarities of the *humerus* have been quite fully dealt with in my article on the Evolution of the Testudinate Humerus, this bone need not be further mentioned now, except to recall the fact that it resembles the humerus of *Dermochelys* more closely than any other, although differing in some very essential features.

The *radius* is only slightly longer than the ulna. Proximally it is triangular, and distally, rather elliptical in transverse section. The most marked characteristic whatsoever is the strong proximal bow, which recalls the lesser proximal bow seen in the radius of *Dermochelys*. Otherwise this form has a rounder, heavier head. The proximal articular face is only slightly concave, its general outline being that of an isosceles triangle, with the base in contact with the inner face of the ulna.

The *ulna* is short and massive. The proximal articular surface is slightly crescentic in general outline, and somewhat concave except for an oblique, low, saddle-shaped ridge which divides this face into subequal areas, the larger facing towards the radius. The distal articular surface is moderately convex antero-posteriorly, and rather flat in the dorso-ventral direction. The bone has a distinct broad and shallow grooving on the proximal ventral, and on the distal anterior side, marking the proximal and distal contact with the radius and producing the effect of a marked twist corresponding to the high angle between the general trend of the proximal and distal articular faces. As in the case of the humerus and radius, there is a certain correspondence with *Dermochelys*, but the ulna of the latter is more rounded.

The *intermedium* is much rounded and very robust. The *ulnare* is suboval in external outline, with the proximal edge much the thicker. The *pisiform* is very large, of subcrescentic outline, thick, and quite flat, but with a raised border on both faces.

The carpalia and metacarpals present have more the appearance seen in the Cheloninæ than in *Dermochelys*, in which respect there is in fact a wide difference, the pronouncedly marine appearance of the rounded subcylindrical and flat-ended metacarpal and phalangal bones of the latter being quite absent.

General Resemblances. In so far as now known, the manus and pes of *Protostega* and *Archelon* resemble those of *Dermochelys* rather more than any other form. Briefly pointed out, the more marked similarities of the manus are, the approximately equal length of the radius and ulna, the heavy proximal bow of the radius, the carpal organization with the centrale excluded from contact with carpale 1, and an enormous pisiform set high up near the ulna, and mainly on the ulnare. The point of most importance and necessarily of the greatest difficulty to settle with complete satisfaction is as to the assumed contact of the centrale with carpale I.

Professor Williston has, I think, omitted one of the tarsalia from his restoration of the hind limb of *Protostega*, so that there is likewise an even closer general correspondence between the hind limbs of these several forms than he suggests. The diminution of the fifth finger of the hind flipper, as he shows, to a single metatarsal is, I suppose, not to be regarded of as much importance as any reorganization of the carpalia or tarsalia (loc. cit.).

Measurements of Archelon ischyros.

(From the type specimen.)

The Radius.

	Meters.
Length	·35
Proximal diameters	·082 and ·114
Least diameters of shaft	·05 and ·067
Distal diameters	·049 and ·114

The Ulna.

Length	·33
Greatest and least proximal diameters	·093 and ·14
" " " diameters of shaft	·054 and ·063
" " " distal diameters	·088 and ·138

Measurements of carpals and metacarpals, viewed from dorsal surfaces:

	Greatest length.	Greatest width.
Intermedium	·8	·11
Ulnare	·11	·08
Pisiform	·14	·12
Centrale	·048	·06
Carpale I	·04	·07
" II	—	—
" III	·06	·056
" IV	·068	·068
" V	·06	·072
Metacarpale I	·09	·10
" V	·156	·056

The extreme length of the accompanying humerus is ·65 meters.

III. *The Cervicals of Toxochelys and Archelon.*

(See Measurements, p. 98.)

The cervical formula has not hitherto been given for any of the Cretaceous marine turtles, so far as the writer is aware, our knowledge having been restricted to scattering or isolated vertebræ. I may hence give the formula for *Toxochelys*, and will show that that of *Archelon* may also be determined as quite similar, since we know the vertebræ most susceptible of change, the last three.

In the Yale specimen of *Toxochelys* (see Measurements), the first, second, fourth, sixth, seventh, and eighth cervical vertebræ are present. The nature of the other two, the third and the fifth, of course follows, as included arbitrarily in the subjoined table, in which are given the formulæ for the present forms and several others presenting interesting or im-

Cervical.	I *Archelon ischyros.*	II *Toxochelys latiremis.*	III *Dermochelys coriaceæ.*	IV *Eretmochelys imbricata.*	V *Chelydra serpentina.*	VI *Testudo polyphemus.*	VII *Erymnochelys Madagascariensis* (Grand).	VIII *Podocnemis Dumerilianus.*	IX. *Trionyx spinifer.*
1	Complex	Complex	Complex	Complex	Complex	Complex	Complex	Complex	Complex
2	Cyrtocœlian	Cyrtocœlian	Cyrtocœlian	Cyrtocœlian	Cyrtocœlian	Cyrtocœlian	Cyrtean	Cyrtean	Cyrtocœlian
3	"	"	"	"	"	"	Cœlocyrtean	Ephippic	"
4	Cyrtean	Cyrtean	Cyrtean	Cyrtean	Cyrtean	Cyrtean	"	"	"
5	Cœlocyrtean	Cœlocyrtean	Cœlocyrtean	Cœlocyrtean	Cœlocyrtean	Cœlocyrtean	"	"	"
6	"	"	"	Cœloplatyan	Cœlo-bicyrtean	Cœlo-bicyrtean	"	"	"
7	"	"	Cœlo-bicyrtean	Platy-bicyrtean	Bicœlo-bicyrtean	Bicœlo-bicœlian	"	Cœlocyrtean	Cyrto-bicœlian
8	"	"	Bicœlo-cyrtean	Bicœlo-cyrtean	Bicœlo-cyrtean	Bicyrto-bicyrtean	"	"	Bicyrto-cyrtean

1. Cyrtean=double-convex; Cœlian=double-concave; Bicœlo-bicyrtean=doubly concave anteriorly, and doubly convex posteriorly, and so on. See this Journal for August, 1899, p. 163.
2. The last cervicals of *Toxochelys* are broad, but do not actually develop into double-concave, double-convex, or flatly terminated centra.
3. No. 7 of *Dermochelys* approaches platybicyrtean as in *Eretmochelys*.
4. The third-sixth cervicals of *Podocnemis* are quite as distinctly saddle-shaped as those of birds, doubtless as the result of the habit of retracting the neck laterally.

portant comparisons. All taken together display the great variations seen in particular in the last five Testudinate cervicals. I may explain that I have introduced a modified nomenclature I proposed in this Journal for August, 1899, p. 163, since the ordinary and incomplete terminology does not adequately express the complicated forms seen in Testudinate cervicals.

The cervicals of *Toxochelys* are distinctly intermediate in character between those of *Chelydra* and the *Chelonidæ*, being most like the former. The ends of the sixth, seventh and eighth broaden, but there are no distinctly biconcave, biconvex, or flat terminations, these vertebra still being procœlous (cœlocyrtean). Their centra have strongly marked elongate and thin or blade-like keels, quite similar to those of the sixth and seventh, but not the eighth centrum, of *Chelydra*. The total length falls far short of that seen in the *Chelydridæ*.

In *Archelon*, the sixth, seventh and eighth cervicals were found in place in the type specimen, as well as several others. All are characteristically procœlous (=cœlocyrtean), and none have their anterior ends markedly broadened as in *Toxochelys*. They are also relatively much shorter than in *Toxochelys*, and very robust (loc. cit.). I have estimated the cervicals of the type specimen of *Archelon* as having a length of ·72^{m}. The cranial length must be about the same. But in *Toxochelys* the total length of the cervicals is about one and a half times, and in *Chelydra* twice that of the cranium. We cannot doubt that the fourth cervical was biconvex (Cyrtean), since it is so in all known marine Testudinates. The vertebræ of *Archelon* are on the whole rather more primitive than in any other marine turtle, and it is certainly very interesting that there should be a closer agreement with *Toxochelys* than any other form.

IV. *Bearing of the Foregoing Data, and Classification.*

A phylogenetic classification of the marine Testudinates will still be held more or less difficult to deduce, according to the view that is taken of the much debated descent of *Dermochelys*. In weighing the evidence at present available, however, it needs to be borne in mind that the wide distribution of the turtles in latitude and time necessitates the consideration of slighter differences than in the case of more variant forms. While this must finally be a great advantage, it is a fact that at present brings home to us with force our imperfect, but happily rapidly increasing, knowledge of the fossil record. Again, there is a constant danger that in such a case one may regard evolution as having taken a far simpler course than has

really been the fact. It would appear that several hypotheses yet require consideration, as follows:

(1) All the known marine Testudinates may be the descendants of a single littoral species.

(2) *Dermochelys* on the one hand, and all the other marine forms on the other hand, may have descended from two different littoral species of the same genus, or from different genera.

(3) *Dermochelys*, *Toxochelys*, *Protostega*, and the living *Chelonidæ* may represent the descendants of four genera of the same, or closely allied families.

(4) *Dermochelys* is of ancient descent, and stands phyletically and morphologically opposed to all other Testudinates.

Doubtless the final truth will be found to lie somewhere between the first and last extremes. Certainly it is difficult to overthrow the conclusion as to the general fact of descent as thus expressed and as defended with such signal ability by Baur:*

"Darüber aber ist kein Zweifel dass *Dermochelys* und *Psephophorous* keine urspünglichen Formen sind, sondern dass sie von wahren 'Thecophoren' und zwar von den 'Pinnaten' abstammen, um mich hier dieses Ausdrucks zu bedienen."

Dollo,† originally a strenuous opponent of this view, has recently adopted it. Taking up the question in further detail, he holds *Dermochelys* to be descended from a pelagic Thecophore with an extremely reduced carapace and plastron, but the descendant of a littoral Thecophore with a fully developed carapace, and a plastron without fontanelles. And this eminent scientist has proposed the ingenious hypothesis that such a Thecophore again acquired littoral habits, resulting in the formation of a heavy mosaic carapace, which, with a second resumption of pelagic habits, again began to disappear, and is still in process of reduction. The persistence of the nuchal is held to be due to its value as an attachment for the nuchal ligaments. However involved such an evolutionary process may appear, it is skilfully presented, and has much in its favor.

On the other hand, Hay‡ has presented at considerable length facts favoring a very early origin of the Dermochelan line.

* G. Baur.—Biologisches Centralblatt, Band ix, 1889, p. 191 (Erlangen).

† L. Dollo.—Sur l'origine de la Tortue Luth (*Dermochelys coriacea*). Extrait. Bull. Soc. roy. des Sciences Med. et Nat. de Bruxelles. Seance 4 fevrier, 1901.

‡ O. P. Hay.—On Protostega, the Systematic Position of *Dermochelys*, and the Morphogeny of the Chelonian Carapace and Plastron. American Naturalist (Boston), Dec. 1898.

Presumably the evidence in favor of Baur's view is increasing. The writer so regards it. The fact that the cervicals of *Toxochelys* and *Archelon* agree in general, and at the same time differ most widely from the cervicals of *Dermochelys* and of the Cheloninæ, is, however, rather unexpected. Did the vertebræ of these Cretaceous forms tend to simplify, or has there been a more or less remote homoplastic parallelism in the course of complication in the case of the sixth, seventh and eighth vertebræ of the modern sea turtles, and such widely different forms, for instance, as the Testudinidæ?

The question at once arises, what is to be regarded as a very primitive Testudinate cervical, and what was the form in the species, genus, or group which made its way into the sea and gave rise to the marine group? We may most reasonably suggest as a very primitive cervical type, that of a turtle like the Pleurodiran *Erymnochelys*, in which there is a well-nigh complete agreement with the modern *Crocodilia*, the second, and not the fourth, centrum being biconvex. And we assume that some descendant of such a primitive type, with double convexity moved back to the fourth cervical centrum, the fifth–eighth centra remaining simply procœlous, stood in some common ancestral relationship to the sea turtles and most other existing Cryptodirans. It would at present, therefore, seem that even since the sea turtles split off from their littoral ancestry there has been a certain parallelism in the secondary cervical modifications undergone by them and the most nearly related land forms. This may hence prove, once we know the record more completely, to be another example of the fact that a course of evolution and change once established in a persistent group, may long continue, after the invasion of wholly new environments. There is in biologic, as in physical evolution, inertia.

As to the carpus of *Archelon*. It will certainly be very interesting if my surmise that there is no union between carpale 1 and the centrale should prove correct. This, although to be regarded as a secondarily acquired character, would indeed go far toward narrowing the gap between the extreme ends of the marine group. I may point out that the greatly accentuated bow of the radius of *Archelon* would make it probable, even in the absence of more direct evidence, that there was present some marked change in the order of the carpals.

Systematic Position of Archelon. While the data given in the preceding notes go far towards showing that *Protostega* and *Archelon* present more osteological resemblances to *Dermochelys* than any other turtles whatsoever, living or extinct, their structure is essentially that of the Chelonidae, of which

they may best be regarded as a subfamily, the Protosteginæ. Moreover, these Dermochelan resemblances are only what we might well expect in Cretaceous turtles. There are likewise, as we see, certain Chelydran resemblances in the general type of skull, just as there are also Chelydran resemblances in *Toxochelys*. We are simply following convergent lines back sufficiently far to somewhat accentuate general relationships.

Position of Toxochelys. The fore flipper and cervicals of *Toxochelys* present some additional Chelydroid characters to those of the cranium and lower jaw, as already pointed out by Cope and Hay. *Toxochelys* hence proves to be one of the most interesting of turtles. Like *Protostega* and *Archelon*, it points with more or less distinctness toward a Chelydra-like ancestry. Baur has said that this genus should be placed in a distinct family, and in this has been followed by Hay and Case. But I think that *Toxochelys* may more conveniently be considered as representing a subfamily of the Chelonidæ, certainly if of common ancestry.

V. *Provisional classification of the marine Testudinates.*

Chelonioidea (Baur).

(Superfamily of the Cryptodira.)

A parieto-squamosal arch; palatine foramen and free nasals sometimes present (Desmatochelydinæ); fourth cervical biconvex, with the centra of the sixth, seventh, and eighth usually greatly modified.

I. *Dermochelydidæ.*

No descending parietal processes; no palatine foramen; other cranial and limb characters not remote from those of the Chelonidæ; carapace represented by the nuchal only, and body enveloped in a leathery hide with an osteodermal mosaic; no claws. Genera: *Dermochelys*, *Psephophorous*, *Eosphargis*.

II. *Chelonidæ.*

Skull with descending processes of parietals, so far as known; palatine foramen sometimes present; vomero-premaxillar union often, but not constantly present; a normal, though often much reduced, carapace and plastron; nuchal with or without process on under side; claws, one or two.

1. Protosteginæ.—No free nasals; no palatine foramina; obturator foramen small and enclosed by ischiopubic contact on median line, as in many land forms.

Genera: *Protostega* and *Archelon*; *Protosphargis?* *Pseudosphargis?*

2. Toxochelydinæ. — No free nasals; palatine foramen, pterygoids, and lower jaw distinctly Chelydra-like; two strong claws.

Genera: *Toxochelys*, *Porthochelys*, *Cynocercus* (?), all of the Niobrara Cretaceous of Kansas, also *Neptunochelys* from the Cretaceous of Mississippi.

3. Desmatochelydinæ.—Free nasals; distinct palatine foramina (except *Rhinochelys*?).

Genera: *Desmatochelys*, *Rhinochelys*, *Atlantochelys*.

4. Cheloninæ.—No free nasals; no palatine foramina; vomero-premaxillar union often, but not constantly present; obturator foramen presumably not enclosed as in *Archelon* in any member of the group; claws, one or two.

Genera: *Osteopygis*, *Allopleuron*, *Lytoloma*, *Argillochelys*, *Eretmochelys*, *Chelone*, *Colpochelys*, *Thalassochelys*.

* * * * * *

Resume.—In the foregoing notes the following additions to the osteology of the marine Testudinates have been made:—

1. The elements and organization of the front flipper of *Toxochelys*.

2. The main elements of the wrist region of the front flipper of *Archelon ischyros*. (These are described from the type of the genus and species. The writer, in his first announcement of the discovery of this gigantic turtle, figured and described the accompanying humerus, with the radius and ulna, as well as the femur, tibia, and fibula,—this being the first instance in which all these limb bones were made known in the case of any extinct marine Testudinate.)

3. Important measurements for the coördination of various skeletal elements of *Toxochelys* and *Archelon*.

4. The deduction (with the exception of the secondary rearrangements of the carpals) of the principal lines of change in the evolution of the fore flipper from the foot of some primitive swamp, or littoral, *Chelydra*-like turtle.

5. The cervical organization of *Toxochelys* and *Archelon*, which is compared with that of living turtles.

6. A classification of the marine turtles.—This has chiefly been made possible by the description during the last few years of large portions of the skeleton of *Protostega* and of *Toxochelys*, and especially by the discovery of *Desmatochelys*, *Archelon*, and *Porthochelys*.

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