THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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VOL. X.—NINTH SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY BAILLIÈRE, PARIS: AND HODGES, FIGGIS, AND CO., DUBLIN.

1922.

adult female, these pleopods must afterwards re-develop, thus providing an example of a phenomenon somewhat uncommon in the animal kingdom, the degeneration of a well-developed and functional organ, and its subsequent re-development at a later stage.

Two specimens of *G. lalandii* which are in the possession of the Natural History Museum, South Kensington, and which were collected by Dr. C. W. Andrews at a spot about 200 feet from the summit of Christmas Island, are respectively a male measuring 18·5 mm. across the carapace and a female measuring 18 mm.

At this stage the abdominal appendages have already assumed the characters of the adults, although the size of the chelæ and abdomen are still the same in both sexes.

Sex-differentiation of the pleopods, therefore, must take place between the first young stage measuring 4·2 mm. across the carapace and the attainment of a size of 18 mm.; and during this period the young crab leaves the sea and migrates inland to take up its future abode in the wooded districts of the interior.

I am indebted to Dr. C. W. Andrews and Dr. W. T. Calman for the loan of specimens and for helpful information and advice.

LIV.—*On a new Brachyurous Crustacean from the Upper Cretaceous of Jamaica.*

By Thomas H. Withers, F.G.S.

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[Plates XVI. & XVII.]

Dr. D. Woolacott recently presented to the Geological Department of the British Museum some crab-remains collected by him from the Upper Cretaceous of Jamaica, and these were entrusted to me for description.

Cretaceous crabs are always interesting, but the interest is greatly increased when, as in this instance, it is possible by careful development to expose many of the appendages, so that the structure can be studied almost as completely as in a recent specimen. The form here described is not only one of the most complete Cretaceous crabs so far discovered, but is

especially interesting from both a morphological and evolutionary standpoint.

Carcineretes * *woolacotti*, gen. et sp. n.

Diagnosis.—Carapace flattened, rectangular, very slightly broader than long; the protogastric lobes are the only ones at all prominent, and are crossed by a transverse ridge—the epigastric line; the frontal region is divided into three lobes, from which it is sharply deflected inwards and downwards to form a shovel-like extension. Orbital region, on either side of the front, wide, thrown into three lobes or teeth, decreasing in width towards the outer orbital angle, which is produced into a prominent tooth, below the base of which the orbit is deeply sunk. Chelipeds rather massive, with the major chela developed on either the right or left. Last pair of ambulatory legs with the propodus and dactylus flattened and broadened to serve as a swimming organ as in the Portunids.

Occurrence.—Dr. Woolacott has supplied the following notes regarding the horizon, locality, and associated species:—

Upper Cretaceous (Turonian?). From grey calcareous shale in the bed of the Rio Minho a little to the west of Trout Hall, Chapelton, Jamaica. The shale is several feet thick, and one band of it, about 3 feet in thickness, is crowded with Rudistæ, forming a Rudist-bank. The crab-remains were obtained from this bank.

The crab-remains were associated with Rudistæ, corals, massive Actæonellid gastropods, and *Ostrea*-like bivalves, the fauna being fairly rich and varied. Among the specimens collected by Dr. Woolacott from the Cretaceous limestones of Jamaica, Dr. Trechmann has determined the following:—

Radiolites cancellatus, Whitfield †.
Radiolites cf. *macroplicatus*, Whitfield.
Caprina cf. *jamaicensis*, Whitfield.

He states regarding the Rudistæ collected that "they include several apparently undescribed forms, among them being *Radiolites* both single and growing in clusters. Among the former are forms having the general shape of *R. sauvagesi* of the European Cretaceous." The species

* καρκίνος = crab; ἐρέτης = rower.

† "Description of Species of Rudistæ from the Cretaceous Rocks of Jamaica," Bull. Amer. Mus. Nat. Hist. vol. ix., July 1897, pl. xiii. figs. 3–7.

which occur in the band from which the crab-remains were obtained include:—

Radiolites cancellatus, Whitfield.
Diploria crassolamellosa, Edwards & Haime.
Heliastrea cyathiformis, Duncan.
—— *exsculpta*, Reuss.
Actæonella sp.

The bank is largely composed of *Radiolites cancellatus*, and it is hoped to describe the fauna from this bed more fully later.

Collection.—Collected by Dr. D. Woolacott, and presented by him to the Geological Department of the British Museum (registered In. 20780–In. 20782).

Material.—Three specimens—holotype, In. 20780, an almost complete male shell with the four ambulatory appendages preserved on the left side; In. 20781, another male carapace with the right minor chela the only one of the appendages preserved; In. 20782, a left major chela.

Description.—*Carapace* rectangular; in specimen In. 20781, length 33·4 mm., breadth 35·8 mm.; in In. 20780, length 34·4 mm., breadth 38·8 mm. Anterior margin generally straight and long, the front and the outer orbital spines prominent, although the front is slightly more forward.

The front is divided into three lobes, the median of which is small, longitudinally oval, and separated by deep channels from the other two; from these lobes the front is sharply deflected slightly inwards and downwards to form a somewhat concave shovel-like extension.

On either side of the front the orbital region is marked off into three wide lobes or teeth. The first of these, counting from the front, is the widest; it is concave from the front and becomes convex where it is folded slightly below the next lobe, which is smaller and markedly convex; there is only a slight notch dividing this second lobe from the third small and rounded lobe; this is followed by a deep notch, and then a small tooth which forms part of the much larger outer orbital tooth marking the outer limit of the orbital region.

The lateral margins are almost straight and converge only very slightly towards the posterior margin; they are somewhat rounded at the postero-lateral angle and merge into the posterior margin, which is only slightly concave in the middle. There is a short sharp spine or tooth on each

lateral margin at the distal extremity of the epibranchial lobe, and a bluntly rounded tooth lies immediately below the lateral furrow.

Surface generally somewhat flattened, and covered, especially near the lateral and anterior margins, by very fine flattened granules. The most prominent of the several areas are the rather swollen and rounded protogastric lobes, which slope towards the front from a slight but definite ridge—the epigastric line,—which extends transversely across their middle. A similar ridge is seen in the Portunid genera *Scylla* and *Neptunus*. Behind the protogastric lobes is the mesogastric lobe, somewhat globular in shape below, and rather indistinctly produced in front into a narrow bottle-neck extension characteristic of this lobe; immediately behind it is the small, rounded, and somewhat crescentic urogastric lobe. Well-defined branchio-cardiac furrows bound the sides of the urogastric lobe and extend below it.

The cervical furrow is well marked, and can be traced between the mesogastric and urogastric lobes; it then extends upwards round the protogastric lobes, and outwards and upwards to the lateral margin near the outer orbital tooth or spine. Immediately below the cervical furrow on the margin is a small triangular lobe—the epibranchial,—followed above by the rather prominent and subtriangular hepatic lobes. Below the cervical furrow on each side are the oblong and rounded mesobranchial lobes, bounded below by the lateral furrow.

Specimen In. 20781, viewed anteriorly, shows the front produced downwards towards the epistome into a bluntly rounded prominence. Below, the epistome is preserved only on the right side, and in its posterior or lower part, which is a narrow spine-like body with a broadly expanded outer extremity; the pointed inner extremity ends just below the front, and appears to have been discontinuous with the left half. Below the front is a short, thick, subtriangular plate (a), which no doubt is the basal joint of the antennule; next to it is a somewhat rounded plate (a′), which is apparently the basal joint of the antenna. The eye-socket is rather wide, deeply excavated, and sunk well below the base of the outer orbital spine. The pterygostomian plate is somewhat displaced, but its inner margin is raised and narrowly bevelled, the basal margin somewhat excavated and with a raised narrow rim, and transversely across the lower part of the plate extends a flatly rounded ridge. All that remains of the third maxilliped is a displaced ischium (i), and this is

a rather broad plate, constricted posteriorly, where it is trilobed, the posterior lobe being the largest; above the second lobe extends a sinuous groove or suture, and from this to the inner anterior angle extends a longitudinal groove similar to that seen in the Eocene *Rhachiosoma* and *Xanthopsis*.

The abdomen in specimen In. 20781 is partially preserved, only the last two plates being exposed; but in specimen In. 20780 all the plates are present except the last. These two specimens show that the abdomen of the male was only moderately broad, and formed an acute triangle. It was composed evidently of five plates—the first wide and narrow; the second not quite so wide or narrow; the next, evidently representing the third, somewhat broader and not so wide; next an almost square plate, probably representing the fused fourth to sixth plates; lastly, the seventh plate or telson, which is subtriangular, with a somewhat narrowly rounded apex.

The sternal plates are not well exposed. In specimen In. 20781 they are seen to be variously shaped, but the three plates agree in having a narrowly rounded excavation on the anterior margin towards the lateral extremity, which is constricted and produced downwards into a small somewhat triangular body.

Chelipeds stout and their surface generally smooth. The fused basis and ischium is short, rounded, and triangular. Carpus short and somewhat globular, with a broad tooth at the inner angle, a blunt median spine a little removed from the anterior margin, and, towards the outer angle, the surface produced into a boss or prominence. The merus has the posterior margin very thick and rounded, but rapidly thins out anteriorly and towards the articulation with the propodus, and here there is a prominent spine on the posterior margin, followed below by two further equidistant spines, the lowest not being nearly so large as the others.

Chelæ unequal, the major chela developed on either the right or left, as shown by the fact that in In. 20780 the major chela is on the right, while in In. 20781 the minor chela is on the right, and the detached major chela (In. 20782) is a left one. The chelæ are rather massive, rounded from below to the margins, which are upturned to form a ridge and consequent concavity on their inner side; there is a longitudinal ridge extending along the crest of the palm, and on its posterior margin, both at the joint with the dactylus and midway between that and the carpus, the margin

is produced into a short blunt spine ; next the articulation of the larger palm with the dactylus there is a large lobe or tooth directed towards the end of the dactylus, as in *Scylla* and *Gatunia*. The digits on their prehensile edges have rather large and closely-set irregular teeth, and the basal tooth in the larger dactylus is much enlarged and directed obliquely backwards as in *Scylla* and *Gatunia*.

The three pairs of ambulatory legs have the segments somewhat flattened; the merus is comparatively long, and the carpus and succeeding segments are very distinctly grooved along their thick anterior margins, the posterior margins being thinner and narrowly rounded. The legs of the last pair are flattened and broadened to serve as swimming organs ; the dactylus, which is slightly incompletely preserved, is broadly ovate and leaf-like, and the propodus is expanded and thinned only on the posterior side, in consequence of which the articulation with the dactylus is close to the stouter anterior edge.

Affinities.—One of the most conspicuous characters of this crab—a feature hitherto unknown earlier than Tertiary times—is the modification of the last pair of legs into swimming paddles resembling very closely those found in the Cyclometopan family Portunidæ. This resemblance does not consist merely in the fact that the segments of the limb are broad and flattened : the broadly ovate leaf-like dactylus, the propodus expanded and thinned only on the ventral or posterior side, so that the articulation with the dactylus is close to the stouter dorsal or anterior edge, and the general outline of these and other segments, are closely paralleled in the swimming-paddle of such a form as *Neptunus*. The persistence of this type of limb throughout the large and varied family Portunidæ might well lead us to regard it as a character of great phylogenetic significance. It reappears, however, with almost identical form in the genus *Matuta* among the Oxystomata, whose community of inheritance with the Portunidæ is very improbable indeed.

The paddle-like extension of the posterior legs is clearly an adaptive character, and may well have been acquired independently by different branches of the Brachyuran stock. This therefore throws no light on the affinities of our present crab.

We consequently have to rely on the structure of the carapace. This is square and flat, and its marked features are the deflexed and trilobed front, the wide stretch marked off into wide rounded teeth on either side of the front, and

the prominent outer orbital teeth. The abdominal segments and the ischium of the third maxilliped show no special features.

Many of the Pre-Cretaceous crabs are allied to the Dromiacea, and it might be thought that this early Cretaceous type would show features in common with that group. Nearly all the Jurassic crabs probably belong to the extinct family Prosoponidæ, and, except in the case of the unique example of *Protocarcinus longipes*, H. Woodward, are known only by their carapace. The carapace is generally longitudinally oval in outline, and has the transverse furrows—the cervical and lateral—prominently marked; the shape of the carapace and the disposition of the furrows show that the Prosoponidæ are allied to the family Homalodromiidæ of the Dromiacea. In our crab the carapace is square rather than longitudinally oblong, although it is not transversely oval as in many modern crabs; but while the transverse furrows are well marked, there is barely a hint of affinity with the Dromiacea. The Dromiacea include the least specialized forms of Brachyura, and retain many primitive characters. One of these is the frequent presence of vestiges of the uropods (the sixth pair of abdominal appendages) in the form of small plates intercalated between the last two segments of the abdomen. These intercalated plates are certainly not developed in our crab, and the legs of the last pair, instead of being reduced or elevated on the back as in many Dromiaceans, are, on the contrary, well developed and modified into swimming-paddles. We cannot, therefore, refer our crab to the Dromiacea, and, in fact, there is nothing at all primitive in any of its characters.

The square flat carapace and, more especially, the strongly deflexed front suggest Catometopa, but the form of the carapace does not resemble in detail any member of that varied group, and the presence of three lobes on the line of deflection of the front is very unlike the arrangement in any Catometopan, where the lobes, often four, are always separated by a median groove. There is, however, one character suggestive of the Portunidæ, and that is the presence of a transverse ridge—the epigastric line—extending across the gastric region, similar to that seen in the genera *Scylla* and *Neptunus*. Moreover, the chelæ are not unlike those in the Portunid genus *Scylla* and in the Miocene genus *Gatunia* of the family Gatuniidæ; in all three forms, next the articulation of the larger palm with the dactylus, there is a large lobe or tooth directed towards the end of the dactylus, and the basal tooth

FIG. 1.

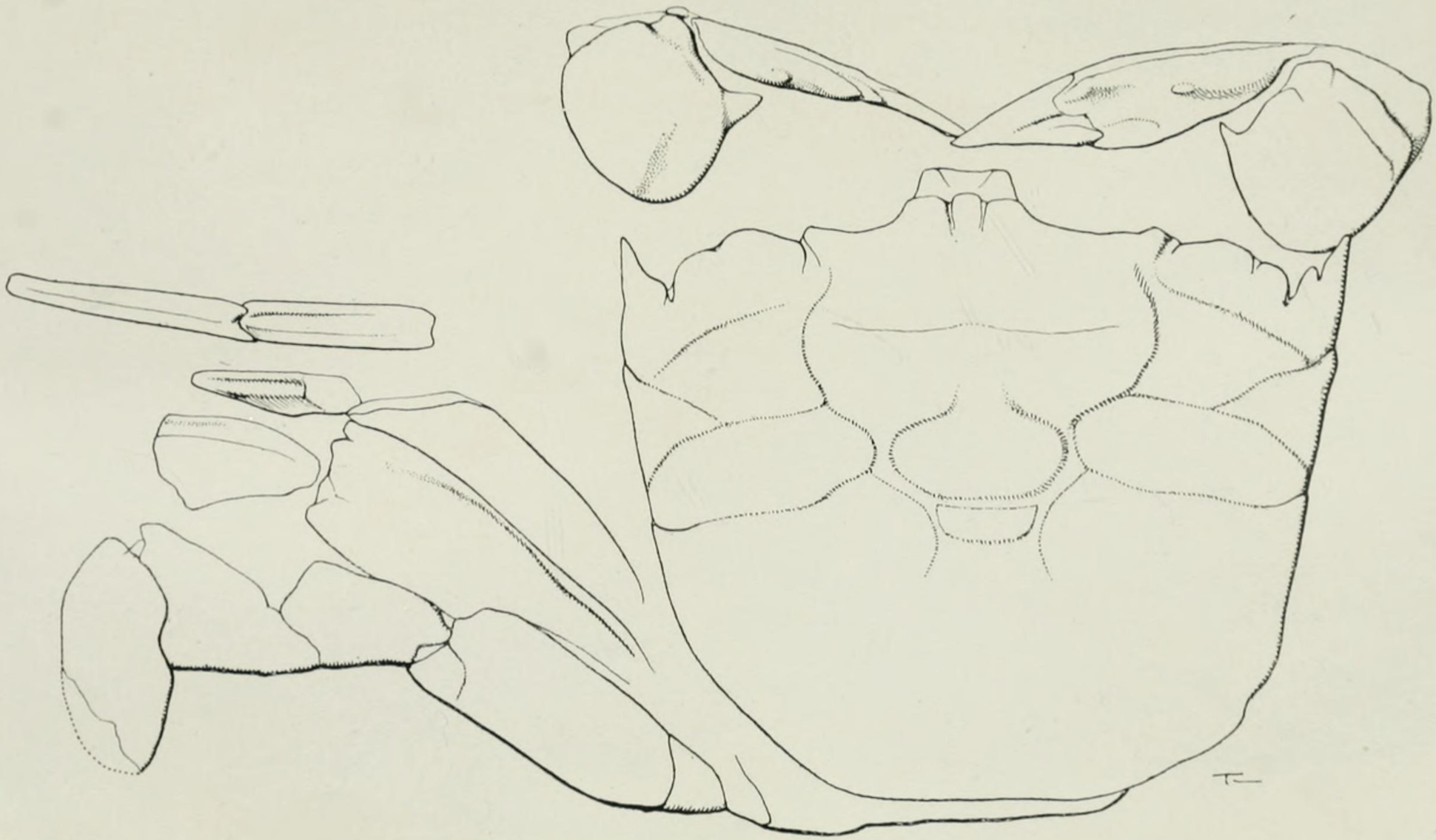

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FIG. 3.

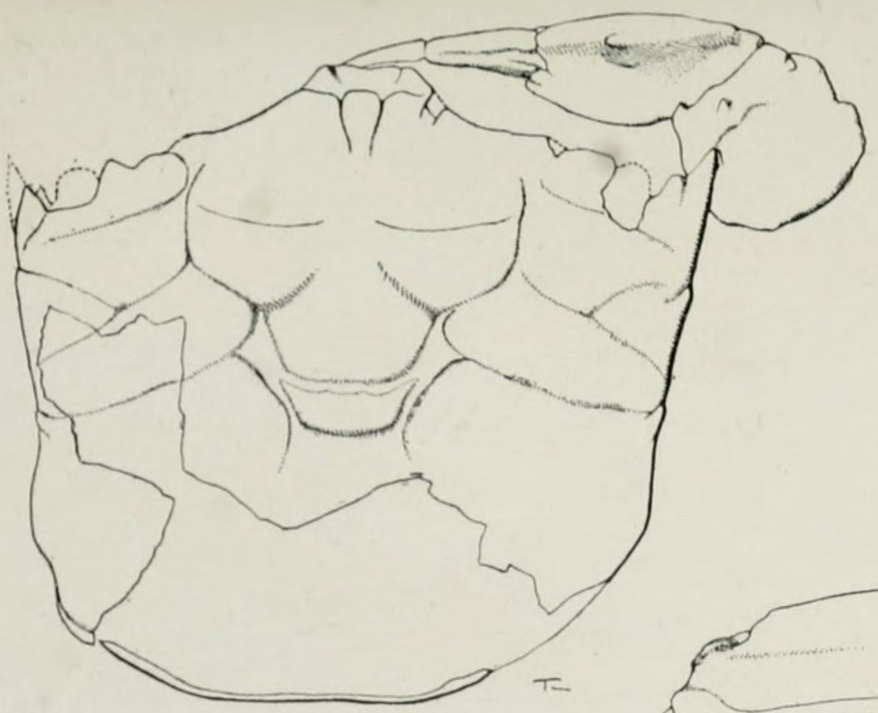


FIG. 2.

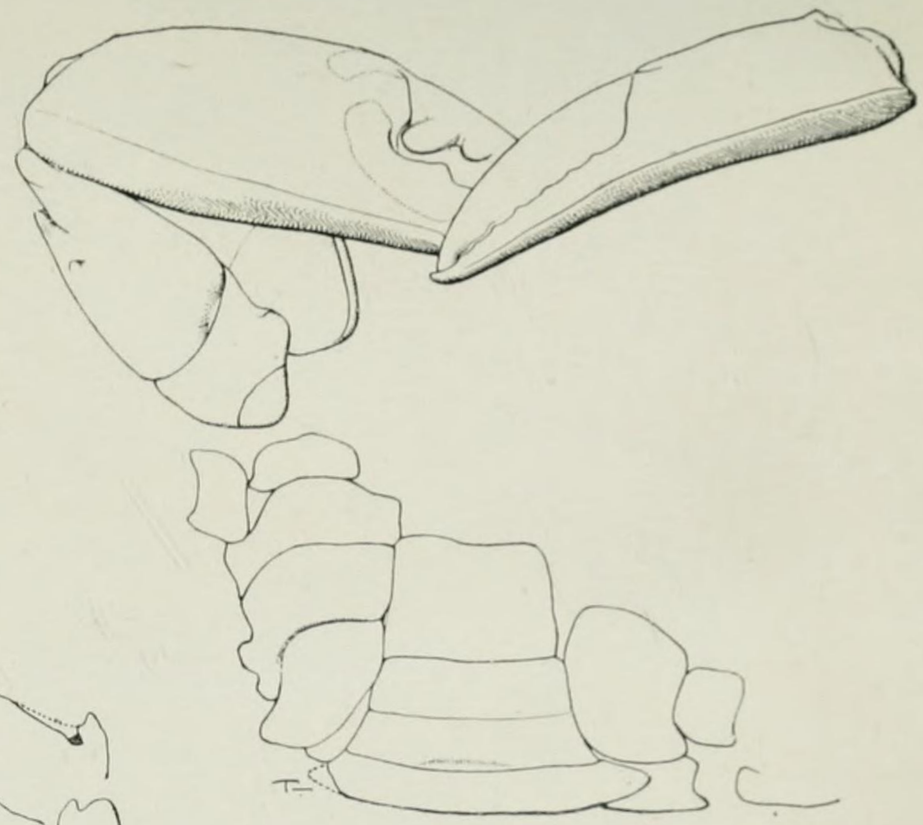


FIG. 4.

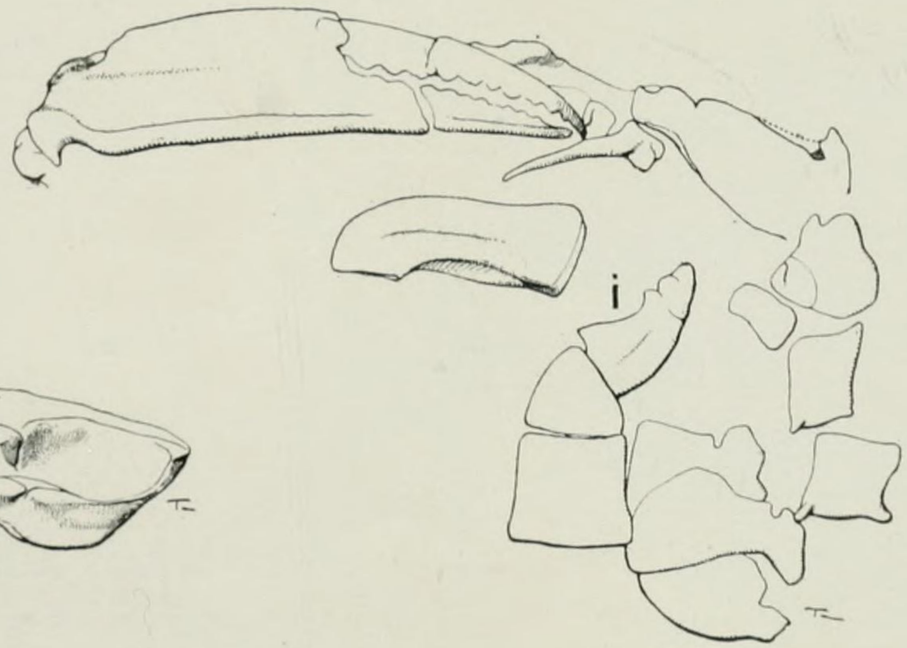


FIG. 5.

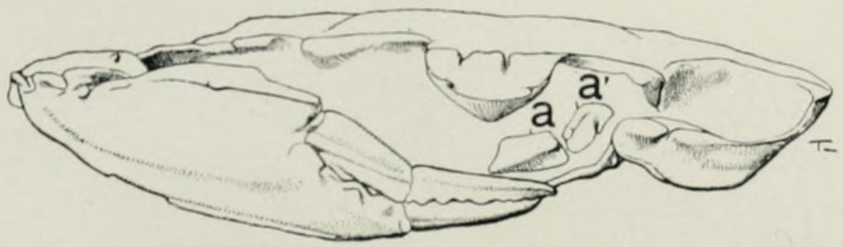
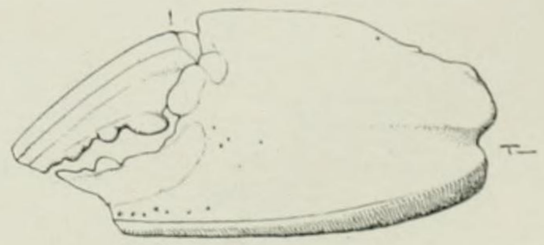


FIG. 6.



Terzi del.

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of the larger dactylus is much enlarged and directed obliquely backwards.

It is in the Cymopoliidæ, however, that we find more characters in common, for in *Cymopolia* the carapace is square and flat, especially in certain species such as *C. whitei*, and, although the arrangement of the furrows does not agree in details, a certain general resemblance with them can be traced. The form of the laterally elongated orbits in *Cymopolia*, with their deeply-cut upper margin and the prominent outer orbital teeth, also suggests our crab; and it may be added that some of the legs, although not the last pair, are flattened for swimming. The front, however, is very different, showing no trace of deflection, but having a median emargination and a thin edge.

On the whole, though the indications of affinity are conflicting, it seems probable that *Cymopolia* is the nearest relative of this Cretaceous crab, with possibly some relationship to the Portunidæ. Though *Cymopolia* is now usually placed in the Catometopa, the fact that its systematic position was till recently the subject of discussion increases the likelihood that it may be the survivor of a primitive group still showing traces of divergent affinity with widely different groups.

In conclusion, I wish to thank Dr. F. A. Bather, F.R.S., and Miss M. J. Rathbun for their assistance, and also Dr. W. T. Calman, F.R.S., who not only gave me access to the collection of recent crabs in his charge, but helped me in other ways.

EXPLANATION OF THE PLATES.

Carcineretes woolacotti, gen. et sp. n.

Plate XVI.

Fig. 1. Dorsal view of almost complete male shell, with the ambulatory appendages on the left side. Holotype, B.M., In. 20780.

Plate XVII.

Fig. 2. Abdominal view of same.
Fig. 3. Dorsal view of another male shell, with the right minor chela the only one of the appendages preserved. B.M., In. 20781.
Fig. 4. Abdominal view of same.
Fig. 5. Anterior view of same.
Fig. 6. Left major chela of another specimen. B.M., In. 20782.

Fig. 1, × 2 diam.; Figs. 2–6, × 1½ diam.