SECTION II.

THE

FOSSIL REPTILIA OF THE CRETACEOUS FORMATIONS.

CHAPTER I.—ORDER CHELONIA.

Genus, Chelone, (Turtles.)

The Cretaceous formations of England consist of the "Upper Chalk," which is white, and is commonly characterised by having horizontal layers of flint nodules; of the "Middle Chalk," which is as white as the Upper Chalk, but usually without the flints in regular layers; and of the "Lower Chalk," which when wet, and sometimes also when dry, has a gray tinge. These divisions of the chalk deposits, which in some parts of the south-east of England attain a thickness of one thousand feet, are best distinguished by some of their organic contents, as e.g. the Terebratulidae, the Echinidae, and the Ventriculidae.* Beneath the Chalk there is a series of Sands and Clays, which in England have received the name of "Upper Green-sand," "Gault," and "Lower Green-sand." The present Section of this History will be devoted to the description of the remains of the Fossil Reptilia that have come under the notice of the author from any of the above-named divisions of the Cretaceous Period.

One of the earliest, if not the first, indication of the occurrence of fossil Turtles in the formations of the Cretaceous Period, is given by the celebrated anatomist Camper, in a 'Memoir on the Petrifications found in St. Peter's Mount, Maestricht,'† where, referring to some specimens which he had procured for the British Museum, he writes:—"Another very beautiful specimen, a foot and a half long, and about ten inches broad, I have been induced to add, because it contains the anterior part of the scutum of a very large Turtle. Of this Mr. John Hunter has an analogous bone from the same mountain in his valuable collection, but sent to him under another name. I am convinced it belonged formerly to a Turtle;—first, because I have from the same mountain the entire back of a Turtle, four feet long and sixteen inches broad, a little damaged at the sides, and a pretty large fragment of another Turtle in my possession: secondly, because I have a similar one, but so placed within the matrix, as to show the inside of that piece in the back of a large Turtle I got in London, by the favour of Mr. Sheldon: thirdly, because I have amongst these bones the lower jaw-bone of a very large Turtle, of which the crura, though not entire, are seven inches long, and distant from one another six inches; the thickness is equal to one inch and a quarter."‡ In a collection of engravings belonging to my

† Philosophical Transactions, 1786.
‡ Ibid., p. 450.
late father-in-law, William Clift, Esq., F.R.S., there is one of a carapace of a large fossil Turtle, corresponding in size with that mentioned by Camper, and in his style of drawing. It is entitled "Tortue petrifiée trouvée dans la Montagne de St. Pierre pres de Maestricht;" and exhibits the "nuchal" and anterior "marginal" plates; ten "neural" plates, of a rhomboidal figure, carinated, and of nearly equal size, the fifth being six inches in diameter: the eight costal plates of the left side, and the first two and last three of those on the right side. The length of the first costal plate is seven inches, that of the last is little more than three inches; remains of the long and slender ribs are shown extending from the apices of the costal plates, which, in proportion to the length of the entire carapace, and to their own antero-posterior diameter, which is five inches, are extremely short, for in a carapace of a Turtle four feet in length, the costal plates must be supposed to have attained their full extent of ossification. The transverse diameter of the neural plates in this large fossil Turtle from Maestricht is three fourths that of the costal plates at the fore-part of the carapace, and is greater than that of the costal plates at the hind part,—a proportion which I have not noticed in any other Turtle, recent or fossil. The same characters appear in the figures given by M. Faujas St. Fond, of the same large species of Turtle.* Cuvier, whose superior anatomical knowledge enabled him to correct some erroneous remarks which M. Faujas St. Fond had published respecting the Chelonian remains in his 'History of the Fossils of St. Peter's Mount,' arrives at the conclusion, that they belonged to the Turtles, or marine genus Chelone, and to a species distinct from any existing Turtle;† but he does not notice the character of the great breadth of the neural plates, as compared with that of the costal ones; he only remarks that the great Maestricht Turtle appears to have much resembled the Chelone caretta.

The formation, near Maestricht, in which these Chelonian fossils occur, is the most recent member of the deposits of the Secondary epoch,—the highest and last formed of the cretaceous group: it consists of a soft yellowish stone, not very unlike chalk, and includes "siliceous masses, which are much more rare than those of the chalk, of greater bulk, and not composed of black flint, but of chert and calcedony.‡

Fossil remains of the Chelonian Order were deemed to be of rarer occurrence in the Chalk formations of England, which are apparently of older date than those at Maestricht. The first intimation of such was given by Dr. Buckland, in his 'Bridge-water Treatise' (1836), vol. ii, p. 67, pl. 44, fig. 3d, which is described as a "beak of a small testudo from chalk, in the collection of Mr. Mantell, showing a fibro-cancellated bony structure, very different from the compact shelly condition of the Rhyncolite, for which it may, from its size and shape, be mistaken." Dr. Mantell states, in his 'Wonders of Geology' (1839), vol. i, p. 330, that this specimen is "from the Lewes

* Histoire Naturelle de la Montagne de Saint-Pierre de Maestricht, 4to, 800, pl. xii-xiv.
‡ Fitton; Proceedings of Geol. Soc., 1830.
Chalk,” and probably, therefore, from the Lower Chalk. Further evidence of the remains of Chelonia in the cretaceous deposit is given in my paper on that subject read before the Geological Society, April 29, 1840, and published in vol. VI, p. 411, of the Second Series of the ‘Geological Transactions.’ The Chelonite there described and figured was obtained from the Middle Chalk at Burham, in Kent, and consisted of four marginal plates of the carapace, and a few other obscure fragments, sufficient to prove that the species was not of a Trionyx or Testudo; and as they differed in form from those of the recent species of Chelone, with which I compared them, and resembled rather the posterior marginal plates of some Emydians, I stated that this correspondence ‘rendered it probable that these remains are referable to that family of Chelonia which live in fresh water or estuaries.’ Subsequent observation of the various interesting modifications by which extinct Chelones diminish, as it were, the gap between the marine and fresh-water genera as they remain at the present day, weakened the impression which the character of the marginal plates of the chalk Chelonite first made in favour of its Emydian affinities; and the examination of the beautiful Chelonite, obtained from the same quarries at Burham, in Kent, and relieved from the chalk matrix by Mr. Bensted, described and figured by Dr. Mantell in the ‘Philosophical Transactions’ for 1841, demonstrated that it is not an Emys but a true Chelone, as I have stated in the note appended to my paper in the ‘Geological Transactions.’

As one of the figures in Dr. Mantell’s Memoir, Pl. 12, fig. 2, exhibits the extraordinary character of ten pairs of ribs in the carapace of this rare fossil, permission was obtained for original drawings to be made from the specimen, and these form the subjects of Plates 41 and 42.

From the time of Caldesi,* the constancy of the number of pairs of ribs which enter into the formation of the carapace of the Chelonian Reptiles has been confirmed by all subsequent observations. No anatomical fact, perhaps, is better determined, and more plainly and positively laid down, in all handbooks of Comparative Anatomy. Perhaps no monstrosity would sooner arrest the attention, or excite more wonder in the Comparative Anatomist, than the appearance in a recent or fossil Chelonian of a greater number of pairs of ribs in the carapace than 8. When, therefore, I saw the figure 2 of Plate XII of the volume of the ‘Philosophical Transactions’ for the year 1841, exhibiting not fewer than 10 expanded ribs on the left or entire side of the fossil carapace, and 9 expanded ribs on the mutilated right side of the same carapace, and found the experienced and well-known author appealing† to

* Osservazioni anatomiche intorno alle Tortarughe maritime d'Acque dolce et Terrestre; 4to, 1687.
† Dr. Mantell’s words are—‘The inner surface of the carapace is also thus displayed (Pl. 12, fig. 2), together with the mode of union and growth of the costal processes, and the attachment of their distal extremities to the osseous border. The accuracy of the drawings renders any detailed description unnecessary.’—Phil. Trans., 1841, p. 156.
the accuracy of the drawings as an excuse for omitting any detailed description of the rare fossil, I was at first inclined to infer the existence of an extraordinary anomaly in the construction of this extinct Chelonian of the Cretaceous period; but, having more pleasure in the contemplation of the harmonies and constants of Nature than her wonders, it was with no regret that I found that the error or lusus lay with her illustrator, and not with his subject, as I have ascertained by a careful inspection of the original. The artist has supplied the additional ribs from his imagination; and in the view, in fact, in which his attention was kept more closely to the parts, as in that of the upper surface of the same carapace (Pl. XI, Phil. Trans., 1841), he gives the true number of 8 pairs of carapacial ribs or costal plates; and the author, in reference to the characters of the carapace "as shown in plate XI," states, that "it is composed of eight ribs on each side the dorsal ridge." The correct view of the under surface of the carapace is given in Plate 42, fig. 1 of the present History.

**Chelone Benstedi, Owen. Plates 41, 42, and 43.**

_Syn._ Emys Benstedi, Mantell. Philosophical Transactions, 1841.


The fossil in question consists of nearly the whole carapace (Pl. 41), and a considerable portion of the plastron (Pl. 42, fig. 2), with a coracoid bone (Ib., fig. 2, 52, 53).

The carapace includes all the neural plates; the usual number, viz., eight pairs of costal plates (Pl. 1—8); and the entire border of marginal plates, save the nuchal and two or three succeeding ones (m 4—12, p). In the plastron (Pl. 42, fig. 2), the hyosternal and hyposternal bones may be distinguished. The general form of the carapace is elliptical, terminated by a point at the narrower posterior end, which, however, is less contracted than in some other Chelones. It is as depressed as in Chelones generally, as is shown in the side view, Pl. 41, fig. 2. To judge from the unmutilated and exposed neural plates, which are the first, the second, and the sixth to the tenth inclusive, the carapace appears to have been traversed by a median longitudinal crest, from which the sides gently slope with a slight convex curvature, as in Chelone mydas.

The more immediate indications of the close affinity of the fossil to the marine Turtles, are given by the incomplete ossification of the costal plates and of the elements of the plastron; the latter being in consequence dislocated from each other; and more especially by the shape and size of the marginal plates (Pl. 42, fig. 1, 6, 7, 8, 9) attached to the third, fourth, fifth, and sixth ribs; as also by the form and length of the coracoid bone.
The neural plates are as narrow relatively as in the ordinary Chelones, and differ in this respect from the broad rhomboidal plates in the Chelone Camperi of Maestricht. The first and second are long and narrow, with almost parallel sides; they are carinate above, and the first is crossed by the indentation of the juncture between the first and second vertebral scutes. The third and fifth are similarly indented. The eighth, which is the smallest of the neural plates, is crossed near its anterior border, by the impression of the juncture between the fourth and fifth vertebral scutes; this neural plate is 3 lines in length and 2 in breadth:* the ninth expands posteriorly into a triangular form; both these have their middle part raised into a ridge: the tenth plate is suddenly expanded, with angular sides, which slope away from a median longitudinal ridge: this is crossed by a transverse impression just anterior to its juncture with the pygal or median terminal plate (py) of the marginal series, which is convex above and traversed by a median longitudinal furrow. The margins of this plate meet posteriorly at an open angle. The second to the seventh pairs of costal plates extend along the upper part of only the vertebral halves of the ribs, of which they appear to be expansions. The length of such expanded part of the third rib (pl. 3) is 9 lines; its narrow, tooth-like part, before it reaches the marginal plate, is 9 lines; about 3 lines of its extremity is inserted into the deep groove of the concave surface of the sixth marginal plate, m6. The width of the interspace between the narrow parts of the third and fourth ribs is 4 lines; the length of the expanded part of the first rib is 10½ lines; the breadth of the expanded part of the first rib is 8 lines; the length of the narrow end of the rib, clear of the marginal plate, is 3 lines. In the superior breadth of the first costal plate (pl. 1), the Chelone Benstedi agrees with existing turtles, and differs strikingly from the Purbeck species (Chelone obovata, Pl. 9). The last short rib (pl. 8) sends almost directly backwards a short, narrow, tooth-like process, at right angles to the anterior margin of its sub-triangular expanded part. In Chelone obovata it is extended more nearly parallel with the expanded part.

The marginal plates (m₄ to py) have the same general uniformity of size which we observe in the existing Chelones (see the Cuts 1 and 2, p. 3, of the 'Section on the Reptiles of the London Clay'); the posterior ones are not expanded as in the Purbeck Chelone, and in certain Emydes, as Emys serrata, &c.; but the most decisive evidence against the Emydian affinities of the present fossil is afforded by the form and development of the inferior borders of the marginal plates attached to the fourth, fifth, and sixth ribs (m₇, m₈, and m₉); for these plates, instead of being expanded and extended inwards to join the hyo- and hyposternals and to combine with these elements of the plastron in forming the lateral supporting wall of the carapace, are not so much developed in breadth as the same parts of the posterior marginal plates, but form with them an even free border, as in other Chelones, in which not any of the

* In all Emydes the proportions of this plate, when it is not suppressed, are the reverse of those in the fossil.
marginal plates are joined with the sternum. This unmistakable evidence of the marine character of Mr. Bensted's beautiful fossil is unequivocally shown at b, in Pl. 12, fig. 2, of the 'Philosophical Transactions' for 1841, in which, nevertheless, the fossil is referred to the genus *Emys*.

With reference to the general imperfect ossification of the carapace, the deductions in favour of the marine nature of the Chalk chelonite might be invalidated by the hypothesis, that it was the young of some very large species of *Emys*; but the existing Emydians at the immature period when they exhibit the incomplete ossification of the carapace and plastron, have the marginal plates opposite the lateral processes of the hyosternals and hyposternals joined with those processes by an inward development of their inferior border, which is suddenly and considerably broader than the inferior border of the contiguous free marginal plates.

The outer contour of the tenth, eleventh, and twelfth plates of the *Chelone Benstedi*, projects in the form of a slight angle, and they thus differ from the same parts of *Chelone mydas* and *Chelone obovata*; most of the others have a straight free margin. The marginal plates appear as if bent upon themselves to form their outer margin, at a rather acute angle, receiving the extremities of the rib in a depression excavated in the concavity of the angle; they are nearly twice as long in the direction parallel with the margin of the carapace than transverse to it, and they are traversed in the latter direction, along the middle of their upper surface, with the groove or impression of the marginal scutes. The free edge of the upper plate of the marginal pieces is slightly notched above the insertion of the rib, and they correspond with those of the Chelonite, from the Burham chalk pit, in the collection of Sir Philip de M. Grey Egerton, Bart., F.R.S.

The form of the median or vertebral scutes of the perishable "tortoise-shell," may be traced by their somewhat wide and moderately-deep impressions. They progressively diminish in size from the second to the fifth, which is the smallest, and which covered the ninth and the major part of the eighth and tenth neural plates; but their relative breadth and the outward extension of their lateral angles correspond, like the characters of the more enduring parts, with the type of structure of the marine turtles. The breadth of the first vertebral scute is 1 inch 8 lines, that of the second scute is 2 inches, that of the fifth scute is 1 inch.

The coracoid is a bone that varies in form so as to be very characteristic of the different genera of Chelonians; it is a triangular plate in *Testudo*, a more elongated triangle in *Chelys*, a broad, bent, elongated plate in *Trionyx*, a narrower bent plate in *Emys*, a long, straight, slender bone, slightly expanded and flattened at the sternal end, in *Chelone*: now it is precisely the latter form that this bone (Pl. 42, fig. 2, 52, 53), fortunately preserved in the present specimen, here exhibits, showing that the same modifications of the skeleton, in reference to the actions of swimming, are combined in the past as in the present species of *Chelone*; it is 1 inch 7 lines in length,
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cylindrical at its humeral half, and gently expanded to a breadth of 3 lines at its sternal end. The proportion which this bone presents of one fourth the length of the carapace is only paralleled in the existing *Chelones*; it is much shorter in the *Emydes*.

The hyosternal and hyposternal bones resemble rather those of the Turtles than of the young *Emydes*; certainly no *Emys*, with a carapace 5 inches in length, presents such forms as these bones exhibit in the present fossil; several rays or pointed spines of bone are developed from the anterior half of the median margin of the hyosternal piece, as in *Chelone caretta*; the rest of the margin continues to form the circumference of the large central aperture of the sternum. The hyposternal sends similar rays from the posterior half of its outer margin, leaving the anterior half to join, probably the same proportion of the outer margin of the hyosternal, so as to form a deep, lateral, angular notch of the sternum. The length of the hyposternal is 1 inch 2 lines. The epi-, ento-, and xiphi-ster nal bones are not preserved.

From the preceding description, it must be obvious, as has been already observed, that the present Chelonite of the chalk can only be supposed to belong to the genus *Emys*, on the supposition that it is a very young specimen of some unusually large species; but against this supposition, the pointed form of the hind end of the carapace, the regularity of the size of the marginal plates, the non-development of the lower margin of any of these plates for a junction with the plastron, the long and slender coracoid, the narrow elongate form of the vertebral plates, and the broad vertebral scutes, collectively and separately militate. Whilst in all these modifications, the Turtle from the Chalk so closely corresponds with the true *Chelones*, that I cannot hesitate to refer it to the marine family of the order.

From the breadth of the xiphisternals in the remains of this species first described by me, I was induced to suppose that a new subgenus (*Cimochelys*) of marine Turtles was thereby indicated, having a closer affinity to the *Emydes* than the typical species; and the same affinity seems to be shown by the more regular elliptical form of the carapace of Mr. Bensted's beautiful specimen. The structure of the cranium, when this desirable part of the skeleton is discovered, may confirm the propriety of the subgeneric distinction; but the numerous decided marks in other parts of closer affinity to *Chelone* leave no alternative than to regard the fossil species of the chalk as a member of that genus.

It differs from all known species, especially the sub-carinated species of Sheppey (*Chelone subcarinata* and *Chelone subcris tata*), in the form of the carapace, which is more truly elliptical than in any other species with which I am acquainted.

A second specimen of *Chelone Benstedi*, of the same size with that above described, also obtained from the lower chalk at Burham, in Kent, and now in the fine collection of J. S. Bowerbank, Esq., F.R.S., gives a better view of the upper surface of the carapace, but the marginal plates have been dislocated and pressed inwards beneath the narrow pointed ends of the ribs. All the neural plates are narrow and carinate
above. They are a little broader in front than behind. The slight angular production of the middle of the outer border of the posterior marginal plates is somewhat better marked than in the preceding specimen, and it gives a serrated character to that part of the circumference of the carapace which is formed by those marginal plates.

An upper view of Mr. Bowerbank's specimen is given in Pl. 43, fig. 1; a side view in fig. 2; an oblique front view, showing some of the anterior marginal plates in fig. 3; and an outline of the transverse vertical section of the Turtle in fig. 4: all of the natural size.

**Chelone pulchriceps, Owen.** Plate 48, figs. 1, 2, 3.


With the exception of a few more or less mutilated mandibles, no parts of the skull of a Chelonian reptile have been, hitherto, discovered in the chalk itself, either at Burham or elsewhere in England; but I have had the opportunity, through the kindness of the Rev. Thomas Image, M.A., of Whepstead, of examining and comparing the fossil cranium of a small turtle from the green-sand which underlies the chalk. The specimen was discovered near Barnwell, in Cambridgeshire. The general form of the skull is elongate and depressed; and it is chiefly remarkable for having the nasal bones (15) marked off by a suture from the pre-frontals (14), being a return to the typical characters of the vertebrated cranium, which I have also noticed in the skull of a larger turtle, from the Portland Stone, where, however, the course of the suture is different.

The characters of the genus Chelone are clearly expressed in the skull of the *Chelone pulchriceps*, by the extensive roof of bone over-arching the temporal fossæ, and by as large a proportion of this roof being formed by the post-frontals (12) as in existing Chelones. The orbits are also large, and their superior interspace is broad.

The median or true frontals (11) form a small proportion of the upper border of the orbits; the anterior extremities of the median frontals, instead of converging to a point, are extended forwards, between the pre-frontals, in a broader proportion than in the Portland turtle, and are obliquely truncated: it is only in the genus Chelys among existing Chelonians, that the pre-frontals are thus separated from each other; but in the Chelys, the intervening extremities of the frontals are continued to the upper border of the external nostril. In the present fossil cranium, the median extremities of the pre-frontals are arrested at the distance of four lines from the nasal aperture, which is bounded above by two distinct nasal bones (15); these bones are joined by suture to the frontals, to the pre-frontals, and to the superior maxillaries (21); the nasal processes of which extend upward, and exclude the pre-frontals from the nasal boundary. The superior maxillaries are traversed obliquely by a large and
deep scutal impression, above which the superior maxillary forms a convex prominence at the anterior part of the orbit. The groove, which traverses the frontals, is as strongly marked; that which impresses the post-frontals is fainter. The expanded trumpet-shaped portion of the tympanic bone comes nearer the upper margin of the cavity than in existing Chelones.

The palatal bones (20), have no palatal process anterior to the inner nostril, as in the Chelone cuneiceps* and modern Turtles; but are situated behind that aperture, as in Emys and Trionyx, and the vomer does not penetrate between them. The palatal processes of the intermaxillary and maxillary bones form an unusually prominent angular ridge, running nearly parallel with the trenchant margin of the jaw; the bony palate is not extended along the middle line beyond the intermaxillaries, which here enter into the formation of both the inner and outer nostrils. The pterygoid bones present moderately wide and deep external emarginations.

The following are the chief dimensions of this fossil skull:

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<tr>
<th>Dimension</th>
<th>In.</th>
<th>Lin.</th>
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<tr>
<td>Length of the cranium from the occipital tubercle</td>
<td>.</td>
<td>2.4</td>
</tr>
<tr>
<td>Breadth of the cranium above the tympanic cavities</td>
<td>.</td>
<td>1.6</td>
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<tr>
<td>Depth of the cranium at the parietal bones</td>
<td>.</td>
<td>1.0</td>
</tr>
<tr>
<td>Antero-posterior diameter of the orbit</td>
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<td>0.9</td>
</tr>
<tr>
<td>Breadth of the interorbital space</td>
<td>.</td>
<td>0.8</td>
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The supracranial scutation of the Chelone pulchriceps much resembles that of the Chelone Couanna. A large oval syncipital scute defending the middle region of the epicranium, and being surrounded by the smaller "frontal," "superorbital," "parietal," and "occipital" scutes: the bones supporting the latter have, however, been too much mutilated to allow of their proportions and forms being determined. The fronto-nasal scutes are each bounded behind by well-defined bold curved lines, convex towards the frontal scute, and deeply indenting the frontal bones. Amongst the existing Chelonia, the character of the distinct nasal bones has been, hitherto, met with only in an Emydian species, on which the sub-genus Hydromedusa† has been founded. The modifications of the bony palate in the Chelone pulchriceps afford another indication of its Emydian affinities.

Chelone Camperi, Owen. (†) Plate 45.

Large Turtle, Camper. Philosophical Transactions, vol. lxxvi, 1786.

I am induced provisionally to refer to the above species the two large bony plates or scutes figured in Pl. 45, on account of their size, their shape, and especially their carinate structure. They have a smooth exterior surface, marked only by faint lines radiating from the median "carina" or ridge. They are thickest at this part, which

* History of Brit. Fos. Reptiles (Tertiary Formations), Pl. 11, fig. 3, 20.  † Ib. Pl. 8, fig. 7.
is from one to two lines, and become gradually thinner to their peripheral border, which, however, is too much fractured to show whether it has been terminated by a dentated suture like the neural plates, which unite with the costal plates in the ordinary Chelones. The degree of thinness of the actual margins of the large scutes in question shows that they were not suturally united to costal plates. On the hypothesis, therefore, that they are the median or neural plates of a Turtle, they can only be referred, as not uniting laterally with costal plates, to the ninth and tenth of the series of neural plates, which are under the same circumstances, and which also differ from the eight preceding plates, in having contracted no osseous continuity or adhesion to the subjacent neural spines. In order to test this particular conformation I carefully excavated the chalk matrix beneath the median part of both scutes to beyond the middle of it, and exposed only a smooth concave surface: there was no trace of the median ridge, which is continuous with the summit of the spine, in the first eight neural plates of the Chelonia.

But besides the two plates, the exterior surface of which is exposed, there is a third plate, the position of which is reversed, and which has slipped under one of the scutes that has retained its natural position. A portion of a fourth similar plate is also present in a similar reversed position in the same block of Chalk. This fact, together with the thin borders of the plates, leads me to suspect that they may belong to the series of marginal plates of a large Turtle, notwithstanding the open angle at which the sides diverge from the median ridge, which, in that case, must have formed the outer and anterior border of the carapace.

On the hypothesis that these large plates have belonged to a Turtle, they indicate an individual with a carapace between forty and fifty inches long; as large, for example, as that of which Camper makes mention in the memoir above quoted. There is a possibility, however, that those large scutes may have belonged to some Saurian reptile, although the probability is small, on account of the absence of any rugosities, pits, or other sculptured character which marks the exteroir surface of all the dermal bony scutes of Saurians hitherto found. It is possible that the Polyptychodon, or the Mosasaurus, if their skin was so defended, might have had light and smooth scutes; but the balance of evidence is at present in favour of the Chelonian character of those in question. Their microscopic structure shows that they have not belonged to a cartilaginous fish, and it agrees pretty closely with that of the osseous tissue of unquestionably Chelonian neural plates of smaller size, from the chalk formation.

Another circumstance which also inclines me to view the large plates above described as being Chelonian, is the corresponding thinness of the costal plates where they are unattached to the subjacent ribs in the specimen from the Burham Chalk-pit, figured in Pl. 46, fig. 3. The outer surface of these plates is also smooth, or at most marked by fine striæ. The borders by which they are in contact do not show
any very distinct character of suture, but appear to have been joined by a wavy line. The length of the rib which projects beyond the conjoined costal plate is considerable, being proportionally greater than in the much smaller *Chelone Benstedi*; and the free portion of the rib is narrower, with a smoother upper surface, evidently indicating a distinction of species. The portion of carapace in question may belong to a young *Chelone Camperi*.

Of the marginal plates of that species only the anterior ones appear, as yet, to have been discovered at Maëstricht; but the liability of such slightly attached parts to be scattered and lost, renders their discovery in natural connection, as in the specimens in Pl. 45, more remarkable, perhaps, than their absence, and affords, at least, no sufficient grounds for the speculation of Faujas St. Fond, that they were cartilaginous in the large Turtle from Maëstricht. The outer surface of the bones of the carapace of the Chelonian Reptiles which actually retain the marginal plates in a gristly state, is characterised by a sculptured character, well shown in several plates of the Section on the Tertiary Chelonia, ex. Pls. 5, 6, 31, but of which no trace exists in the *Chelone Camperi*, from Maëstricht, any more than in the neural or marginal plates in Pl. 45, or the costal plates in Pl. 46 of the Chelonites from the upper chalk of Kent.

**Chelones indeterminatae.**

Various portions of the fossilised skeletons of Chelonian Reptiles have been kindly submitted to me by Mrs. Smith, of Tonbridge Wells; by J. S. Bowerbank, Esq.; and by Thomas Charles, Esq., of Maidstone, from which specimens I have selected the subjects figured in Pls. 44, 46, and Pl. 48.

The specimen, fig. 8, Pl. 48, from the Collection of J. S. Bowerbank, Esq., is of a similar nature to those above described and figured in Pl. 45; but it is rather smaller, and is more decidedly shown to belong to the marginal series of scutes by the unsymmetrical development of the two sides which slope away from the median ridge; and this, also, is oblique: the sides form a less open angle: their substance, which is hardly a line in thickness at the meridian ridge, gradually thins off to the border, which is produced on one side into a number of dentated processes, that to all appearances are natural.

There are two similar but rather smaller marginal scutes in the same Collection.

Mr. John Quekett, the Assistant Conservator of the Museum of the Royal College of Surgeons, has kindly prepared sections for the microscope from the preceding specimens, and the form, size, and arrangement of the bone-cells agrees with those in similar preparations from the scutes of the recent Turtle.

The portion of mandible, Pl. 48, figs. 4 and 5, resembles that of the *Chelone planimentum*, Pl. 18, fig. 3, of a former Section, and of some of the Eocene Turtles from Bracklesham, figured in Mr. Dixon's work 'On the Tertiary and Cretaceous Deposits of Sussex,' Tab. XIII, in the great extent of the bony symphysis; but this differs in
having the upper surface traversed by two longitudinal furrows, slightly converging as they approach to the point. The outer or alveolar borders are obtusely rounded; and are perforated, as in most Chelonians, by a series of small vascular foramina: the rounded border increases in breadth as it extends backwards where it is continued upon, or forms, the outer surface of the beginning of the ramus of the jaw. The commencement of the coracoid process rises from the inner border of the ramus which is continued from the hinder and upper border of the broad symphysis. In this character, also, the present mandible differs from all that I have previously seen, either fossil or recent. In its general form it resembles, like some of those from the Bracklesham Clay, the mandible in the Trionycidae, rather than that in the existing Chelones. The specimen is in the Collection of James S. Bowerbank, Esq., F.R.S.

In the same rich depositary of British Fossil remains is the portion of a Chelonian mandible, Pl. 48, figs. 6 and 7. It has formed part of a longer, narrower, and more pointed lower jaw than the one above described. The bony symphysis is much shorter; the rami longer, deeper, and more regularly convex on their outer side. It thus, likewise, presents the characters rather of a Trionyx than of a modern Chelone; but the modifications of the lower jaw, in indubitable species of true Turtle from the older Tertiary deposits, forbid a conclusion against its having belonged to a similarly modified species of Chelone.

I am indebted to Mr. Catt, of Brighton, for the specimens of the right scapula and coracoid, in almost their natural juxta-position, Pl. 48, fig. 9, of a Turtle which must have been about two feet in length, from the chalk: the letter a shows the surface contributed by the scapula to the humeral joint, the letter b that by which it was united with the coracoid: c is the base of the acromial process or clavicle, which has been sent off in the same oblique direction as in the recent Turtles; d is the beginning of the body of the slender scapula. The coracoid has been rotated, so as to show its scapular surface at b: that which it contributed to the shoulder-joint is shown at a: the long and slender shaft of the coracoid and its very gradual expansion is eminently characteristic of the marine nature of the species to which it belonged.

In Pl. 48, fig. 10, is shown the opposite side of the right coracoid of a Turtle of double the dimensions of that from which the preceding specimens came. It is from the chalk-pit at Burham, so fertile in fine fossils, and forms part of the collection of Mrs. Smith, of Tonbridge Wells. The margin of the articular end is more produced than in the Chelone mydas, and, as in the preceding fossil, the articular surface b for the scapula is relatively less in proportion to that for the humerus a, than in the same recent Turtle: the slender beginning of the shaft of the bone is more compressed, less triedral. I estimate the fossil fragment, by the proportions of that of the Chelone mydas, to have been part of a coracoid of one foot in length, and calculating the proportions of the carapace by those of the Chelone Bonstedti, it must have been about three feet six inches in length in the Turtle from which the coracoid in question came.
Pl. 44, fig. 1 is the slender portion of the entosternal, es, and a fragment of the right hyosternal of a turtle, which must have been about one foot eight inches in length.

Figure 2 gives an inside view of a rib, with the connate costal plate, the gradual narrowing of which towards the free end of the rib resembles that in the Chelone Benstedi.

Figure 3 is a similar specimen from the carapace of a larger turtle, with the neck of the rib more freely relieved from the connate costal plate.

Figure 4 is a more mutilated example of a larger rib and costal plate.

Figure 5 is the right hyposternal of the Chelone Benstedi, and has belonged to a specimen not larger than either of those figured in Pls. 41—43.

Figure 6 is the humeral end of the connate scapula and clavicle of a turtle.

Figure 7 is the outer side of a marginal scute of a large turtle.

Figure 8 is the left humerus of a turtle, which differs from that of the existing species in the greater expansion of its distal end.

Figure 9 is the left ulna of a turtle, belonging to a larger example than that to which the humerus belonged.

I have been favoured with the opportunity of inspecting portions of the skeleton of a large Chelonian obtained by Mrs. Smith, of Tonbridge Wells, from the lower chalk at Burham, Kent, and skilfully relieved from their mineral bed by that lady. The principal bones consist of two series, one containing five, the other three and parts of two, of the marginal plates of the carapace, in natural connection, and from that part of the margin where they receive the extremities of the vertebral ribs (Pl. 46, figs. 1 and 2). These marginal plates in Chelone mydas are three-sided, and have two thick terminal borders by which they are united, sutureally, to one another: of the three free surfaces, the one, directed towards the interior of the body, is concave and characterised by a deep depression for the reception of the tooth-like extremity of the rib (fig. 2); the other two (upper and under) surfaces meet at an angle, which is produced at certain parts to form the marginal dentations of the lateral and posterior parts of the carapace in that species of turtle, but is more open and obtuse in the marginal plates at the anterior part of the carapace. In the fossil the marginal plates have the general characters of those of the genus Chelone, but differ from those of the Chelone mydas in being more concave on the central or perforated side, and they are also concave at the upper side, and in a slighter degree at the under side; these sides likewise meet at a more acute angle, and this angle is produced into a sharper and more continuous ridge; but this ridge subsides at one end of the series of plates in fig. 1, and the upper and under sides gradually meet at a more open angle, which is rounded off in the first of the series. This plate, therefore, answers to the third marginal plate in the Chelone mydas, or that which receives the end of the first expanded vertebral rib; and the remainder, therefore, to the fourth, fifth, sixth, and seventh marginal plates: now these are precisely the marginal plates in the Emys
which have their inferior margins developed inwards, and articulated by suture to the lateral wall of the carapace: but these margins not being so developed or terminated in the present fossil, but, on the contrary, being inferior to the upper margin in breadth,* and terminating like that margin in a blunted edge, prove the present Chelonite to belong, like the smaller Chelonite from the same chalk-pit already described, to the marine genus Chelone.

The length of the carapace of the Chelone mydas is about nine times that of the sixth marginal plate, whence I calculate the length of the carapace to which the marginal plates here described belonged to have been about fourteen inches.

The following admeasurements will show the different proportions of the marginal plates of the present specimen as compared with the corresponding ones of a Chelone mydas of similar general size:—

<table>
<thead>
<tr>
<th></th>
<th>Fossil Chel.</th>
<th>Chel. mydas.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In. Lin.</td>
<td>In. Lin.</td>
</tr>
<tr>
<td>Length of the series of five plates in a straight line</td>
<td>7 3</td>
<td>8 2</td>
</tr>
<tr>
<td>Breadth of the upper surface of the third (fifth)</td>
<td>1 1</td>
<td>0 10</td>
</tr>
<tr>
<td>Interspace of costal depressions</td>
<td>1 2</td>
<td>1 6</td>
</tr>
</tbody>
</table>

Thus the marginal plates of the chalk turtle, besides being more concave, are broader in proportion to their length, or antero-posterior diameter. In these respects they correspond with the form of the marginal plates in the Chelonite Benscledi, but more evidence must be had, before these large fossil marginal plates can be referred to a larger and older specimen of the species.

There are other two marginal plates imbedded in the same portion of chalk, with their upper, smooth, slightly concave surfaces exposed; and the toothed or sternal extremities of three of the vertebral ribs, which by their length and size also prove this specimen to be a Turtle. One of these fragments of rib measures 5½ inches, and the expanded plates developed from each side of its upper surface are concave on their exterior surface, which is flat or slightly convex in Chelone mydas.

A separate portion of chalk from the same pit contains the scapula and its acromial branch or anchylosed clavicle, with the articular surface which joins with the coracoid and humerus. The angle at which the scapula and clavicle meet is more open in Chelone than in Emys or Chelys: the present specimen presents the same angle as in the Maëstricht Chelone figured by Cuvier,† in which it is rather more open than in the recent species of turtle. A broad, thin, slightly concave plate of bone appears, by the radiation of the fine striae at its under part, to represent the expanded parietal bone of the cranium.

* The upper margin, which is distinguished by a slight notch where the costal groove leads to the pit, is broader than the lower one, in these plates of the Chelone mydas; but the difference is less than in the present fossil species.
† Ossem. Foss., tom. v, part ii, pl. xiv, fig. 5.
Genus, Protemys, Owen.

In the operations of quarrying a rock of the hard variety of the gray arenaceous limestone, called "Kentish Rag," which belongs to the "Green-sand" Formation, near the town of Maidstone, in Kent, Mr. Bensted, the owner of the quarry, had the good fortune to discover the dislocated remains of the carapace and plastron of a Chelonian reptile, which remains were grouped together in a slightly dislocated mass, having a circumference of three feet. This fine specimen, still unique of its kind, has been liberally transmitted, by Capt. Guise, F.G.S., its present possessor, to me for the purposes of being described and figured in the present work.

It represents, as will be shown in the account that follows, a distinct sub-genus in the Family Emydidae, which may be characterised as follows:—

*Sternum dilatatum, per gomphosin cum testá conjunctum, suturis hypo-et hypo-sternorum in medio lateribusque sterni interruptis.*

Protemys serrata, Owen. Pl. 47.

The specimen consists of the principal part of the carapace and a small part of the plastron. The carapace presents an ovate form, being apparently widest about two thirds from the nuchal plate. Both the nuchal (Pl. 47, ch) and the pygal (ib., py) plates are preserved, and the total length of the carapace is 1 foot 1½ inch. The extreme breadth of the carapace at the part above indicated appears to have been about 9 inches. The carapace is moderately convex, but becomes concave near the margin of the hinder half, by a slight upward curve of the marginal plates there.

The nuchal plate is tranversely oblong, slightly but widely emarginate anteriorly, 3 inches 9 lines in transverse length, 1 inch 2 lines in the axis of the carapace. The first vertebral scute, \( v_1 \), advances within three lines of the anterior border of the nuchal plate, which bears the impressions of a small nuchal scute 10 lines wide, of the first marginal scute, and of part of the second marginal scute on each side.

The first costal plate, (pl. 1,) articulates anteriorly with the nuchal and first marginal plates, \( m_1 \), and is connate with the subjacent rib to within half an inch of its pointed end, which penetrates or abuts against the third marginal plate, \( m_3 \). It is impressed by the triradiate line of union of the first, \( v_1 \), and second, \( v_2 \), vertebral scutes with the first costal scute. The rib forms a strong projection on its under surface, as is shown by the impression on the left side of the carapace. The length of the first costal plate, exclusive of the free end of the rib, is 2 inches 8 lines. The first neural plate is lost. The second, \( s_2 \), is long and narrow, and has been, apparently,
notched posteriorly, between the two truncate angles. Its length is 1 inch 5 lines; its breadth 6 lines: there is no appearance of a carina on its upper surface. The second costal plate, pl. 2, is 3 inches 2 lines in length, 1 inch 4 lines in breadth; it is slightly concave in the axis of the carapace; convex in the direction of its own length or across the carapace. On the right side it is fractured, and its outer end is overlapped by the dislocated fourth marginal plate, m 4, into the upper border of which the free end of the rib, which now projects below it, was implanted. The upper surface of the costal plate is impressed by the triradiate line of union of the second vertebral scute, v 2, with the first, c 1, and second, c 2, costal scutes. The third, pl. 3, and fourth, pl. 4, costal plates have their median ends straight with the posterior angles truncate. About seven lines of the free end of the conjoined rib projects beyond their broad outer ends. Beyond these the carapace is broken through by the pressure of the plastron from below: the upper surfaces of the conjoined hyposternals appear at ps, ps, the dislocated parts of the carapace, which were above them, having been removed. The outer portions of the fifth and sixth costal plates are seen on the right side, terminating the one, pl. 5, between the seventh and eighth marginal plates, the other, pl. 6, between the eighth and ninth marginal plates. The seventh and eighth, pl. 7, pl. 8, costal plates are preserved on the left side. The median ends of the eighth pair seem almost or quite to have met anterior to the ninth neural plate, s 9, as in the Emys levis,* the ninth plate presents a triangular form with the apex turned forwards: the breadth of its base is 1 inch 7 lines, its length is 1 inch. The tenth neural plate is a hexagonal one, 1 inch 10 lines in length. It articulates immediately with the pygal plate, py, which is subquadrate, rather broader behind, where it is notched in the middle. Its length is 1 inch 5 lines; its breadth 1 inch 8 lines. Not any of these neural plates are carinate.

The left hyposternal (ps) has been displaced, so that its under or outer surface would be in view in the block displaying the upper surface of the carapace, Pl. 47, were not the major part of its substance retained in the other half of the block, which therefore shows in part the contour of its upper or inner surface, Pl. 48, fig. 11, from which, however, the produced outer and anterior angle is broken off, that part remaining attached to the other moiety at ps, Pl. 47, where it dips beneath the border of the carapace. It is this produced angle which, bending upwards and forwards, effects the union between the plastron and carapace at the fore part of the lateral wall, by its insertion into the carapace; and it affords the chief proof of the Emydian affinities of the Chelonite under consideration.

Yet in some respects, the hyposternal in the fossil resembles more that of a young than of an old Emydian: its median border is not straight, and the concavity of the hinder half of that border indicates a persistent vacuity in the middle of the bony plastron;

* History of Brit. Fos. Reptiles (Tertiary Formations), pl. 3, fig. 1.
the posterior border is convex, showing that it was not united in its whole extent to the corresponding anterior border of the hyposternal.

With the broad nuchal plate (ch) is articulated the first marginal plate m 1, of the right side: its upper surface is square, and is impressed by the junction of the first costal scute with the second and third marginal scutes. The second marginal plate is lost. The third is displaced, and its concave side is turned upwards: the upper and under walls of the concavity are of almost equal extent, and meet externally at a right angle. Unless the back part of this plate has been turned forwards, it differs from the corresponding plate in the Emydians in not having the inner concavity confined to the posterior part, but extending its whole length, as in Thalassians; its proportions, however, are such as we find in the genus Emys. The fourth marginal plate, m 4, has its inferior and superior walls equally produced, as in Emydians, and meeting at a right angle: it articulates with the second costal plate, and probably, also, with the hyosternal below, but it has been displaced upwards. The fifth marginal plate is lost. Only the outer margin of the sixth, m 6, is produced; this also shows an upper and an under plate meeting at a right angle. The seventh marginal plate, m 7, which is preserved on the left side, although fractured, shows its rapid progressive compression towards its posterior border. The eighth marginal plate, m 8, is a broad, subquadrate, depressed plate, with a thin outer margin, and the thicker inner margin slightly produced into the angle between the fifth and sixth costal plates: its upper surface is concave, and impressed with the T-shaped union of the third costal scute with the eighth and ninth marginal scutes. The ninth marginal plate, m 9, presents a similar form; its outer border is injured. In the tenth marginal plate, m 10, the impression of that border is left on the matrix, showing that it had an angular notch. The same character is as strongly marked in the eleventh marginal plate, m 11, and the pygal plate, as has been already observed is notched at the middle of the posterior border. It is from the consequent serrated character of the hinder border of the carapace that the specific name has been taken.

Compared with the existing species of the genus Chelone, the present fossil differs greatly in the completeness of the ossification of the carapace, due to the extension of the costal to the marginal plates: in the form and proportions of the marginal plates, especially from the first to the seventh inclusive; and in the form of the recognisable elements of the plastron, more particularly in the curved and produced angle of the hyosternal. But when we compare it with some of the extinct Turtles of the Eocene epoch, as e. g., Chelone longiceps, Chelone convexa, and Chelone subcarinata, the difference in regard to the extent of ossification of the costal plates is less; whilst the persistent partial want of union between the elements of the plastron in the present fossil, approximates that part of its skeleton to the condition of the plastron in the Eocene Chelones above cited, in which the ossification of the plastral elements has proceeded further than in the typical Turtles.
In these extinct species, the life-periods of which successively stretch backwards in time from the oldest Tertiary to the newer Secondary Epochs, there is plain evidence of a gradual breaking down of the distinctions that now trenchantly divide the fresh-water from the marine species: the actual interval being then filled up by several well-marked species, that have apparently perished.

The Thalassian affinities of the Emydoid *Chelones* of the Eocene Period were, nevertheless, in some instances well established by the structure of the shell, and by the forms and proportions of the limbs,—parts, which it is important to bear in mind, are more constant in their nature than the dermal ossifications on which the solidity or otherwise of the carapace and plastron depends. And it must also be remembered, that with the transitional species, there were associated good typical forms of Turtle, *e.g.*, *Chelone planimentum* and *Chelone crassicostata*, as well as of Fresh-water Tortoises; *e.g.*, *Emys levis, Emys bicarinata, Platemys Bullockii*.

The *Chelonite* from the Maidstone Green-sand, which forms the subject of the present section, deviates from the typical Emydian structure in the arrest of the dermal ossification requisite for the complete solidification of the plastron, and, perhaps, also in the form of the third pair of marginal plates; but, with the exception of this doubtful point, the structure and form of every other element of the carapace are more strictly Emydian, than in the most modified of the Eocene *Chelones* above cited; and the Emydian affinity is more decisively shown in the form of the hyosternal element, PIs. 47 and 48, fig. 1, *hy*. The departure of which from that of a mature typical *Emys* does not bring it so near to the form of the same element in the typical *Chelone*, as it does to that of an immature *Emys*, Pl. 48, fig. 12. In the nature and amount of departure from the Emydian type recognisable in the *Protemys serrata*, there is plainly to be seen an arrest of the development of the plastron, which so far as it has proceeded, has followed that type: there is no trace of a deviation from the embryonal common fundamental pattern of the part towards the special modifications characteristic of the genus *Chelone*.

In the small Turtle from the Chalk (*Chelone Benstedi*) the ossification has extended from the hyosternal and hyposternal centres by many diverging rays; the inferior plates of the marginal bones, Pl. 42, fig. 1, 4—12, are feebly and subequally developed throughout; and there are other differences from the *Protemys serrata* of the Greensand, which no degree of immaturity in the Chalk specimens exhibiting them would explain, as, *e.g.*, the carinated neural plates, PIs. 41 and 43, *s, s*, and the pointed pygal plate, Pl. 41, fig. 1, *py*.

Were a recent form of *Emydian*, so modified as the large species from the Maidstone Green-sand, to be presented to the study of the modern Herpetologist, one cannot doubt, but that it would be referred to a distinct sub-genus in the Fresh-water family; and I have accordingly characterised such, as far as the condition of the *Chelonite* in question will permit. It is to be hoped, that future discoveries may bring
to light the modifications of the head and limbs of the *Protemys*; from those of the plastron we may infer that the species was more aquatic in its habits than the typical Emydians. The *Protemys serrata* may have been an Estuary species, and its discovery in the same formation and quarry as that in which the remains of an Iguanodon have been found, adds probability to the explanation of the occurrence of the latter in a Green-sand or Neocomian Deposit, on the supposition that the carcase had been drifted out to sea.

**CHAPTER II.**

**Order, Lacertilia.**

**Lizards.**

In passing from the Tertiary to the Secondary periods of Geology, in quest of the evidences of Reptilian organisation, we have found no material change in that of the Chelonian order; the characters by which the marine species are now generically separated from other *Testudines* of Linnaeus, and which were not deemed worthy of that distinction by the great systematic reformer of Natural History, are recognisably retained in the old Turtles, the contemporaries of the Ichthyosaurs, Plesiosaurs, Pterodactyles, and Belemnites, that swam the ocean in which the Corals and Sponges lived, which deposited the main part of the material that now constitutes our Chalk Downs. The differences which are traceable on a comparison of the Turtles of that period with those of the Tertiary deposits and of the actual seas, merely prove them to have been distinct species, with some slight indications of a nearer affinity to the Emydian type of structure than we observe in the present representatives of the genus *Chelone*.

The Lizards of the present day are characterised, with the exception of one genus, *Gecko*, by the same cup-and-ball articulation of the vertebrae as the modern Crocodiles, viz. with the cup at the fore part of the body of the vertebra and the ball at the back part, an arrangement signified by the term “procoelian,” as applied to such vertebrae. The fossil Lizards of the Cretaceous period, whether terrestrial, amphibious, or more especially modified for marine life, present the same procoelian type.

**Tribe, Repentia.**

**Genus, Raphiosaurus, Owen.**

‘Transactions of the Geological Society,’ vol. vi, 2d Series, p. 413, April, 1840.

Species, *Raphiosaurus subulidens*, Owen, (Plate 9, figs. 1, 2, 3.)


In a Memoir communicated to the Geological Society of London in 1840, and in