On the anatomy of Sagartia Schilleriana *and* Membranipora Bengalensis, *a new Coral and a Bryozoon living in brackish water at Port Canning;—by* Ferd. Stoliczka, *Esq. Ph. D., F. G. S. Palæontologist of the Geol. Survey of India.*

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Special interest is always attached to the study of any organic forms, found living under unusual and sometimes anomalous conditions, inasmuch as these forms very often represent peculiar types of organisation, adapted to the peculiar circumstances under which they live.

In a theoretical point of view, there exist, we may say, in *each specific* organism a number of forces which, by their harmonious action, produce a certain stable equilibrium between the organisation of the animal, and the influences of the medium in which it lives. Should it now happen that the animal is, either voluntarily or accidentally, placed, under conditions *different* from those under which it formerly existed, and further, should the influence of these external agencies be so great as to overthrow, or be not sufficient to maintain this equilibrium, it devolves upon the organism to restore this balance, or to be dissolved into various other forces. The latter case need not occupy here our attention any further; but as to the former, we may observe in general that the amount of the changes in the organism, necessitated for the purpose of restoring the disturbed or unstable equilibrium, may in various cases be very different.

In some cases an alteration in the colour or in the viscosity of the animal may suffice; in others it requires a change in the digestive or the nervous system, and again in others it becomes necessary to change the existing, or to produce new and additional organs of locomotion, &c. Thus are clearly by *natural selection* produced new forms or types of organisms, designated by naturalist *varieties*, *species*, *genera*, &c.

Looking at the same time upon the numerously varied organisation of beings in general, it will readily be understood that the less different the organs of a species may be,—that is in other words, the lower its place is in the natural system,—in the same degree would probably decrease the necessit for a change in the organs. In any case, this change would not be so easily perceptible, as when the organs are numerous, various and more highly developed. Expressing, therefore, this idea in a more general way, we imply that, within certain limits,* forms of lower organisation possess a greater faculty of accommodating themselves to different conditions of life, than more highly organized beings.

In the present communication I shall record a very interesting case of the persistency of a form under different conditions, relating to a coralline species, a so-called sea-anemone, and to another species belonging to the Bryozoa, or the lowest organized Molluscs. With respect to the anatomy and physiology of these two species, I shall state all the data which I have obtained, for though some of them are not directly new discoveries, still detailed records of these animals are so rare, that I must treat the subject somewhat at length, in order to be intelligible; and this, I think, is very necessary as naturalists have become in late years rather sceptical regarding new species, only characterised by few high sounding,—occasionally unintelligible,—terms. Besides this, it would be impossible for me to give additional observations, without bringing them into a systematic connection with those which are already known on this subject.

Phylum, Cœlenterata.†

(Cnidozoa or Actinozoa.)

The name *Cnidozoa* is derived from the word *αἱ κνίδαι*, used by Aristotles for the designation of this group of animals; the same word is now retained for the name of special, defensive cells which characterize these animals, as will be shown subsequently. For the extent of the various divisions of the Cœlenterata, Leukart and Kölliker's works have to be consulted.

* It is very often stated that the more highly organized forms possess a greater faculty of accommodation; this is, however, I think, a mistaken idea, originating partly in the comparison of the same external influences upon organisms of different kind and degree, partly in the difficulty of noticing any changes in the lower organisms. The comparison must always be a truly relative one; for in differently organized forms, there is a different amount of forces present to counteract the influence of external agencies.

† The first few principal divisions are noticed according to Hæckel's *Generale Morphologie*, 1866, vol. II, p. L.

Sub-phylum, PETRACALEPHÆ.*

(Polypi).

Class, ANTHOZOA.

(Zoophyta.†)

Body fleshy, attached with one end; on the other provided with a mouth usually surrounded by hollow and perforated tentacles; internal cavity divided by septa.

Sub-class, HEXACORALLIA.

The original number of septa and tentacles are *six*.

Order, HALIRHODA.‡

(Zoantheria malacodermata, sea-roses, sea-flowers, or sea-anemones.)

Body soft, septa not forming an external hard skeleton, into which the animal can retract.

Sub-order, ACTINIACEA.

Body very rarely containing loose, scleroid particles; base adherent at pleasure, not adapted to form a swimming sac; internal cavity instructed with very long, not emissible thread-like organs *(craspeda)*,§ containing the so called nettle-cells, or *cnidæ*.

Family, SAGARTIIDÆ.||

Body pierced with loop-holes *(cinclides)* for the purpose of emitting long, retractile threads *(acontia)* containing *cnidæ*, being the defensive organs of the animal.

This family may be separated intò two divisions, the *Sagartiinæ* and the *Bunodinæ*, the latter of which have the column instructed with tubercles.

* From being usually adherent to *rocks*, the other sub-phylum is called *Nectacalephæ*, including the swimming or oceanic forms.

† This name is inconsistent with the usual nomenclature, and could only be used by reversing it into *Phytozoa*, but to this the name *Anthozoa* is preferable.

‡ This name only can imply that the animals live in water, which contains a proportion of salt, &c. it must not be understood as pure sea-water, for there are numerous brackish species belonging to this order.

§ To avoid numerous repetitions, I must direct any one, not acquainted with the terminology of the anotomy of corals, and especially of that of the HALIRHODA, to the subsequent detailed description of the various organs. Most of the terms will be found fully explained in Gosse's admirable History of British Sea-anemones. London, 1866.

|| The true *Actiniidæ*, and several other allied families, do not possess emissible threads, or *acontia*, and are therefore destitute of loop-holes, or *cinclides*.

Sub-family, Sagartiinæ.

(Sagartiadæ, Gosse.)

The body is, according to Gosse, generally remarkably soft, more or less pulpy, lubricated on the surface with copious mucus, exteriorly mostly studded with *sucking cavities*, which, by forming a vacuum have the power of adhering to foreign bodies, but the margins of these cavities *do not rise into conspicuous warts;* the base is usually broad, the column moderately high, furrowed longitudinally; the tentacles are smooth, simple, generally arranged in uninterrupted circles at the margin of the disk; the *cnidæ* of the tissue are usually of the stilet kind, being long cells, with a short in itself retractile flagellum, called by Gosse the *ecthoræum.*

Gosse distinguishes the following divisions, from the relation of which the generic classification of our species will become apparent.

A; Tentacles moderately long, slender,
  a; disk perfectly retractile,
    α; column soft, destitute of suckers ... *Actinoloba,*
    β; " " with suckers .... *Sagartia,*
    γ; " partly provided with a rough epidermis .... *Phellia*
  b; disk imperfectly retractile, . *Adamsia et Gregoria*
B; Tentacles represented by mere warts .. *Discosoma.*

Genus, Sagartia, Gosse, 1855.

All the species of *Sagartia* are characterized by a thick, fleshy, contractile body, adherent by a *base* which is under ordinary circumstances *wider than the height of the column;* the surface is studded with numerous small suckers, not forming permanent warts, and with many comparatively large *cinclides;* the peripherical margin of the disk is distinct, *but not separately thickened;* the tentacles are simple, placed near the outer periphery of the disk; they are generally very numerous, but variable in length and arrangement; the mouth is somewhat elevated, provided with two *gonidial* grooves, each having a pair of tubercles on either side; the *acontia are numerous, and are emitted freely.*

The *presence of solid scleroid particles* of two kinds, as they will be described in the present species, may likely be added to the generic characters of this genus, but this has to be proved by the examination of other species.

Species. Sagartia Schilleriana, *Stoliczka*, 1868.

Plates X and XI.

Char. *Sagartia corpore pulposo, transparente, virescente pallido, basi lata, sæpissime rotundata adherente; columna cylindracea, in altitudine diamatro basis fere æquante, longitudinaliter angustatim sulcata, transversaliter minutissime corrugata; septis ad peripheriam plerumque* 48, *distinctis, æqidistantibus, alternatim virescentibus; tentaculis numerosis, prope peripheriam disci sitis, exterioribus brevissimis, interioribus gradatim longioribus, omninis ad basin inflatis, versus apicem attenuatis, terminationibus subtruncatis et perforatis instructis; tentaculis seriem primam formantibus senis ceteris conspicue crassioribus, ad basin sæpissime rubescentibus, ad terminationes albidis; apertura transversaliter ovata, angusta; labio plus minusve prominente, ad marginem undulato, sub-reflexo, tuberculis duodenis instructo; lentiginibus bipartitis, ad utrumque angulum gonidialem sitis, tuberculis ceteris minoribus; canalibus gonidialibus parvis, orificiis rotundatis, vix prominulis, albide marginatis notatis; radiis gonidialibus vix dignoscendis; gula sulcis virescentibus furcata.*

Ovariis duodenis, bipartitis, folliculis in utroque latere septorum sitis, cæruleo-purpurescentibus; craspedis numerosis, sordide luteolis, interne suprâ ovaria suspensis; acontiis albis, perlongis; cinclidibus subrotundatis, numerosis, paululum impressis, in tegumine irregulariter dispersis, nonnullis prope marginem superiorem columnæ positis latissimis, semper apertis, ceteris minoribus aliquantisper obscuris; cnidis ovato-elongatis, stiliformibus, ecthoræis brevibus prope rectis instructis; septis mesenterialibus intus ad basin solidulis, albis; tegumine corporibus minutis tabulatis siliceis, ac alteris subcylindraceis et varie dentatis calcareis instructis.*

* Gosse in his above quoted Treatise on the British Sea-Anemones distinguishes four kinds of *cnidæ*, all of which have rather long, spirally coiled *ecthoræa*, except one globular kind, in which no ecthoræum was observable. The *cnidæ* of the present species of *Sagartia* are mostly, short, straight, or very rarely slightly bent. I shall term this kind of *cnidæ* which were also observed formerly by Blainville, Leukart, and others, *stiliform.* Gosse says that the chambered form is the usual one in the *Actiniidæ,* though the present variation seems quite as common.

The principal and characteristic distinctions of this species are, the very great softness and transparency of the body, having a very slight greenish tinge, mingled with somewhat of a pale fleshy colour, a distinct layer of a dark green pigment being deposited near the external surface, below the outer muscular layer of each alternate septum, and thus producing greenish, longitudinal bands of about equal width; further, the prominent lips of the aperture, the great thickness of the primary tentacles, the blueish purple colouring of the ovaria, the yellowish craspeda, the purely white acontia, and their great length.

I shall at first speak of the various normal *forms* of this species, than of the *anatomy of the different organs* and of their signification, and last of the *physiology*, *the habits and modes of life.*

a. *Form.*

The general form of the body of *Sag. Schilleriana* is common to that of other truly marine species of the same genus, the column being, however, when the animal is expanded in a normal condition, a little shorter than the diameter of the basis (see pl. X. fig. 1). In consequence of the softness of the fleshy substance, the base, (which is comparatively more solid than any other part), always adapts itself entirely to the object on which the animal is sessile. On a smooth surface, the circumference of the base is almost circular, only on account of the projecting septa slightly undulating at the margin; on a rough surface all cavities* are filled up with the fleshy mass, securing at the same time the attachment of the body, but also altering the original roundish form into an oval or irregularly polygonal one. The septa are distinctly traceable by the alternate greenish bands.

There are three principal forms to be observed, which may be called the *normal* ones, being successively adopted by every animal in a healthy condition. The first is the expanded form (pl. X. fig. 1) from which these animals derived their name of *sea-flowers*. The frequent bright colouring of the disc, as a rule, increases their resemblance to

* I have seen portions of the body filling such cavities of about half an inch in depth, and one-fifth of an inch broad. When the animal was carefully detached, it lasted for several days, till all the protuberances disappeared, but they were at last assimilated to the regular form of the body.

an open flower of one of the *Compositæ.* The tentacles reach far beyond the diameter of the column, of which only the lower portion is visible; the body is perfectly transparent, allowing all the internal organs to be traced without difficulty, the lips of the mouth are slightly prominent; the water is seen moving up and down in the hollow tentacles, which play about actively in all directions, being strongly inflated at their roots, and gradually becoming thinner towards their tips.

None of the *Actinozoa* possess special organs of sensation, though they are highly sensitive to the touch of any solid body, and even to the influence of radiating heat, or to the light. The fact is that their entire body, when soft, and not covered by a thickened epidermis, is almost throughout equally sensitive and, therefore, makes special organs of sensation superfluous. Still, I should think, there must be an intimate connection of some kind of nervous system through the entire organism, inasmuch as the slightest touch of the tip of a tentacle is sometimes momentarily communicated to the whole body, its effect being exhibited by a change of the whole form of the body.

Thus a slight unusual movement of the surrounding water, or the coming into contact with a solid object, causes the *Sagartia*, when expanded partially, to contract, by which a quantity of the water contained, is always ejected through the existing openings, *(cinclides)*. In this position, (pl. X. fig. 3) the animal forms a short column, with the upper margin [of which I shall speak as the *collar*] somewhat thickened, the aperture hidden, and the tentacles protruding about one-forth of their length; the transparency of the body slightly diminishes; a few *acontia* are usually seen to rise from the central portion of the base, being then forcibly ejected through the *cinclides*, at or near the *collar*. Sometimes the tentacles are laid down, very slightly protruding, forming a sort of a broad cone; and then viewed from above, they are seen arranged most regularly: those, belonging to the different circles, being easily traceable from their thickness, (see pl. X. fig. 2). Any further disturbance generally induces the *Sagartia* entirely to contract, its form resembling in this position a short, depressed conical heap, (see pl. X. fig 4), leaving only a small opening in the upper centre, from which usually the white tips of the primary tentacles slightly project. In consequence of the contraction of the outer muscular layer,- chiefly consisting of concentric fibres, - the transverse plication becomes somewhat more distinct than it was before, and the immediate neighbourhood of the suckers slightly rises to short, transverse prominences. The greater contraction of the pigment layer also makes the greenish bands of the septa more distinct, though the entire body possesses a slight tinge of the same colour. The *cinclides*, especially those placed near or on the collar, become rather widely open, and others are distinctly traceable; the *acontia* are numerously ejected on different places of the body, and the general transparency has again diminished as compared with the former position.

Besides these three, so called normal, positions* of a *Sagartia*, there are others which the animal assumes under certain abnormal conditions, generally resulting from ill health, and being produced, either by excessive heat or light, or by a change in the saline constituents of the water, &c. Some of the principal forms, as observed on one and the same specimen, are represented in figures 6 to 9, on plate X; but I will defer the remarks upon these, until I come to speak of the physiology and the habits of the animal.

b. *Anatomical Structure.*

In order more easily to understand the general anatomical structure of the animal, I must direct the reader to the vertical section, as represented in figure 3 on plate XI. This section is taken only in half of the diametral length, being sufficient for our purposes, and the different letters, noted in this figure, have the following significations :— a, base; b, column; c, collar; d, disc; e, tentacles; g, throat; h, larynx; i, stomach, or internal cavity; k, *craspeda*; l, *acontia*; m, ovaria, or the reproductive organs; n, *cinclides*, or pores in the integument for the purpose of emitting the *acontia*. I shall now briefly describe these parts as much as possible in the same order, in which I have just mentioned them.

The entire body of the *Sagartia* is surrounded by an external, mucous layer, which chiefly consists of numerous, oval *cnidæ*, and sparingly dispersed green pigment cells.

a. The base is, as already stated, a more or less round disk; on which the septa are distinctly traceable (pl. X. fig. 5), being of con-

* Being observable in most other Halirhoda.

siderable thickness, according to the different series to which they belong. The twelve ovarian strings, or reproductive organs, can be seen through the transparent skin; and equally easily traceable are the six bundles of the craspeda, in position nearer to the centre of the axial cavity than are the former.

b. The column represents the peripherical portions of the mesenterial folds, grown together, and it will, therefore, be sufficient to give a detailed statement of the structure of one of the septa. The original number of these, as represented in the view of the basis (pl. X. fig. 5), is six, radiating from the centre. The second cicle is again six, the third, fourth, and fifth are each twelve, one septum first appearing next adjoining the primary septa, then one next to the secondary ones, than again one between the two last ones. This is a common law in all Hexacorallia, and I only notice it here, because I will subsequently draw the attention to the difference, apparently existing between the increase of the septa and that of the tentacles. The septa of the first, and usually also of the second, cicle are distinctly traceable almost up to the centre, those of the 3rd and 4th nearly so, both being about equal in strength, but those of the 5th are considerably shorter. I have not observed in any of the numerous specimens which I have examined, a larger number of cicles than five, or 48 septa altogether; small specimens often had only three or four cicles developed. The various cicles are shematically represented in figure 2 of plate XI.

Each septum is composed of five distinct layers, as represented in the enlarged section, plate XI, figure 3-α β, γ, δ, ϵ. The outermost α is, as formerly noticed, almost only a mucous fluid, composed of a loose cellular substance, and a very large number of elongated nettle cells, or *cnidæ*, and a few dispersed cells of greenish pigment. The *cnidæ* of this mucous layer are, compared with others, the shortest, being ovately elongated, slightly curved or kidney-shaped, having, as a rule, an ecthoræum, shorter than their own length; they also appear to be nearly smooth.—Figure 4 of plate XI represents the appearance of the mucous layer under the microscope, and 4*a* three-isolated *cnidæ* still more enlarged.—The next layer (β) is strongly muscular, chiefly consisting of concentric or cross fibres, forming at intervals slightly elevated ridges which contain the so-called suckers; these becoming more distinctly apparent in the contracted position of the animal, (see fig. 4, pl. X). These suckers, however, are not essentially characteristic, and appear to vary greatly with the age. Along the dorsal edges of the septa, there seem to be also some longitudinal fibres present. This second layer is the same which, in several Actiniacea, becomes *coriaceous*, taking a principal part in the formation of the *exotheca* of other corals. The third layer (γ) only consists of thick, transverse fibres, containing large, dark green pigment cells. Below this follows a tough muscular tissue (δ) consisting of thin longitudinal and much stronger concentric fibres, gradually passing into a regular cartilagenous skeleton (ε), composed of an intercellular substance, and a large number of various scleroid particles; the figures 5, 5*a*, 5*b* and 5*c*, on plate XI will illustrate this. Figure 5 represents a small portion of the fourth layer, the three upper ones having previously been removed by maceration. The muscular fibres are especially strong on a portion of the septum; the cinclides are spacious. Fig. 5a represents the reverse or internal side of the same portion of the integument, and shews on the surface an irregular distribution of the scleroids.

The two last layers (δ and ε) chiefly compose the mesenterial septa, extending above to the mouth and at the base up to the centre, but being on the internal edge along the central axial cavity deeply insinuated. The hardest portions of the septa are those round the larynx and at the base, evidently on the two places where the strongest muscular actions are required. In figure 3, pl. XI the most cartilaginous portions are indicated by cross lines.

It is usually stated that the Halirhoda, and especially the Actiniacea have neither an internal, nor an external solid skeleton, and this notion gave rise to the name *Hexacorallia malacodermata.* There can be, however, no doubt that in the present case the two internal layers, as represented on plate XI, figures 3 and 5, correspond to those which - in the Astræacea for instance - secrete the enthotheca. The scleroid particles are of two kinds; some of them are long, with slight lateral appendages, and others simple, sharply angular flat bodies, as shewn in figures 5b and 5c on plate XI. These scleroid particles are only visible when enlarged to about 500 diameters; and some of them are still extremely minute. In the fourth muscular layer, which chiefly consists of cross fibres, there are at distances small round holes to be observed, which evidently lead to the cinclides of the outer integument; these holes are often rather indistinctly traceable in the scleroid parenchym.

My observation as to the presence of solid scleroid particles in the internal tissue of the *Sagartia* has, in the first instance, been made in consequence of a simple process of maceration in water, and weak acid. It became, however, important to test further the true nature of these different scleroids. I consequently exposed a specimen, placed in a platina crucible, to a heat sufficient to remove every trace of organic matter, and was satisfied to find in it the residue of a perfect, solid skeleton of the *Sagartia*, on which were seen externally the holes for the cinclides, and, in being broken up, internally the septa. The external portions appeared more fibrous, the internal more broadly cellular or reticular. The character of the substance perfectly resembled the spongy and irregularly cellular structure of the corallum of other reef-forming *Anthozoa* (see fig. 6, plate XI). A portion of this skeleton was then placed in hydrochloric acid; this operation shewing that the solid skeleton mostly consisted of carbonate of lime, which is present in the form of the long scleroids (pl. XI. fig. 5*b*); the flat angular particles, being of silica, remained unaltered (fig. 5*c*.). The latter formed a dark, very thin, irregular network, though most of them were loose, and apparently irregularly distributed among the calcareous scleroids. Besides the two kinds of scleroids, I observed a large number of extremely fine, often branching threads; but whether these belong to the tissue of the coral, or to some species of *sponges*, I was unable to ascertain. The proportion of siliceous scleroids to those consisting of lime is not probably more than one to twenty.

This direct proof of the secretion of solid scleroid particles in the internal tissue of the *Sagartia* is very important, inasmuch as it will in time, when more observations of this kind have been made, necessitate a change in the characteristics of the so-called *Anthozoa malacodermata*. It would be premature and unjustifiable to state that all the *Sagartiidæ*, or other Actiniacea, possess an internal skeleton, as no other observations have been yet made on this point. It is, however, to be hoped that the present statement will induce stricter and more accurate inquiry, especially as Mil. Edward, Blainville, and others, many years ago directed attention to the existence of those solid bodies in the internal tissue of some of the species of *Zoanthus*, *Actineria*, and others. In spite of the solid skeleton which I have described, I must, however, remark that the softness of the body is unusually great in the present species, and nobody in observing the pulpy appearance of the same would suspect solid scleroids in it.

c. The *collar*, or the upper margin of the column, is generally slightly marked, though always indicated by a slight contraction below the upper edge. In the abnormal positions of the species, it becomes occasionally much more prominent, (see figs. 6, 7, 8, and 9 in pl. X); the muscular tissue is also much stronger on it, than on the other parts of the column, and sometimes nearly hardend. The cinclides on the collar are generally the largest, often forming a continuous series at its outer edge, while other loop-holes are irregularly dispersed over the entire column.

d. The *disc*, forming the upper part of the body, is very soft and transparent; it is only marked by radiating furrows which, strictly speaking, are in the present case an essential part of the tentacles. It probably consists like these only of four layers, the innermost, containing the scleroids, being wanting, or at least so much reduced, as to be hardly traceable.

e. The *tentacles* partially originate, according to the above statement, at the mouth, becoming isolated some distance from it; towards the periphery they are separated from the collar by a broad groove.

In the expanded animal, they are roundish, or slightly compressed from front to back, strongly inflated in the middle and at their roots, becoming after the first half length rapidly thinner. Their tips are slightly swollen or obtuse, and perforated. Externally the surface of the tentacles is smooth; but under the glass fine whitish spots, indicating the presence of *cnidæ*, may be observed (pl. X. fig. 1*a*). In the primary tentacles of older specimens the whitish specks are visible to the naked eye (see pl. X, fig. 1*b*). The anatomical structure (see pl. X, fig. 1*d*) of each of the tentacles is similar to that of the septa, except that they appear to want the scleroid layer. They are enveloped in a soft and usually very thick, mucous outer layer, being a little more consistent only at their bases. The *cnidæ* of the outer layer are of the same shape as those of the column, but slightly longer; the ecthoræum being about the same length as the cell, or a little shorter and distinctly turned inside; the largest *cnidæ* are not more than $\frac{1}{600}$th of an inch in length (pl. XI, fig. 7).

Below the mucous layer, there is a thin muscular, then a pigment, and below this again a muscular layer (pl. X, fig 1*d*). When the tentacles shrink in a sickly or a dead specimen, they have the appearance of thin, undulating threads, with a dark green centre, surrounded by a transparent viscous layer; the former representing the three inner, the latter the mucous layer, with a large number of *cnidæ*, (pl. XI, fig. 1*a*).

In a full grown specimen there can usually be counted about 160 tentacles, sometimes more; but I have not been able to trace in a perpendicular section more than five series of them. To illustrate the difference in the increase of the septa, and in that of the tentacles, as I presume it to be the case, I must direct attention to pl. XI, fig. 2, in which, on the right half, the disposition of the former, on the left that of the latter is shewn. The six primary septa meet, as I have formerly stated, in the centre of the base, but are not traceable on the disc. The six primary tentacles are seen to originate from each two tubercles of the lip, they are distinguished from others by their great thickness, though in length usually exceeded by the secondary ones. In the healthy animal they often are of a light fleshy colour, especially at their bases, and snow-white towards the tips; they are carried in a simple outward curve, generally with their tips, leisurely moving about between the other tentacles, which are more actively employed, as already stated. Observed with a moderately magnifying glass, the greenish and reddish pigment cells can easily be traced out. The white tint of the tips is, I believe, only due to a very large accumulation of *cnidæ*, which appear to be arranged in spiral rows, and become very distinct, when their inter-cellular substance is removed by its more rapid decomposition. On pl. X, fig. 1*c*, a representation is given of the tip of a primary tentacle, largely magnified. The *cnidæ* of this portion of the tentacles differ little in form from others of the integument, except in their larger size, having at the same time a proportionately thicker ecthoræum. Their fluid contents is homogeneous, perfectly transparent, and the cell-membrane is rather more tough, than in other *cnidæ*.

In very young specimens, the white tips at first appear on the three alternate primaries, subsequently and gradually on all six. In very old specimens, the tips of the next, and even partially of the third series, become white. Wherever there is a large accumulation of *cnidæ* on the column, or where the *cnidæ* are of a larger size, the white specks in the integument are readily recognised, even with the naked eye.

To return to our former statement regarding the position of the tentacles; the next, or second series of them, consists of twelve,* being distinctly traceable by a bipartition of the primary tentacles, with which they are connected on one side, while on the other, they extend to the lip. Thus, in position, the secondary tentacles originate more peripherically, and in pairs alternate with the primary ones; they often are the longest of all, being in large specimens about $1\frac{3}{4}$—2 inches in length, and most of them indicate by their whitish tips the presence of numerous *cnidæ*. This statement, relative to the position of the two first series of tentacles, is in the present species, based upon direct observation, but it was impossible to do the same with the other series; though in the next at least, or the third cicle, a more or less regular bi-division partially appeared observable. Sometimes I could notice three tentacles of a next series springing up from one of the former series; but this certainly is not the rule. Moreover, judging from the total number of the tentacles, which appears to be rather constant in specimens of equal size, and allowing for accidental irregularities, we cannot be far from the truth, when we also accept a regular bipartition for the third and fourth series, as partially represented in fig. 2 of pl. XI. By this bi-division we obtain very closely the total number observed in live specimens, being about 160. In the specimen figured on pl. X, the tentacles of the first series had a length of $1\frac{1}{4}$ inches, those of the second $1\frac{3}{4}$, of the third $1\frac{1}{4}$, of the fourth $\frac{3}{4}$, and of the fifth $\frac{1}{2}$ of an inch.

f. The *mouth* is a transversally oval, or more or less linear opening, surrounded by prominent lips, which consist of twelve, elongated, inflated tubercles, between each pair of which originates one primary tentacle. On the two opposite ends of the longitudinal axis, terminate the *gonidial canals* with small roundish openings, (see *c*

* The second series of the septa is only six, like the first; thus tentacles and septa do not, as already stated, take equal steps in their development.

in fig. 2, pl. XI). The functions of these internal canals have not as yet been traced out; I even failed to observe their extensions into the internal space. *Gosse*, and others, suppose that the eggs and spermatozoa are ejected through them, though I usually observed these conveyed through the mouth. The tubercles placed on either side of the gonidial canals, have been called *lentigines*, they are smaller than the others, and bipartite, (see *l* in fig. 2 of pl. XI). There also often extends a groove from the gonidial canal towards the periphery, which has been termed *gonidial radius*, but this is hardly traceable in our species. The greenish or pale fleshy colours are occasionally very distinct on the lips, and the internal muscular tissue of the latter is stronger, than that of the disk and of the tentacles.

g. The *throat* is the immediate continuation of the lips into the interior; it is longitudinally sulcated, the furrows being marked by greenish lines, produced by the contraction of the pigment layer. The length of the throat from the lip to the *larynx*, is about half an inch; towards the base it is slightly enlarged, and then forms a strong projection (the *larynx*) into the inner space.

h. All along the throat the inner muscular layer, with the scleroids, is rather consistent, and especially so at the *larynx*, where it is very tough and nearly cartilaginous, often more so than at the bases of the septa themselves. This muscular strength of the lips, of the throat, and especially of the larynx, is of course indispensable for the existence of the animal, being not only required for the seizure of the prey, intended for food in the stomach, but also for its retention.

i. The *stomach*, the internal axial cavity, is produced by an insinuation of the inner margins of the septa, these projecting to a greater or lesser extent into its space. The stomach extends from the larynx, which guards its entrance, to the base of the column. When the animal is expanded, the height of the stomach measures about $\frac{2}{3}$ of the total height of the column. *Gosse* states that in some species, he observed internally on the septa thin, coloured layers, and is inclined to explain them as a sort of a substitute for the liver. Nothing of these layers was observable in any of the specimens of the present species examined. The stomachial cavity is the receptaculum of the food, and contains besides several other organs which are placed peripherically.

k. On the internal side of the larynx, and next to the entrance of the stomach, are suspended the mesenterial-threads, or *craspeda.* These are, in the present species, flat bands of one, or one and a half inch in length, being of a pale greyish yellow colour, and with the lateral margins partially rolled in, so as to have the appearance of nearly cylindrical tubes. They hang down loosely, and the greater portion of them lies in small heaps round the centre of the base. Their more central position as regards the reproductive organs, is clearly visible in the view of the base, (pl. X, fig. 5). There are always numerous threads together, but they cannot be easily distinguished through the integument of the base.

In figure 1, pl. XI, is given a representation of a specimen, which had itself turned inside out. In the centre the thickness of the primary *mesenterial* septa is clearly traceable, then the pairs of the ovaria, partly attached to the septa, and beyond those towards the periphery, the very numerous *craspeda*, and then follow the *tentacles*, with their shrunken tips ;—two of the threads extending beyond the periphery representing the *acontia.* The *craspeda* are seen constantly winding up and down, like worms, contracting and expanding, and thus shewing great vitality, but I have not observed in them any rapid motions ; they are never ejected through the cinclides. Examined under the microscope (see figs. 8 and 8a, pl. XI) their *cnidæ* are seen to be arranged in two marginal rows, lying with their longer diameter perpendicularly to the length of the craspedum, and leaving in the middle a sort of a canal or a string, which is filled with a cellular substance and a very large number of pigment cells ; no larger *cnidæ* being visible in the centre. The cellular substance probably assists in effecting the muscular motions. The *cnidæ* are distinguished by a considerable length, (the longest about $\frac{1}{500}$th of an inch), being rather straight, generally attenuated at one end, and usually shewing in a slight curve an indistinct central line, indicating a moderately long but very thin ecthoræum ; this latter is rarely seen ejected, but if it is it appears to be about one-third longer than the nettle-cell itself. The thinner ends of the *cnidæ* slightly project on the lateral marginal surface of the craspedal bands, giving them a very fine ciliated appearance. Numerous pigment cells and others are also observable between the marginal *cnidæ.*

The true nature of the craspeda in the physiological economy of the animal is not known, and various suggestions have been made as to their signification. It appears to me that most probably they represent some organs of secretion. It is, however, likely that they also serve other purposes at the same time. I shall subsequently relate a case which tends to prove that they are especially active when the *Sagartia* takes some food into its stomach, thus, by their natural central position, they not only guard the reproductive organs against any injury from hard particles which are received as food into the internal cavity, but they most probably also facilitate the maceration and digestion of the food. The ready nutriment, or chilus, must be absorbed by the entire inner surface of the body, for no special organs are observable for its distribution.

1. Next in importance, for the existence of the animal, appear to be the *acontia*, which are also flat bands consisting of *cnidæ ;* these being likewise arranged transversally in two rows on either side, leaving a narrow space in the centre which is, however, in the present case occupied by large transparent cells, a very small quantity of a fine granular substance, and by *cnidæ* of different size (see figs. 9, 9a, 9b, pl. XI). The marginal *cnidæ* are projecting at the edges about one-fourth or one-fifth of their length, and not unusually have their *ecthoræa* ejected. The *cnidæ* of the *acontia* are distinguished by their great length (some of them being above $\frac{1}{400}$th of an inch) ; they are either straight, or more often slightly curved, and almost equally attenuated on both ends. The *ecthoræa*, when ejected, often exceed the *cnidæ* by one half of their length, and are sometimes doubly as long ; their thickness is about $\frac{1}{15}$th of that of the *cnidæ*, being hollow and provided nearly to the tip with short, reversed cilia (fig. 9a, pl. XI). It is not improbable that the *ecthoræa* of all the other kind of *cnidæ* are also bearded, but I have not been able to observe their minute cilia. The cellular substance in the centre of the acontia is transparent, but the large number of the marginal *cnidæ* produces a milky white colour, which strongly contrasts with the purple colour of the *ovaria* and the yellowish *craspeda*, and thus makes the *acontia* readily discernible.

The *acontia* are in constant motion, expanding and contracting, and winding up and down in different directions ; their movements being much quicker, than those of the *craspeda*. Their length generally amounts to three or four inches, probably sometimes more. I have seen them ejected on every part of the column, even at the base, when the animal is forcibly removed from its place of attachment, in which case the large number of the *acontia* forms a regular net work round the animal. It is, I believe, principally due to the bearded ecthoræa of the *cnidæ*, that the acontia stick firmly to every thing which they meet, until the hooks are forcibly removed, or until the organs themselves relax. For small animals the acontia are, therefore, formidable weapons, and there can be little doubt that the fluid of the *cnidæ* acts as a kind of poison, in the same way as it does in the *Acalephæ*.

The different modes of emitting the acontia from the body will be mentioned subsequently, but I must make here some observations regarding their internal attachment, although it is very difficult to pronounce a conclusive opinion on this point. I have dissected several specimens for the sole purpose of obtaining a clear idea as to the places where the acontia originate,* and it always appeared to me that some of them are attached at the larynx, between the ovaria and the craspeda, but at the same time there seem to be some of them fixed below, near the centre of the base, between the muscular thickenings of the mesenterial folds. I am not aware whether any thing about the attachment of the *acontia* has been previously observed, and it is possible that the basal attachment is only auxiliary to the one at the larynx, so as to support the muscular power required for their emission.

m. Each *ovarium* consists of two parts, one placed on either side of the primary septa. The *ovaria* are long undulating strings, which are firmly attached with one end on the internal side of the larynx, then partially all along the internal cavity between the mesenterial folds, and loosely by some threads to the base. The halves of each pair are perfectly symmetrical, they run in a slight curve, generally parallel to the convexity of the column. The colour is a bluish purple, slightly varying in tint in different specimens.

* This operation is indeed not so simple, as it would appear, judging from the transparency of the animal. As soon as a portion of the *Sagartia* is cut off, it immediately contracts to such a degree that it is almost impossible to observe separately any of the internal parts.

Blainville was one of the first who pointed out different sexes in the *Actiniacea*, and since then, it has been repeatedly stated, that some of the species are hermaphrodites, while others appear to be sexually distinct. I have examined a large number of specimens of the present species, and always found the ovarian strings consisting of *ova* only, being connected by thin threads, attached to a conspicuous median string, and enveloped in a pale purplish coloured mucous substance, (see pl. XI. figs. 10, 10a, 10b). The eggs usually were of various sizes, some of them small, evidently in a young stage, others much larger, those of largest size measuring about $\frac{1}{45}$ of an inch in diameter, so as to be distinctly visible even without a glass, (see fig. 10a, pl. XI). The apparantly ripe eggs were perfectly globular, each attached to the ovarium by a thin string, it possessed a markedly thickened epidermis, surrounding a finely granular dark substance, and having a large, usually eccentric transparent spot, with a minute opaque centre, (see fig. 10b, pl. XI). Besides these eggs there were always smaller and larger globular masses of irregular shape visible; they were in a constant rotating motion, and probably represented earlier stages of ova, or others in a state of furcation. Boiled in hydrochloric acid, the ova remained almost unchanged, from which it would seem that their epidermis partially consists of *chitin*, which I have reason to believe is also represented in the integument. In the mucous substance of the ovaria *cnidæ* are sometimes observed of an elongated oval shape, having a thin remarkably long and strongly bearded *ecthoræum*, as represented in fig. 10*c* on pl. XI.

With respect to the sexual difference of our *Sagartia*, I have to record the following observations which, when confirmed, may throw some light upon the generative system of the *Actiniacea*. After having kept the specimen, figured on pl. X, and the history of which I shall relate subsequently, for about 18 days in my aquarium, it began in small quantities to issue from its mouth a milky white, viscous substance which, upon examination under a very high power of the microscope, appeared to consist of small round globules of different sizes, not however exhibiting any motion. There were only a few *cnidæ* interspersed in that mass. Sickly *Actiniæ* are said often to issue a similar white substance, but in the present case I could not see the slightest distinction between the character and form of those granules (pl. XI, fig. 11) and early stage of eggs, attached to the ovaria themselves, except that the former were deprived of the purple coloured coating, which always surrounded the latter, when connected with the folicles of the ovaria. In connection with the white viscous mass, there were occasionally issued pale yellowish, contorted bands. Each of these consisted of a thin but tough, almost leathery skin, with numerous irregular partitions (pl. XI, fig. 12) filled with extremely minute spermatozoa; on one side the edge of the band was considerably thickened. The spermatozoa appeared as round globules, each with a very thin and short tail (pl. XI, fig. 13); their motions were extremely rapid in all directions, and whenever a few eggs were introduced into the mass, the spermatzoa were seen collecting round each (pl. XI, fig. 14), until they formed a regular coating to it. Eggs observed a few hours afterwards, distinctly exhibited a motion of their fluid contents, but I have not been able to trace their further changes and development. It is not at all improbable that the spermatozoa, and in fact the whole of the male folicles, are developed, as in many other corals, either at a certain season of the year, or at a certain age of the animals. The act of fructification may result in the death of the animal, but this is not at all likely to be always the case. I shall subsequently again recur to this subject in somewhat more detail, as connected with the existence of the animal.

c. Physiology.

In tracing out the principal physiological phænomena of the present *Sagartia*, I may best attain my object by briefly relating the history of the specimen figured on pl. X.

The specimen was obtained, on the 22nd March, 1868, in a tank close to the railway station of Port Canning. I filled my aquarium with a quantity of the same brackish water, and placed the specimen with several others of smaller size in it. During the first ten days, the large specimen exhibited great activity, usually having its tentacles spread out, attacking every small animal that came in contact with them. The six primary tentacles, being considerably thicker than the rest, were bent out in a curve, usually leisurely moving about between the bases of the other tentacles. The least touch with a solid object of any part of the body, or even an unusual movement of the water, or the sudden direction of the sun's rays against the animal instantly effected its sensitiveness, the effect being a total or partial contraction of the body. At this act a quantity of water was emitted, and generally a few *acontia* were ejected from the cinclides of the collar, this being done with such a force, as to make the *acontia* rise nearly two inches in a perpendicular direction. They usually remained for a few moments in the extended position, and were then gradually rolled up in a closely coiled spiral line and retracted. Seldom were there any *acontia* seen to issue from any other part of the column. According to the magnitude of the disturbance, from one to about five minutes elapsed before the animal, when it had once entirely closed the disk, expanded again.

After the first ten days, the specimen gradually lost somewhat of its high sensitiveness; it almost constantly remained expanded, but the tentacles were much less active than before, and it required a rather forcible touch to induce the animal to retract them. In a similar manner, the expansion of the body, or the unfolding of the tentacles was remarkably slow, though the animal would not voluntarily remain closed longer than five or six minutes. Other specimens, however, which also partially lost their original sensitiveness, would remain closed for several hours; some of them did not expand their tentacles, even for many days, at least not in the day time.

The *acontia* were always first discernible to begin their movements near the centre of the base, proceeding towards the periphery, then rising along the wall of the column, till they met a *cinclis*, through which they were ejected; they did not, however always rise as high as the collar. When they came in contact with a foreign object, they attached themselves so firmly, that they had to be removed with force. This attachment is, as I have already stated, undoubtedly due to the serrated or bearded *ecthoræa* of their *cnidæ* which are of considerable length. The ejection of the *acontia* is almost momentanous, but the retraction sometimes extends over 8 or 10 minutes, or even longer;-in a perfectly healthy animal for about three minutes. When the *acontium* is retracted within the body, it again usually remains lying for sometime along the wall of the column, or is coiled up at the periphery of the base, till it wholly disappears towards the centre. I have never seen any acontia issuing from the tentacles, or any part of the disc; as a rule they are emitted only from the sides of the column, but when the animal has been removed from the place of its attachment, I have seen them as already stated, to be emitted from the base near its periphery.

Gosse says that each *cinclis* is not assigned to a special *acontium*, but that at the contraction of the animal, a quantity of water is thrown out, carrying the *acontia* with it, and issuing them through any cinclis which happens to lie nearest. This appears in general to be correct; but at the same time it can, I believe, hardly be questioned that some muscular power is connected with the issue of the *acontia*, and perhaps the motion of the water only supports the former principal action, and directs the *acontium* towards a cinclis. It would be, for instance, impossible to understand why in the fresh and healthy animal, nearly all *acontia* issue at the collar; and besides that some of them are under circumstances issued with great force in a contracted state of the animal, where extremely little water is given out. Moreover it is very probable that the same muscular power which retracts the *acontia*, after they were ejected, is also in operation at the act of their emission.

Regarding the digestive system of which I have previously treated, I must here record a very interesting observation, inasmuch as it supports the suggestions previously made. I fed a large specimen with a small Crustacean,-after it had been slightly pressed, so as to reduce its active motions, and prevent its escaping from the mouth of the animal. The *Sagartia* kept the Crustacean for about five minutes between the lips, and then by almost insensibly slow movements of the labial muscles gradually swallowed it down. When this had been done, it remained in a half contracted position for more than an hour. During this whole time the craspeda were seen much more actively moving about, than either before or after that. The Crustacean was actually so thoroughly enveloped in the net of the craspeda, that I could not trace its form; even the next day the craspeda were seen more approximate and arranged round the central space, than they were on former occasions. This observation appears to be in favour of my previous statement, that the physiological signification of the *craspeda* is to some extent that of secretive organs, as liver, gall, panacreas &c., being essential for the digestion of the food. It would be probably going too far in stating that the ready chylus is also conveyed through the *craspeda* to the body, though the anatomical structure of their central portion is not directly opposed to this opinion. There can be however, little doubt that by the numerous marginal *cnidæ*, the *craspeda* have among others the object of protecting the generative organs from any injury which could be produced by the objects taken internally as food. The *acontia* evidently only serve for external defence, they do not seem to have any other physiological duties to perform.

Passing these remarks, I may return to the history of our specimen. It remained in the less active state, as previously described, for about 8 or 10 days. After this time it generally somewhat retracted the tentacles raised the disk and the lips (pl. X, fig. 7), and began to emit from the mouth a granular substance, the granules appearing, as I have already noticed, to be eggs in very early stages of development. The white substance was extremely viscous, and in irregular masses more or less resembling contorted strings. The next day I observed that, besides the white substance, there also were pale yellowish strings issued, containing the very minutest spermatozoa, as above described (p. 47). This issue of white substance, with eggs (?) and spermatozoen follicles lasted in intervals for two days, after which the specimen began to expand and contract its body in various ways. The tentacles were reduced to about half their usual length, the lips were projecting, the disc was occasionally produced, then again retracted, the collar more or less inflated, and at the same time, either the upper or the lower part of the body attenuated and extended, sometimes to more than double the usual length, (see pl. X, figs. 6, 8, 9). These various transformations of the body were observed for about 8 hours, during which time the *Sagartia* left its former place of attachment, (being a small piece of wood) and was seated at the bottom of the aquarium, on a horizontal ground. The next morning the specimen was found flat, perfectly turned inside out, exhibiting all the internal organs, (pl. XI, fig. 1). The *acontia*, *craspeda*, and even the tentacles shewed subsequently signs of vitality for more than 24 hours. Upon examining the figured, and another specimen which died under similar conditions, I found that the eggs on the ovaria were rather larger than usually in other live specimens, and the spermatozoa were accumulated in large numbers between all the mesenterial folds, and some of the pale strings which contained them, appeared to be attached irregularly between the ovaria. In a third instance they almost seemed to me that they have taken the place of some of the craspeda.

The important question resulting from this observation is, whether the death of the specimen was an accidental, or a natural one. I would not in the least deny, that the somewhat different conditions under which the animals were placed, accelerated the death of two of the specimens, but it would be strange to affirm that their death was caused merely by these different conditions,* inasmuch as they had hardly any influence upon other specimens, living in the same aquarium, and remaining healthy for a long time. Before those observations were made and afterwards, I had at different times dissected several specimens, but I never found a trace of any spermatozoen follicles, or any spermatozoa between the ovaria, though the ova were sometimes of large size and highly developed. I have, never observed internally any young *Sagartiæ*. Still it appears very probable that the present species is like many other *Actiniacea* viviparous, this being the ordinary course of propagation. I have likewise not observed any buds or stolones, or a natural division of any of the specimens. However, either at certain times of the year or, more likely, at a certain age the male follicles may be formed and spermatozoa developed in large numbers. The death of a specimen after the act of fructification may be only an accidental one, but this has still to be confirmed by other observations. In the specimen of which I have given the history, the eggs remained after its death perfect, only loosened from the ovarian strings, while the other animal substance quickly decomposed. Gosse says that he once observed an *Actinia* issuing spermatozoa, but he does not state whether the act resulted in the death of the specimen or not. Blainville's observations, if I remember rightly, gave a distinct proof that in some species ovaria and spermatozoa are developed in one and the same specimen.

* Being probably a slight alteration of the percentage of the saline constituents of the water, caused by evaporation, (though this percentage was maintained as much as possible), greater exposure to light and increased temperature, want of sufficient motion in the water, etc.

It is usually stated that, when an *Actinia* is cut into a number of pieces, each restores itself to a perfect animal. Though this kind of propagation no doubt has its limit, I may, record, that experiments made on some specimens of this species in general confirm the great vitality and reproductive power of the *Actiniacea*.

With the object of observing some of the ovaria, I once cut a specimen in two halves, and left one part of it in water attached to a piece of wood. In about 24 hours I found the half *Sagartia* closed again and after a few days the animal was perfectly restored, only counting a smaller number of septa, but even these were in time partially replaced. The specimen, however did not grow larger, although I fed it with mosquitoes and various larvæ for about six months. The other half which was removed from its place of attachment died shortly afterwards.

d. Habitat.

It is generally stated that all the *Actiniacea* are truly marine animals, and there are indeed very few instances known where species have for a time been kept in aquaria in which the saline constituents of the water were in proportion considerably less, than represented in pure sea-water. *Actiniæ*, and others, are sometimes found attached to rocks above the low-water mark, or living in small pools of sea-water, but I am not acquainted with any record of a species having been observed living permanently in brackish water.

The present species was found, as I have already stated, in one of the tanks close to the railway station of Port Canning. It lives here attached to old trunks of trees.* I have not observed it in any of the other tanks, partially on account of a difference in the water, partially on account of the want of any fit places of attachment. The specimens which I collected were of different size, the smallest about one quarter of an inch in the basal diameter, and the largest measuring about $1\frac{1}{2}$ inches in the same diameter. They usually were seen 8 or 10 inches below the surface of the water but sometimes at the surface itself; sometimes even a part of the animal was above it, and while the exposed portion became perfectfy dried up under the direct influence of the sun, the other half remained as usually vital.

Slight progressive movements have often been observed in *Actiniæ*

* Hæckel's name *Petracalephœ* would on this account not suit this species, we had to create a name something like *Lignacalephœ*.

and I may mention, that one of my specimens moved in 24 hours by gradually contracting and expanding its base* four inches on a level horizontal bottom, and three inches on the perpendicular side of the glass, so as to reach the surface of the water; in all therefore seven inches. All the specimens shewed a particular liking to move nearer to the surface of the water. The above shews that the *Sagartia* has the power to move progressively at about the rate of 0.26 of an inch in one hour, which is comparatively a very quick motion for these usually sessile animals.

The species is also common all along the banks of the Mutlah river. During low water the specimens often remain for hours exposed to the direct influence of the sun, attached to wooden pillars, stems of trees, &c. Each specimen always retains a large quantity of water during the time of exposure, and gives a portion of it up when disturbed.

In conclusion I have only to mention a few words regarding the chemical constituents of the brackish water, in which the animals were found living, as compared with those of sea water. Mr. D. Waldie, who very kindly undertook to make an analysis of the water, tells me that 1000 grs. contain a total quantity of solids of 12.87 grs., of which are 0.78 sulphuric acid (anhydrous), 0.78 magnesia and 0.23 lime. Mr. Waldie further observes, "the arrangement of the constituents is arbitrary; supposing the acids and bases are combined in accordance with the analyses usually given of sea-water, it will stand as follows:—

Chloride of Sodium (including potassium),	9.81
" " Calcium,	0.46
" " Magnesium,	0.93
Sulphate of Magnesia,	1.17
Carbonic acid, &c.,	0.50
	12.87

This will be found very nearly the composition of sea-water as to its principal constituents, but in quantity amounting only to very nearly one-third of sea-water for the same volume of water." Dana in his Manuel of Mineralogy also states that the amount of solid substances in sea-water changes between 32 and 37 parts in 1000 pts. of water.

* Measuring about one inch in diameter.

We may, therefore, say that the brackish water from Port Canning is composed of very nearly *one part of sea, and two parts of river-water.*

The occurrence of a species of *Sagartia* in brackish water, resembling in nearly all respects of its organisation marine species, is one additional fact how often an animal has it in its power to select or change the conditions of its life. It does not apparently depend so much on the quantity of certain solid constituents, composing sea-water, as it does on their presence in general; smaller quantities of them may occasionally have no effect upon the animal life, but the absence of one or the other of them could likely produce a thorough change in the fauna.

Considering the great disturbances of the atmosphere which have taken place towards the close of the last year (1867), we could suppose that these corals may have been transferred from the sea coast in the tank accidentally. This however is not the case. Although the water of the river is subject to constant changes of flood and tide, and contains a large proportion of fine mud and silt, which undoubtedly would greatly interfere with the existence of most other corals, the *Sagartiæ* live in it in large numbers. I also found them several miles north of Canning, in the tributaries of the Mutlah river, where the water is often much less brackish than further south. Besides the *Sagartiæ* there are in the same tanks at Port Canning, and in the neighbourhood, a large number of most interesting species of Mollusca living which mostly belong to marme types. Many of the animals may die or otherwise become less active, when during the monsoons the water of the tanks is nearly quite fresh, but some of them certainly must survive. Pure fresh water, or even that of the Hooghly obtained at the height of the flood, acted injuriously on the *Sagartia.* The animals, when placed in it were momentarily paralysed, though exhibiting vitality for some time afterwards, but they died in about 24 hours; still I think it very probable that the specimens would gradually and in time get accustomed to the Hooghly water also and they probably also occur in this river further south, and nearer the sea.

I have associated with this extremely interesting species, which gave me the opportunity of observing so many new points regarding the anatomy of the *Actiniacea*, the name of my friend, *Ferdinand Schiller*, who has been so actively engaged in the improvements of the locality where the species was discovered.

Phylum, MOLLUSCA.

Sub-phylum, HIMATEGA.*

These animals are also called *Moluscoidea*,—they are without a complete nervous system, the heart is wanting and if present it is without an auricle.

Class, BRYOZOA or CILIIPODA (*Polyzoa*, auctorum).

Heart and special organs of sensation wanting.

Sub-class, GYMNOLÆMA.†

With a simple row of tentacles.

Order, CHILOSTOMATA.‡—(*Cellulinea* d'Orb.)

Cells more or less ovate, aperture not produced, closed by an operculum or a muscular lappet.

Sub-order, INCRUSTATA.

Cells more or less attached by the entire, or a portion of their base.

Tribe, MEMBRANACEA.

Cells above wholly or partially membranaceous, the aperture being situated in that membrane.

Family, FLUSTRELLARIIDÆ.

Cells without special pores.

Genus. MEMBRANIPORA, *Blainville.*

Cells large, depressed, their single layers generally incrusting different objects; upper portion mostly membraneous; aperture with simple, entire margins, situated at the anterior end.

Species. Membranipora Bengalensis, *Stoliczka*, 1868.

Pl. XII.

Memb. polyzoario semi-calcareo, simplici, incrustante seu varie torto; cellulis depressis, sexangularibus, longioribus quam latis, in seriebus alternantibus positis, supra membranaceis, minutissime porosis, infra ac lateraliter calcareis, in adultis ad marginem superiorem nonnullis spinis solidulis paulum elevatis instructis; apertura in adultis speciminibus sub-rotundata, antice ad terminationem sita, marginibus integris aliquantum prominentibus circumdata; margine posteriori paulo producto atque sæpius quatuor spinis postice prolongatibus instructo:

* Hæckel, *Generelle Morphologie*, Berlin, 1866, Vol. II. p. cv.

† The other sub-class form the PHYLACTOLÆMA.

‡ The other orders are *Cyclostomata, Ctenostomata, Paludicellea* and *Urnatellea.*

spinis inæqualibus, exterioribus brevioribus quam interioribus. Animal virescente album, tentaculis longis, 14-18 *instructum.*

a. Form of cells.

The polyzoarium of this species is extremely variable, its form being altogether dependent upon that of the object to which it is attached. It is either found incrusting stones or wood, or it grows on different water-plants, being then variously contorted and apparently partially free. According to this the cells undergo many variations, often so much so that it is extremely difficult to determine the characters of the species.

As a rule they are hexagonal, slightly elevated, about twice as long than broad and posteriorly emarginated (pl. XII, fig. 1, f). The base and the sides are in full grown cells always solid, the upper portion more or less membranaceous, representing a usually slightly convex, very thin covering. The upper margins of the solid portion of the cell,—where the thin membrane is attached—are somewhat raised, and each cell is separated from the next by a slight furrow. The aperture lies at the anterior end, being roundish and provided with somewhat thickened, elevated and solid lips. The anterior portion of each cell with its margin extends into the basal indendation of the previous one, while the posterior margin of the aperture is much more prominent, possessing a small thickened projection which is posteriorly often prolonged into four, radiating spines, the outer pair of these being much shorter than the inner one (see pl. XII, fig. 2).

In consequence of the greater elevation of the posterior margin the aperture, when viewed perpendicularly from above, appears almost semicircular, but viewed at about an angle of 45 degrees from the front its round shape* is distinctly perceptible. The posterior upper portion of the cell is always convex, thin, finely perforated, and according to the different stages more or less solid. The radii or ribs originate at the upper lateral solid edges and extend in a more or less regular way from both sides toward the centre. Sometimes, but not usually, they unite in the median line and form solid cross bars. The length of the radii also varies with the age of the cells, but their number appears entirely to depend upon the length of the cells, (see figs. 3, 4, pl. XII).

* I mention this point here particularly, because the same *roundish* form of the aperture also occurs in many marine *Celleporæ* and *Lepraliæ,* and is usually stated to be semilunar, though in reality it is not so.

In live specimens, the cells are so thoroughly transparent, that their detailed structure is very difficultly noticed; but in dead cells the membranaceous covering generally disappears, and the solid radii or spines are seen to project towards the median line. It is, however, not always the case that they can be observed, even when the cells appear well preserved. On account of their great tenderness, they not only become in dried specimens variously contorted, but are often very easily broken off; such is the case in almost all the fossil *Membraniporæ*. In some, even very old cells however, they remain rudimentary, or do not develop at all, with the exception of one posterior, median spine which is always present. Again other very old cells become entirely incrusted, even at the aperture. All these variations of the form of the cells and the differences in the arrangement of the marginal spines are amply exhibited in figures 1-4 of plate XII, and these will give a better idea of those changes than any lengthened description.

I hardly need to notice the great importance of the study of those structural differences of the cells in one and the same species. In the present case, I find that the cells which spread over a large flat surface usually are short and broad (fig. 3), those which incrust small, thin stems of water plants, and the like, are much elongated and narrower (fig. 4). Were these forms not passing one into the other, and had the animals not in each case been observed, one would certainly may think to have a good reason for acknowledging these forms as distinct *species.* How different would this be in the case of their being fossil *Lepraliæ* or *Membraniporæ!* It is certainly true that we often describe merely fossil forms, and not species.

Only the sides and the base of the cells are, as I have previously stated, solid; they are chiefly composed of carbonate of lime, forming a thin porous layer. Each cell communicates through a large pore with each of the six adjoining cells. Two of those larger pores are found on each side and one in front and one behind. Sometimes, however, in younger cells the number of large pores is greater. When the polyzoarium is partially free, for instance in growing round a quantity of algæ, each cell usually has at the base a long membranaceous tube, through which a muscle, originating at the lower side of the mantle, is protruded, attaching the cell to the plants, (figs. 7 and 8). The round opening of this tube brocken off, with a slightly raised margin, is generally visible near the centre of the base of each dead cell, when carefully removed from its place of attachment; it is rarely wanting except in very old cells (see pl. XII, figs. 5 and 6). When, however, the cells are firmly attached with their entire base the opening often becomes closed up, and in time disappears altogether. Viewing the basal portion of a polyzoarium each cell appears separated from the others by a raised margin, while their median portions usually are slightly excavated. The surface is finely porous. The usual colour of the cell is pure white, occasionally slightly opac or brownish.

b. Animal.

There is little of special interest that I can mention with reference to the animal of this species. It is enveloped in a perfectly transparent mantle, which lines the internal, slightly rugous surface of the cell, and appears to be firmly attached to it posteriorly and at the margins of the aperture (see fig. 1, *f*, pl. XII). When the cell is broken and the animal taken out, the mantle generally remains with the cell; it is therefore very difficult to trace out the connection of the animal to its mantle. I have only observed a few very thin muscles posteriorly, but none anteriorly, though they also may exist. Equally difficult is it to observe the animal expanded, because the slightest motion of the water compels it to remain closed for a long time. When it protrudes out of its cell, the total length of the tentacles and a portion of the collar is visible. In the retracted position the *V-form* twisted viscera can be clearly traced through the cell-membrane. In the animal, taken out (fig. 1, *h*) of its cell, the length of the retracted tentacles (*t*) measures nearly one fourth of that of the entire body; they are separated by a groove from the muscular larynx, in the centre of which lies the mouth; then follow the viscera, usually somewhat contorted, being thickest in the middle, and by a sharp twist joining the membrane which surrounds the tentacles at about one-third distance from their base. At the end of the visceral cavity, there is usually seen one, seldom two or three oval, dark bodies,—probably *statoblasts.* These viewed under the microscope, seemed to be filled with a rather homogenous, granular mass, but sometimes there was a contorted, dark string visible, and the rest was filled with a clear fluid (fig. 1 *i*). Whether this difference is due to different stages of growth I am not in a position to say. I have not observed their development in the present species, but I hope to recur to this subject at some future occasion, when treating of the development of some of our fresh-water Bryozoa.

The microscopical structure of the animal is a granular, or cellular substance in which numerous greenish pigment cells are interspersed. There is no trace of *cnidæ*, such as described in the *Actiniacea* and *Acalephæ*. The tentacles generally are moved about slowly, not being usually widely separated from each other, and the movements of each are independent from those of the other, they also often have the tips bent outward, (see fig. 1, *g*, pl. XII). It is generally stated that the tentacles of all the Bryozoa are tubular, but in the present species it always appeared to me, that they are flat bands with the lateral edges folded in, so as to leave a broad furrow in the middle. They consist of about six or seven rows of large angular cells, being finely ciliated on either side. The cellular structure is perfectly different from that of the tentacles of the corals, but remarkably resembling, for instance, that of the tentacles or eye-pedicles of small Gastropoda (see pl. XII. fig. 1, *k*).

c. *Growth of the polyzoarium.*

The progressive growth of the polyzoarium of the present species deserves a short notice, inasmuch as the observations on this point are as yet rather imperfect.

The terminal end of each fresh polyzoarium (see fig. 1*a*) is very thin and membranaceous, being wholly composed of young cells, in different stages of development. It is in all the incrusting species of this group of Bryozoa free, becoming attached only in an advanced age. The first stage (1*b*) appears to be that of a small, flat and homogenous cell, filled with a quantity of a dark granular substance. This cell is produced in the form of a knosp from the previous cell of the same row. Young cells, especially seem to have the power of propagating themselves by buds, but in the old cells this mode is replaced by the formation of statoblasts.

In a next stage, subsequent to that above mentioned, cells are observable in which the granular substance is a little reduced, but generally in the right basal corner a dark spot becomes visible with a translucent centre. This is the first distinct embroyonal form (fig. 1c). Subsequent to this the upper edges of the sides of the cell and the base become more solid, (fig. 1*d*), then a small spine appears posteriorly, but no aperture as yet in the upper membrane, though it seems to be indicated by an opac-line (fig. 1 *e*). In the transparent centre of the embryo there are furrows to be observed, radiating from the centre and indicating the formation of the tentacles; a few thin muscles are also seen attaching the young animal to the posterior end of the cell. After this, the development appears to make more rapid progress ; the body extends, the twisted viscera become perceptible, the membrane covering the aperture is absorbed and the basal string which gives the cell a fixed position developed (fig. 1 *f*). Thus the animal is seen perfect, lying in the cavity of the cell, and the mantle becomes attached all round the margins of the aperture. At a progressive age, the statobasts appear in the posterior portion of the visceral cavity, and the upper membrane of the cell gradually attains a greater solidity by a number of thickened radii or spines. All these stages of cells may often be observed on only a small terminal portion of a large polyzoarium (fig. 1). The basal string is very strong in the young cells, but becomes obsolete in advanced age, as I have previously mentioned, it is therefore only a temporary organ, and not essential to the existence of the animal.

I also may notice at this opportunity that I observed on one of the polyzoria, small membranaceous tubes attached between each two cells, near their apertural margins. Out of these tubes an organ was voluntarily, and independent of the animals in the cells, projected and retracted. It simply consisted of two fleshy *flagellæ;* these were probably the so called *avicularia* the true nature of which,—as apprehensive organs,—is as yet little known, but the surface was so much covered with different *Spongillæ*, that I was unable to trace the immediate condition of these supposed *avicularia* with the cells themselves. When the polyzoarium was dried, the membranaceous tubes and naturally also their contents disappeared.

d. Chemical composition of the polyzoarium.

When boiled in hydrochloric acid, the polyzoarium left as residue a very thin membranaceous skeleton; it was complete as regards form of the cells. This membranaceous skeleton could hardly be anything else, than chitin, as distinguished from the common horny substance by being insoluble in hydrochloric acid.* Subsequently I burned several portions of the polyzoria in a platina crucible, until every trace of organic matter disappeared. The cells were by this operation not materially affected, but placed in hydrochloric acid, they were almost perfectly dissolved, they seem therefore to a very large proportion to consist of carbonate of lime. There was a small residue of siliceous spiculæ and scleroid particles left, but these were most probably derived from the numerous *Spongillæ* adhering to the cells.

e. Habitat.

Membranipora Bengalensis was found at Port Canning with *Sagartia Schilleriana* in the same tank of brackish water; it is, however, much more widely distributed as the last. It also occurs in tanks, the water of which contains only about one fifth of sea-water. I found the species incrusting old trunks of wood on several places along the Mutlah river, on many points in the salt-lakes and in other places of the Sanderban. The present species does not, however, occur in fresh water, where it appears to be replaced by *Hislopia*, evidently belonging to the same family of *Chilostomata*. There are a large number of similar forms found on various places of the coast of the Bengal Bay. One of these, with smaller cells, is often seen on shells and fragments of wood coming from the lower portions of the Sanderban, but it is difficult to obtain it in good preservation.

A marine species which I lately collected at Ceylon and at Aden is very like the one here described but it has the cells much more solid.

* The plates at the entrance of the œsophagus, or the so-called theeth, have been found also to consist of chitin.

Explanation of Plates.

Plate X, (p. 33).

Fig. 1. Unfolded specimen of *Sagartia Schilleriana,* in natural size (see p. 33); 1 *a,* a portion of a tentacle of the second series; 1 *b,* a portion of a tentacle of the first series, both enlarged twice the natnral size; 1 *c,* termination of a primary tentacle, with the *cnidæ* arranged in spiral rows, six times the natural size; 1 *d,* longitudinal section of one tentacle, shewing the different layers of which it is composed, (p. 39).

Fig. 2. Top-view of the specimen represented in fig. 1, when in a half contracted position, (p. 34).

Fig. 3. Side-view of the same, with the ovaria visible through the transparent body, the tentacles half protruding, and several *acontia* ejected.

Fig. 4. Side-view of the same specimen in a fully contracted position, the transverse rugations being more distinct than in the former positions, (p. 34).

Fig. 5. View of the basis; numbers 1-5 shewing the 5 series of the septa; the dark spots, each situated on either side of the primary septa, represent the *ovaria,* and the striped marks, more centrally situated, the bundles of the *craspeda,* (p. 35.)

Figs. 6—9. Side-views of the various abnormal forms of the same specimen, (p. 50).

Plate XI, (p. 35).

Fig. 1. View of a specimen turned inside out, the primary septa and the ovaria accompaning them being prominent, (p. 50); 1 *a,* represent three shrunken tentacles, enlarged.

Fig. 2. Ideal representation of the distribution of the septa and tentacles according to the different circles (p. 40).

Fig. 3. Ideal perpendicular section of a *Sagartia,* in half of its basal diameter, (see explanation of the various letters on p. 35).

Fig. 4. Appearance of the mucous layer, enlarged 200 diameters; 4 *a,* a few isolated *cnidæ,* enlarged 500 diameters (see p. 36).

Fig. 5. Upper or outer view of the scleroid tissue; 5 *a,* the internal view of the same; 5 *b,* calcareous scleroids; 5 *c,* siliceous scleroids, very much enlarged, (p. 37).

Fig. 6. A portion of the scleroid skeleton, after the specimen was burnt in a crucible (see p. 38).

Fig. 7. *Cnidæ* of the tentacles (p. 40).

Fig. 8. Longitudinal section of a portion of a *craspedum,* and 8 *a,* its *cnidæ,* more enlarged (p. 43).

Fig. 9. Longitudinal section of a portion of an *acontium;* 9 *a* and 9 *b*, its *cnidæ* (p. 44).

Fig. 10. A portion of an *ovarium*, 10 *a*, shewing the distribution of the eggs in the mass; 10 *b*, eggs much enlarged; 10 *c*, one *cnida* from the ovaria (p. 46).

Fig. 11. Appearance of the spermatozoa slightly enlarged.

Fig. 12. Male follicle, (see p. 50).

Fig. 13. Spermatozoa, very much enlarged.

Fig. 14. Eggs surrounded by spermatozoa, (p. 47).

Plate XII, (p. 55).

Fig. 1. Natural size, of a portion of the polyzoarium of *Membranipora Bengalensis;* 1 *a*, enlarged, with two supposed *avicularia* on the left corner; 1 *b*,—1 *f*, various stages in the development of one cell (see p. 59); 1 *g*, a full grown cell with the animal partially protruding, the body seen through the transparent cell; 1 *h*, the animal taken out (p. 58); 1 *i*, a statoblast; 1 *k*, internal view of the terminal portion of a tentacle (p. 59).

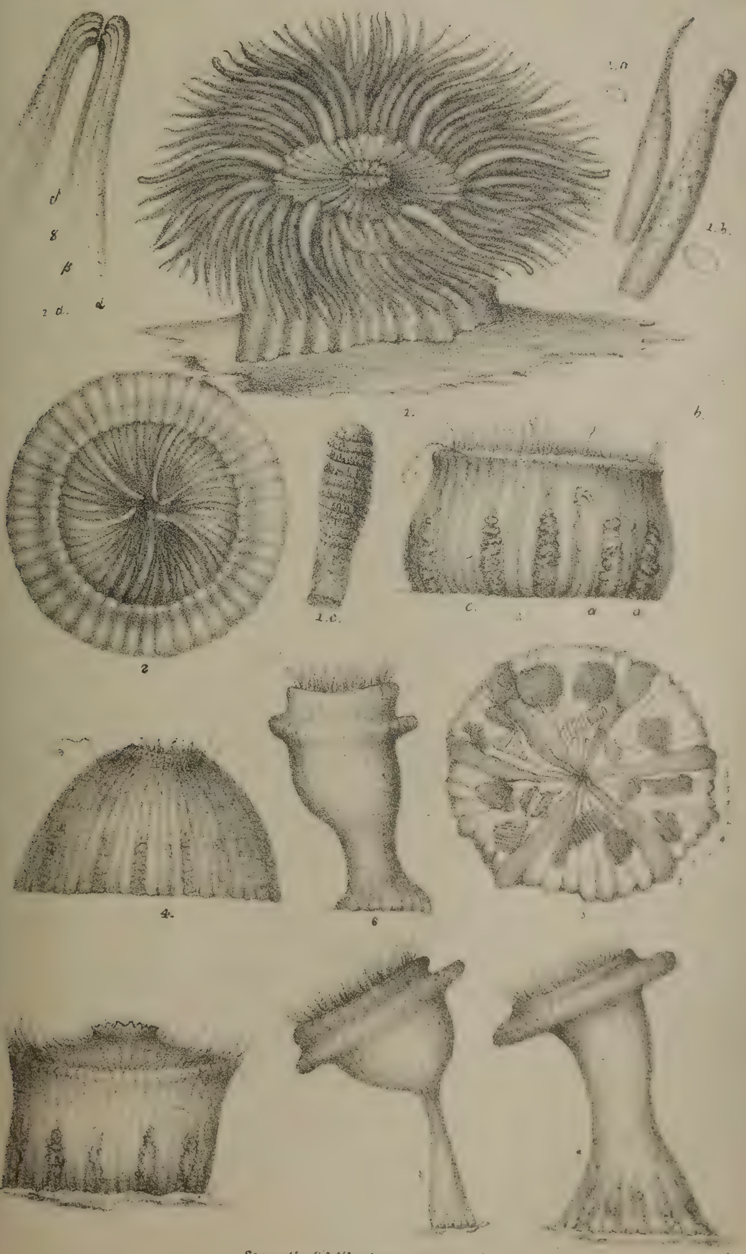
Fig. 2. Front view of a few cells, greatly enlarged, also shewing the spines attached to the lower lip (p. 57).

Fig. 3. Front view of a number of cells of an oval shape; 3 *a*, much enlarged portion of the upper surface, with two transverse, solid radii.

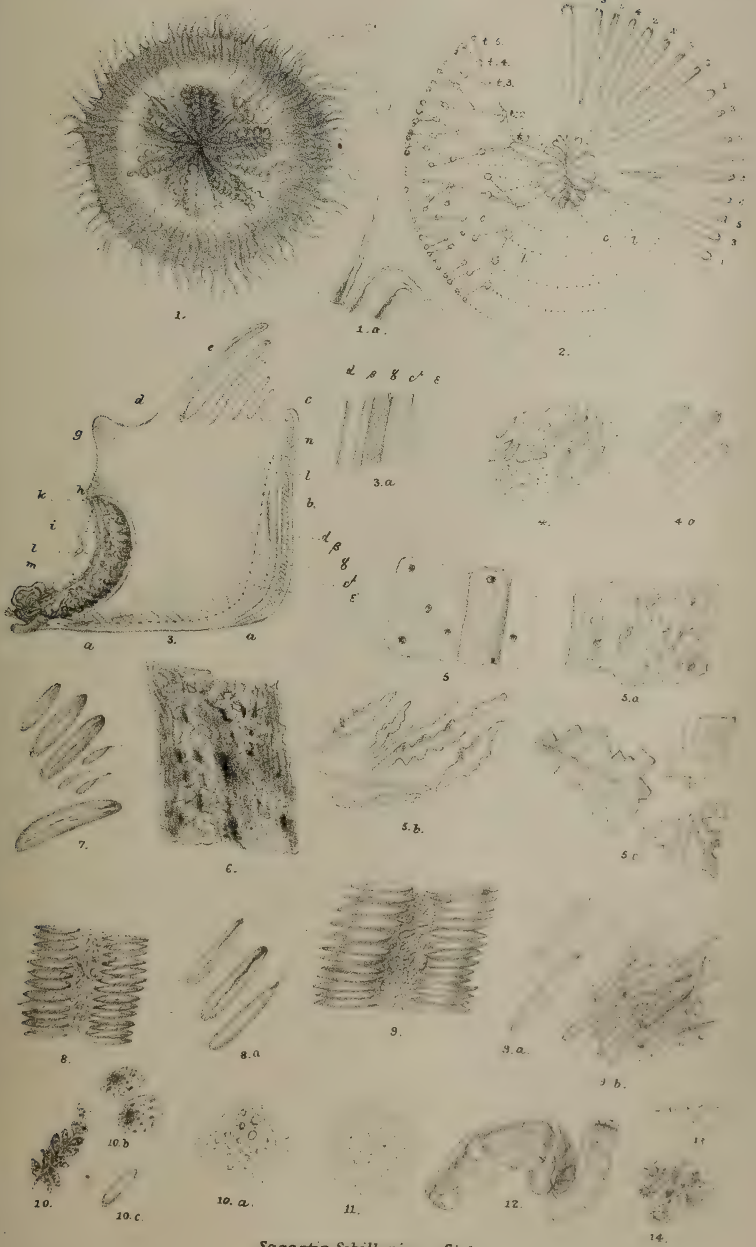
Fig. 4. Much elongated cells which were attached to a stem of a plant.

Figs. 5-6. Back-views of two kinds of cells, corresponding to figures 3 and 4.

Figs. 7-8. Side-views two cells, shewing the lateral pores by which they communicate with the adjoining cells, and also shewing the lower string which is well developed in young cells.



Sagartia Schilleriana, Stol.



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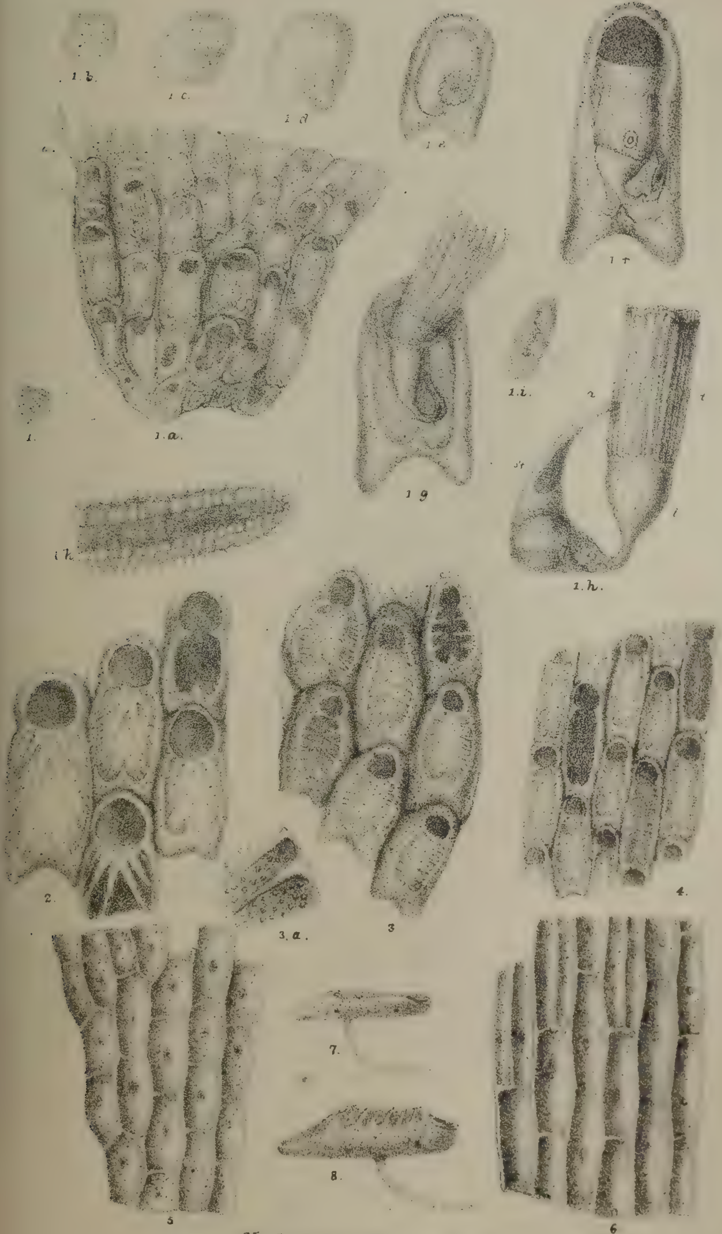
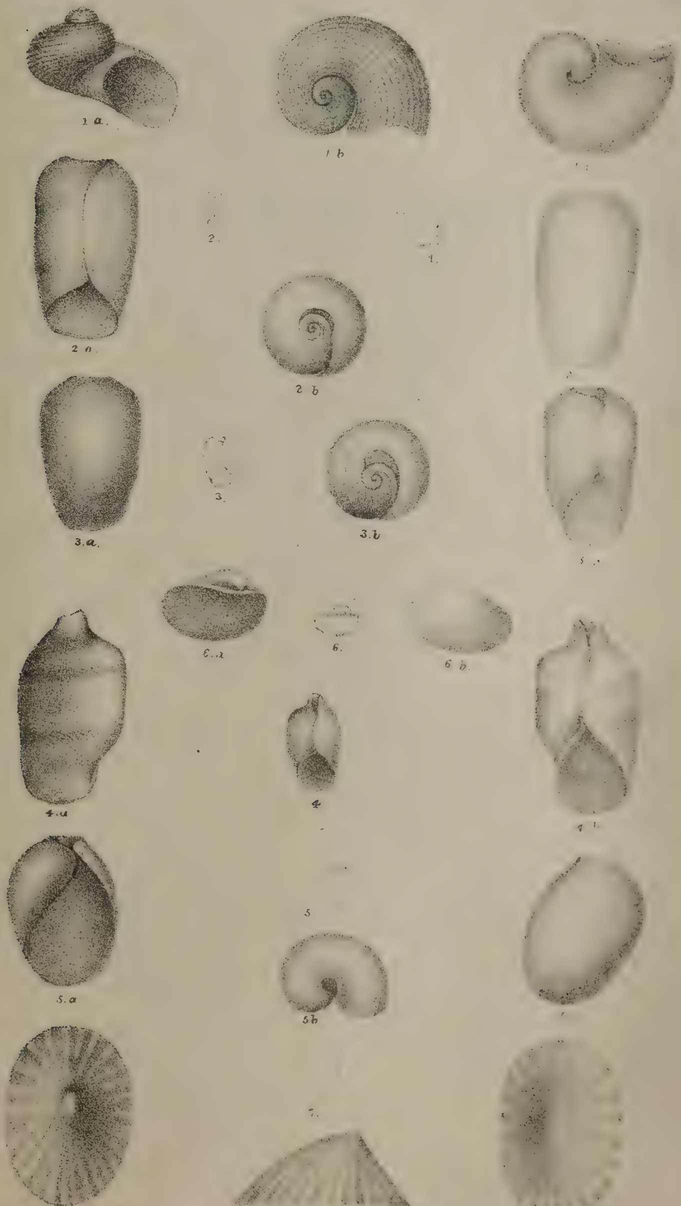


Membranipora Bengalensis, Stol.



1. [illegible] sub-disjuncta, H. Ad.
2. Cylindrobulla pusilla, Nev
3. " sculpta, ,,
4. Oxynoe cincta. Nev
5. " delicatula, ,,
6. Lobiger viridis, ,,
7. Broderipia eximia, Nev.