MEMOIRS

OF

THE GEOLOGICAL SURVEY OF INDIA

Palæontologia Indica,

BEING

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OBSERVATIONS ON FOSSIL CRABS FROM TERTIARY DEPOSITS IN SIND AND KUTCH,

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[With Plates I—V].

The fossil *Crustacea*, about to be noticed in the present communication, all belong to the Decapod group, with a short, ventrally inflected tail, known under the name of *Brachyura*. Al. Milne-Edwards, in one of his recent publications,* specially devoted to the study of fossil *Crustacea*, separates the *Brachyura* into *B. macrocephala*, which have the facial region well developed, and *B. microcephala*, which have it less developed.

The former he sub-divides into *Macroceph. eustomata*, with a broad frontal region, and *Macr. oligorhyncha*, in which the same part becomes considerably narrowed. The *Eustomata* he again classes in *Cyclometopa*, *Catometopa*, and *Oxyrhyncha*. The first tribe, the forms of which are characterized by a large carapace with the anterior part regularly curved, the posterior contracted, and in the males of which the tail occupies the whole width of the sternum, includes two large families, the *PORTUNIDÆ* and *CANCERIDÆ*, the former having the last pair of feet natatory, and broadly flattened, while in the latter the same are ambulatory, and quite similar in form to the three preceding pairs of feet. The greater number of the tertiary fossil *Brachyura* belongs to these two families, each of which is again sub-divided into sub-families and a great number of genera, carefully reviewed by Al. Milne-Edwards in the above quoted work. As compared with each other, the *CANCERIDÆ* are in recent and fossil state more numerous than the *PORTUNIDÆ*. I will note three species of the former, belonging to the genera *Palæocarpilius* and *Galenopsis*, and two species of the latter, referable to the genus *Neptunus*.

The second principal division of the *Brachyura*,—the *Microcephala*,—only includes the family *LEUCOSIDÆ*, and in this I will have to record a very peculiar small crab, for which I propose the new generic name *Typilobus*.

* Histoire des Crustacés Podophthalmaires fossiles, Vol. I, Paris, 1861-65, (Ann. de Sc. Nat., ivme Série).

Until very recently, there was only one species of tertiary *Brachyura* known from North-Western India. It was described by Messrs. Haime and d'Archiac from the nummulitic beds of Sind under the names of *Arges Murchisoni* and *Edwardsii*, and was referred by Al. Milne-Edwards, under the former specific name, to his newly proposed genus *Galenopsis*. The same author also states that certain specimens from the Hala range of Sind are identical with *Palæocarpilius macrocheilus*, Desm., a well known species occurring in eocene deposits through a large part of Southern Europe and also in Egypt. Although it seems unlikely that M.-Edwards should have been mistaken in his identification, I am unable to refer any of our very numerous specimens from those regions to *P. macrocheilus*, but I will describe a similar species under the name of *Palæoc. rugifer*.

The materials which form the subject of the present memoir had been partially deposited for some time in the Museum of the Geological Survey of India: they are those to be noticed from Sind; partially they were more recently collected in Kutch by Mr. A. B. Wynne, who had charge of the geological survey of this province. The stratigraphic position of the beds from which the fossils have been derived will be found discussed by Mr. Wynne in his report on the geology of Kutch, published in the Memoirs of the Geological Survey of India.

Besides the six species, which I shall describe in greater detail, I would only draw attention to some interesting fragments of two other *Brachyura*. They are not sufficiently perfect to give distinctly recognizable characteristics of the species, but they may serve as a guide in further search after these interesting fossils. I have therefore given a few illustrations of these fragments.

Figs. 1 and 2, on Plate II, represent the outer and inner views of two right hands, evidently belonging to a *Canceroid*, and probably to an *Atergatis*, or a *Galena*. Only these two specimens are in the collection; they are from a yellowish brown argillaceous rock between Soojapoor and Badra, south of Mhurr in Kutch; the beds belong to Mr. Wynne's Argillaceous group of the nummulitic series.

Figs. 3—10, on Plate I, represent right and left hands apparently of one of the GRAPSIDÆ, an *Uca* or *Cardisoma*, or some other allied genus. The two hands are equal or sub-equal; the left appears to be less inflated; the palms are nearly quadrangular, with a sharp serrated edge above and below, granular on the surface, the granules being most numerous on the median part of the outer side and on the lower half of the inner side; they are conspicuously larger at the base of the fingers than in other places. The fingers are of a rather slender shape, and nearly equal the palms in length; they are moderately arched on the outer serrated edge; each finger has two longitudinal rows of distant spines, which in the fossils, are usually indicated only by small pits. The immovable fingers have the internal edge closely and sub-equally tuberculated, the tubercles being flattened about the middle, and more or less confluent. The movable fingers have the inner edge sharper, on the basal half provided with a few large tubercles, and further on very finely serrated. Fragments of the chelæ of this species are more common than those of the *Canceroid*, just noticed; they were also collected by

Mr. Wynne in the same argillaceous beds of the nummulitic series between Soojapoor and Badra, and also to the north of the former locality, in Kutch.

Family,—PORTUNIDÆ.

Genus,—NEPTUNUS, Haan.

The species of *Neptunus* are easily distinguished from the allied genera, *Scylla, Lupa, and Achelous,* by having the last, or costal spine, considerably longer than the remaining eight spines of the antero-lateral margin.

The recent species are tolerably numerous in the Eastern and American seas; one also occurs in the Mediterranean. Of fossil forms Al. Milne-Edwards only lately described six tertiary species, one from France, one from Sardinia, and four from Northern Italy (Vicentin), (*Vide* Hist. des crust. Podophthal. foss., vol. i, 1861-65, p. 106, et seq.). To these I have to add two new species from the tertiary beds of Sind, *N. Wynneanus* and *Sindensis.* They exhibit some peculiarities which deserve special mention, because they throw some light upon the value of certain characters in the *PORTUNIDÆ.*

Haan (in Fauna Japonica) distinguished three equivalent sub-genera, *Neptunus, Amphitrite,* and *Pontus.* They are all characterized by the large size of the costal spine. The sub-divisions are made according to the form of the third endopodite joint of the outer maxillary feet. In *Neptunus* this joint is longer than broad, with the lower inner angle conspicuously produced, and with the upper hinder edge rounded. In *Amphitrite* the upper hinder edge of the third endopodite is considerably produced and also rounded. In *Pontus* the same joint is said to be square. The last sub-genus is based upon a new species not further characterized. *Amphitrite* was accepted by *Dana,* but united with *Neptunus* by Milne-Edwards. The character relating to the form of the third joint seems to be subordinate, but it is remarkable to find the *Ampitrite*-form already represented in fossil species, as may be seen from the examination of *N. Wynneanus.* This shows that the character in question possesses a certain constancy, and that some classificatory value may be attached to it. It would probably be convenient to retain *Amphitrite* as a sub-genus of *Neptunus,* though under a different denomination, *Amphitrite* having been already used by Müller in 1771 as a generic name. In the other species which I shall notice, *Nept. Sindensis,* the third endopodite of the outer maxillipeds is not preserved, but both species agree in one or two other points.

In the typical *Neptunus* (type, *N. pelagicus)* the antennulary ridge is anteriorly produced into a sharp spine which projects beyond the front margin. In the two Indian fossil species the spine is indicated, but does not even reach the margin. I also do not see it indicated in the figures of the species, referred by de Haan to *Amphitrite,* and as I have no recent examples of this to compare, I cannot say what importance is to be attached to the development of this spine, but it appears that, if Milne-Edwards is correct in identifying the three forms under one genus, as he has done, the long inter-antennulary spine cannot be regarded as an essential character of *Neptunus.*

A third point which deserves mention in the two Indian fossil species is the comparative shortness and great thickness (or height) of the hand; the species agree in this respect, as well as in the distribution of the tubercles on the fingers, much better with *Scylla* than with any of the recent species of *Neptunus*, in which the hand of the *Chelæ* is always very much elongated and comparatively thin.

NEPTUNUS WYNNEANUS, *Stol.*, Pl. I, Figs. 1—2.

The carapace of the female is transversally oblong, the width being in proportion to its length as 32 : 17, nearly smooth above, finely granular at the lateral margins; the median portion is slightly and somewhat irregularly tumid, the different divisions being marked by shallow depressions; towards the lateral and front margins the carapace is flattened or slightly concave. The frontal lobes are small, little elevated, separated from each other by a groove which originates between the two median frontal spines and continues between the rounded epigastric lobes to the faint epigastric line, which is somewhat flexuous in the middle; the proto- and meso-gastric are nearly confluent, but distinctly higher than the adjoining hepatic region. The metagastric lobe, including the basal urogastric portion, which occupies the centre of the back, is margined below, and laterally by a distinct horse-shoe shaped groove; from this a short groove on either side bounds the upper portion of the cardiac region, the epicardiac being in the middle slightly depressed, forming two rounded lobes, while the metacardiac consists of three parts, the median of which is broadest, most elevated, and slopes gradually to the posterior margin. The epibranchial is not distinct from the adjoining hepatic region, but the meso- and meta- branchial are about equally tumid and nearly confluent; there is also a small rounded lobe distinct on each side of the upper edge of the epicardiac region, between the urogastric, the meso- and meta- branchial; it may be regarded as an internal portion of the last lobe.

The front margin is almost straight, with six sub-equal depressed spines, those at the inner edge of the orbits being a little broader and shorter than the others, but less projecting. The orbits are large, elongately oval, with finely serrated margins; each is somewhat longer than half the length of the front; the upper margin has two incisions, a longer median one, and a shorter near the external spine; the lower margin has only one near the external spine; the lower internal angle of the orbit is produced into a broadly accuminate tooth.

The antero-lateral margin is, as usually, marked with nine spines; the eight anterior ones are alternately larger and smaller, all directed forward and slightly upwards; the ninth, or costal spine, is more than double the size of any of the others, and almost straight; its anterior edge is very minutely serrated, and there are also a few interspersed granules at the edges between the other spines. The epibranchial, finely granular, line runs from the tip of the costal spine in a flexuous curve towards the median upper edge of the mesobranchial lobe, where it becomes indistinct. The infero-lateral margin is also marked above by a raised

granular edge, extending from the costal spine two-thirds the length, where the lateral, flexuously bent, border of the equally finely serrated rim of the posterior margin comes in. The side of the carapace below the serrated line of the postero-lateral margin is densely covered with fine, slightly unequal, granules. The sub-hepatic region which extends on the ventral side of the carapace from the inner angle of the eye to the costal spine is throughout very distinctly granular, (including the lower side of the antero-lateral spines), and is separated from the antero-pleural region by a raised granular line; the pleural region itself is only near this line granular; on the inner area it is nearly smooth, and so is also its internal slightly thickened margin, the upper edge of which is curved, rather elevated, and extending to the base of the antennæ.

The basal joint of the external antennæ occupies the inner angle of the orbit; it is very short, oblique, somewhat rugose on the surface and thicker at the end, with a short prolongation on the lower external side, coalescing with the inner lower spine of the orbit and reaching to within a short distance from its tip. The so-called auditory tubercle at the outer base of the antennæ is very small, oval.

The pit for the inner antennæ, or antennulæ, is oval, with the lower margin insinuated, entire; its length equals about half that of the orbit; a shallow groove runs from it above the base of the external antennæ. The greater part of the internal cavity of the pit is occupied by the subtrihedral auditory sack, (see fig. 2*a*, pl. i,) which is attached to the external side of the small basal joint of the antennulæ. The inter-antennulary ridge which separates the pits is short, its lower portion is concave below and anteriorly it is produced into a short point. It is not very well preserved in any of the specimens which I have examined, but it certainly does not appear to have projected beyond the frontal margin, a character which Milne-Edwards considers essentially distinctive for all species of *Neptunus*. The epistome is sulcated for the whole of its width; it is longest in the middle, the posterior raised edge being angularly bent and entirely minutely serrated. The endostome is placed a little higher than the epistome; it is narrowest in the middle, divided by a sharp crest; the lateral endostomic ridges are oblique, at the posterior edge considerably thickened and raised.

Of the maxillary feet only the outer pair is partially preserved. The basilary joint, or epipodite, is very thin; the first joint of the endopodite is triangular, with an obtuse angle below and a short cross groove near it, extending from the inner margin to half the width. The second joint of the endopodite is the largest; its proportions of length to breadth are as 5 : 2; the base is narrowest, nearly straight with the usual tooth on the outer side; the inner margin is convex, the outer concave, and the upper still more so; at a distance of two-fifths of the breadth from the inner margin runs a longitudinal groove, but it does not reach the base. The third joint is sub-quadrangular, about two-thirds the length of the second joint; its lower and outer margins are flexuous, the inner slightly oblique, and the upper much so, the upper posterior angle being considerably produced and rounded, a character upon which Haan based his sub-genus *Amphitrite*,

as already noticed. The fourth joint is articulated a little below the upper anterior angle; it is short and thick. The two last joints have not been observed. Of the exopodite, or external branch, only the second joint is preserved; its width equals one-third the width of the corresponding endopodite, and its length nearly that of the second and third joints together, which character again agrees better with Haan's *Amphitrite* than with *Neptunus* (as restricted).

The chelæ are equal in size in the female. The total length of each exceeds the width of the carapace by a little more than one-sixth. The distribution of the spines and tubercles on the different joints is the same, as in nearly all other PORTUNIDÆ; they can easily be traced from figs. 1, and 1*a*, and 1*b*, on pl. i. The surface is, as usually, granular near the rounded edges of the joints and between the spines, at the sides it is smooth. The hands are mostly smooth, above with two ridges, externally and internally near the middle somewhat roundly tumescent, the inner sub-marginal sharp tubercle between the digits being distinct, the outer just traceable; the lower side is rounded. The length of the hand itself slightly exceeds that of one finger, and its height is a little more than one-third of the total length, which form more agrees with *Scylla* than with *Neptunus*, as already noticed. The sub-median longitudinal, punctated, groove on the inner and outer sides of the immovable finger is only slightly indicated; the interlocking tubercles on both the movable and immovable digits, and especially those at the base of the movable, also exactly correspond to those of *Scylla serrata*, both in number and relative size.

Of the three pairs of ambulatory feet only portions are preserved, and these show clearly the compressed form of the different joints; the anterior side is always a little flatter than the posterior, and the upper edges of all the joints beginning at the terminal portion of the femur is crested. The form of the last, or natatory, pair of feet has not been observed.

The sternal plastrum with its different divisions offers no occasion for remark; its form is clearly exhibited in figs. 1*b* and 2*b* of pl. ii. Its length is only slightly larger than its width, and neither of the two measurements equals half the breadth of the carapace. The tail of the female consists, as usually, of seven joints; the four first are very short, transversally subangular; the fifth is nearly, and the sixth fully, three times as long as any of the preceding joints. The first and fourth joints are equal in breadth, the second is a little wider, and the third the widest; the sixth joint is bottle-shaped, truncate above and below; the seventh is triangular and smallest.

Of the male only an incomplete carapace (figs. 2, 2*a*, and 2*b*), has been examined. It differs, so far as preserved, in no other respect from that of the female, except that the tail is much narrower, more regularly trigonal, with very slightly concave sides, and that the third, fourth, and fifth joints are united, the anterior part, corresponding to the third joint, being the widest.

Geological position.—Three specimens have been procured by Mr. A. B. Wynne in a soft, yellow, argillaceous bed, together with great numbers of

Orbitoides and other *Foraminifera* of the nummulitic series, in a stream under Kootra hill, near Pípúr, Kutch.

NEPTUNUS SINDENSIS, *Stol.*, Pl. II, Figs. 3—5, and Pl. III, Fig. 1.

The carapace of this species is slightly more than one-third broader than long, the breadth being in proportion to the length as 16 : 10, considerably less than in the last-named species. The different regions of the upper side of the carapace are equally well marked in both, and it is not necessary to repeat them; the horse-shoe shaped groove, defining the meta- and uro-gastric lobes below and laterally, is deeper than in *N. Wynneanus*. The upper and lower sides of the carapace are rather coarsely granular towards the margins. The front edge has six spines, the four interior are sub-equal, those at the inner angle of the orbit less projecting and more obtuse. The width of each orbit is more than half of the front edge, the upper margins have each a sub-median and a posterior incision, the lower only a posterior. The nine antero-lateral spines are alternately larger and smaller, all are slightly bent upward and forward; the costal spine is the largest; it barely, however, exceeds the outer spine of the orbit by one-half of its size, while in the last-described species it is doubly strong.

The facial portion is remarkably thin, the inter-antennulary ridge thick, probably with an obtuse point, but certainly not projecting beyond the front margin. The antennular pits are comparatively small and depressed; the basilar joint of the antennæ conspicuously thickened, short, with a distinct groove between it and the front margin, and with the external appendage greatly prolonged, somewhat spoon-shaped, and projecting almost as far as the lower spine at the inner angle of the orbit.

Of the maxillipeds, only the first and second joints of the external pair are preserved; they do not differ in any particular from those of the last species, neither does there appear to be any essential difference between the chelæ and the ambulatory feet, as far as seen preserved. The hand itself is considerably longer than the fingers, and as the inner tubercles are again exactly similarly disposed as in *Scylla*, this character combined with the increased length of the carapace exhibits a still greater relation to that genus, than is the case in the former species.

All the specimens examined are males, with a regularly pyramidal tapering tail; the third, fourth and fifth joints are united, but their sutures are indicated by slight depressions; the third joint is the widest. The sternum is a little narrower as compared with that of the last species; its length is very nearly one-half the width of the carapace, but its greatest breadth is only a little more than two-fifths of the same width.

Locality.—In a yellowish, nummulitic limestone, from the Lukkee Hills in Sind. Four specimens and a number of fragments of chelæ and ambulatory feet have been for some time past deposited in the Geological Survey collection. They were presented by Col. (now Genl. Sir) W. E. Baker.

Family,—CANCERIDÆ.

Genus,—PALÆOCARPILIUS, Milne-Ed.

Hist. Crust. Podophthalmaires foss. par Al. M.-Edwards, 1865, vol. I, p. 183.

Al. Milne-Edwards proposed the above generic name for a certain number of tertiary and other *CANCERIDÆ*, formerly referred to *Cancer*, and then to *Atergatis*. He very properly pointed out the greater generic relation of those species to *Carpilius* than to *Atergatis*, considering Desmarest's *Cancer macrocheilus* as the type of the new genus *Palæocarpilius*.

In summing up the principal characteristics of the genus, as distinguished from its ally *Carpilius*, M.-Edwards says,—"*nous powons placer en premiére ligne la presénce des tubercules sur le bord supérieur de la main et sur la face externe de l'avant bras, la longueur extréme de l'article basilaire des antennes externes*," *&c.* Now, the really important character appears to me to consist only in the great length of the basilary joint of the antennæ; the presence or absence of tubercles on the hand cannot be included in the generic characters. The median extension of the front edge seems, however, to be a very characteristic point in the shape of the carapace of *Palæocarpilius*.

In the description of the genus, Milne-Edwards also says that the ambulatory feet are cylindrical, as in *Carpilius*, and that in the male the tail consists of six joints, the fourth and fifth being united. I do not think that these characters could strictly be applied to the species of *Palæocarpilius* in general. First, the ambulatory feet are never, strictly speaking, cylindrical, not even in *Carpilius;* they are always a little compressed, but with the upper and lower edges rounded, not crested as in *Atergatis*. In specimens of the Indian *Pal. rugifer*, the third, fourth and fifth joints are united in the tail of the male, and this appears rather the rule than the exception. In Milne-Edwards' figure 1a, pl. iii (l. cit.) of *P. macrocheilus*, those three joints also appear to be united; and Reuss indicates their form merely by a punctated line, not by a distinct suture as between the other joints. (Compare Denksch Akad., Wien, vol. XVII, pt. I, pl. xii, fig. 2).

PALÆOCARPILIUS RUGIFER, *Stol.*, Pl. IV, Figs. 1—6, and Pl. V, Figs. 1—5.

Carapace transversally ovate, the breadth exceeding the length very nearly by one-third, or being in proportion to each other as 100 : 68 or 69; very convex, the front being in young specimens almost perpendicularly deflected; in older specimens, the deflection is sometimes a little less precipitous. The fresh surface is covered with larger and smaller round, shallow, pits, and about the branchial regions, with very conspicuous, more or less confluent, transverse rugosities. In old specimens, these rugosities sometimes also extend over the greater part of the median gastric region. On the posterior slope and at the postero-lateral margin, as well as at the lower side, the surface is smooth; but when the outer somewhat glazy layer is removed, the entire surface becomes equally and densely granular, and by further

decomposition the granules are replaced by equally small pits. The lobes of the carapace are indistinct, only the semi-lunar depressions at the sides of the urogastric region are traceable.

The front edge has a thickened margin, with two median projecting tubercles and two others at the inner angle of the orbit; the distance between these inner tubercles very nearly or fully equals the length of one antero-lateral margin. The orbits are nearly circular, deeply indented above, and with a swollen margin; below somewhat flattened, and with a sub-median projecting tubercle. Each antero-lateral margin has eight tubercles, of which the last one slightly exceeds the others in size and is also more pointed; the costal ridges are distinct, and each nearly one-third of the breadth of the carapace.

The basilar joint of the antennæ is very long, at its base scarcely higher than at any other part of its length; it terminates with a truncate edge in the orbit.

The basilar joint of the antennulæ is, as usually, semilunar, with a flexuous upper edge; auditory tubercles somewhat smaller than the superseding portion of the basilar joint of the antennæ; epistome almost linear, conspicuously depressed in the middle, especially below the inter-antennulary prolongation; endostome with a sharp, almost continuous, lower edge, the lateral endostomic ridges rather close together and somewhat curving outwards. Suture between the sub-hepatic and pleural region simple throughout.

The second endopodite joint of the outer maxillipeds is not much longer than broad, about the middle slightly depressed, but without any distinct groove; the third endopodite is somewhat broader than the last, a little less high externally, and with an obtuse angle on the inner edge; the fifth endopodite is a little longer than the fourth, both are narrow. The second exopodite is about as long as the second and third endopodite together, becoming somewhat narrowed towards above. It would appear as if the comparative width of the outer maxillipeds was a little smaller in the male than it is in the female.

The chelæ are very strong, each equalling in length the greatest width of the carapace. The fore-arm has externally three spines: two near the base, one above the other, and one anteriorly. The right hand is scarcely longer, but considerably higher and comparatively more compressed than the left, on which, however, the fingers are thinner and longer: they are internally obtusely ridged, while the fingers on the right hand are internally broadly flattened: there is sometimes at the base of the lower finger an obtuse tubercle indicated. The upper edge of the right hand is crowned with from five to seven large obtuse tubercles, that of the left hand with four to five; the upper outer surface of each hand is very strongly rugose; each movable finger has near the upper base a strong tubercle, which in very old specimens becomes sometimes unequally bipartite. The fingers on both hands are very distinctly black coloured, which is of usual occurrence in the whole of this group of *CANCERIDÆ*. The ambulatory feet equal in length the chelæ; they are very distinctly laterally compressed, obtusely rounded above and

below; the last joints are comparatively very long, each considerably exceeding in length its relatively previous joint. The last joint has a strong, punctated, groove near the base on either side and six other longitudinal grooves originating a short distance from the base and continuing to the tip.

The sternum is long and comparatively narrow, its greatest width being somewhat less than one-third the width of the carapace; there is no appreciable difference in its form in the two sexes, but the tails are, as usually, very different in shape. In the female all the seven joints are separated; the first is shortest, each of the four succeeding a little broader, the sixth nearly double the length of the previous, the seventh again a little longer and of a more or less broadly semi-elliptical or semi-oval shape. The width of all the previous joints differs very slightly; all are about the middle slightly convex anteriorly and concave posteriorly. In the male, the third, fourth and fifth joints are united, the suture being indicated by a few minute dots; the third joint is widest, and the two others with conspicuously concave lateral margins.

In every other respect male and female specimens do not appear to differ from each other.

Locality.—Stream under Kootra Hill, near Pípúr, in soft, yellowish, argillaceous beds, containing a very large number of *Orbitulites* and other *Foraminifera;* also in similar beds north of Kannai; rolled up, west of Bair, in a kind of glauconitic sandstone; one mile east of Goer, in Kutch; and in a light-brown nummulitic limestone in the Lukkee Hills, in Sind.

I am not certain whether the present species is the same to which Milne-Edwards (Hist. Crust. Podoph., vol. I, p. 186,) refers as being identical with *Palæoc. macrocheilus*, Desm., a species of very wide geographical distribution, occurring in nummulitic beds of South France, Northern Italy, Egypt, and supposed also in the Hala range of the Punjab. I have not seen a single Indian specimen which could satisfactorily be identified with that species, but it is perhaps not correct to suppose that Milne-Edwards had overlooked such marked distinctions as those existing between *P. macrocheilus* and *rugifer*. The general shape of the carapace is in both much the same; but in the Indian species the front is considerably wider, being very nearly or fully equal to the length of the antero-lateral margin, while in *macrocheilus* the latter margin is invariably longer than the width of the front; further, none of the rugosities so conspicuous on the branchial regions of the carapace and on the upper outer sides of the hands of *rugifer* are to be observed in any of the existing figures of *macrocheilus;* in this species also the tubercles at the upper edge of the two hands are smaller and more numerous than in *rugifer;* in *macrocheilus* the base of the first antennary joint is thick, sub-quadrate, and the end obliquely obtuse, while in *rugifer* the base is much less high and the outer end is regularly truncate; the total length of the basilar joint also appears to be greater in the last-named species. Some other distinctions which seem to possess rather a generic than a specific value, I have already had occasion to notice.

PALÆOCARPILIUS SIMPLEX, *Stol.*, Pl. V, Fig. 6.

The single fragmentary specimen of this species indicates a transversally oblong shape of the carapace, moderately convex, pitted above, and apparently smooth below, with the front entire, sulcated near the edge, produced and bent downwards in the middle; the antero-lateral margins were probably shorter than the distance between the eyes; they are thin, without any tubercles. The basilar joint of the antennæ is narrow, slightly flexuous, and very long; it terminates with a truncate edge in the inner angle of the orbit; its base is conspicuously thicker than the rest of its length. The pits for the antennulæ are rather elongately elliptical, and the basilar joint occupies considerably more than one-half of the cavity; its upper edge is raised and flexuous. The outer maxillipeds are imperfectly preserved, but the three first endopodite joints exactly agree in form with those of the male *Palæoc. rugifer.*

The chelæ appear to be rather short and thick; the left hand is smooth, without any tubercles at the upper edge; the outer surface is evenly, the inner angularly, convex, the lower edge is rather sharply angular. The fingers are not quite equal to half the length of the hand, thin, pointed, with the inner edges sharp and slightly undulating, provided with indistinct tubercles: both are coloured black.

Although the above-noted characters are few, they are mostly so far characteristic that they may serve as sufficient to recognize the species. It is easily distinguished from *P. Klipsteini*, which also has an entire front edge, by the great width of the frontal region and the absence of tubercles on the hands. The great length of the basilar joint of the antennæ characterizes the species as a *Palæocarpilius.*

Locality.—Rare, in a white earthy limestone of the Babúa Hill, north of Punandrow, south of Lukput.

Genus,—GALENOPSIS, *Al. Milne-Edwards.*

GALENOPSIS MURCHISONI, *M.-Edw.*, Pl. III, Fig. 2.

This species was originally described under two distinct names, *Arges Murchisoni* and *Edwardsii*, Haime and d'Archiac, (Descript. des foss. numulit. de l'Inde, p. 340). Al. Milne-Edwards (Crust. Podoph., I, p. 350,) considers the distinctions pointed out in the greater or lesser tumidity of the carapaces as referring to the males and females of the same species. The same author has shown that the generic determination of the Indian fossil was not correct, the typical species of *Arges* (*A. parallelus*, deHaan,) belonging to the CATOMETOPIDÆ, and not to the CANCERIDÆ. Having recognized the affinities of several other similar species to the recent *Galenæ*, he proposed to unite them into a new genus, under the name *Galenopsis*, and also referred *Arges Murchisoni* to it. The materials at his disposal were not sufficient for an exhaustive description of the species, and unfortunately this cannot be given even at present. We only possess in our Museum a single male specimen, which is, however, in several respects better preserved than any other as yet on record. I shall, therefore, first give a brief description of this, and then note some of the characters which bear upon the generic determination of our fossil.

Carapace convex, transversally broadly ovate, about one-fourth broader than long, broadest near the front, narrower in the branchial regions, and very much contracted near the tail. Upper surface smooth, subhepatic region very minutely punctated, pleural region almost equally minutely granulate. Of the different lobes of the carapace, only the two small, rounded, frontal lobes are tolerably well defined; a semilunar, scrobiculate, depressed groove runs on either side of the urogastric lobe, and a slight depression separates the cardiac from the posterior branchial region, which is conspicuously convex. Front bent downwards, its margin greatly thickened, separated from the frontal face by a shallow groove, which continues also above the thickened edge of the orbits; the breadth of the front edge equals that of the two orbits together; it is four-lobed, possessing two larger median lobes, and two smaller at the inner angles of the orbit, each sharply projecting interiorly. Orbits roundly oval, the upper edge entire, internally near the middle with a sharp ridge; lower edge with a smaller tubercle near the outer orbital one and a larger at the inner angle, followed again by a very small tubercle at the edge of the orbital hiatus. Antero-lateral margin about equal in length to three diameters of one orbit, obtusely angular at the edge, with four unequal tubercles,—the outer orbital rounded, the next small and obtuse, the third also small, but pointed, the fourth largest, also pointed, and directed outwardly forward. Postero-lateral margin smooth, rounded, about the last fourth of its length rapidly contracted, and the last fifth of its length distinctly insinuated for the insertion of the last ambulatory pair of feet. This insinuation greatly resembles that of *Carcinus*, and is very rarely equally well marked in other *CANCERIDÆ*, but it is characteristic for all *PORTUNIDÆ*.

The basilar joint of antennulæ is transversally much elongated, with a narrow long pit above it, communicating by a groove with the orbit, the inter-antennulary ridge sharp, prominent. The basilary joint of the antennæ must be very small, seated in a narrow depression between the antennulary joint and the depressed auditory tubercle; it is not externally visible; the eye-peduncle is thick and fills up from internally the greater part of the orbital hiatus. Epistome fully as long as the frontal margin, with a slight longitudinal groove; the ends slightly wider; in the middle with an angular projection opposite the inter-antennulary ridge, but separated from it by a depression.

The outer maxillipeds are of great length; the upper end of the basipodite has a convex surface, with a longer, slightly concave, upper, and a narrower, almost vertical, antero-lateral edge,—the former for the insertion of the exopodite, the latter for the endopodite. The first triangular endopodite is not quite separated from the next; the second has a very distinct, slightly oblique, nearly median, longitudinal furrow; and another less distinct one along the inner edge, which is (at least partially) dentate. The corresponding second exopodite is apparently a little longer, but scarcely of half the width of the endopodite; third endopodite subquadrangular, its length equal to half of that of the two previous joints; inner edge with an obtuse projecting angle near the middle, the upper slope serving for the attachment of the remaining three endopodites; the lower inner edge is

slightly concave. The surface is marked with two diagonal depressions, one extending from the base of the fourth endopodite to the opposite infero-posterior angle, the other from the inner sub-median projection to near the middle of the lower edge, but not reaching it.

The chelæ appear to be of moderate length, as in most other *CANCERIDÆ;* the upper arm is triangular, smooth, with an obtuse terminal tubercle at the upper outer ridge, and a much sharper tubercle at the upper inner one. The palm of the right hand (the only one as yet found preserved) is a little longer than high, rounded above and below, and almost equally convex on the outer and inner sides. The surface was probably smooth, or nearly so; it is partially decomposed or removed in the specimen and appears, therefore, reticularly scrobiculate. The fingers are very strong, equal in length to the height of the hand; the immovable stronger, a little shorter, but more convex at the outer margin than the other; the inner edges are irregularly dentate and sulcated longitudinally from within. None of the ambulatory legs are preserved.

The greatest width of the sternum is slightly less than half that of the carapace; the third sternite is rather coarsely scrobiculate, with a slightly convex posterior edge, emarginate and strongly depressed in the middle. Tail long and of moderate width; all the joints apparently separated:* the first very short, but apparently broadest, the next at least double as long, and the following gradually increasing in length, but decreasing in breadth, each with somewhat concave lateral margins; the last is elongately semioval, anteriorly with projecting edges, and posteriorly obtusely rounded.

So far the description of the Indian species which Al. Milne-Edwards has, I believe correctly, referred to his new genus *Galenopsis*, though in the description of the species (loc. cit., p. 350,) he suggests that a new generic name may be required for it. On this account only have I gone into several minor details which would otherwise be thought unnecessary, but there are several points in the characteristics of the genus which yet require correct definition.

The affinities of *Galenopsis* to *Galena* are expressed in the general shape of the carapace, much more inflated anteriorly than posteriorly, the subhepatic and pleural regions being considerably tumid; in the short antero-lateral, and in the much longer and concave postero-lateral, margins; in the moderate size of the orbits directed towards the front and provided with a large internal hiatus, the basilar joint of the antennæ being very small; further, in the subquadrangular shape of the third endopodite of the outer maxillipeds, the large size of internally tuberculated fingers on the hands, and the apparently entirely separated joints of the tail in the male sex.

The chief difference from *Galena* consists in the indistinct separation of the lobes of the carapace, and,—if we are allowed to regard the present species as a true *Galenopsis*,—in the peculiar depression of the outer maxillipeds, the second

* On the specimen the third, fourth, and fifth joints are mostly seen as impressions only, and they are separated almost throughout by fine raised lines which appear to indicate sutures between the joints, or at least considerably excavated grooves.

endopodite possessing a sub-median, slightly oblique, longitudinal groove, and another near the inner margin, which is serrated or denticulate: a character apparently of very rare occurrence in other *Canceridæ*. It is indicated in deHaan's *Acanthodes*, and with this genus also the form of the third endopodite agrees, possessing two diagonal sulcations on the surface. The antennæ must be very small in *Galenopsis;* the basilar joint lies in a depression between the well-developed auditory tubercle, the inner edge of the orbit, and the flattened outer side of the large basilar joint of the antennulæ; the antennulary pit is narrow and greatly elongated, communicating by an open groove with the orbit; the inter-antennulary ridge is apparently quite separate from the anterior median projection of the endostome, and this latter is fully as long, or even a little longer than the front margin.

Locality.—Hala range in Sind, in a white nummulitic limestone.

Family,—LEUCOSIDÆ.

TYPILOBUS, n. gen.

Carapace transversally oval, moderately convex; front lobes small, gastric lobe reversely bottle-shaped, truncate below; hepatic region small, very little elevated; branchial large, tumid; cardiac transversally oval, very convex, and circumscribed by a deep sulcus: none of these five principal lobes are sub-divided; front very narrow, above longitudinally grooved in the middle and slightly projecting at the edge; orbits close together, small, sub-circular, inner angle with a wide hiatus; basilar joint of the antennulæ slightly ovally rounded, occupying its whole cavity and directly adjoining the inner hiatus of the orbit; basilar joint of the antennæ very small, wedged in between the former joint, the small auditory tubercle and the orbit; epistome as long as the front margin; outer maxillipeds long; the second endopodite is equally broad as the corresponding exopodite; third endopodite sub-pyramidal, upper end roundly obtuse, all joints smooth, not sulcated; sub-hepatic region very narrow, anterior part of pleural region tumid; sternum comparatively broad, with long, narrow sternites. Tail of female about half the length of the body, with sub-parallel sides, consisting of seven joints: tail of male a little longer, narrow, obtuse at the end; third, fourth, and fifth joints united.

Although none of the extremities have as yet been found preserved in the single species to be described, this peculiar genus can readily be distinguished from any other by the strict definition of each of the five lobes into which the carapace is usually divided; by the very narrow, and in the middle slightly projecting, front edge and approximate orbits; by the equal or sub-equal width of the second endo- and exo-podites of the outer maxillipeds, and the sub-pyramidal form of the third endopodite; &c., &c.

As regards the true classification of the genus, it is for the present somewhat difficult to give a quite satisfactory opinion. The transversally ovate form of the carapace and that of the tail would apparently indicate a *Canceride Cyclometope*. With the *Carpilius* group agrees the somewhat predominant length of the antero-ateral over the postero-lateral margin; but the form of the marginal spines appears

to resemble more those seen in *Xantholites* and *Xanthopsis* than in *Carpilius* and allied genera. With *Galena*, and the fossil *Galenopsis*, there appear to be also some marked affinities, as, for instance, the tumidity of the anterior part of the pleural region, giving a considerable thickness to the front part of the carapace, the comparatively small rounded orbits, with a hiatus at the inner angle, and the very small size of the basilar joint of the antennæ. Among other fossil genera, *Typilobus* appears to possess also a great resemblance to Bell's *Plagiolophus*,* which Milne-Edwards classes with *Galena* in one group. The outer maxillipeds of *Plagiolophus* are not well known, but they also in some respects appear to resemble those of the present genus.

By much the prevailing characters of *Typilobus* seem, however, to show decided affinities to the *Leucosidæ*, a family of the *microcephalic Brachyura*, formerly generally called *Oxystomata*. In that family the carapace is more or less rounded, slightly wider than long, the front edge is short, slightly projecting, orbits close together, and their inner hiatus filled in by the antennulary basal joint, while the antennæ are very small. They are almost the only family in which the first joints of the outer-maxillipeds are very long, and the last joints externally not, or barely, visible; they also have the second endopodite of about equal width with the corresponding exopodite. For a comparison, nay, almost identity, in the form of these joints of *Typilobus*, I may particularly refer to the recent genus *Ebalia*, as figured in Cuvier's Regne animale, pl. 24.

The only peculiarity to be observed in *Typilobus*, distinct from other *Leucosidæ*, is the form of the tail in the female, being of equal width throughout, while in *Ebalia*, *Ixa*, and allied genera the median joints are sub-circularly enlarged.

There appear to be as yet very few fossil *Leucosidæ* known. Al. Milne-Edwards suggests† that Bell's *Mythracia*‡ (haud *Mithrax)* probably belongs to the present family.

Typilobus granulosus, *Stol.*, Pl. III, Figs. 3—5.

Carapace transversally ovate, its length being in proportion to width very nearly as 8 : 10; the anterior larger half nearly semicircular, the posterior smaller, gradually narrowed and truncate at the posterior edge, with a small tubercle at each end; upper surface rather coarsely, equally, and very densely granular, or, when the surface is not well preserved, provided with numerous shallow pits of equal size; the sub-hepatic and pleural regions are similarly marked, sub-branchial region only finely rugose. Division of lobes typical for the genus; the lateral grooves defining the gastric region are anteriorly rather indistinct, posteriorly, where they contract, much deeper; groove between the hepatic and branchial region slight; cardiac lobe very convex, transversally sub-ovate, somewhat wider than the base of the gastric, and separated by a flattened area from the posterior margin of the carapace. Branchial region mostly elevated near the base of the gastric, and poste-

* Monog. foss. Malac. Crustacea of Great Britain, Part I, 1857, p. 191, Palæontographical Society of London.

† Crust. Podophthalmaires, Vol. I, p. 62.

‡ Monog. foss. Mal. Crust., etc., p. 9.

riorly opposite the median part of the cardiac, lobe on each side provided with a sharp, spinose tubercle, placed somewhat below the edge. Front very narrow, with the margin swollen, divided by a distinct groove in the middle, slightly projecting; it is confluent with the supra-orbital edge, which is almost shorter and less tumescent; each is very slightly emarginate at the edge itself.

The antero-lateral margin is considerably longer than the distance between the outer angles of the orbits, each of which is armed externally with a short spiny tubercle, margined above and below by a short groove. The edge of the margin itself is sharp, with numerous rather fine serrations: one tubercle, distant two-thirds the length of the antero-lateral margin from the orbit, equals in size the outer orbital spine, while the costal tubercle is conspicuously the largest, depressed, and sharply pointed. Postero-lateral margin somewhat shorter than the antero-lateral, high, flattened, smooth at the junction; the posterior edge provided with a flexuous ridge. Lower edge of orbit short, slightly projecting in the middle, internally angular. Basilar joint of the antennulæ almost larger than the eye-peduncle and filling out the inner side of the orbit; auditory tubercles and basilar joint of antennæ very small, scarcely distinguishable. Epistome thin, as long as the front, with a sharp projection in the median anterior front, opposite the inter-antennulary ridge, but not united with it. Sub-hepatic region narrow, pleural region broader, very tumid, more or less projecting, separated from the former by a broadish, deep groove, which becomes about the middle confluent with a thin ridge separating the outer from the inner sub-branchial regions. Third endopodite joint obtusely and narrowly truncate at the end, very slightly curved at the outer, and straight at the inner, edge. Greatest width of sternum somewhat exceeding half the width of the carapace; the sternites a little broader at the end than at the base.

The tail of the female is of equal width throughout; it appears to consist of seven separate joints, but they are not very well defined in the single specimen; the first joint is shortest and smooth; the succeeding ones gradually increase in length; each has a rounded tubercle in the middle and one at either end; these tubercles, however, again become indistinct on the last joint, which is broadly rounded at the posterior edge.

In the male the tail is much narrower and comparatively longer, linguate; the first and second joints are the shorter and of equal width; the third is widest and united with the fourth and fifth, which become gradually narrower up to the last, the posterior edge of which is narrowly rounded: all the joints are sub-tuberculate along the middle and at the sides.

None of the feet have been observed.

Length of carapace of the largest specimen (a male) 10 m.m., width of the same 13 m.m., height 5·3 m.m.

Locality.—From a ferruginous clay, apparently of nummulitic age, in Sind. Mr. Wynne also obtained a single specimen in a ferruginous, conglomeratic sandstone at the Saheind hill scarp, west of Egera, in Kutch.

PLATE I.

Figs. 1—2. NEPTUNUS WYNNEANUS, *Stol.*, p. 4; back-, front-, and ventral-views of a female and male specimen; *s*, epistome; *ir*, inter-antennulary ridge; *ao*, outer orbital spine; *cs*, costal spine; *h*, hepatic lobe; *g*, gastric lobe; *b*, branchial lobe; *c*, cardiac lobe; *o*, auditory sack; *ac*, basal joint of the antennæ; *an*, basal joint of the antennulæ. Both specimens are from near Pípúr, Kutch.

Figs. 3—10. Fragments of chelæ of an *Uca* or *Cardisoma* from between Soojapoor and Badra, Kutch; 3 and 4, outer-views of the hands; 5—7, outer-views of the fingers; 9 and 10, inner-views of the hands, (see p. 2).

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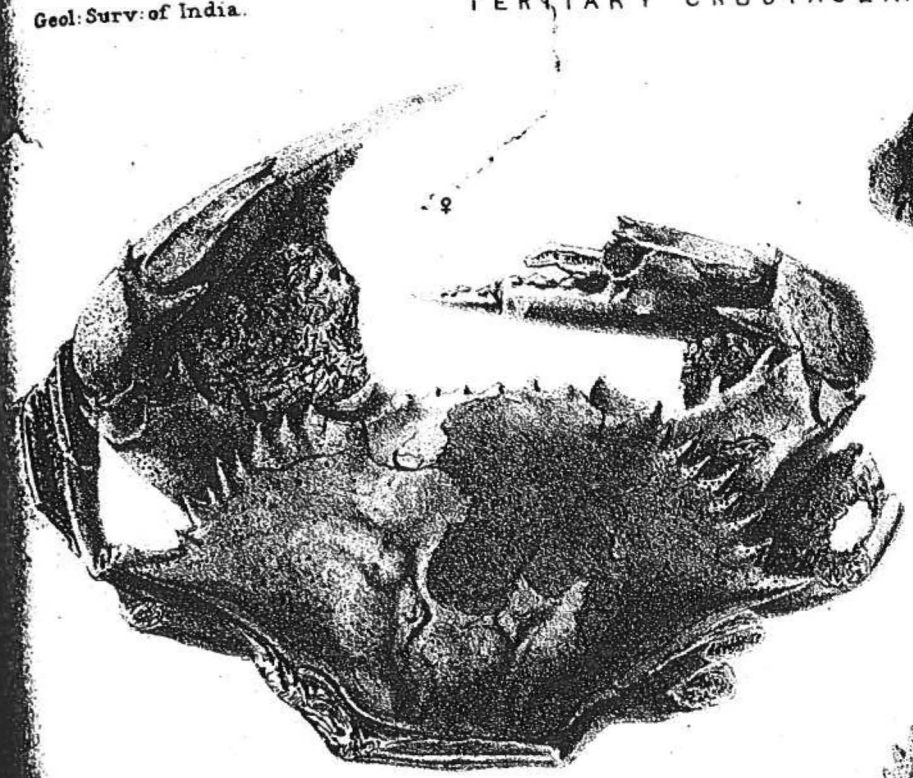
TERTIARY CRUSTACEA.

Pl: I.



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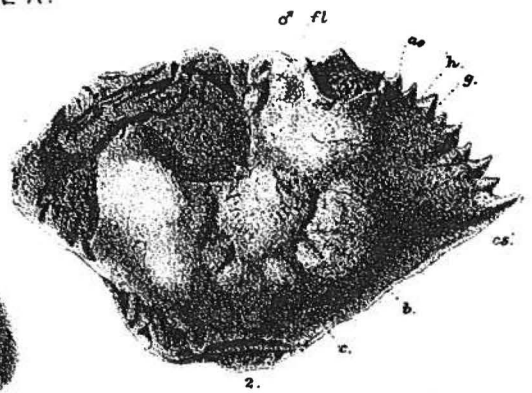

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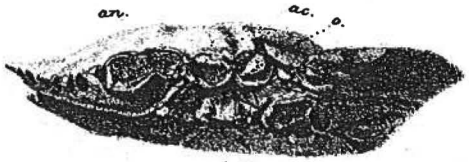

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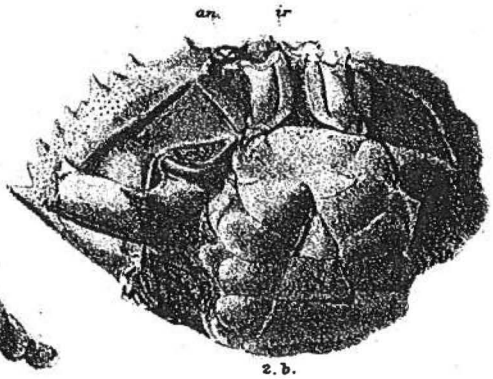

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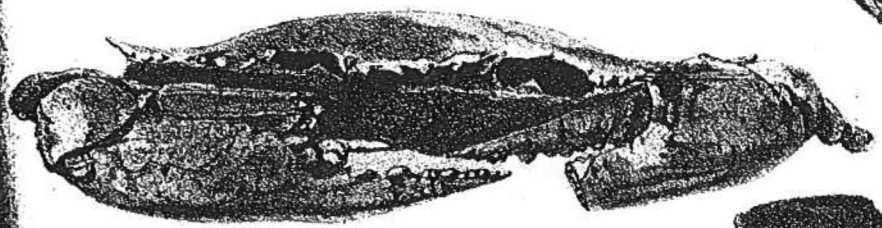

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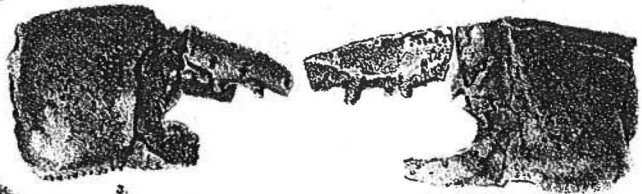

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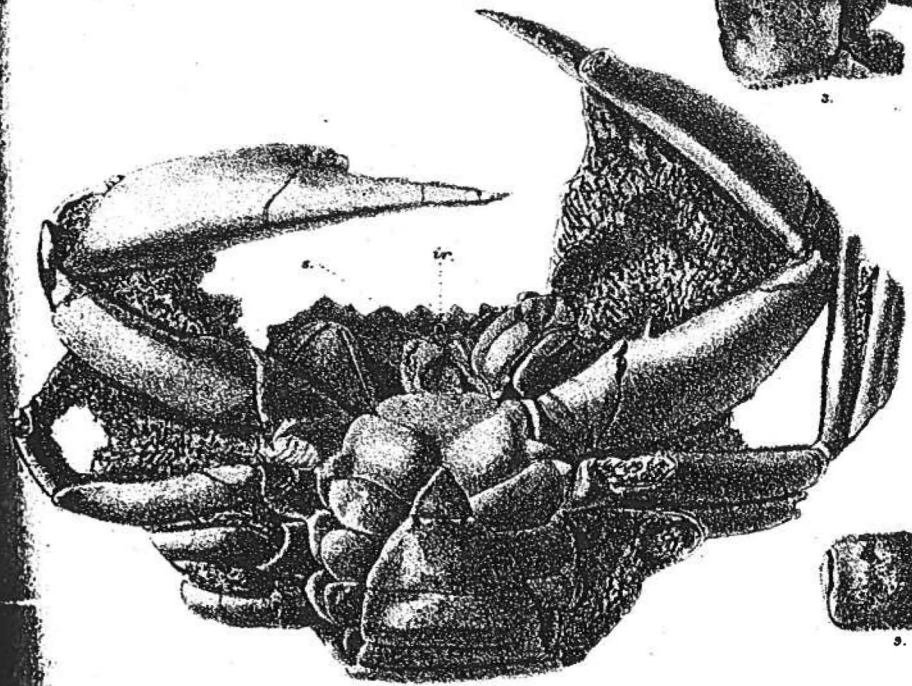

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PLATE II.

Figs. 1—2. Outer- and inner-views of two hands probably belonging to an *Atergatis*, from between Soojapoor and Badra, Kutch, (see p. 2).

Figs. 3—5. NEPTUNUS SINDENSIS, *Stol.*, p. 7, from the Lukkee hills in Sind; 3, 3*a*, 3*b*, back-, front-, and ventral-views of the carapace of a male specimen; *cs* = gastric lobe; *bl*, branchial lobe; *cl*, cardiac lobe; *hl*, hepatic lobe; *pl*, post-frontal lobe; *fl*, frontal lobe; *gs*, outer orbital spine; *as*, lower inner orbital spine; *is*, basal joint of antennæ; *cp*, outer maxillipeds; *r*, inter-antennulary ridge; *c*, epistome; *bj*, basal joint of antennæ; 4, back-view of a specimen with a portion of the right chela preserved; the left side of the carapace is towards the margin mostly broken off; 5 and 5*a*, outer- and inner-views of a right hand of another specimen.

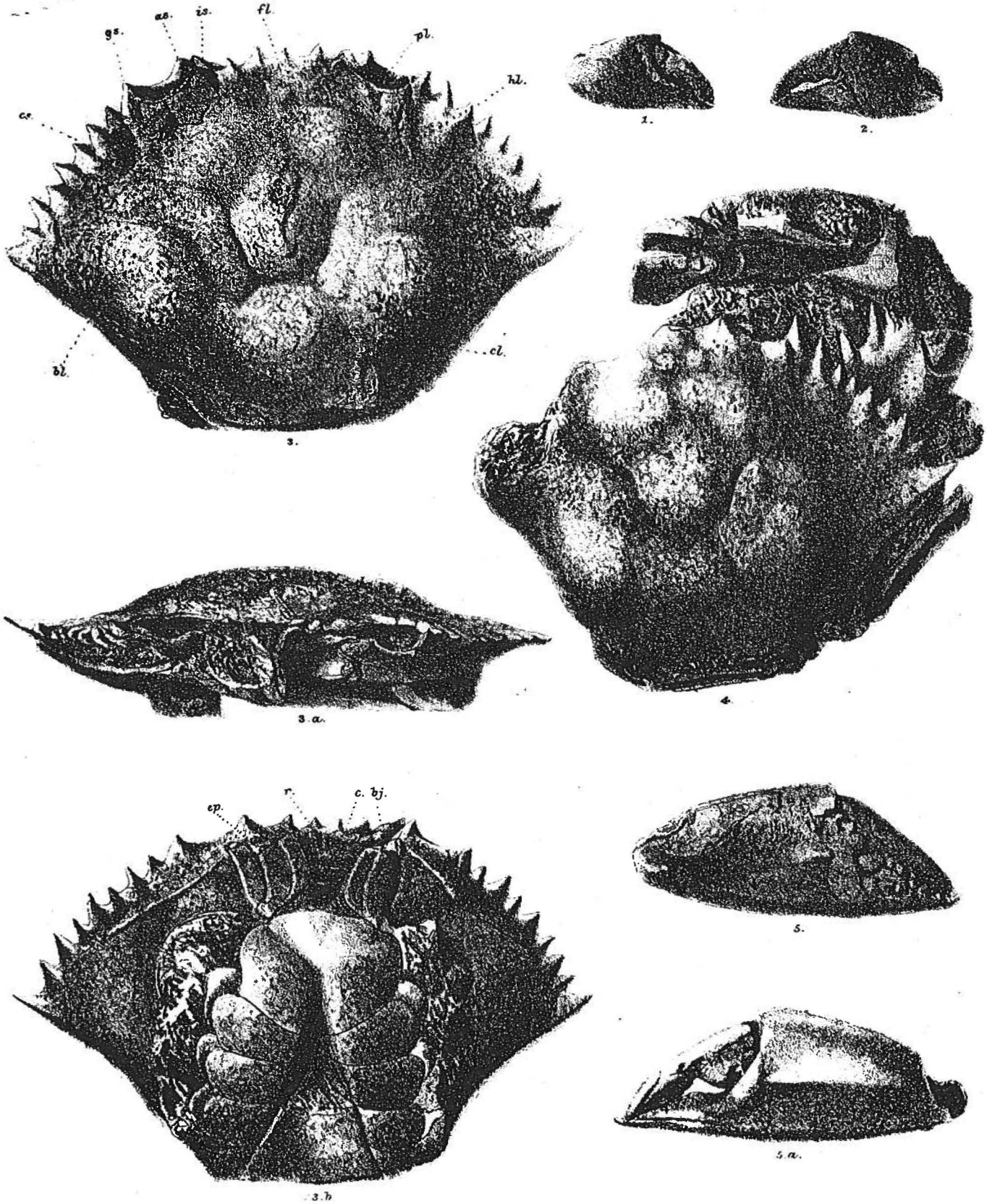
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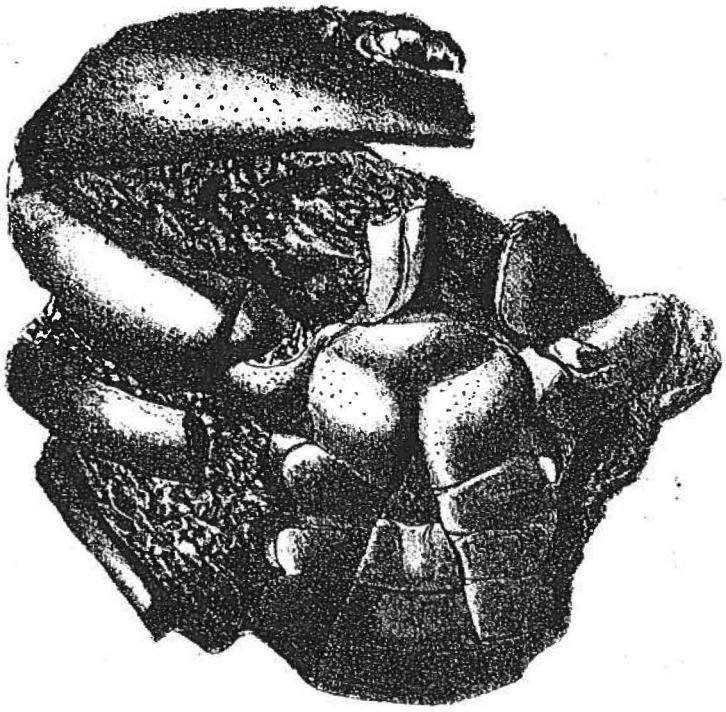
PLATE III.

Fig. ... 1. NEPTUNUS SINDENSIS, *Stol.*, p. 7. Ventral-view of the same specimen as figured on pl. II, fig. 4.

Fig. ... 2. GALENOPSIS MURCHISONI, *M. Edw.*, p. 11; 2, 2*a*, 2*b*, back-, front-, and ventral-views of a male specimen; *i*, outer orbital tubercle; *a*, inner orbital tubercle; *r*, inter-antennulary ridge; *b*, basilar joint of antennæ; *o*, auditory tubercle; 2*c*, 2*d*, 2*e*, outer-, inner-, and top-views of a right hand of the same specimen.

Figs. 3—5. TYPILOBUS GRANULOSUS,* *Stol.*, p. 15, from Sind; 3, natural size of a male specimen; 3*a*, 3*b*, 3*c*, back-, front-, and ventral-views of the same, three times the natural size; 3*d*, outline of the joints of the tail, the 3-5th joints appear to be united; 4, diagrammatic view of the maxillipeds of a male specimen; 5, natural size of a female specimen; 5*a*, 5*b*, and 5*c*, back-, front-, and ventral-views of the same, enlarged three times the natural size; 5*d*, outline of the disunited joints of the tail.

* This species occurs also in clayey beds north-west of Bair, Kutch.



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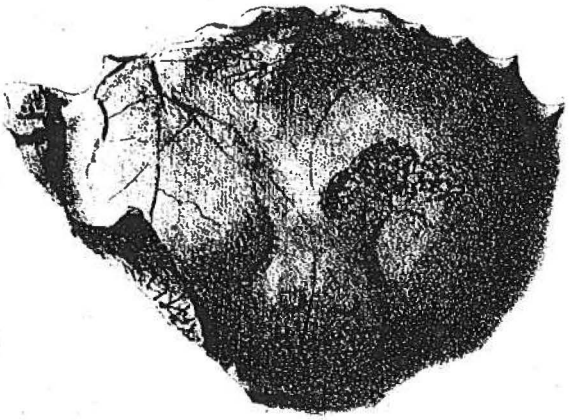

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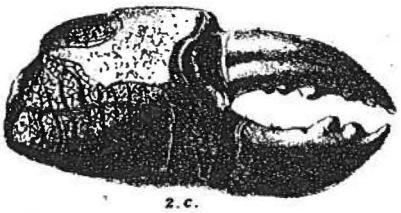

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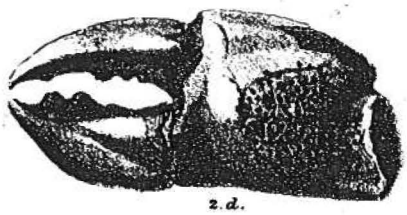

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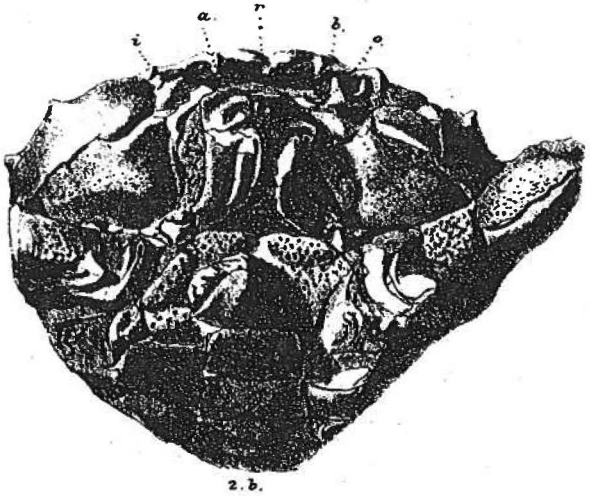

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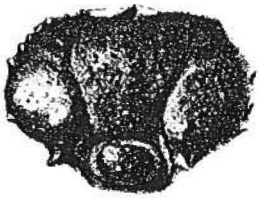

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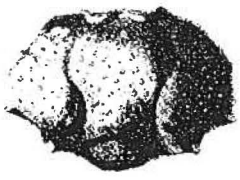

5.a.

5.b.

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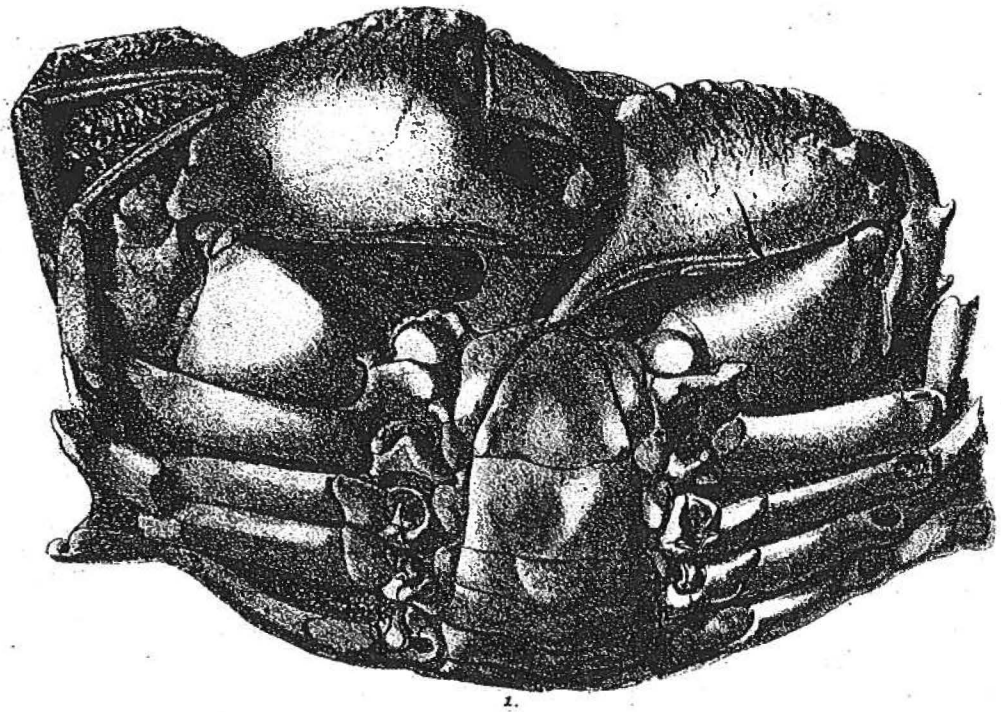
PLATE IV.

Figs. 1—6. PALÆOCARPILIUS RUGIFER, *Stol.*, p. 8; 1, ventral-view of a large female specimen, two of the right anterior feet are perfectly preserved, showing the grooves on the last joints; 2, front-view of another large ♀ specimen; 3, back-view of a small, almost perfect ♀ specimen; 4, outline of the segments of a ♀, and 5, those of the ♂; in the former all the seven segments are separated, in the latter the 3rd-5th are united; 6, back-view of a small ♂ specimen with a rather convex thorax; 6*a*, front-view of the same, showing the strong deflection of the front.

All the specimens are from the argillaceous beds in the stream under Kóba hill, Kutch.



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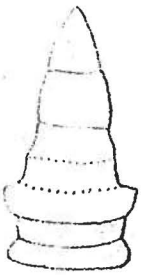

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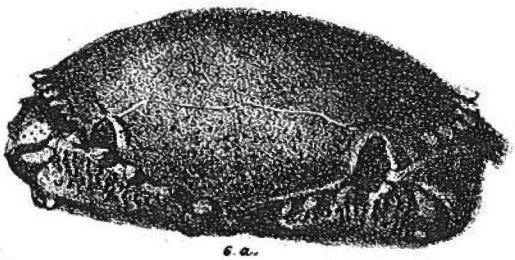

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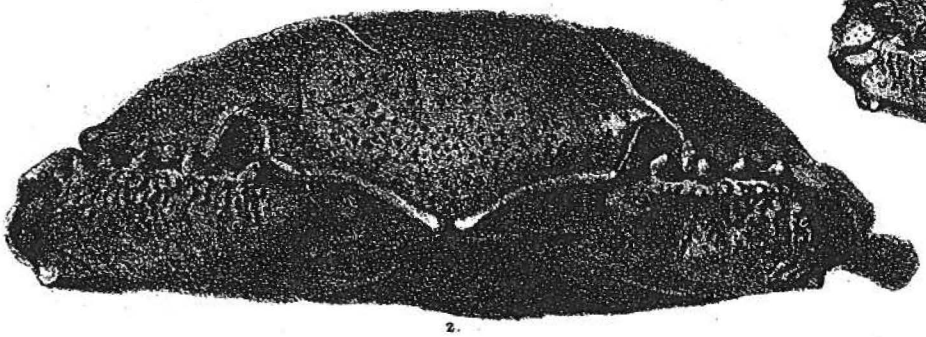

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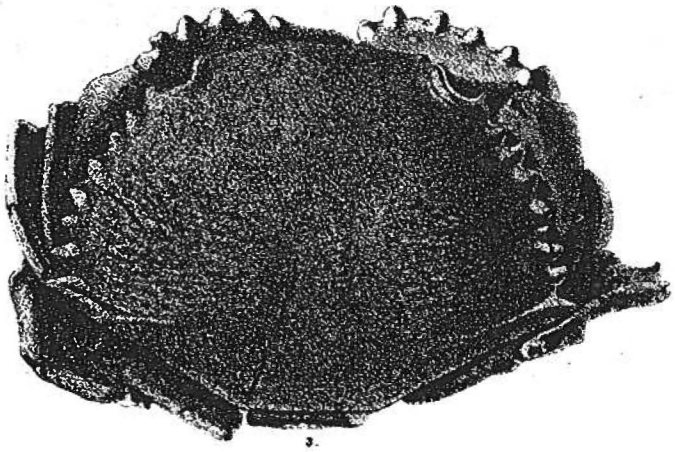

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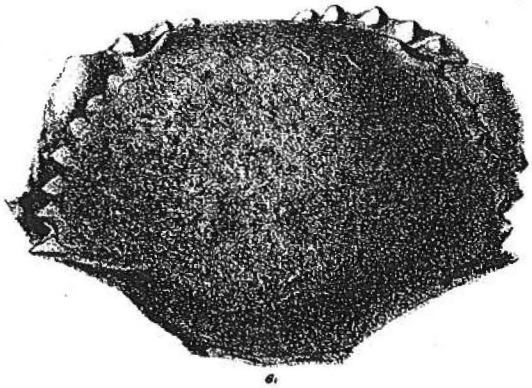

6.

PLATE V.

Figs. 1—5. PALÆOCARPILIUS RUGIFER, *Stol.*, p. 8; 1, ventral-view of a ♂ specimen, the right chela laid out in order to show the inner side; *b*, antennulary pit; *a*, basal joint of antennæ; *i*, inner orbital tubercle; *c*, lower outer orbital tubercle; 2 and 3 are outer-views of the right and left chelæ of a very large female specimen, and 4 are the outer maxillipeds of the same, all figures of the natural size; 5, ventral-view of a small male specimen, the pits of the antennulæ, the basal joints of the antennæ, epistome, &c.; in 5*a* the same organs are enlarged; *a*, basal joint of antennæ; *b*, antennulary pits; *o*, auditory tubercle; *r*, inter-antennulary ridge; *e*, epistome; *g*, endostome; *gr*, endostomic ridges; *p*, inner edge of the pleural region.

All the specimens are from the yellow argillaceous beds in the stream under the Kóba hill, near Pípúr.

Fig. ... 6. PALÆOCARPILIUS SIMPLEX, *Stol.*, p. 11; 6, 6*a*, and 6*b*, back-, ventral-, and front-views of the only specimen as yet known from Babúa hill, Kutch.

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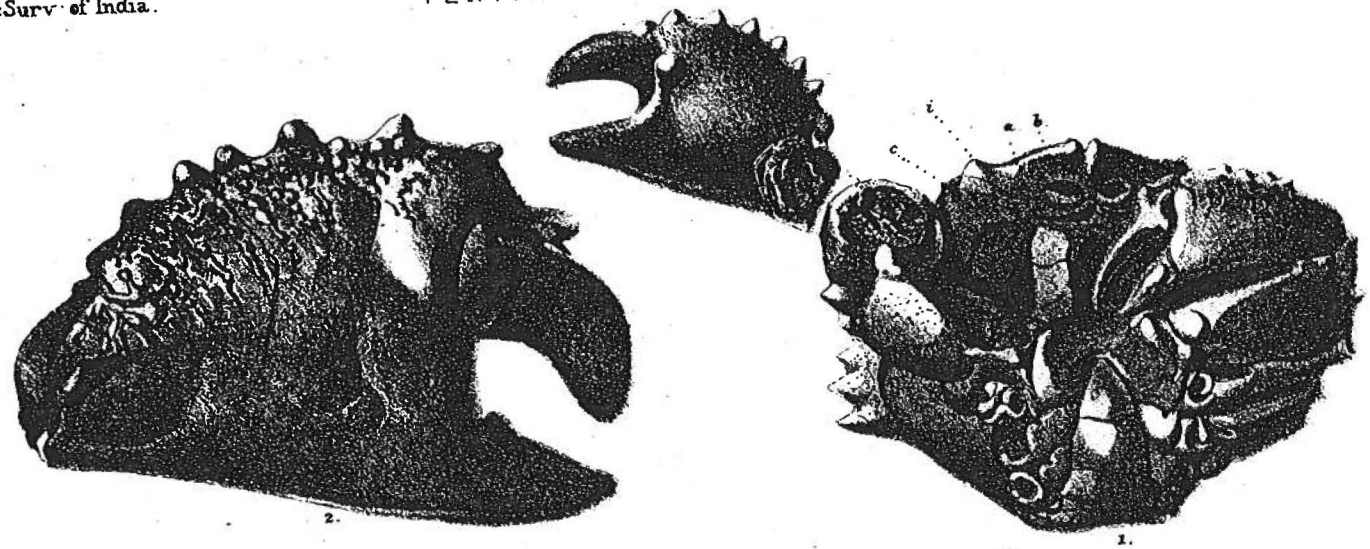
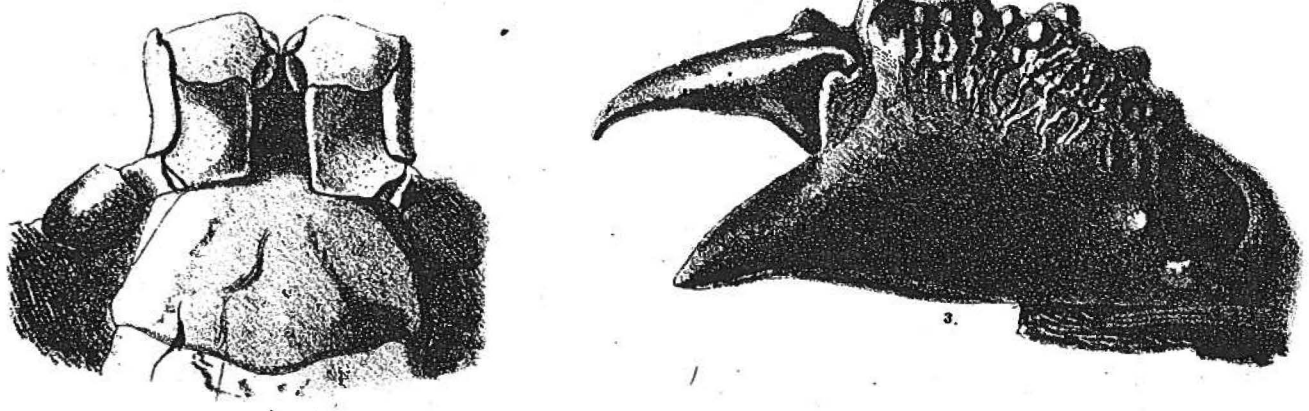
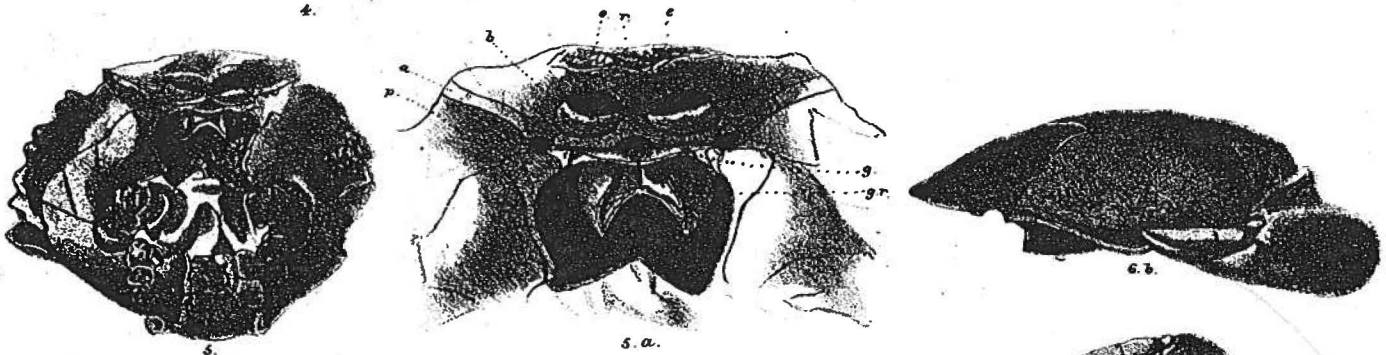
TERTIARY CRUSTACEA.







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