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## THE OSTEOLOGY OF THE NEW GUINEA TURTLE

(*CARETTOCHELYS INSCULPTA*, *Ramsay*).

By EDGAR R. WAITE, F.L.S., Zoologist.

(Plates xxiv.-xxvii., and figs. 30-32).

Since first described by Dr. E. P. Ramsay in 1886,<sup>1</sup> the New Guinea turtle, *Carettochelys insculpta*, has excited considerable interest and provoked much speculation as to its systematic position.

Hitherto the species, which as far as ascertained is the sole living representative of the genus and family, was known only from the type and two imperfect skulls; the latter described by Dr. G. A. Boulenger as ornaments or charms attached to a dancing stick, from the Fly River, British New Guinea.<sup>2</sup>

In the account of the original specimen no mention is made of the manner in which it was procured. As the history of such an example will be of interest, I venture to publish the following particulars from information kindly supplied by Mr. Walter W. Froggatt, F.L.S., Government Entomologist for New South Wales:—

“The fresh-water turtle described by Ramsay was one of two specimens obtained in the Strickland River (the upper right hand branch of the Fly River), in the Geographical Society of Australasia's Expedition to New Guinea in 1885. Captain Hy. C. Everill was in charge, and I was Entomologist and Assistant Zoologist, etc. There were large sand banks all along, but we saw no signs of these turtles in the lower parts of the river. Six of us took the whale boat up the last hundred miles after the ‘Bonito’ stuck in the gravel, and as we towed the boat along the two turtles ran off the sand banks into shallow water and were caught. We ate the contents of both: a large number of eggs were found inside them. It was evidently breeding time as some of the sand banks were covered with their tracks: though we hunted round at several camps we could not find any buried eggs. This was about the middle of October, 1885. Jas. H. Shaw and I caught the type one evening, and I skinned and cleaned it.”

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<sup>1</sup> Ramsay—Proc. Linn. Soc. N. S. Wales. (2), i., 1886, pp. 158-162, pls. iii.-vi.

<sup>2</sup> Boulenger—Proc. Zool. Soc., 1898, p. 851.

Portions of another example of *Carettochelys*, of unknown sex, just received by the Trustees, enable me to supplement the published accounts of its structure and also to correct errors in previous descriptions.

The material consists of the head, with four cervical vertebræ attached, in spirits, and the carapace and plastron. The turtle was taken at the island of Kiwai (Kewai) at the mouth of the Fly River. It was caught at night with hook and line by natives, and the portions not eaten or broken were obtained, and kindly forwarded by the Rev. E. B. Riley. Captain Arthur J. Wyrill of the London Missionary Society's S.S. "John Williams," obligingly brought the salvage to Sydney.

The following is a description of the portions examined :—

*Head.*—The anterior portion of the head is in perfect condition, but the hinder part above, and the hyoids had been removed. The snout is perhaps the most remarkable feature of the head, it is much more prominent than would be inferred from the published figures of the type which was probably dried before an examination had been made. The snout is a fleshy organ, its front and lateral aspects covered with tubercles and freely furrowed; it is much bent downwards and is produced considerably beyond the margin of the jaw. Its front edge is truncated, pig-like, being very deep and blunt: the wide nostrils are situated in its upper portion;

their relative position is shown in the accompanying sketch (fig. 30), five-sixths natural size. A valve-like process is developed within the nostril on the inner side. In the preserved example no trace of sutures is visible in the large head shields, and those described by Ramsay are, as indicated by Dr. G. Baur, simply impressions of the bony sutures of the skull, to which the skin has moulded

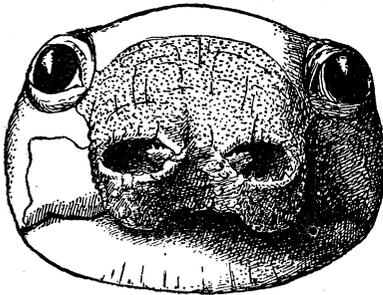


Fig. 30.

itself in drying. The rugosities of the surface which also merely repeat the inequalities of the skull are not so pronounced in the preserved as in the dried example.

*Skull.*—The skull is moderately arched and of even contour. The orbits are subcircular, large, lateral, and widely separated:

each is encircled by five bones, namely the maxillary, prefrontal, frontal, postfrontal, and jugal. The bony external nostril is very large, wider than deep, and is bounded by the single premaxillary, the maxillaries and prefrontals. The orbital margin of the postfrontal is greater than that of the prefrontal, that of the frontal being smallest of the three. The suture between the postfrontal and parietal is shorter than that between the postfrontal and frontal. The parietals, though laterally expanded, do not roof over the temporal regions, the fossæ extending forward to the postfrontals: the latter bones are separated from the squamosals by the quadrato-jugal. The maxillary is sutured with the quadrato-jugal below the jugal. The quadrate forms a complete frame to the tympanum, the deep quadrato-jugal and squamosal just failing to meet above. The quadrate is not completely closed behind, and the posterior notch, though wide, is not deeply cleft; its lower surface bears two articular facets. The supraoccipital process is extensive and its inferior margin is laterally expanded forming a spoon-shaped plate whose width exceeds the greatest depth of the crest. The foramen magnum is an even oval, deeper than broad and is bounded by the supraoccipital and the exoccipitals. The elements are not apparent in the occipital condyle. The vomer is small and if naturally connected with the premaxillary, the slender process has been broken away. The prefrontals are connected with the vomer and palatines by a broad thin process developed from the prefrontals, the sutures being close to the vomer and not to the roof of the snout; the lateral view through both orbits is thus, not as usual, but mainly through the palato-maxillary foramina. The palatines are large, separated in front by the small V-shaped vomer, but extensively in contact on the mid-line. The basisphenoid is large, widest behind where it is in contact with the basioccipital; these bones are evenly sutured, the first-named not forming a shelf below the latter. The pterygoids are long and narrow, in contact, in front, with the maxillaries: they are wholly separated by the basisphenoid and are produced backwards to form the outer boundaries of the basioccipitals. At the side of the basisphenoid each pterygoid develops a lateral process which is separated from the quadrate by a deep groove. The connection between the parietals and pterygoids is carried forward, below to the palatines, and above, to the suture between the prefrontals and frontals. The lamellæ thus formed broaden laterally in front and meet on the mid-line, and they run so close to the prefronto-palatine connection, before described, that it is not possible to pass an object as thin as a penknife blade, through the orbits, between them.

The mandible has the elements distinct but no symphyseal suture is apparent in the adult; the coronoid and postarticular processes are well developed. The hyoids were removed by the natives and not recovered. Baur described the supraoccipital process as "club-shaped," this scarcely conveys an idea of the true form but it will doubtless be understood that the outline as seen from above or below only is intended; the whole process being formed of two lamellæ at right angles to each other, a vertical crest and a basal lateral expansion. The question raised by this writer as to whether the pterygoids are completely separated by the basisphenoid or not, is now answered in the affirmative. Baur also remarks that in the type the frontals are excluded from the orbits, I am not aware how this information was obtained, but in the specimen under examination, as above described and as also shown in the photograph (pl. xxvi.), the frontal forms a portion of the orbital boundary, though the smallest of any bone so doing. Another point raised is the condition of the premaxillary, this has already been determined by Boulenger to be a single bone, and he also found that "the pterygoids are not turned up in front."

*Vertebrae.*—The CERVICAL vertebrae are comparatively short and do not possess transverse processes. Though but five of the eight presumed cervical vertebrae were preserved, it would seem that the neck is shorter than the combined dorsal vertebrae.

The first vertebra (axis) is biconcave and has all the elements united into a single bone, the postzygapophyses are long and widely spread.

The second vertebra (atlas) is convexo-concave and has the spinous process well developed.

The third vertebra is also convexo-concave and, as usual, has no spinous process.

The fourth vertebra, the character of which has an important bearing on the classification of the order, has most unfortunately had the posterior portion cut away, anteriorly its articulation is convex.

The three following vertebrae are absent, but the last cervical, which may be presumed to be the eighth, is doubly biconvex so that the articulation between the seventh and eighth cervicals and the latter and the first dorsal is of the ginglymoid type. The posterior articular surface of the eighth vertebra extends along the whole length of the curved portion and the dipping action is thus very considerable. The usual forwardly directed ventral keel is, in this species, replaced by a pair of conical pro-

cesses. The general form of the eighth vertebra will be best comprehended by reference to the figures depicting the lateral and ventral aspects (Pl. xxvii., figs. 4a, 4c).

The DORSAL vertebræ are ten in number. The first is shorter than the second and has a depressed centrum with two concave articular surfaces in front, it bears a short rib connected with the second rib. The ventral aspect of this vertebra together with portion of the carapace to which it is attached is shown in Pl. xxvii., fig. 5c.

The second to the seventh vertebræ, inclusive, are long and strongly compressed but do not form a distinct ventral keel.

The eighth is rounded below, and the ninth bears on its anterior ventral surface a deep pit nearly as wide as the centrum itself.

The tenth vertebra is short with a posterior condyle, the tenth rib is connected directly with the carapace and does not abut on to the preceding rib.

The following free vertebræ are absent, but the nature of the parts remaining shows definitely that the pelvis is not ankylosed to the carapace and plastron. Dr. Hans Gadow<sup>3</sup> writes as though the pelvis was known: "the skeleton, notably the plastron, pelvis, and skull, conform with the Pleurodirous type."

*Carapace.*—The carapace measures 430 mm. in length and 330 mm. in breadth. During, probably, immature life, it received an injury, having apparently been crushed between the right anterior and left posterior aspects, resulting in distortion of the former and breaking of the latter, one of the marginal plates also being cracked; these defects will be seen in Pl. xxiv. and fig. 32.

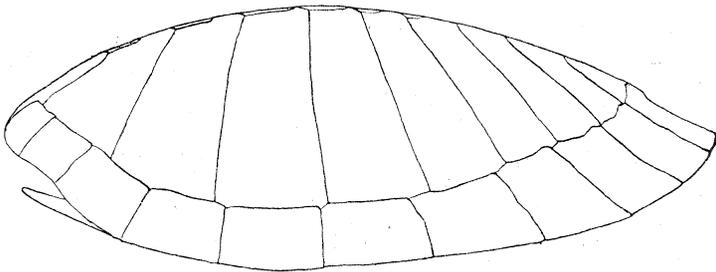


Fig. 31.

The posterior dorsal keel is extremely marked, much more so than in the type; the relative contours are illustrated in the

<sup>3</sup> Gadow—Cambridge Nat. Hist., viii., Reptiles, 1901, p. 404.

accompanying diagrams, fig. 31 representing the type and fig. 32 the specimen now described, which is smaller and possibly younger than the former.

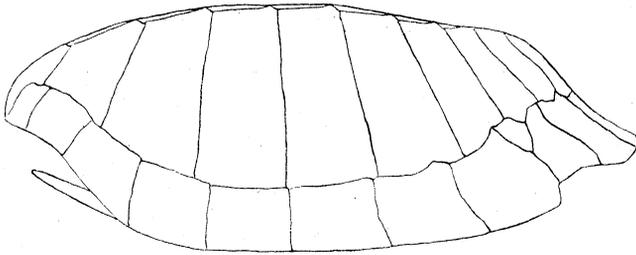


Fig. 32.

The neural plates are seven in number, but as the posterior one is very small it may be that in earlier life an eighth even may be developed and afterwards lost by encroachment of the costals. The relative larger size and greater number of neurals in the younger specimen suggests that a median growth of the costals takes place with age; for they are entirely separated by the fifth, sixth, and seventh neurals, and the sutures between the anterior pairs of costals is not more than 3 mm., while in the type all the costals meet in the mid line and the sutures referred to nearly equal the length of the respective neurals. The anterior marginals, of which there are ten pairs, are separated by the large nuchal, and the posterior pair by the single pygo-marginal.

The absence of epidermal shields is well illustrated in the accompanying photographs, where the dark lines on the inner side of the carapace (Pl. xxiv.) will be seen to be coincident with the sutures indicated on the dorsal surface.

*Plastron.*—The plastron was originally described as formed of nine shields, but Ramsay remarked:—"There are two small portions cut away from between the second and third plates and the marginals, so that it is impossible to say if these are extra plates or parts of the marginals." . . . They "are probably only the curved-in portions of the adjacent marginals." Respecting the carapace and plastron Baur wrote:—"Both have been figured by Ramsay, but there was some doubt about the presence or absence of a mesoplastral element. . . . The most interesting new point to be noted in the plastron is the presence of a small distinct mesoplastral element. The structure of the plastron is best seen from the figure."

With the actual specimen in hand Ramsay was unable to decide this point, and yet from the inspection of a photograph only, Baur definitely pronounced on the presence of a mesoplastron. His conclusions are quite wrong, there is no such plate; an incurvation of the marginal being responsible for the appearance in the illustration. My photograph, published on Pl. xxiv., fig. 2, very clearly shows the exact condition. I may mention that the carapace and plastron have not been separated, and are illustrated in natural connection. The sutures also have not been artificially emphasised.

*Dimensions* :—

Carapace—length	...	...	430	mm.
"    breadth	...	...	330	"
Plastron—length	...	...	320	"
"    breadth	...	...	272	"
Skull— length	...	...	123	"
"    "    basal	...	...	93.6	"
"    width	...	...	75.0	"
"    "    interorbital	...	...	34.7	"
1st Vertebra, length of centrum	...	...	14.3	"
2nd "    "    "	...	...	27.2	"
3rd "    "    "	...	...	29.2	"
8th "    "    "	...	...	10.5	"
1st Vertebra, width outside				
posterior zygapophyses...			27.9	"
2nd "    "    "	...	...	23.6	"
3rd "    "    "	...	...	26.1	"
8th "    "    "	...	...	26.0	"
Dorsal Vertebrae <i>in situ</i>	...	...	278.0	"

In reading the proofs Dr. Ramsay overlooked some vagaries of the printer. The genus is rendered as *Carettochelys*, but associated with the species it reads *Carettochelys*, while on the only other occasion on which the word is used it appears as *Carretochelys*.

The author of the species referred it to the family Trionychidæ and suggested that it formed a link between the river tortoises and the sea turtles. In raising the genus to family rank Boulenger assumed that it was a Pleurodiran because, all then known Papuanian and Australian Chelonians belonged to that division. Characters of the neural bones, and plates on the fore limbs were also considered to point in that direction. Baur thoroughly reviewed the situation and rejected the Pleurodiran nature of the genus. He considered that the Carettochelydidæ, to which he assigned both *Pseudotrionyx* and *Carettochelys* "came from a group of tortoises related to the stock from which

Staurotypidæ and Cinosternidæ developed." He also thought it "probable that the Carettochelyidæ are very close to the ancestors of the Trionychia, of which they are only survivals." When examining the two imperfect skulls, previously referred to, Boulenger found characters possessed only by *Chelys*, among the Pleurodira and by the Trionychidæ.

From the Pleurodira it is definitely excluded by the following characters:—

The neck is bent in a vertical and not in a lateral plane; the cervical vertebræ do not possess transverse processes, and the articulation between the centra of some of the posterior vertebræ is ginglymoid. The pelvis is not ankylosed to the carapace and plastron.

Vaillant placed *Carettochelys* next to the Dermatemydidæ in the sub-tribe Phaneroderinea of the Euchelonina.

*Carettochelys* has considerable affinity with the Cryptodira as defined by Boulenger; especially, as pointed out by Baur, with the families Dermatemydidæ, Staurotypidæ, and Kinosternidæ. The difference as regards deep-seated characters may be expressed as that of the condition of the pterygoid bones. In *Carettochelys* they are widely separated by the palatines, basisphenoid and basioccipital. In the cryptodiran chelonians, the pterygoids are in contact on the mid-line. The cervico-dorsal articulation is cryptodiran, being, as I have shown, between the centra of the vertebræ, and not between the zygapophyses alone, as in the Trionychoidea. On the other hand, the character of the pterygoids and premaxillary associates *Carettochelys* with the latter division.

It would seem therefore that, fundamentally, the Cryptodirans and the Trionychoideans are related through *Carettochelys* and its fossil allies, and that the two divisions should not be separated, in a linear arrangement, by the Pleurodirans. The features of this reptile thus support the classification adopted in recent revisions. Want of an acquaintance with fossil forms, the absence of specimens for comparison and the necessary literature, compel me to abstain from a discussion of this subject. I trust, however, that those who are qualified to weigh the facts adduced, will find the *data* and illustrations supplied, useful in the elucidation of an interesting problem.

The whole characters of this Chelonian are not yet, by any means, perfectly known, and further material will be necessary before the fourth and three succeeding vertebræ, the pelvis, and caudal vertebræ can be described. We know nothing of the shoulder-girdle and limb bones, and the number of phalanges in the digits is still an uncertain quantity.

A few other points remain to be dealt with. Up to 1903 all the Chelonians recorded from New Guinea were Pleurodirans. In that year, however, I announced the occurrence of *Pelochelys cantoris*, Gray, in New Guinea,<sup>4</sup> and thus added a member of the Trionychoidea to the known fauna.

Ramsay remarked that the head was non-retractile, a statement doubted by Baur, and as I have shown incorrect.

In comparing *Carettochelys* with *Pseudotrionyx*, an affinity suggested by Boulenger, Baur noted the difference in the number of the neural plates, six in the former, seven in the latter. Our example, however, shows an agreement in this respect between the two genera. The characters of the family as defined by this writer require emendation, the plastron in *Carettochelys* being composed of nine elements only, the supposed mesoplastra being absent.

This turtle was originally described as an inhabitant of fresh water, but the occurrence of an example at the island of Kiwai shows that it is also an estuarine form. The main outlet of the Fly River is twelve miles across, and Kiwai is a large island in the river about eight miles from the mouth. It supports two villages separated by a salt-water creek, but connected by a native bridge. Mr. Froggatt tells me that at Kiwai the water is absolutely salt, so that the turtle may not be confined to the Fly River or its tributaries, but occur also in other rivers entering the Papuan Gulf.

The following references may be added to the bibliography of the subject, since its publication in the paper first-named below.

Baur, G.—On the relations of *Carettochelys*, Ramsay. *Amer. Nat.*, xxv., 1891, pp. 631-639, pl. xiv-xvi. and *Science*, xvii., 1891, p. 190.

Vaillant, L.—Essai sur la Classification générale des chéloniens. *Ann. Sci. Nat.*, (7), xvi., 1894, pp. 331-345.

Boulenger, G. A.—Remarks on two imperfect skulls of *Carettochelys insculpta*. *Proc. Zool. Soc.*, 1898, p. 851.

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<sup>4</sup> Waite—*Rec. Aust. Mus.*, v., 1903, p. 50.

EXPLANATION OF PLATE XXIV

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CARETTOCHELYS INSCULPTA, *Ramsay*.

Fig. 1. Carapace.

„ 2. Plastron.



1.



2.

EXPLANATION OF PLATE XXV.

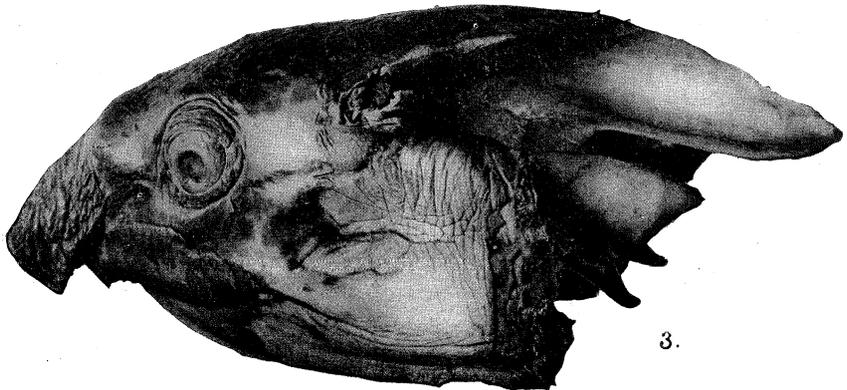
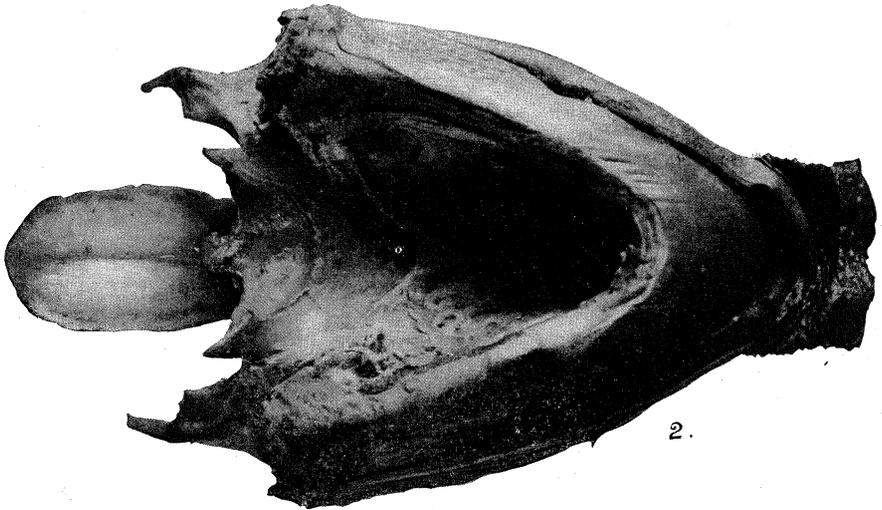
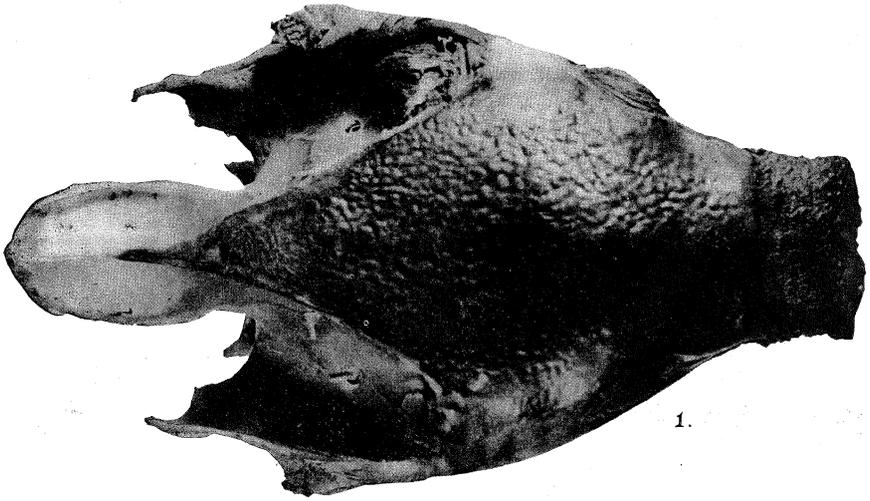
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CAROTOCHELYS INSCULPTA, *Ramsay*.

Fig. 1. Head—Upper view.

„ 2. „ Lower „

„ 3. „ Lateral „

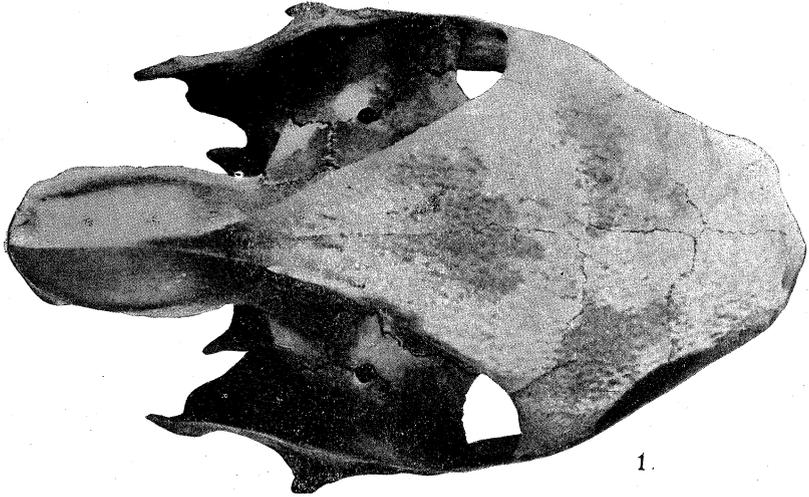


EXPLANATION OF PLATE XXVI.

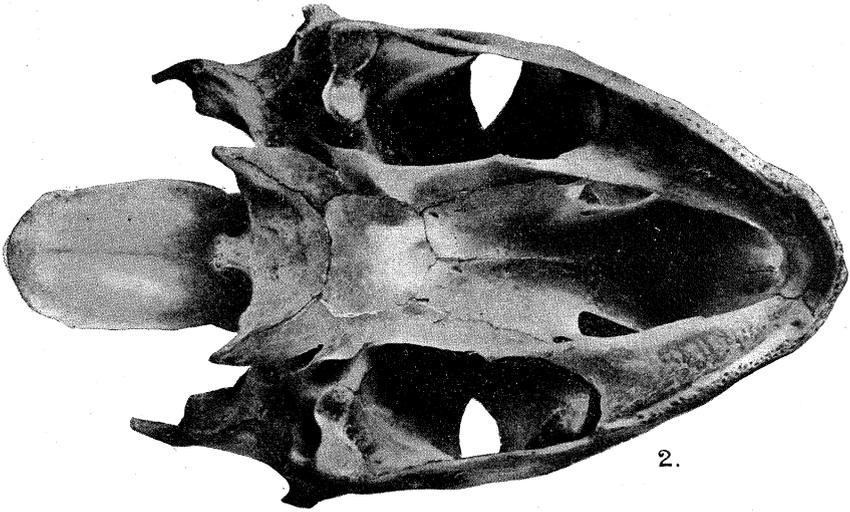
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CARETTOCHELYS INSCULPTA, *Ramsay*.

- Fig. 1. Skull—Upper view  
„ 2. „ Lower „  
„ 3. „ Lateral „



1.



2.



3.

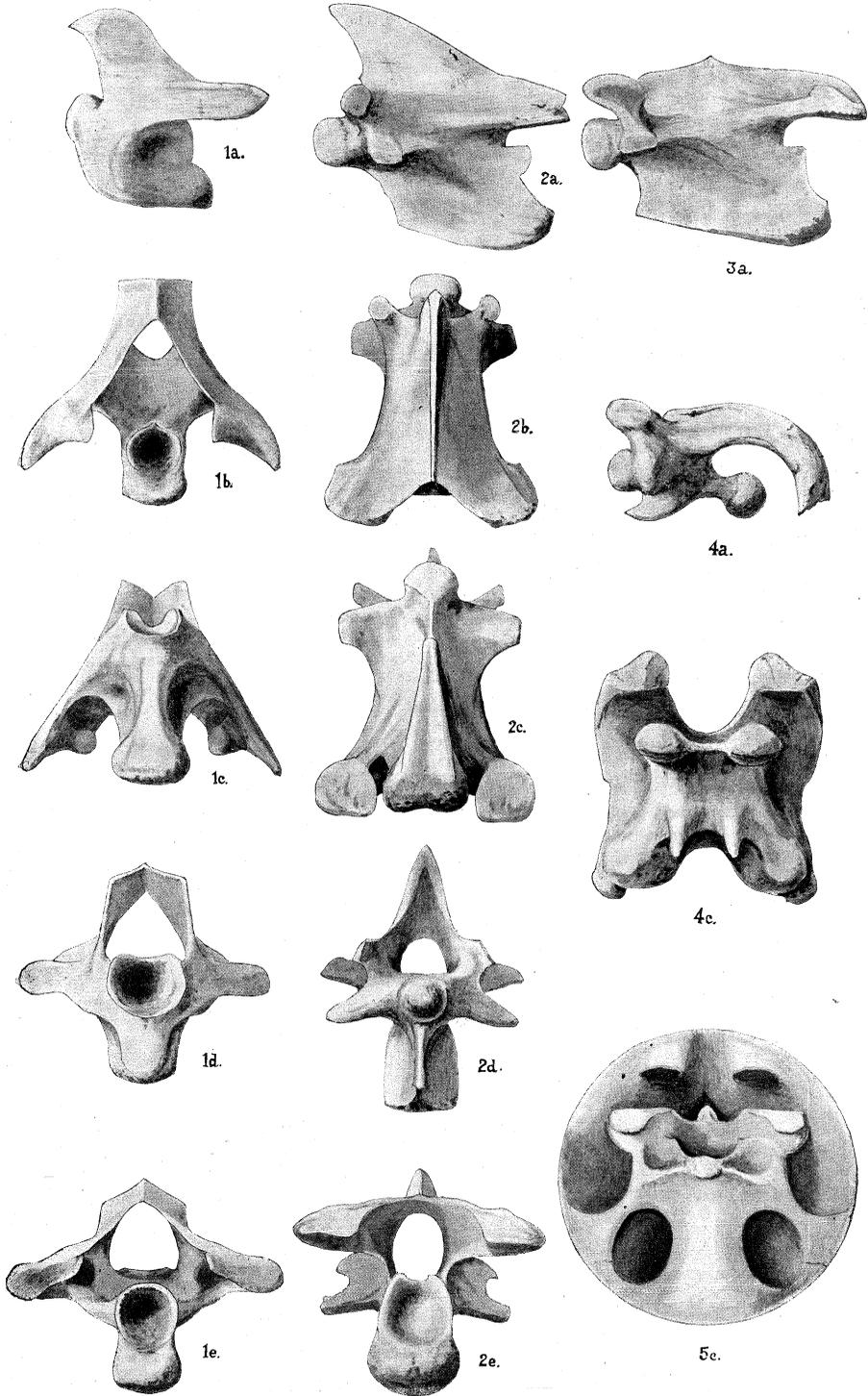
EXPLANATION OF PLATE XXVII.

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CARETTOCHELYS INSCULPTA, *Ramsay*.

- Fig. 1. First Cervical Vertebra.  
„ 2. Second „ „  
„ 3. Third „ „  
„ 4. Eighth „ „  
„ 5. First Dorsal Vertebra and portion of Carapace.

*a.* Lateral; *b.* Dorsal; *c.* Ventral; *d.* Anterior; and *e.* Posterior aspects.



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Austr. Mus.