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The Fauna and Geography of the Maldive and Laccadive Archipelagoes

Being the Account of the Work carried on and of the Collections made by an Expedition during the years 1899 and 1900

Edited by

J. STANLEY GARDINER, M.A.

Fellow of Gonville and Caius College and late Balfour Student of the University of Cambridge.

VOLUME II. PART III.

With Plates XLIX—LXVI.

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CONTENTS OF VOL. II. PART III.

Reports.

MARINE CRUSTACEANS.

XII. ISOPODA, WITH DESCRIPTION OF A NEW GENUS.

By the Rev. T. R. R. Stebbing, M.A., F.R.S., Sec. L.S.

(With Plates XLIX.—LIII.)

This small collection of Isopoda was entrusted to me for identification and description by my friend Mr L. A. Borradaile, M.A., F.Z.S., of Selwyn College, Cambridge. Of the fourteen species contained in it eight appear to be new, and for some of those which are not new the collection has supplied information likely to be of service. Especially attention may be called to the opinion expressed about Dana's genus *Corallana*, that opinion, if correct, involving the transfer of several species from Dana's genus to a new one named *Excorallana*.

FLABELLIFERA.

Flabellifera, 1882, Sars, *Forh. Selsk. Christian.*, No. 18, p. 15; 1893, Stebbing, *History of Crustacea*, p. 330; 1897, Sars, *Crustacea of Norway*, Vol. II. Pt. 3, p. 43; 1901, Harriet Richardson, *Proc. U.S. Mus.* Vol. XXIII. p. 505.

Sars observes that 'the tribe includes six very distinct families, viz. *Anthuridae*, *Gnathiidae*, *Cymothoidae*, *Serolidae*, *Sphaeromidae*, and *Limnoriidae*; but of these the third has generally been again subdivided into six families, viz. *Aegidae*, *Cirolanidae*, *Corallanidae*, *Alcironidae*, *Barybrotidae*, and *Cymothoidae*, thereby increasing the number of families to no less than eleven in all.' That the existing classification requires to be slightly modified will be argued in the following pages. The number of the families, however, will not be altered, and species representing six of them will have to be considered.

Fam. **Anthuridae.**

In Willey's *Zoological Results*, Part 5, pp. 618—620, 1900, I have rather fully discussed the history of this family from its institution by Leach in 1814 to the end of the nineteenth century, and am unwilling therefore to repeat what has been so recently published.

The resemblance that often exists between some at least of the limbs in species of this family and those in the Cryptoniscus-stage of the *Epicaridea* is perhaps not unworthy of remark.

A single specimen, about 6 mm. long, of a species apparently belonging to *Anthura* or *Cyathura*, was 'found on the back of a teat-fish at Minikoi.' As the specimen had gone dry, it seemed expedient to wait for further material before attempting to give this form its place in classification.

Gen. *Calathura*, Norman and Stebbing.

Calathura, 1886, Norman and Stebbing, *Trans. Zool. Soc. London*, Vol. XII. Pt. 4, p. 122; 1893, Stebbing, *History of Crustacea*, p. 332; 1897, Sars, *Crustacea of Norway*, Vol. II. Pt. 3, p. 44; 1901, H. Richardson, *Proc. U.S. Mus.* Vol. XXIII. p. 509; 1901, Axel Ohlin, *Bihang till K. Svenska Vet.-Akad. Handlingar*, Vol. XXVI. Pt. 4, p. 17.

The genus was instituted to receive *Anthura brachiata*, Stimpson, of which *Paranthura norvegica*, Sars, and *Paranthura arctica*, Heller, were considered to be synonyms. Sars in 1897 maintains the distinctness of his *C. norvegica*, which Ohlin in 1901 refuses to admit. The *C. affinis* of Bonnier belongs, as I have earlier argued, rather to *Paranthura* or *Leptanthura*. In 1901 Miss Richardson added a new species, *C. crenulata*, from the Bahamas and Yucatan. If we admit the presence of eyes in *C. brachiata*, as affirmed by Harger and Heller and Sars, but denied by Ohlin, the species of the genus may be distinguished as follows:—

1	Eyes wanting.	1. *C. norvegica*, Sars.
	Eyes present.—2.	
2	Eyes feebly developed, with pigment white.	2. *C. brachiata* (Stimpson).
	Eyes well developed, with pigment black.—3.	
3	Head only half as long as first peraeon-segment.	3. *C. crenulata*, Richardson.
	Head much longer than half the first peraeon-segment.	4. *C. borradailei*, n. sp.

It is not altogether improbable that the second species which Haswell referred to his genus *Haliophasma*, namely *H. maculatum*, may when more fully described have to be transferred from that genus to *Calathura*.

1. *Calathura borradailei*, n. sp. Pl. XLIX A.

Head with distinct rostral point, the lateral angles strongly produced. Segments of peraeon stout, apparently not carinate at the sides, the first as usual closely attached to the head, and the second distally narrowed, the seventh segment much the shortest. Segments of the pleon all distinct. The long narrowly oval telson has the apex fringed with setae nearly as long as itself, with scarcely perceptible crenulation. There is no appearance in it of 'statocysts' such as those described in *Anthura gracilis* by A. Thienemann (*Zool. Anzeiger*, Vol. XXVI. May 8, 1903).

The eyes are black, subtriangular, with the apex upward, situated near the antero-lateral angles of the head, which are rounded, not acute as they appear in a dorsal view.

The first antennae have the first joint of the peduncle longer than the other two combined, and a flagellum of twenty-one joints, the first seven stout, the rest filiform. The second antennae have a long second joint between two shorter joints, the fourth much longer than the third, and the fifth as long as the second. The flagellum, fringed with short setae, is composed of twenty-two joints.

The horny-pointed mandibles have the third joint of the palps the longest and probably armed with spines, though they were not actually seen. The second maxillae are evidently present, very slender, armed with long setae, and joining with the lower lip and maxillipeds to form a tube. In the maxillipeds it is difficult to determine whether that which Sars claims as the very short first joint of the palp may not be the base of the large joint

which he makes the second. Should that be so, the palp in *Calathura* will be not three-jointed, but, in accordance with Harger's view, two-jointed.

The first gnathopods are robust, but so provided with lobes and grooves that the various joints may be compactly folded together. As usual the fourth joint is broad, and the fifth very small, resting on the boss which projects at the base of the palm. The sixth joint is massive, with the convex front margin longer than the hinder one, which differs from what is found in the other species by forming a convex instead of a concave palm. This is bordered with spinules and flanked with setae projecting from the surface on either side. The finger is long and curved.

The second gnathopods were mutilated, wanting the last three joints, but they were evidently in agreement with the first peraeopods, which have the fifth joint very small, triangular, underriding the narrowly oblong oval sixth joint. The latter is fringed along the hind margin with setae and six spines, which are followed near the junction with the finger by a series of trifurcate spines. The finger has some little stiff hairs along the inner margin and many setules on the convex outer margin. It ends in a spine and a small nail.

The remaining peraeopods are more slender, and have the fifth joint attached end to end to the neighbouring joints, attaining its greatest length in the fourth pair. The second and third pairs are the shortest. In all the finger is shorter than the sixth joint.

The pleopods have the inner branch narrowly oblong. The male appendage of the second pair reaches beyond the branches and is slightly widened at the apex.

The uropods appear nearly to resemble those of *C. crenulata*, but to be fringed with much longer setae. The upper ramus, however, though elongate, does not reach beyond the basal joint of the lower one. The terminal joint of the latter is only a third as long as the basal. There seems to be a short peduncle distinct from the rami. The specimen in spirit had a few brown spots and stellate markings on a light ground.

Length of the specimen in strongly curved position 6 mm.; actual length about 10 mm.

Locality. A single specimen, male, taken at 23 fathoms depth, on hard ground, in Fadifolu Atoll.

The specific name is chosen out of respect to Mr L. A. Borradaile, the zealous carcinologist, through whom the present collection of isopods was entrusted to me.

Fam. **Cirolanidae.**

For the bibliography of this family reference may be made to Willey's *Zoological Results*, Part 5, p. 628, 1900, and *South African Crustacea*, Part 2, p. 49, 1902.

2. *Cirolana sulcaticauda*, n. sp. Pl. XLIX B.

This small species belongs to the group in which the angles of the fifth pleon segment are enclosed by those of the fourth, and in which the hind limbs are not adorned with long setae. By the longitudinal medio-dorsal furrow of the telsonic segment its close approximation to *C. sulcata*, Hansen, is established. In other respects the pleon clearly separates the present from the South African species.

The first segment of the peraeon is much the longest, the last three are somewhat transversely rugose, with a line of tubercles adjacent to the hind margin. The first two segments

of the pleon are short and smooth; the following three have each three conspicuous tubercles, of which the middle one is the largest. In a lateral view the large median tubercle of the fifth segment has the appearance of a great boss overhanging the telsonic segment. The latter, though like *C. sulcata* furrowed down the centre between two tuberculate carinae, differs by the greater parallelism of these keels which in the other species bend towards one another at each extremity. Here the telson has eight spines at the apex instead of six; its convergent sides are ridged, but not notched near the base. The setae are plumose.

The eyes are dark, of moderate size. The first antennae have the peduncle clearly three-jointed, especially on the under side; in the short six-jointed flagellum the first joint is considerably the longest. The second antennae have a peduncle as long as the first antennae, its first three joints subequally short, the fifth a little longer than the fourth; the thirteen-jointed flagellum rather longer than the peduncle.

The frontal lamina has its apex rounded, the sides converging slightly to the short wide epistome. The upper lip has the lower margin slightly concave. The spines of the mandibular palp are short, finely denticulate. The inner plate of the first maxillae carries three short hirsute setae. The plates on the second joint of the maxillipeds are held together by two pairs of hooked spines; the fourth joint is short, the seventh narrow.

The first gnathopods have five stumpy spines on the hind border of the fourth joint; the fifth scarcely asserts its existence except by a blunt projection of its hind margin; the sixth has two blunt spines; the finger is tolerably stout with a well pronounced nail.

In the following limbs the fifth joint successively gains in prominence, till in the fifth peraeopods it is subequal to the fourth or sixth. In the hind limbs the fourth and fifth joints carry some long spines which are finely serrate.

In the second pleopods the male appendage is rather longer than the ramus to which it is attached. The rami of the uropods are fringed with spines and plumose setae, the setae at the apical notched angles being the longest. The inner ramus is very broad, reaching beyond the outer one and the telson.

The specimen was 5 mm. long, with a breadth of about 2 mm.

Locality. The single specimen, a male, was taken at Hulule, along with some of Dana's *C. latistylis.*

The specific name is chosen to call attention to the relationship between this and the species with which it has been compared.

3. *Cirolana latistylis*, Dana.

Cirolana latistylis, 1853, Dana, *U.S. Expl. Exp.*, Vol. XIII. p. 772, Pl. 51, fig. 6 *a—c*; 1884, Miers, *Report Zool. H.M.S. Alert*, pp. 303, 304; 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Part 3, p. 356; 1897, Whitelegge, *Mem. Australian Museum*, Vol. III. Pt. 2, p. 149; 1900, Borradaile, *Proc. Zool. Soc. London*, p. 797.

'Body smooth, naked, but slightly interrupted at base of abdomen. Head transverse, anteriorly rounded, not longer than next segment. Abdomen six-jointed; first segment nearly concealed under the thorax; caudal segment subtriangular, a little oblong, broadly rounded at extremity and crenulate, and ornate with spinules and shortish hairs. Caudal appendages not reaching beyond line of abdomen, inner lamella broadly subovate, having crenulations, spinules, and hairs like the caudal segment; the hairs not half as long as the lamella; outer lamella

considerably the shorter and half narrower.' This description given by Dana agrees excellently with our specimens, except that in them the inner ramus of the uropods extends slightly beyond the telsonic segment, and the outer ramus is as in Dana's own figure a little over half as broad as the inner. The hind margin of the head is concave. The second and third segments of the peraeon are rather shorter than the rest. The eyes are large, black, wide apart, so that their size is more apparent in a ventral than a dorsal view.

The upper antennae are separated only by the meeting apices of the head's underfolding triangular rostral point and the pentagonal frontal lamina. The first two joints of the peduncle are only faintly separated, and the third joint is subequal in length to the two combined; the first joint of the nine-jointed flagellum is much shorter than the second, the whole reaching a little beyond the peduncle of the second antennae. In these the first three joints are short, the fifth slightly longer than the fourth, the elongate flagellum in the specimen examined consisting of 21 joints.

The mouth-organs are characteristic of the genus.

The limbs are of the same general type as in the preceding species, the sixth joint in the first gnathopod is considerably broader than in the two following pairs of legs. Dana observes that 'the fourth joint of the third pair is a little shorter than either the third or fifth pairs, and longer than the tarsus.' In our notation this should read that the fifth joint is a little shorter than the fourth or sixth, and longer (but only a little longer) than the seventh.

In the telsonic segment there are four spines on each side of the bifid apical point.

Colour (in spirit) light, with brown speckling of very variable density.

Length 5 mm. by a breadth of 2 mm. or a little over. Dana gives the length as three lines, which would be something more than 6 mm.

Locality. North Malé Atoll, 35 fathoms, hard sand; Hulule; Suvadiva Atoll, 44 fathoms, hard muddy bottom; Kolumadulu Atoll, 38 fathoms, mud and weed.

Dana obtained the species from Straits of Balabac, north of Borneo, Whitelegge from 'sponges in sandy pools' at Funafuti Atoll, Borradaile also from Funafuti, 'three examples found on weed in the lagoon, one dredged in the lagoon in 15—25 fathoms of water.'

A specimen from Minikoi, noted as an 'Isopod living in tentacles of large tubicolous worm (Polychaeta 4),' measured 5 mm. in length, by only 1·25 mm. in breadth. But after drawing and dissecting it I could find no character but the narrowness to separate it from Dana's species. It was a female, but not carrying eggs or young. The marsupial plates have the hind margin cut into a fringe.

Fam. **Corallanidae.**

Corallanidae (part), 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Pt. 3, p. 280; *Alcironidae*, 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Pt. 3, pp. 285, 312, 390; 1893, *Corallanidae* (part), Stebbing, *History of Crustacea*, p. 345; *Alcironidae*, 1893, Stebbing, *History of Crustacea*, p. 346; *Corallanidae* (part), 1901, Richardson, *Proc. U.S. Mus.*, Vol. XXIII. p. 517; *Alcironidae*, 1901, Richardson, *Proc. U.S. Mus.*, Vol. XXIII. p. 519.

In 1895 Dr H. J. Hansen reduced these two families to the rank of subfamilies. Whatever the systematic dignity allowed them, they must, I think, be united. Were the Alcironidae independent that group would more properly take its name from *Tachaea* of Schiödte and Meinert,

that genus being older than *Alcirona* and *Lanocira*, both instituted by Hansen in 1890 to be its companions. At the same date that author beautifully illustrated and described with his accustomed clearness seven species from western waters, which he assigned to Dana's genus *Corallana*. Miss Harriet Richardson in 1901 added to this set an eighth species from Florida. Hansen had further noted eleven species earlier than his own as with more or less probability belonging to the same genus or at least to the same family. One of them, however, is *Corallana hirticauda*, the single species on which Dana founded his genus. Although the description does not satisfy all modern requirements it enables the species when obtained to be recognized, and the conclusion cannot be escaped that its generic character is distinct from that of the species assigned to *Corallana* by Hansen and Richardson. These, accordingly, I have referred to a separate genus *Excorallana*, distinguished by the great length of the apical tooth of the mandibles, the bifid termination of the second maxillae, and the elongate antepenultimate joint of the maxillipeds. The true *Corallana* agrees with *Tachaea*, *Alcirona*, and *Lanocira*, in not having the point of the mandible very strongly produced, in having the apex of the second maxillae simple, and in having the antepenultimate joint of the maxillipeds not longer than broad. Hansen's definition of the *Alcironidae* appears very well to suit the *Corallanidae*, taken to include the above-named four genera, but excluding *Excorallana*, which will become the representative of a family *Excorallanidae*.

Gen. *Corallana*, Dana.

Corallana, 1853, Dana, *U.S. Expl. Exp.*, Vol. XIII. pp. 748, 773; 1879, Schiödte and Meinert, *Naturhist. Tidsskrift*, Ser. 3, Vol. XII. p. 286.

Schiödte and Meinert, in their treatise *De Cirolanis Aegas simulantibus*, group together *Barybrotes*, *Tachaea*, new genera, with Dana's *Corallana*. The first of these was placed by Hansen in a separate family, *Barybrotidae*. To the third the joint authors assigned six species, one of them being Heller's *Aega basalis* from the Nicobar Islands, the remaining five (of which four were new) having all been found at Ubay in the Philippines. Two of their species they distinguished as *Corallana hirticauda*, Dana, and *Corallana hirsuta*, n. sp. Their figures and descriptions leave no doubt in my mind that they have had before them the original species for which the genus was instituted

For distinguishing this genus from the other members of the family it is convenient to remember that *Alcirona* alone has the apex of the outer plate in the first maxillae armed with two spines, that *Tachaea* alone has the joints of the maxillipeds reduced to six, apparently by coalescence of the second and third, and that in *Lanocira* the second joint of the maxillipeds (leaving out of count the expansion in the female) is very little longer than broad, but very much longer than broad in *Corallana*.

4. *Corallana hirsuta*, Schiödte and Meinert. Pl. L B.

Corallana hirsuta, 1879, Schiödte and Meinert, *Naturhist. Tidsskr.*, Ser. 3, Vol. XII. pp. 287, 297, Pl. 5, figs. 11, 12.

Dana, in describing *Corallana hirticauda*, from the coral reefs of Tongatabu, writes as follows:—'Body moderately narrow, posterior half of back to extremity of abdomen hirsute. Head a little transverse. Eyes large. Antennae very unequal; second pair long, reaching to fifth segment of thorax; flagellum about eighteen-jointed; first pair not much longer than

base of second. Abdomen six-jointed, last segment triangular; sides straight; extremity rounded. Caudal stylets not extending beyond abdomen, branches obtuse, outer much the narrower, not longer than the inner. Feet short setulose.'

Neither in this nor in the much fuller account given by Schiödte and Meinert can I find any character except one to justify the separation of their *C. hirsuta* from Dana's *C. hirticauda*. Dana says that the outer branch of the uropod is 'not longer than the inner,' and figures it as somewhat shorter. Schiödte and Meinert say that the inner branch is scarcely shorter than the outer, implying that the outer if anything has the advantage, which in their figure they give it very decidedly. But on the other hand they say that in their own *C. hirsuta* the inner branch is much shorter than the outer. This again is borne out by their figure and corresponds with what is observed in the specimens of the present collection. All of them appear to have this particular feature, so that with reluctance I allow them to stand under the name which separates them from Dana's original species.

The body is depressed, so that here, as in other species of the genus, it shows the side-plates even in a dorsal view. The very hirsute telsonic segment has bisinuate sides converging to a rather broad slightly convex apex which carries eight spines.

The first antennae are prominent and contiguous at the base, with a broad, not very long, composite basal joint, only a little longer than the next or true third joint. The flagellum has 11 joints, most of them carrying sensory filaments, the first joint much shorter than the second. The second antennae have the first three joints very short, the fourth subequal in length to the fifth, widest at its base, this character appearing in both sexes and the young, but most developed in the male. The joints of the flagellum numbered 21 in one male specimen, but only 15 in another, 20 in a female, 14 in a little young specimen.

The mandibles end in a short uncinate tooth accompanied by a small trifid plate; there is a slight marginal prominence, perhaps representative of a vanished molar; the second joint of the palp is the longest, both this and the third being in the distal part fringed with setiform spines.

The first maxillae have a narrow inner plate, slightly expanded at its apex; the outer plate ends in a strong unciform tooth.

The second maxillae are feeble, simple, with narrowly rounded apex.

The maxillipeds are narrow, only the second joint elongate, the fourth and fifth with length and breadth subequal in the male but broader than long in the female, the sixth and seventh joints small in both sexes.

The first gnathopods are short and stout, with four robust spines on the fourth joint, between which and the sixth joint the fifth makes very little show. The spines on the sixth joint are not robust. The finger is curved with a strong unguis.

The second gnathopods have the fifth joint very short but quite distinct, being otherwise very similar to the first gnathopods.

The first peraeopods are very like the second gnathopods. In the following pairs the fifth joint attains greater importance, and the joints from the third to the sixth have longer spines and a greater variety. In the last three pairs the fifth joint carries several spinose spines on the apical border.

The very broad inner ramus of the uropods in addition to numerous setae carries nine spines on the broadly rounded distal margin. The longer but very much narrower outer ramus has a fringing of long setae with spines at intervals, the apex subacute.

Colour, a pale ground sometimes strongly marbled with dark-brown stellate flecks, sometimes carrying only more or less distant spots of brown.

Length. A specimen here and there a little exceeded the length of 10 mm., but as a rule specimens, even those loaded with young ones, did not reach fully 9 mm. Dana gives the length of his species as nearly five lines, which may be reckoned as equivalent to 10 mm. Schiödte and Meinert describe an ovigerous female of Dana's species, which was 6·5 mm. long. Of their own species the ovigerous female described was 8·5 mm. in length, and the 'virgo' 9—9·5. As they had two specimens of the latter form, it may be inferred that they differed slightly in size. In their 'conspectus specierum' these authors distinguish *C. hirticauda* as having 'Cauda media obscure bisulcata vel subaequata' and 'Oculi aequati vel subaequati' from *C. hirsuta*, with 'Cauda media manifesto bisulcata' and 'Oculi manifesto granulati.' In the present collection the bisulcation of the pleon is quite obscure, but whether the eyes are less granular than in Schiödte and Meinert's specimens I have no means of determining.

Locality. Minikoi, from rotten log in the lagoon, some of them marked as coming from borings (possibly of *Teredo*) in the rotten wood. With them were some specimens of *Limnoria*.

Gen. *Lanocira*, Hansen.

Lanocira, 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Pt. 3, pp. 287, 313, 391, 395; 1893, Stebbing, *History of Crustacea*, p. 346.

Hansen, having only a single species at command, notes that in this genus, as distinguished from *Alcirona*, the hinder part of the body is naked, that is to say, not setigerous. But this character is not applicable to the new species about to be described.

5. *Lanocira gardineri*, n. sp. Pl. LI A.

The head (at least in the adult male) has the front upturned into a little horn, and near the hind margin, adjacent to the rather large dark eyes, there are a pair of tubercles. The appearance is therefore something like that of *Excorallana tricornis* (Hansen). The first segment of the peraeon is considerably the longest, the seventh the shortest. The front side-plates are rounded behind, the three hinder pairs somewhat quadrate and obliquely ridged. The first segment of the pleon is medio-dorsally obsolete; the fifth has its angles a little produced but flanked by those of the fourth segment. The telsonic segment has the sides very slightly sinuous, fringed with setae, and converging to a rather broad truncate apex carrying plumose setae and six spines. The dorsal surface of this segment is armed with twenty-six rather spine-like setae, and there are a few on other parts of the back.

The first antennae have the first and second joints coalescent, lying under the projecting front of the head, the third joint a little shorter than the composite one, the six-jointed flagellum shorter than the peduncle, and the whole appendage not longer than the peduncle of the second antennae. This is robust, with the first three joints together equalling the stout but not very elongate fourth, the fifth shorter and much narrower than the fourth. The flagellum, slightly longer than the peduncle, has numerous setae on the first seven of its thirteen joints.

The frontal lamina is pentagonal. The mandibles, as usual in this family, are very firmly attached to the lower lip, and have their free ends closely clipped in by the short upper lip. The trunk of the mandible, besides having a curved margin, makes a rather strong bend of the whole plate near the narrowed centre. The apex has no well-defined uncinate tooth as in *Corallana* and *Excorallana*, but some ill-defined dentations, accompanied by a row of spine-teeth, which on one of the mandibles point backward. The palp is attached near the base, and has the middle joint the longest.

The outer plate of the first maxillae ends in a single, very long, strongly curved spine, which is only seen in its natural shape when the trunk of the maxilla is set more or less edgewise.

The second maxillae are nearly as in *L. kröyeri*, Hansen, the broad 'lacinia of the second joint' being surmounted by an almost linear third joint which here carries a short seta in addition to the long one described for *L. kröyeri*.

The maxillipeds have the second joint a little longer than wide, the third, fourth, and seventh joints small, and the fifth and sixth not very large.

The first gnathopods have the second and third joints channelled, the third carrying a long spine on the front apex and a stout one on the hinder, the fourth joint is bordered with five stout spines, the apical much the largest; the fifth joint is hidden between its neighbours; the sixth is not strongly armed; the finger is large, and by help of its long nail strongly curved. The second gnathopods scarcely differ from the first in structure, except that the fifth joint is rather more conspicuous. The first peraeopods are like the second gnathopods. The four following pairs are successively longer, otherwise agreeing closely together in structure, the second joint broad, broadest in the fourth peraeopods, the fourth joint with the hind apex broadly produced, the third to the sixth but especially the fifth furnished with numerous spines on the apical border, the sixth joint short, a little longer than the strongly curved finger.

In the second pleopods the male appendage has an acute apex, not nearly reaching the end of the ramus.

The inner branch of the uropods reaches beyond the telsonic segment; it is fringed with plumose setae and has nine spines on the broadly rounded distal margin. The much narrower outer ramus does not reach beyond the telsonic segment; it carries eight spines among a fringing of long setae.

The colour is light, speckled with scattered flecks of brown.

Length a little under 7 mm., by a breadth of nearly 3 mm. Another specimen, smooth-headed, but apparently of the same species, was 4·5 mm. long by 2 mm. broad.

Locality. Mahlosmadulu Atoll, at 20 fathoms, on coarse sand and rubble.

The species is named out of respect to Mr Stanley Gardiner, by whom it was obtained.

6. *Lanocira rotundicauda*, n. sp. Pl. L A.

There is so much resemblance between this and the preceding species that, when the points of difference have been noticed, the question will still remain whether they may not possibly depend on difference of sex and age in the specimens examined.

The form about to be described was a female carrying numerous young ones, with their dark eyes showing conspicuously through the marsupium.

The head is smooth, the telsonic segment is broadly rounded, not at all apically truncate dorsally sprinkled with setiform spines, which seem to be less stiff than those in the other species and not arranged in the same order. Round the apical border the armature was for the most part worn away, but in the young there are six spines with intervening setae just as in *L. gardineri*.

The first antennae have a five-jointed flagellum, its first joint much the longest, the last two minute, as is the case in the young taken from the marsupium.

The second antennae are not specially robust; the flagellum is thirteen-jointed.

The mouth-organs do not give much assistance, because as shown in the figure the first maxilla of the young one is normal, as was also the case with a larger juvenile specimen not taken from the pouch of the mother, but this organ in the mother itself has a comparatively short terminal hook and a short oval inner plate. This form of the first maxilla is probably therefore a casual abnormality. The maxillipeds are very short, with the vibratory plate of the second joint extending to the top of the sixth joint. In the maxillipeds of the juvenile specimens there is nothing to show that the shortness of these appendages is abnormal, but as they are without the vibratory plate of the female comparison is not easy.

The peraeopods are rather more slender than in *L. gardineri*.

Length 5·25 mm., by a breadth of 2 mm. There were also two small specimens, each under 3 mm. long.

Locality. Mahlosmadulu Atoll, taken along with *Lanocira gardineri* at 20 fathoms.

L. kröyeri, Hansen, the type species of the genus, from Rio Janeiro, among other differences has only four spines on the apical margin of the telsonic segment.

Gen. *Alcirona*, Hansen.

Alcirona, 1890, Hansen, *Vid. Selsk. Skr.*, Ser. 6, Vol. v. Pt. 3, pp. 285, 313, 391; 1893, Stebbing, *History of Crustacea*, p. 346.

This genus is well characterized by the very broadly crescentic epistome, the elongate peduncle of the second antennae, and the two-spined apex of the first maxillae.

To the two species for which it was instituted by Hansen, a third is now added. The three may be distinguished as follows:

1	Hinder part of body remarkably setose.	1. *A. krebsii*, Hansen.
	Hinder part of body very moderately setose.—2.	
2	First gnathopods with robustly pectinate finger.	2. *A. insularis*, Hansen.
	First gnathopods with the finger simple.	3. *A. maldivensis*, n. sp.

7. *Alcirona maldivensis*, n. sp. Pl. LI B.

The head is smooth, with a rather blunt rostral point. At the centre of the back the fourth segment of the peraeon is nearly as long as the first, and the seventh not much shorter than the fourth. The first two segments of the pleon are much concealed, the first, however, though very short at the middle is not at that part obsolete as in the species of *Lanocira* here described. The angles of the fourth segment are strongly produced, outflanking the rounded slightly produced corners of the fifth segment. The telsonic segment has the sides

slightly bisinuate, strongly convergent to an apex of very moderate breadth, with four spines on what may be called the truncate part, but another on each side not quite in line with the four, yet completing the series. The distal part of the whole margin is fringed with rather short setae and about eighteen are sprinkled on the surface.

The eyes are large and dark. The first antennae have the third joint at least as long as the composite first and second. The ten- or eleven-jointed flagellum is rather longer than the peduncle, and the whole appendage longer than the peduncle of the second pair. In that the fourth joint is longer than the first three combined, the fifth considerably longer than the fourth, the eighteen-jointed flagellum a good deal longer than the peduncle.

The frontal plate is pentagonal. The epistome stretches on either side much beyond the short and narrow upper lip. The mandibles as mounted *in situ* with their cutting edges under the lip appear to be much like those in *Lanocira*. The first maxillae have a slender, blunt-headed inner plate, and two strong spine-teeth at the apex of the outer plate. The second maxillae end in a smooth ovoid joint with the narrow end uppermost. The maxillipeds are short and compact, a little more robust and with a larger seventh joint than in the female *Lanocira rotundicauda*.

The limbs of the peraeon differ little from the pattern of those in the preceding genus, except that the hinder peraeopods are more slenderly built, with the apical spines of the sixth joint more strongly spinose, and the sixth joint more elongate.

The inner branch of the uropods reaches considerably beyond the telsonic segment. It is fringed with nine spines and numerous setae. The outer ramus is much shorter and much narrower, with eight spines and many setae. Each ramus has a little notch, clearly apical in the outer one, and occupying the outer angle of the inner one.

Colour, light with brown speckling.

Length, about 5 mm., by a breadth of about 2·5 mm.

Locality. Hulule, Maldive Islands. A single specimen, female with young.

Specific name from the locality. Hansen's *A. krebsii* was from the West Indies, his *A. insularis* from Samoa.

Fam. **Cymothoidae.**

For the limitation and extension in which this family is accepted I may refer to the discussion of the synonymy in *South African Crustacea*, Part 1, p. 55, 1900.

Gen. *Cymothoa*, Fabricius.

Cymothoa, 1793, Fabricius, *Entomologia systematica*, Vol. II. p. 503; 1884, Schiödte and Meinert, *Naturhist. Tidsskr.*, Ser. 3, Vol. XIV. p. 223.

The synonymy of the genus could be produced to a considerable length, but would be inappropriate here.

8. *Cymothoa borbonica*, Schiödte and Meinert, 1884.

Cymothoa borbonica, Schiödte and Meinert, *Naturhist. Tidsskr.*, Ser. 3, Vol. XIV. pp. 226, 282, Pl. X. figs. 7–10.

As the present collection includes only two of the small males, this identification may remain open to some question. The head has the incurved, broadly rounded front described by the above-named authors, but the eyes which they speak of as 'evanidi,' are rather large and though dull fairly conspicuous. The first antennae are well separated at the base, eight-jointed, equal in length to the much more slender, nine-jointed second pair. The anterior margin of the first peraeon segment is not so markedly trisinuate as figured in the *Tidsskrift*, and the telsonic segment there spoken of as sulcate in the middle shows in our specimens a slight transverse depression near the base but no longitudinal furrow. It is, as Schiödte and Meinert say, a little wider than the fifth segment of the pleon, but this is in contradiction to the character which they give of their sub-family *Cymothoinae* (*op. cit.* p. 222), in which they say that the pleon has the fifth segment broader than the terminal one. Their statement that the uropods are much shorter than the telsonic segment is quite opposed to their figure, which shows them not at all shorter. In our specimens the difference in length is very small. The rami of the uropods agree with the description by the joint authors, both being obtuse-ended, the outer a little the longer, slightly curving inward, the inner a little the broader.

The male appendage of the second pleopods is stiliform, reaching a little beyond the very broad rami.

Colour, pale, with dark dots minute and distant, little affecting the general appearance.

Length of one specimen 10 mm., breadth 3·75 mm., of the other 8 by 4 mm. Schiödte and Meinert give the length 11·5—14 mm. The breadth, 'duplo longior quam latior,' does not correspond exactly with the figure, which is more than twice as long as the greatest breadth, so that the relation of length to breadth may be taken as to some extent variable.

Locality. Hulule, from 'Gills of large Parrot-fish.'

Fam. **Sphaeromidae.**

References to the literature of this family, with some remarks on the still rather obscure boundaries of the included genera, are given in the *Proc. Zool. Soc. London*, p. 552, 1900; in Willey's *Zoological Results*, Part 5, p. 643, 1900; and in *South African Crustacea*, Part 2, p. 64, 1902. From the Malay Peninsula Mr W. F. Lanchester has recently described a new species under the name *Sphaeroma felix*, in *Proc. Zool. Soc. London*, p. 379, pl. 35, fig. 10, 1902. The character of the maxillipeds is not specified.

Gen. *Exosphaeroma*, Stebbing.

Exosphaeroma, 1900, Stebbing, *Proc. Zool. Soc. London*, p. 553; 1902, *South African Crustacea*, Part 2, p. 64.

Sphaeroma serratum (Fabricius), for which the genus *Sphaeroma* was instituted by Bosc, has the maxillipeds differently constructed from those of almost all the later species, in regard to which these appendages have been described, for, while in those species the fourth, fifth and sixth joints are all produced into conspicuous lobes on the inner side, in the original species there are no such lobes. The species now to be noticed has the fourth and fifth joints very slightly lobed, but the sixth not at all. It therefore occupies an intermediate position between *Exosphaeroma* and *Sphaeroma*, yet so much nearer to the former than to the latter that it cannot well be left in the genus to which Dana assigned it.

9. *Sphaeroma* [*Exosphaeroma*?] *globicauda*, Dana.

Spheroma globicauda, 1853, Dana, *U.S. Expl. Exp.*, Vol. XIII. p. 781, pl. 52, fig. 9 *a*, *b*.

Dana gives the following description:—'Body nearly smooth, in part very fine granulous and pubescent. Abdomen subtriangular, very tumid, excepting the parts towards the margin around; at extremity a deep fissure, which at its inner end is produced a short distance transversely in either direction. Caudal appendages reaching slightly beyond line of abdomen; inner lamella the broader and slightly the longer, broadly rounded at apex; outer having the outer margin much reflexed.' Then, after stating that the habitat was 'Nassau Bay, Fuegia,' he adds:—'Length of body, two and a half lines. The fissure in the extremity of the abdomen is of peculiar depth and shape; the part of the surface of the abdomen anterior to its inner extremity is a little raised, independently of the general globose elevation which characterizes the whole segment anterior to this raised point. The minute hairs of the surface and slight granulation are seen with a lens most distinctly on the caudal segment.'

Specimens from the lagoon at Minikoi agree so well with this account that nothing but the difference of size, which in them scarcely exceeds 3 mm., could cause any doubt as to the identity of the species. An examination, however, of what may confidently be regarded as the sexes of one and the same species leads to the conclusion that the aperture in the telsonic segment belongs only to the male. It is probably a character of the adult, since all the smaller specimens as well as the female carrying young are devoid of this transversely rounded opening. *Cymodoce cordiforaminalis*, Chilton, has the aperture of a rather different shape, but is otherwise a species so similar to the present that it will be interesting to learn whether it exhibits the same sexual difference.

The head has a blunt rostral point between two emarginations. In the male the seventh segment of the peraeon is slightly indented at the middle of the hind margin, which is smoothly convex in the female. The pleon has a very short first segment overlapped by the peraeon. This segment is closely united to a composite segment, probably representing the second to the fifth, the angles of the fourth and fifth being to a certain extent distinct but strongly overlapped by those of the preceding segment.

The eyes are not very large, but prominent, conspicuously faceted. The first antennae have a stout composite basal joint, followed by a third joint not much longer than broad, and much shorter than the first joint of the eight-jointed flagellum, which exceeds the peduncle in length and has sensory filaments on the terminal joints. What is here regarded as the first joint of the flagellum corresponds with the third joint of the peduncle in Chilton's description.

The second antennae are rather longer than the first, the second joint longer than the first or third, the fourth than the second, the fifth than the fourth, but not 'nearly twice as long' as in Chilton's species. The flagellum is nine-jointed.

The mandibles have a strong molar and tridentate cutting edge with accessory plate and spine-row, and three-jointed palp. The inner plate of the first maxillae is tipped with four setae. But none of the mouth-organs appear to offer any very distinctive features except the maxillipeds. These differ in a marked degree from those of *Sphaeroma serratum*, as also from those of *Sphaeroma rugicauda*, Leach, but neither do they fully agree with those that have been described in any of the species of *Exosphaeroma* or *Cymodoce*. The fourth joint is considerably longer than the fifth, and each of these is distally expanded on the inner side,

but without forming an elongate lobe; the sixth is fully as long as the fifth, but much narrower; it is broader and longer than the seventh, but forms no distal lobe. The armature is feeble, except on the apex of the plate of the second joint.

The anterior limbs of the peraeon are rather robust, the first pair distinguished from the rest by the fifth joint underriding the sixth, its triangular form allowing the fourth and sixth joints to meet on their outer margin. In the more elongated limbs of the last three pairs the fifth joint has its share in the lengthening. In all the limbs the finger has a little hooked spine in advance of the small hooked unguis. The male appendages of the last peraeon-segment are elongate, close together at the base, with their stiliform apices a little divergent.

The male appendage of the second pleopod appears to be of unusual breadth at the base, then tapering to a narrow apex at some distance beyond the plate that carries it. In *Sphaeroma rugicauda* this appendage is very long and has a somewhat widened rounded apex.

In the uropods the movable outer ramus is serrate almost all along the outer margin as well as on the rounded apex, in the ramus coalesced with the peduncle the serration reaches up the outer margin barely halfway. Length 3 mm., by a breadth of 1·5 mm.

Locality. Lagoon, Minikoi, along with a specimen of *Ligia*.

Heller in the *Crustacea of the Novara Expedition*, pl. 12, figures three species each with a foramen in the telsonic segment, which he names respectively *Sphaeroma perforata*, Milne-Edwards, *S. stimpsoni*, n. sp., and *S. scabricula*, n. sp. None of them can be confused with the present species. The first is easily distinguished by the long median tooth of the last peraeon-segment. But it claims attention here as having the same sexual difference in the telsonic segment as our species exhibits. Heller is certainly wrong in attributing the circular aperture to the female and the simply notched telson to the male. He also says that the postero-median tooth of the peraeon is shorter in the male than in the female, as to which the reverse may be taken for granted. But his text is plainly contradicted by the explanation of the plate above cited.

Gen. *Cymodoce*, Leach.

Cymodoce, 1814, Leach, *Edinb. Encycl.*, Vol. VII. p. 433; 1902, Stebbing, *South African Crustacea*, Part 2, p. 73.

The difficulties connected with the definition of this and various other genera of the Sphaeromidae are discussed by Mr Beddard in his *Challenger Isopoda, Reports*, Vol. 17, p. 145. Until a monograph of the family is carried out by some patient and skilful hand these difficulties are likely to remain. The incapacity of the animal to become completely globular, the resistance to complete folding of one plate over the other in the uropods, and the presence of a lobe in the excavated apex of the telson, are superficial characters which do not offer very firm ground for generic distinction. The maxillipeds do not differ from those found in *Exosphaeroma gigas*, and in most of the species which I have assigned to that genus.

10. *Cymodoce bicarinata*, n. sp. Pl. LII B.

The head broad, the first segment of the peraeon the longest, the sides of the body very hirsute, and the hind margins of the segments hairy, the sixth and seventh also tuberculose. In the pleon a small first segment is covered by the peraeon, the composite

segment which follows has on the hind margin two sub-median bosses. These are followed on the telsonic segment by two slightly divergent carinae leading to two very large bosses each carrying a crest of hairs. To them succeeds a large median boss. This is followed by a convex-sided apically truncate process emerging beyond the convergent apices of the telsonic emargination. All these parts are strongly fringed with setae, and distinguish the species from *C. pilosa*, Milne-Edwards, which has an otherwise similar pleon, but ending in an almost cylindrical median plate, rounded at the end and not reaching beyond the two lateral apices. In *C. aculeata*, Haswell, the median plate projects beyond the lateral points, but it is differently shaped, and the bosses on the pleon are arranged transversely, not in successive pairs. In *C. tuberculata*, Haswell, the bosses are successive, but of quite different character, and the apices of the terminal notch project beyond the median process.

The eyes are wide apart, the anterior margin of the first peraeon-segment being deeply emarginate to receive them.

The first antennae have a large, bent, composite basal joint, with the following joint not very large. To the stoutly constructed peduncle succeeds a slender flagellum of 14 joints, of which the first is much the longest. In the second antennae the peduncle is not robust, the fifth joint a little longer than the fourth, the flagellum 17-jointed. In the mandibles the principal cutting edge is horny-looking, not dentate. The palp is rather slight. The maxillipeds have the fourth, fifth and sixth joints fully lobed. As will be seen in the figure the palp on one side of the specimen was in process of regeneration. The limbs of the peraeon are of the character usual in this family. The male appendages of the seventh peraeon-segment are rather long, not very acute. In the second pleopods the male appendage is very long, with its narrow inward-curving apical part reaching much beyond the plate to which it is attached.

The uropods are straight, rather narrow, very setose, the outer ramus more obliquely truncate than the inner, which it outreaches, both extending beyond the telsonic segment, the outer having a prominent spine at the apex of its raised outer border. In *C. longistylis*, Miers, the inner ramus has an outward curve, and decidedly outreaches the outer.

Length, 6 mm., breadth, 3 mm.

Locality. Minikoi, from 5 to 7 fathoms in centre of lagoon.

Specific name referring to the carinae on the pleon.

Fam. **Limnoriidae.**

Limnoriadae, 1850, White (part), *List of British Animals in Brit. Mus., Crustacea*, p. 68 (without definition); *Limnoriidae*, 1880, Harger, *Rep. U.S. Fisheries*, Part 6, p. 371; 1893, Stebbing, *History of Crustacea*, p. 367; 1897, Sars, *Crustacea of Norway*, Vol. II. Part 4, p. 74.

The family, as restricted by Harger, still contains a single genus.

Gen. *Limnoria*, Leach.

Limnoria, 1814, Leach, *Edin. Encycl.*, Vol. VII. p. 433; 1867, Bate and Westwood, *Brit. Sessile-eyed Crustacea*, Vol. II. Part 18, p. 349; 1880, Harger, *Rep. U.S. Fisheries*, Part 6, p. 373; 1897, Sars, *Crustacea of Norway*, Vol. II. Part 4, p. 76.

The full definition drawn up by Professor Sars was probably based on the species *L. lignorum* alone. To include the other species undoubtedly belonging to the genus it requires some slight modification. Thus the epipod of the maxillipeds is not always lanceolate, and the outer ramus of the uropods is not always unguiform. Authors generally (myself included) have agreed in speaking of the trunk limbs as similar in structure, but, while no doubt they have some features in common, especially in regard to the terminal couple of joints, they are at the same time uncommonly well provided with distinguishing points. Between the first gnathopod and the fifth peraeopod the contrast is sufficiently striking.

The four species now known, all of them small, pale, setose, and very much alike in general appearance, may be distinguished as follows:—

1	Maxillipeds with epipod shorter than the second joint, outer ramus of uropods unguiform.	1. *L. lignorum* (J. Rathke), 1799.
	Maxillipeds with epipod longer than the second joint, outer ramus of uropods not unguiform.—2.	
2	Both rami of uropods very small.	2. *L. antarctica*, Pfeffer, 1887.
	Only the outer ramus of uropods very small.—3.	
3	Epipod of maxillipeds narrow, mandibular palp diminutive.	3. *L. segnis*, Chilton, 1883.
	Epipod of maxillipeds broad, mandibular palp well developed.	4. *L. pfefferi*, n. sp.

In the well-known species of the Atlantic coast Harger notices that in the mandibles 'below there is a slight tubercle, apparently the rudiment of the molar process.' His conjecture is supported by the rather stronger development of this tubercle in *L. segnis*. Between the acutely lanceolate epipod of the *L. lignorum*, and the forms with rounded apex in *L. segnis* and *L. pfefferi*, the narrow leaf shape in *L. antarctica* offers an intermediate term. In his elaborate description of the last-named species Dr Pfeffer broaches an extraordinary theory that 'the pleopods in general have not the value of a limb but of an epipod, so that accordingly the branchial plates of the Isopoda like those of the Decapoda are epipods, and therefore in a certain sense equivalent formations.' That this view has met with no acceptance was to be expected.

11. *Limnoria pfefferi*, n. sp. Pl. LII A.

The general appearance in close agreement with *L. lignorum*, like which it has the head almost globular, much narrower than the rest of the body, the first segment of the peraeon much the longest with a conspicuous dorsal V-shaped grooving, the side-plates of the second and third segments quadrangular oval, the four following pairs more or less acute, the upper surface of the body beset with hairs of varying length. In the pleon the angles of the first segment are a little less prominent than those of the four following segments; the fifth at the middle is as long as the first four together, and about half as long as the almost circular, flatly saucer-shaped telsonic segment, with the proximal part of which it shares in forming a smoothly rounded median elevation.

The eyes are wide apart, very small.

The first antennae have the second joint subequal to the third, not shorter as in *L. segnis* and *L. lignorum*, and the second joint of the flagellum is not so abruptly narrower

than the first, as in the latter species. The long olfactory setae are present. The second antennae closely resemble those of *L. lignorum*. The epistome, lips, mandibles, and both pairs of maxillae agree with those of the last-mentioned species. The maxillipeds also are nearly the same in structure, but with a differently shaped epipod. This is little more than twice as long as broad, broadly rounded at both ends, reaching well beyond the long narrow second joint of the maxilliped, the ovoid form impaired only by the lower part of the inner margin being slightly concave. This appendage in *L. segnis* is about four times as long as broad, and is apically acute in the other two species.

The first gnathopods are as usual distinguished from the other limbs by the fifth joint underriding the sixth, and having no free hind margin. Along front and hind margins of the third and along the hind margin of the three following joints small blunt spines are discernible. At the hinder end of the sixth joint there is a prominent spine with a convex comb as in *L. lignorum*, and the finger just above its long curved nail has the well-known bifid spine. The other limbs agree closely in shape and armature with those of the last named species, the first and second peraeopods being the smallest, but distinguished by their position as confronting one another. The fifth peraeopods are the longest, with the second joint much narrower than in the preceding pairs; the fourth joint is produced far over the hind margin of the fifth, the length of its slender spine-fringed process being particularly conspicuous in the new species; the fringe of pectinate spines round the fifth joint is found in all the species. The spine above the finger-nail is bifid only in the first gnathopods. The pleopods except in the last pair have the inner plate narrowly oblong. The male stylet of the second pair I have not observed. Probably, as in the other three species, and as in the genus *Eurydice*, it is affixed near the middle of the inner margin.

The uropods have the inner ramus shorter than the stout peduncle, twice the length of the small straight outer branch, all the constituents being setose. The peduncle is much larger in comparison with the inner ramus than in *L. segnis*.

Length of unrolled specimen 3·5 mm., breadth 1·25 mm.

Locality. Rotten wood in lagoon, Minikoi.

EPICARIDEA.

Epicarida, 1882, Sars, *Forh. Selsk. Christian.*, No. 18, p. 18; *Epicaridea*, 1893, Stebbing, *History of Crustacea*, p. 392; *Bopyridae*, 1895, Hansen, *Isopoden...der Plankton-Exp.*, p. 18; *Epicarida*, 1898, Sars, *Crustacea of Norway*, Vol. II. Pt. 11, p. 193; *Épicarides*, 1900, Bonnier, *Contr. à l'étude des Épicarides les Bopyridae*, p. 90.

Of the seven families recognized by Giard and Bonnier, Sars rejects the Microniscidae, 'as only representing transitory larval stages of different Epicarida,' and combines the Cyproniscidae, Cabiropsidae, and Cryptoniscidae under the last of those names. Bonnier a little later upholds the Microniscidae, and distinguishes in all twelve families.

Fam. **Bopyridae.**

As this is not the place to explain the various extensions and restrictions which authors have assigned to this family name, it will be sufficient to refer to the bibliographical index in M. Jules Bonnier's admirable monograph, *Contribution à l'étude des Épicarides les Bopyridae*.

published in the year 1900, and to the discussion of this group by Professor Sars in 1898. The latter author, while highly commending the services rendered to our knowledge of the Epicaridea by MM. Giard and Bonnier in 1887 and subsequent years, raises a protest against the assumption that the mere statement of the host is sufficient to identify the parasite. He points out that 'one and the same species of Crustacea not seldom is found to be infested by several species of parasites.' So far as at present known the Bopyridae are parasitic only on decapod Malacostraca. It is a little confusing that M. Bonnier should make the Bopyridae one of the families of a section Bopyrinae, when Dr Hansen has already made the Bopyrinae one of the subfamilies of the Bopyridae.

Tylokepon, n. g.

Among the various genera closely allied to *Kepon*, Duvernoy, 1840, *Leidya*, established by Cornalia and Panceri in 1861, is the only one founded on the male sex, and this is unique in the possession of elongate uropods. Among those dependent on characters of the female, *Giguntione*, Kossmann, 1881, alone has in that sex biramous uropods. *Ergyne*, Risso, 1816, the *Portunicepon* of Giard and Bonnier, agrees with *Kepon* and is distinguished from the rest by having the branches of the pleopods more nearly equal. *Cancricepon*, Giard and Bonnier, 1887, has a medio-dorsal boss on each of the last four peraeon-segments. *Trapezicepon*, Bonnier, 1900, has none of these. *Grapsicepon*, Giard and Bonnier, 1887, has a medio-dorsal boss on each of the last two peraeon-segments, and herein it agrees with the new genus, which differs from it in that, instead of a simple boss on the sixth peraeon-segment, the boss there is strongly trifid. The head also furnishes a striking character for the new genus, being formed as it were of two short stout cylinders with rounded ends, of which the inner ones look as if they were flattened below where they meet, forming nearly a right angle.

The name of the genus is formed in allusion to its affinity with *Kepon*, and to the fact that the parasitic species for which it is instituted was found in the branchial region of *Tylocarcinus styx* (Herbst) as identified by Mr L. A. Borradaile, through whom I received the specimens.

Though the generic characters above given may not be thought of very high value, they fall well into line with those of the kindred genera already established, and under existing circumstances a new generic name seemed rather a matter of necessity than of choice.

12. *Tylokepon bonnieri*, n. sp. Pl. LIII.

♀. The appearance of the prominent white head has been already described. The peraeon from its opaque orange colour did not show clearly either the division of the segments or the contour of the lateral bosses, but the triple boss in the middle of the sixth segment was white and stood out clearly. The single median boss on the seventh segment was also white and directed somewhat upwards. When mounted this proved to have its rounded end marked off by a slight constriction. The laminae of the first pleon-segment are very large, strongly tuberculate on the upper surface and edges. The following pairs are successively smaller.

The first antennae are very small, three-jointed; the second a little larger, five-jointed.

The 'buccal rostrum' and the pair of maxillipeds, each member of which is consolidated into a single piece of great breadth at the centre with a narrow incurving apex to represent the terminal joints, differ very slightly from the corresponding parts in *Cancricepon* (see

Bonnier, *op. cit.* Pl. VII. figs. 3, 4). The strong muscles are conspicuous in their large but shallow cavity. Below the maxillipeds is that which Bonnier designates as the lower cephalic lamina. This in *Cancricepon elegans*, Giard and Bonnier, forms three lobes on either side in such a way that the outermost are produced furthest backward and the innermost the least far. In the present species the central piece, though pretty strongly emarginate, is scarcely bilobed, and by extending back much beyond the two lateral pairs of lobes appears to differ from the corresponding part in all the neighbouring genera.

The vast marsupial plates attached to the minute first gnathopods have as usual the anterior section underlying much of the maxillipeds, this part being produced on the inner (upper) surface into a broad sculptured lappet overlying a piece of the plate's hinder section. On the outer (ventral) surface the two sections pass smoothly into union, the upper one having a convex groove near the proximal part of the leg. The first gnathopods differ from the rest of the limbs chiefly in having the fifth joint smaller and more completely overlapped by the compact sixth joint. The second and third joints increase in size in the successive pairs of limbs to the fourth peraeopods. In both the fourth and fifth peraeopods the second joint is rather remarkable for the bulging of the two margins, and the third joint is greatly widened distally.

The pleopods have the outer branch similar to the pleural laminae of the segment, but smaller, and the inner branch very much smaller than the outer, with the margins a little irregular, at least in the earlier pairs, and perhaps in all.

The uropods are single-branched, long and slender, very much crumpled in the spirit specimen.

Length 3 mm., with a breadth of about 2·5 mm.

Locality. The specimen had been already extracted from the host, *Tylocarcinus styx*, which was taken at 'Hulule, Malé Atoll, Maldives,' and which showed on the left branchial region of the carapace the cavity that had been occupied by the parasite.

The specific name is chosen in compliment to M. Jules Bonnier, whose finely executed and instructive work on this group of the Isopoda has been more than once referred to above.

In the same bottle with the specimen just described there were four other isopods, which I am disposed to regard as belonging to the same species, although, as Sars rightly argues, Idem propterea non est, quia captus ibidem.

♂. This minute creature bears a very near resemblance to the males of *Cancricepon elegans* and *Grapsicepon edwardsi*, as figured by M. Bonnier. It would be an extraordinary chance that the female parasite of *Tylocarcinus* should have reached England from the Maldives, without a male of its own species, but accompanied by a male belonging to some other species of the same family.

The present specimen is probably not mature, since it has second antennae reminiscent of the cryptoniscus-stage. The pleopods also are more strongly developed than in the adult of *Cancricepon elegans*, but in correspondence with the bopyrian stage of that species. No dorsal or ventral bosses were perceptible.

The eyes are dark, longer than wide. The limbs all nearly alike, with the fourth and fifth joints very small, the sixth compact. The terminal segment of the pleon is bilobed, the lobes a little prolonged, each with a minute seta at the apex and another at the side.

Length estimated at half a millimetre.

The cryptoniscus-stage, whether of this or some other species, was represented by three specimens, smooth, narrow, sharply tapering to the uropods, the head broader than long, with a pair of gleaming eyes. In describing *Liriopsis pygmaea* (Rathke) Sars says, 'eyes very distinct, each consisting of a dark pigment, within which is imbedded a single rather large, refractive lenticular body.' The dorsal view which he gives of that species is in fair agreement with the specimens now under notice, but in these the ocular pigment is not dark, and the fourth and fifth peraeopods have not the peculiar shape characteristic of *Liriopsis*.

The first and second gnathopods are compact, subchelate, with the fifth joint apparently in coalescence with the sixth. The peraeopods are slender, all having the fourth and fifth joints very small, the fifth triangular, underriding the sixth. The second joint is widest at the middle and narrow at both ends; the third, which is rather shorter but broader, is narrow only at the base; the sixth like the second and third has a convex outer and more or less straight inner margin; near the apex of the latter it carries a fine spine and in the first three pairs two minute spinules on the widened apical margin, but a single spine on the comparatively narrow apex of the last two pairs. The finger is thin, slightly curved, longer on the fourth and fifth peraeopods than on the three preceding pairs, but in none longer than the sixth joint.

The pleopods have a broad but short peduncle armed at the inner angle with two long spines. The rami are short, not longer than the peduncle, each carrying four long plumose setae, the outer which is the less robust having in addition a short plumose seta at the outer angle.

The uropods have short peduncles, quite as broad as they are long. The outer ramus, scarcely longer than the peduncle, carries a long seta and two that are shorter. The inner ramus, more than twice the length of the outer, tapers to the apex, which nearly agrees with that of the outer ramus in armature.

Length 1·5 mm., with a breadth of about 0·4 mm.

ONISCIDEA.

Fam. **Ligiidae.**

Gen. *Ligia*, Fabricius.

For references to the bibliography of tribe, family, and genus, the reader may be invited to consult Willey's *Zoological Results*, Part 5, p. 645, 1900.

13. *Ligia exotica*, Roux[1].

Ligia exotica, 1828, Roux, *Crust. de la Médit. et de son littoral*, Livr. III. Pl. XIII. fig. 9; 1885, Budde-Lund, *Isopoda terrestria*, p. 266.

Budde-Lund, from whom the reference to Roux is taken, gives a full synonymy. The single specimen in the present collection was a female without the uropods, the flagellum of the second antennae having about thirty-eight joints, the telsonic segment agreeing well with Dana's figure of that part in the species which he names '*Lyg. gaudichaudii* ?,' adopting the specific name from Milne-Edwards. Budde-Lund puts both the French author's and Dana's names in the synonymy of *L. exotica*.

Locality. Lagoon, Minikoi. Taken along with *Sphaeroma* [*Exosphaeroma* ?] *globicauda*.

[1] See "Land Crustaceans," by L. A. Borradaile, *Fauna Geogr. Maldives*, etc., vol. I. p. 98.

EXPLANATION OF PLATES.

PLATE XLIX A. *Calathura borradailei*, n. sp. (p. 700).

n. s. Natural size, that is, length when fully extended, of specimen represented in the adjoining figure, lateral view, curved position.

C. Cephalon with first peraeon segment in dorsal view.

Pl. Pleon with last peraeon segment in dorsal view.

a. s., *a. i.* Upper and lower antennae.

m., *mx.* 1, *mxp.* Mandible, first maxilla, maxillipeds.

gn. 1, *prp.* 1, *prp.* 5. First gnathopod, first peraeopod, fifth peraeopod, with higher magnification of some spines of *prp.* 1, and of finger tip of *prp.* 5.

plp. 1, *plp.* 2. First and second pleopods, with higher magnification of distal part of male appendix.

T., *urp.* Telson and uropods, ventral view. This figure and all the figures of separate appendages are magnified to the same scale, except those of the mouth-organs, which are on the same scale as the enlarged details of *prp.* 1, 5, and *plp.* 2.

PLATE XLIX B. *Cirolana sulcaticauda*, n. sp. (p. 701).

n. s. Lines indicating natural size of specimen figured below in dorsal and lateral views.

a. s., *a. i.*, *m. m.* First and second antennae, and mandibles, above which are the upper lip, epistome, and frontal lamina.

mx. 1, *mx.* 2, *mxp.* First and second maxillae, and the maxillipeds.

gn. 1, *prp.* 5. First gnathopod and fifth peraeopod.

plp. 2. Second pleopod.

Pl. Pleon in dorsal view, less highly magnified than the rest of the details, which are on a uniform scale.

PLATE L A. *Lanocira rotundicauda*, n. sp. (p. 707).

n. s. Natural size of female specimen figured below in dorsal view.

a. s., *a. i.* First and second antennae.

m., *mx.* 1, *mx.* 2, *mxp.* Mandible, first and second maxillae, and maxilliped.

gn. 1, *prp.* 5. First gnathopod and fifth peraeopod.

Pl. Pleon less highly magnified than the foregoing details, and these than the following.

mx. 1, *juv.* First maxilla of young extracted from the maternal pouch.

Pl. juv. Pleon of the same juvenile specimen.

PLATE L B. *Corallana hirsuta*, Schiödte and Meinert (p. 704).

n. s. Lines indicating natural size of female specimen figured below in dorsal view.

a. s. ♂. First antenna of male, with part of head showing facets of eye.

a. i. ♂. Second antenna of male, flagellum incomplete.

mxp. ♂. Maxilliped of male.

prp. 5. ♂. Fifth peraeopod of male.

m. Mandible of female; this and following details not from the specimen figured in full.

l. i. Lower lip of female, in lateral view.

mx. 1, *mx.* 2, *mxp.* First and second maxillae, and maxillipeds of female.

gn. 1. First gnathopod of female.

Pl. Pleon of female, less highly magnified than the other details.

PLATE LI A. *Lanocira gardineri*, n. sp. (p. 706).

n. s. Natural size of male specimen figured below in dorsal and dorso-lateral view.

a. s., *a. i.* First and second antennae.

m. m. Mandibles, with cutting edge of one more highly magnified.

mx. 1, *mx.* 2, *mxp.* First and second maxillae and maxillipeds.

gn. 1, *prp.* 5. First gnathopod and fifth peraeopod.

plp. 2. Second pleopod.

Pl. Pleon, less highly magnified than the foregoing details.

PLATE LI B. *Alcirona maldivensis*, n. sp. (p. 708).

n. s. Natural size of female specimen figured below in dorsal view.

a. s., *a. i.*, *m. m.* First and second antennae and mandibles surmounted by upper lip, epistome, and frontal lamina.

mx. 1, *mx.* 2, *mxp.* First and second maxillae and maxillipeds.

gn. 1, *prp.* 5. First gnathopod and fifth peraeopod.

Pl. Pleon in dorsal view, less highly magnified than the foregoing or following details.

a. s., *a. i.*, *juv.* First and second antennae, with part of head showing the eyes, in a specimen extracted from the maternal pouch.

Pl. juv. Pleon of the same juvenile specimen.

PLATE LII A. *Limnoria pfefferi*, n. sp. (p. 714).

n. s. Natural size of specimen figured below in dorsal view.

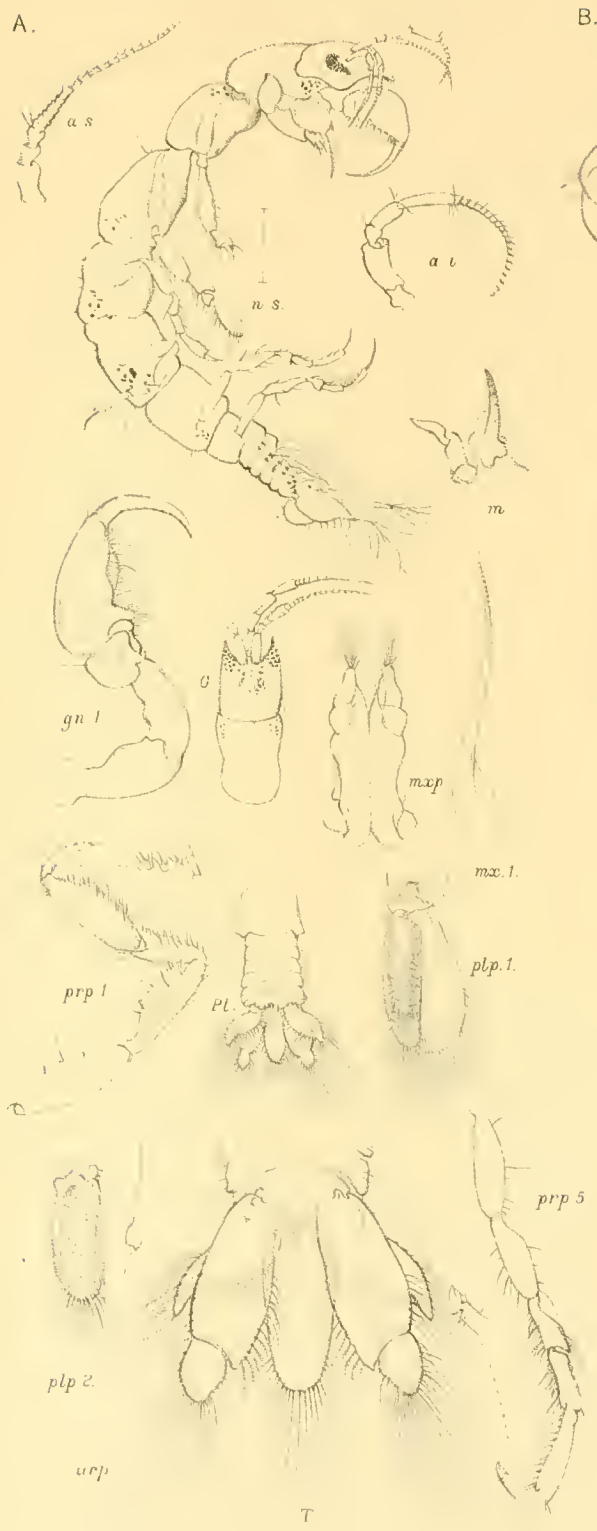
a.s., *a.i.* First and second antennae.

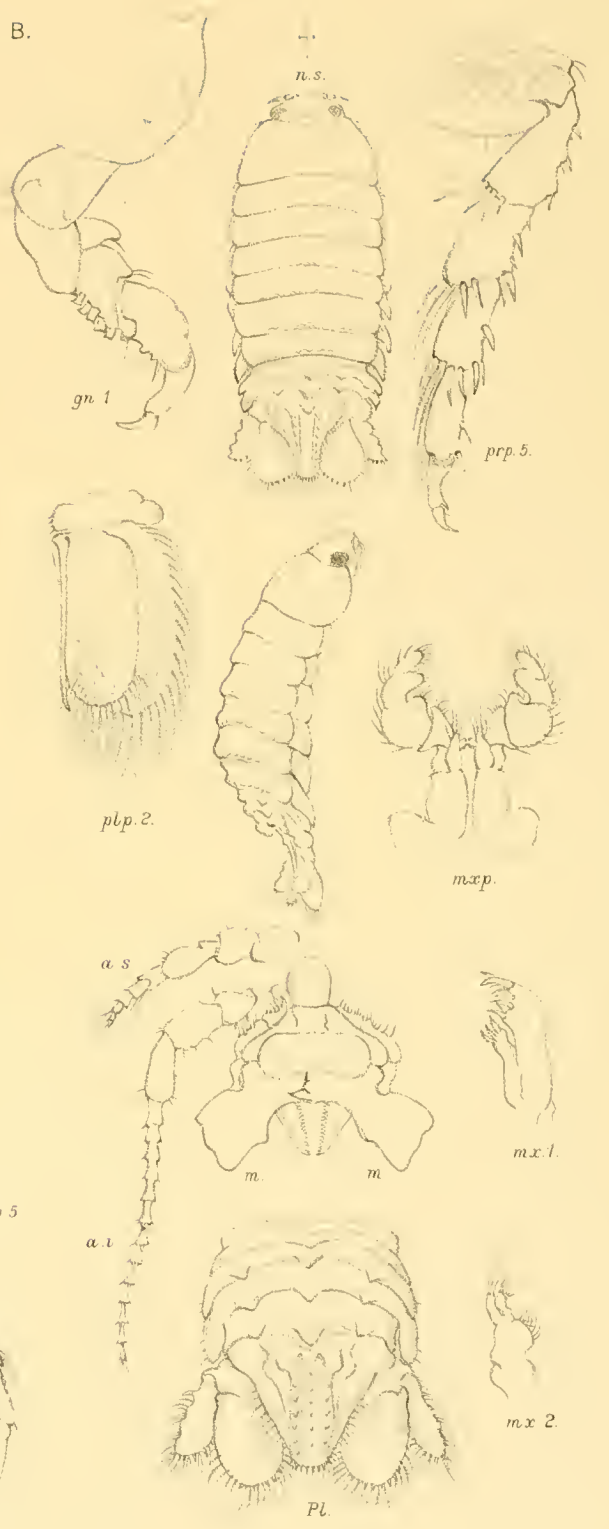
l. s., *l. i.* Upper lip with epistome, and lower lip.

m. m., *mx.* 1, *mx.* 2, *mxp.* Mandibles, first and second maxillae, maxilliped.

gn. 1, *gn.* 2, *prp.* 5. First and second gnathopods and fifth peraeopod, with parts more enlarged.

urp., *Pl.* Uropod in two aspects, pleon in dorsal view.



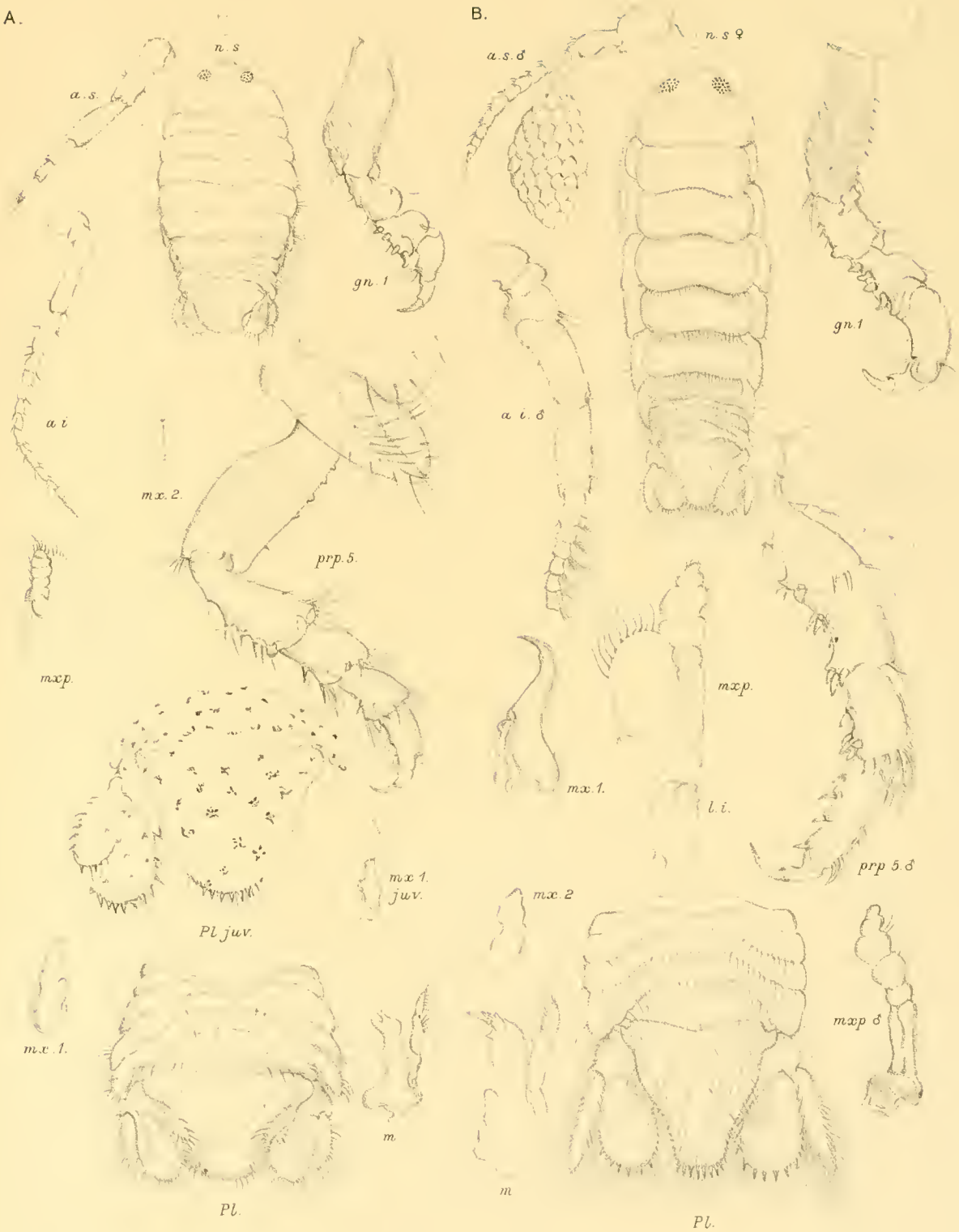


T R R. Stebbing del

E Wilson, Cambridge.

CALATHURA BORRADAILEI, n sp.

CIROLANA SULCATICAUDA, n sp.

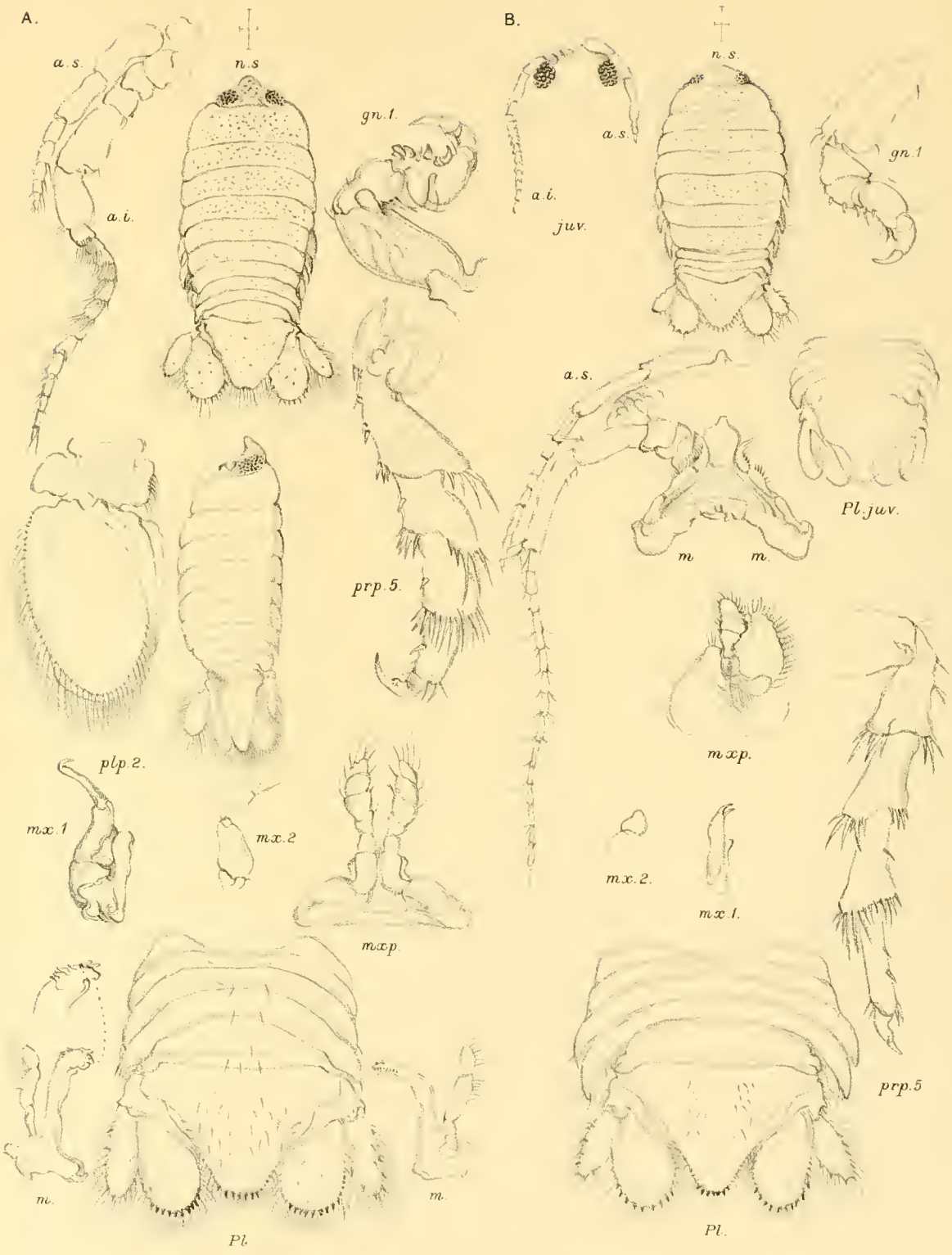


R. R. Stebbing, del.

E. Wilson, Cambridge

LANOCIRA ROTUNDICAUDA, n sp

CORALLANA HIRSUTA, Sch. & Mein



LANOCIRA GARDINERI, n.sp.

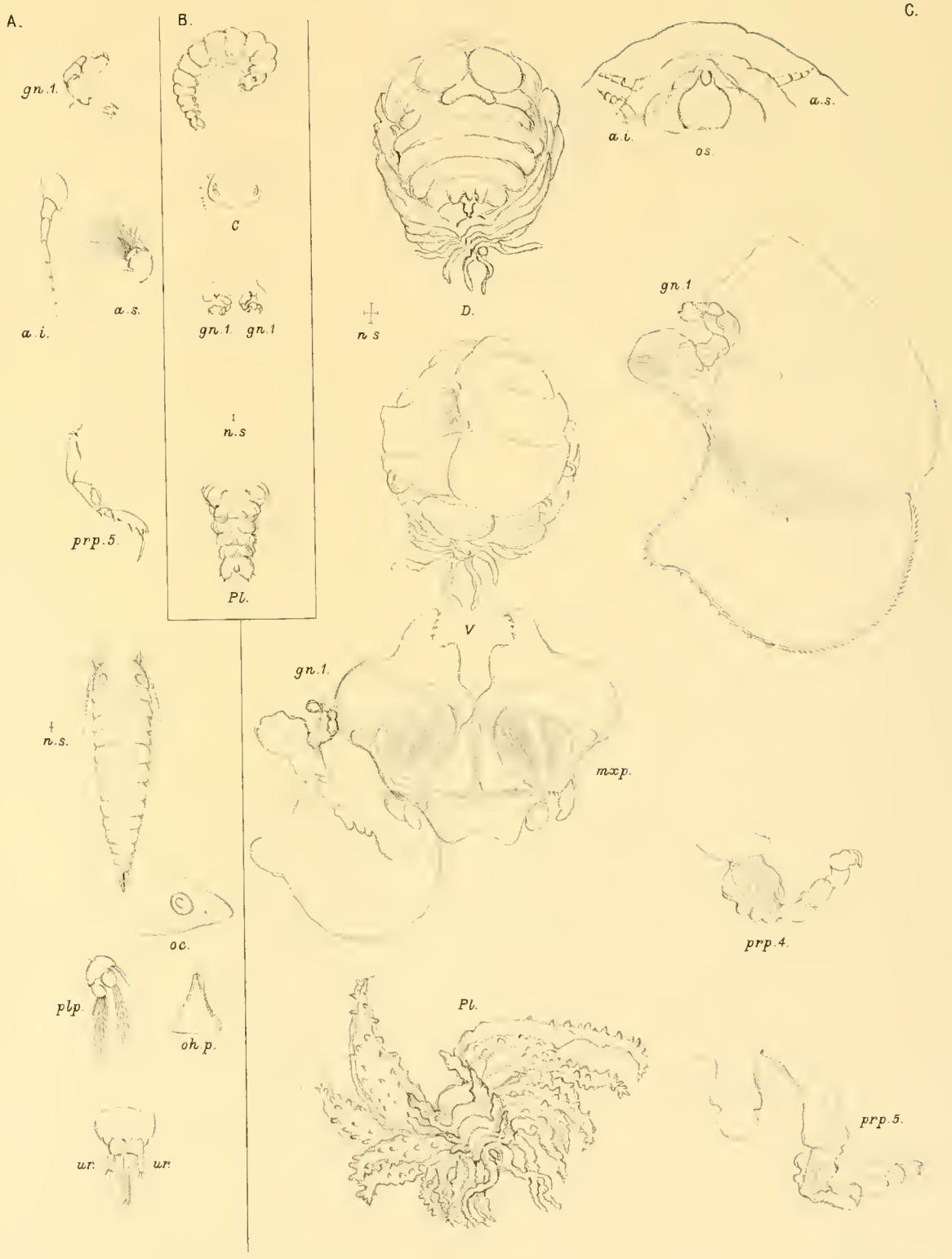
ALCIRONA MALDIVENSIS, n.sp.

F R R Stebbing de

E Wilson, Cambridge

LIMNORIA PFEFFERI[illegible]sp

CYMODOCE BICARINATA, n sp.



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A CRYPTONISCUS. STAGE: C.♂: B.♀: TYLOKEPON BONNIERI n.g. et sp.

PLATE LII B. *Cymodoce bicarinata*, n. sp. (p. 712).

n. s. Natural size of male specimen figured below in dorsal and lateral views.

a. s., *a. i.* First and second antennae.

l. s., *l. i.* Upper lip with epistome, and lower lip.

m. m., *mx.* 1, *mx.* 2, *mxp.* Mandibles, first and second maxillae, and maxillipeds.

gn. 1, *prp.* 5, *plp.* 2. First gnathopod, fifth peraeopod, second pleopod.

o. m. Male appendages of seventh peraeon segment and second pleopod, these and the mouth-organs being much more highly magnified than the antennae, limbs, and pleon.

Pl. Pleon in dorsal view.

PLATE LIII A, B, C. *Tylokepon bonnieri.*

A. (p. 718).

n. s. Natural size of Cryptoniscus-stage in dorsal view to the right.

oc. Eye in lateral part of the head, as seen when flattened out.

a. s., *a. i.*, *or. p.* First and second antennae, and oral parts.

gn. 1, *prp.* 5, *plp.*, *urp.* First gnathopod, fifth peraeopod, a pleopod, uropods and end of pleon.

B. (p. 717).

n. s. Natural size of supposed male in curved position figured above laterally.

C. Head with antenna of one side.

gn. 1, *gn.* 1. First gnathopods in attachment to the segment.

Pl. Pleon in ventral view.

C. (p. 716).

n. s. Natural size of female specimen figured to the right in dorsal and ventral views.

a. s., *a. i.*, *os.* First and second antennae and mouth *in situ.*

mxp., *gn.* 1. Maxilliped and first gnathopod in their relative position, first gnathopod separately more highly magnified.

prp. 4, *prp.* 5. Fourth and fifth peraeopods on the same scale as the separated *gn.* 1.

Pl. Pleon in dorsal view.

HYDROMEDUSAE,

WITH A REVISION OF THE WILLIADAE AND PETASIDAE.

By Edward T. Browne, B.A., *Zoological Research Laboratory, University College, London.*

(With Plates LIV.—LVII.)

CONTENTS.

INTRODUCTION.

Although the collection does not contain many specimens, a few more would have been a distinct advantage, and the species are not numerous; it has, nevertheless, brought to light some interesting medusae. It is a welcome addition to our knowledge of the Hydromedusae of the Indian Ocean, and I express my sincere thanks to Mr Stanley Gardiner for allowing me the privilege of examining the specimens.

The Anthomedusae and the Leptomedusae of the Indian Ocean are not well known and a very few species have been recorded. There are five species in this collection and four of them are new to science. The medusae belonging to these two Orders are usually found in littoral waters and seldom far away from land. They are liberated, with few exceptions, from fixed hydroids, and consequently their geographical distribution is limited to the region occupied by their hydroids. A genus often has a wide geographical range, but seldom its species, which are usually confined to definite areas, or even to certain localities, so that some of the new species belonging to the Anthomedusae and the Leptomedusae are probably limited to the Maldive Islands.

The Trachomedusae, the Narcomedusae and the Siphonophora have no fixed stage in their life-history and they are the inhabitants of the oceans, drifting hither and thither with the currents. Their species have usually a very wide geographical range and some extend over the Atlantic, Indian, and Pacific Oceans. Although Mr Gardiner made extensive use of the tow-net, yet a very few specimens of the Oceanic medusae were taken, and considering the geographical position of the Islands one would have expected to have seen a more extensive collection.

SUMMARY.

In the revision of the Williadae I have used for the generic character the number of radial canals which leave the stomach, and for the specific character the branching of the canal system. There are now two genera, namely, *Proboscidactyla* and *Willia*. The genera *Dyscannota* and *Willetta* of Haeckel are no longer needed. In three species of the Williadae I have found that the circular canal is absent and that its place is occupied by a solid chord of endoderm cells. The radial canals are in direct communication with the basal bulbs of the tentacles.

Mesonema pensile, one of the Aequoridae, has the lower wall of the stomach quite rudimentary, so that the mouth must always remain very wide open. I have failed to see how this stomach can act as a digestive organ and have suggested that the canal system has taken on the function of a stomach. This may also apply to other Aequoridae and account for the large number of radial canals and the excretory pores on the circular canal. The Maldive specimens are exactly like a figure of a medusa given by Forskål (1771), afterwards called *Mesonema pensile*. I cannot find any evidence that this medusa has been taken since Forskål's time. The Aequoridae require a thorough revision, but this can only be properly done with the aid of a sufficient number of specimens as most of the species now have imperfect descriptions. Special attention should be paid to the shape of the basal bulbs of the tentacles. So far I have found the shape to be different in every species which I have examined.

As the shape is constant for each species in all stages of development, it is easy to identify the early and intermediate stages, which are liable to be described as distinct species and perhaps placed in different genera.

The revision of the genera belonging to the Petasidae has not involved any alterations in generic names. The structure of the sense organs has been taken for the character of the two subfamilies, Petnachnidae and Olindiadae, instead of the absence or presence of centripetal canals, which was used as the subfamily character by Haeckel. The genera *Aglauropsis* and *Gossea* have been placed among the Olindiadae, and so have the following additional genera, *Gonionemus, Gonionemoides,* and *Vallentinia.* The structure of the tentacles has been used as the principal character of the genera belonging to the Olindiadae.

A new genus, *Amphogona,* has been instituted for *Pantachogon apsteini* of Vanhöffen. This medusa is bisexual, having male and female reproductive organs on alternating radial canals. I believe this to be the first recorded case of hermaphroditism amongst the Craspedote medusae. The new genus has been placed with the Aglauridae, but it also possesses characters of the Trachynemidae and looks like a connecting link between the two families.

Order ANTHOMEDUSAE.

Family **Williadae**, Forbes, 1848.

Character of the family. Anthomedusae with 4, 6 or more radial canals, each having one or more lateral branches (except in the earliest stage) running to the margin of the umbrella. Stomach with 4, 6 or more lobes, upon which the gonads are situated. Mouth with four or more lips, or with a folded margin. Tentacles simple, evenly distributed (not arranged in groups) round the margin of the umbrella.

The Williadae were classified by L. Agassiz (1862) as a family belonging to the Tubulariae (Gymnoblastea-Anthomedusae), but Haeckel (1879) removed the family to the Leptomedusae. He considered the gonads to be upon the radial canals and not upon the stomach. In 1893 I succeeded in connecting *Willia stellata,* Forbes, with the Gymnoblastic hydroid *Lar sabellarum,* Gosse, and cut a series of sections which showed that the gonads were upon the stomach and its lobes.

Haeckel placed the Williadae as a subfamily of the Cannotidae, and used the mode of branching of the canal system as the basis for classification. He introduced two new genera, namely, *Dyscannota* and *Willetta,* on the supposition that A. Agassiz had wrongly identified his specimens. It appears to me that the number of main radial canals is of greater importance than the mode of branching of the canal system and should be used for the generic character. The mode of branching, which carries with it the number of tentacles, would be of more value as a specific character.

The development of the radial canal system shows that the earliest free-swimming stage has unbranched canals. A young *Proboscidactyla* has four radial canals, without branches, and four tentacles. A young *Willia* has six unbranched radial canals and six tentacles. The branching of the canals appears later and passes through a definite series of stages.

A single abnormal specimen in the Maldive Collection, belonging to the Williadae, led me to investigate the literature relating to all the species and I have now attempted to make a revision of the family.

The Absence of a Circular Canal. Brandt (1838) in his description of *Proboscidactyla flavicirrata* states that a circular canal was not observed, but a very definite inner marginal edge was visible. When I was examining specimens of *Willia mutabilis* I noticed that what then was regarded by me as the circular canal was very slender and inconspicuous compared with the radial canals. As I could not make out a definite canal with the microscope a series of sections was cut. The sections showed a solid chord of cells without any opening in the centre. Sections were also cut of *Willia stellata* and these failed to show a circular canal. I have also examined *Willia stellata* alive when an active circulation was going on in the radial canals and inside the basal bulbs of the tentacles, but I did not see a circulation round the margin of the umbrella. Externally the solid chord of cells looks like a circular canal and expecting one to be present it is easy to mistake it for a canal. As every tentacle is in direct communication with the radial canals, the circular canal became functionless and it has now ceased to exist.

The Clusters of Nematocysts on the Ex-umbrella. In several species the nematocysts on the ex-umbrella have been carefully described, and it has been shown that their arrangement is a definite one. Radial clusters of nematocysts, situated midway between every two tentacles, extend from near the margin of the umbrella to about halfway or nearly to the top of the umbrella. The clusters are connected with one another by a kind of canal (just under the surface of the ex-umbrella), along which the nematocysts travel. An investigation of the nematocysts in *Willia stellata* when alive showed that isolated nematocysts travelled along the margin of the umbrella, then entered a canal, and after proceeding a short distance stopped. A cluster is formed by the accumulation of nematocysts. I could not find a cluster of nematocysts on the very margin of the umbrella, but always isolated nematocysts; the first cluster being at a little distance from the margin. In the earliest free-swimming stage there is only a single cluster between every two tentacles and as the umbrella increases in size other clusters are formed. The number of nematocysts in a cluster, the shape of the cluster, and the number of clusters in each row, I found to be very variable in the adult of *Willia stellata*.

Genus *Proboscidactyla*, Brandt, 1835.

Generic Character. Williadae with four radial canals leaving the stomach.

Proboscidactyla flavicirrata Brandt, 1835.

Proboscidactyla flavicirrata, Brandt (1835); Brandt (1838, p. 390, Taf. XIX.); Lesson (1843); L. Agassiz (1862); A. Agassiz (1865, p. 173, figs. 280—282); Haeckel (1879); *Proboscidactyla brevicirrata*, Haeckel (1879, p. 160); Murbach and Shearer (1902), (1903, p. 178).

The description of this species by Brandt and in addition the figures drawn from life by Mertens show that the main radial canals have two principal branches (a wide bifurcation), which run to the margin of the umbrella. From the inner side of each of the principal branches a number of branchlets run to the margin and the branchlets again branch near the margin. Mertens' figures show that a main canal has 18 branches which are in connection with 18 tentacles. The medusa should have altogether about 72 tentacles, a number far in excess of those of any other described species of the family.

A. Agassiz figures the same type of radial canal system for specimens taken on the American side of the Pacific Ocean. He records the presence of clusters of nematocysts on the ex-umbrella. Haeckel, however, considered that Agassiz's specimens were specifically distinct from those described by Brandt and gave to them a new specific name—*P. brevicirrata*. Murbach and Shearer have given a description, without figures, which practically confirms Agassiz's observations.

The specimens which have been described by the above authors had all reached the adult stage, but not quite the same stage in growth. Murbach records 54 tentacles for the largest specimen, Agassiz gives 64 tentacles, and Mertens' figures show about 70 tentacles. The early and intermediate stages of this species have not yet been recorded.

Distribution. North Pacific: Kamchatka (Mertens, *vide* Brandt). British Columbia: Gulf of Georgia (A. Agassiz). British Columbia: Victoria Harbour (Shearer).

Proboscidactyla occidentalis (Fewkes), 1889.

Willia occidentalis, Fewkes (1889, p. 109, Pl. V, fig. 3).

The four main radial canals run straight to the margin of the umbrella, and each canal gives off two opposite lateral branches, which again branch. Each main canal has therefore five terminations leading direct into five tentacles. A single cluster of nematocysts lies on the ex-umbrella between every two tentacles. Fewkes states that the "ovaries are four in number, arranged at the base of a four-parted stomach." The medusa has twenty tentacles, with bright reddish basal bulbs.

Distribution. North Pacific: California; Santa Cruz Is. (Fewkes).

Proboscidactyla ornata (McCrady), 1858.

Willsia ornata, McCrady (1858, p. 149, Pl. IX.); L. Agassiz (1862); A. Agassiz (1865, p. 171, figs. 274 *a*—279). *Dyscannota dysdipleura*, Haeckel (1879). *Willetta ornata*, Haeckel (1879). *Willia ornata*, Fewkes (1882, p. 299, figs. 22—23).

In the earliest free-swimming stage the medusa has four main radial canals, without any branches, and four tentacles (Fewkes, 1882). Agassiz (1865) has figured the intermediate stages showing that each main radial canal gives off a branch which runs to the margin of the umbrella. Later on a second branch appears on the side opposite to the first branch, and this also goes to the margin. McCrady (1858) described the adult stage with four main radial canals, each with three terminal branches and sixteen tentacles. Owing to the growth of the umbrella during the development of the canal system the main canals become curved and in the adult the appearance of the system is correctly expressed by saying that each main canal is twice dichotomously branched. The development of the canal system in this species is similar to that of *Willia stellata*, and can be conveniently separated into four stages.

First stage. Four radial canals without branches. 4 tentacles.

Second stage. Each main canal with one branch. 8 tentacles.

Third stage. Each main canal with two opposite branches. 12 tentacles.

Fourth stage. Each main canal with three branches. 16 tentacles.

Haeckel's classification of the family Cannotidae is primarily based upon the branching of the radial canal system, and secondarily upon the number of main radial canals from the stomach and the position of the gonads. The genera of this family have become somewhat complicated, as both Anthomedusae and Leptomedusae have been mingled together. Haeckel placed *Willia ornata*, McCrady (non Agassiz) in a new genus—*Willetta*, belonging to the sub-family Williadae. *Willia ornata*, A. Agassiz (non McCrady) is given a new generic and a new specific name, *Dyscannota dysdipleura*, and placed in the sub-family Berenicidae. Haeckel did not recognise the fact that Agassiz was describing the early and intermediate stages, showing the development of the canal system.

Distribution. North Atlantic: United States; South Carolina (McCrady). Massachusetts (A. Agassiz). Rhode Island (Fewkes), (Brooks).

Proboscidactyla gemmifera (Fewkes), 1882.

Willia ornata, Brooks (non McCrady), (1880); Brooks (1882). *Willia gemmifera*, Fewkes (1882, p. 300, Pl. I.). *Dyscannota gemmifera*, Mayer (1900, p. 47, Pl. VIII.).

When Brooks first found this species with medusa-buds he considered it to be a stage in the life-history of *Willia ornata*, McCrady. Fewkes succeeded in finding the first stage of *Willia ornata*, McCrady, and reared it up to the adult without seeing medusa-buds, and, as Agassiz had also described the early and intermediate stages without medusa-buds, Fewkes considered Brooks's medusa-budding *Willia* to be a distinct species and proposed for it a new specific name. Mayer fortunately found some specimens and has described them with excellent figures. He has adopted Haeckel's system of classification, hence the generic name *Dyscannota*. Mayer's figure shows that the medusa-bud, still attached to its parent, but ready for liberation, has four radial canals, without branches, and four tentacles. The parent medusa has two branches to each main canal, and twelve tentacles. Brooks's specimen belonged to an earlier stage, having only one branch to each canal, and eight tentacles.

The medusa-buds are upon stolons which hang down inside the cavity of the umbrella. The stolons are situated on the radial canals at their juncture with the stomach, one stolon on each of the four canals, and have at their free ends medusa-buds.

Distribution. North Atlantic: United States; North Carolina (Brooks). Tropical Atlantic: off Florida; in the Gulf Stream (Mayer).

Proboscidactyla tropica, species nova.

Willsia sp. Huxley (1877, p. 120, fig. 17).

This medusa has, up to the present, escaped having a specific name, and although figured and partly described in the well-known textbook, "A Manual of the Anatomy of Invertebrate Animals," it was omitted by Haeckel in his Monograph. Huxley's description is as follows:

"In August 1849, while in the North Pacific, off the Louisiade Archipelago, I took a species of *Willsia*, in which stolons were developed at the bifurcations of each of the four principal radiating canals of the nectocalyx. Each stolon was terminated by a knobbed extremity containing many nematocysts and gave rise, on one side, to a series of buds, of which those nearest the free end of the stolon had acquired the form of a complete medusoid. They

had four unbranched radiating canals and four tentacles; but it is probable that they would assume the form of the parent stock after development."

With the aid of the figures I have been able to draw up a description of the species and by bestowing upon it a specific name may prevent it from becoming lost again.

Description. Umbrella hemispherical, with a slight apical projection. Stomach short. Four main radial canals, each with three branches, all going to the margin of the umbrella. A stolon bearing medusa-buds hangs from each main canal at its junction with its first branch, and has at the free end a cluster of nematocysts. Sixteen short marginal tentacles, in direct communication with the radial canals. Size and colour not recorded.

Distribution. Tropical Pacific: Australasia; Louisiade Islands (Huxley).

Proboscidactyla varians, species nova (Pl. LIV. figs. 1, 2).

The collection contains only a single specimen, and though in a good state of preservation, yet it is badly contracted and has lost its natural shape. It is regarded by me as an abnormal specimen.

Description. Umbrella a little broader than high. Stomach with six lobes. Six radial canals, each with one to three lateral branches. Circular canal absent. Medusa-buds upon the radial canals, close to the stomach. Sixteen or more tentacles, with large triangular basal bulbs. Clusters of nematocysts on the ex-umbrella, arranged in radial rows.

Colour. Basal bulbs of the tentacles dark brown (in formalin).

Size. Umbrella 3 mm. in width and 2 mm. in length.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

If this solitary specimen had possessed no medusa-buds I should have placed it in the genus *Willia*, on account of its possessing six main radial canals. The medusa-buds show only four basal bulbs, with tentacles just beginning to develop, and there is not the slightest trace of any more bulbs. The fully developed medusa-buds of *Proboscidactyla tropica* and *gemmifera* have four main radial canals and four tentacles. The earliest free-swimming stage of *Proboscidactyla ornata* has also four main radial canals and four tentacles. But the earliest stage of *Willia stellata* has six main canals and six tentacles. The medusa-buds of this specimen indicate that it belongs to the genus *Proboscidactyla* and not to the genus *Willia*.

The parent medusa has six main radial canals with a variable number of lateral branches, and the lobes of the stomach show a want of symmetry. *Willia stellata* frequently shows a variation in the number of radial canals and in the number of lateral branches. As a rule when the number of main canals is above the normal number, then the branching of the canals is irregular. It will be seen in the figure that the abnormality of this specimen occurs in one quadrant, where three adjacent canals leave the stomach, each having only one lateral branch. These occupy the place of a main canal with four terminations on the margin of the umbrella. In a normal specimen at this stage, I consider that there should be a stomach with four lobes, four main radial canals, each twice dichotomously branched, sixteen tentacles. The specimen has only two medusa-buds, each of which is situated on a main radial canal, adjacent to the stomach. There is no stolon with a series of medusa-buds as found in *P. tropica* and *P. gemmifera*. The basal bulbs of the tentacles (fig. 2) are large and extend

into the substance of the umbrella, and the brown pigment of the bulbs is extended along some of the canals. Inside the margin of the umbrella there is a circular band of endoderm cells, but no circular canal can be seen. The groups of nematocysts extend over the ex-umbrella from near the margin to the top of the umbrella and are arranged in radial rows, one row between every two tentacles. In each row there are about six to seven circular clusters of nematocysts. Near the margin of the umbrella the canal along which the nematocysts travel is present, but it is only visible for a short distance.

Psythia prolifera, Agassiz and Mayer (1902, p. 143, Pl. I.). The authors, in placing the new genus in the family Williadae make the following statement: "In all previously known genera of the family Williadae the radial canals are branched. The general form, colour, shape of proboscis, and method of budding of the present medusa, however, all incline one to place it among the Williadae. It may be a primitive, or ancestral, form in which the canals have remained simple, or possibly an atavistic sport from some of the more complex Williadae, or an immature individual which may give rise to medusa-buds before attaining its complete development." A single specimen was found at the Tortugas, in the Gulf Stream off Florida. The medusa has four radial canals without branches; four tentacles with basal bulbs without any pigment; four perradial stolons bearing medusa-buds on the side of the stomach. There are no clusters of nematocysts on the ex-umbrella, but the medusa-bud has a few scattered nematocysts on the ex-umbrella, and they are absent in the parent medusa. It is like the first stage of *Proboscidactyla gemmifera* in possessing four radial canals, four tentacles, and stolons bearing medusa-buds. But the stolons are upon the stomach and not upon the radial canals, as in the other medusa-budding Williadae. The peculiar clusters of nematocysts are absent and also the pigment in the basal bulbs of the tentacles. The presence of medusa-buds and the absence of gonads indicate that the medusa is an early stage, but there is no conclusive evidence that it belongs to the Williadae.

Genus *Willia*, Forbes, 1846.

Generic Character. Williadae with six radial canals leaving the stomach.

Willia stellata Forbes, 1846.

Medusoid form.

Willsia stellata, Forbes (1846), (1848, p. 19, Pl. I.); Gosse (1853, p. 359, Pl. XX.); *Willia stellata*, L. Agassiz (1862); Haeckel (1879); *Willsia cornubica*, Peach (1867, p. 357, Pl. I.); *Lar sabellarum*, Browne (1896, p. 468, Pl. XVI.); (1898, p. 818, figs. 1—9).

Hydroid form.

Lar sabellarum, Gosse (1857, p. 113, Pl. XX.); Hincks (1872, p. 313, Pl. XIX.); Allman (1872).

Distribution. North Atlantic; British Isles.

Willia mutabilis Browne, 1902.

Willia mutabilis, Browne (1902, p. 280).

Distribution. South Atlantic; Falkland Islands (Vallentin).

Willia furcata, Haeckel (1879, p. 158). There is no figure published of this species, but the description shows that, if it is not identical with *Willia stellata*, it comes very close to it.

Distribution. North Atlantic; France (Haeckel).

Order LEPTOMEDUSAE.

Family **Eucopidae**, Gegenbaur, 1856.

Genus *Phialidium*, Leuckart, 1856.

Generic Character. Eucopidae with many marginal sensory vesicles; one or more between every two tentacles, each having a single otolith. Many tentacles. No marginal cirri. A gonad on each of the four radial canals. Stomach not on a peduncle.

Phialidium tenue, species nova. (Pl. LIV. fig. 4, Pl. LVII. fig. 16.)

Description. Umbrella watch-glass-shaped and thin. Stomach small, quadrangular in shape, and situated on a semi-globular thickening of the umbrella. Mouth with four lips and a sinuous margin. Four gonads extending over the outer half of each radial canal. Tentacles 25 in number. One or two minute marginal bulbs between every two tentacles. Sense organs numerous, one or two (rarely three) between every two tentacles, with a single otolith.

Size. Diameter of the umbrella 15 mm.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

There is only one specimen in the collection. The semi-globular thickening of the umbrella upon which the stomach is situated cannot be regarded as a true peduncle; it is simply a thickening of the wall of the umbrella. The tentacles are thin and slender with transverse rows of nematocysts. Their basal bulbs are a little broader than long; one measured 0·45 mm. in width, 0·33 mm. in length. The specimen closely resembles *Phialidium temporarium*, Browne, one of the commonest medusae in the British seas. It differs in the shape and size of the basal bulbs of the tentacles, being broader and about twice the size. The umbrella is a little thicker and the semi-globular mass of jelly at the top of the sub-umbrella cavity is very much larger. In *Phialidium temporarium* this thickening is often absent and never very conspicuous.

Genus *Pseudoclytia*, Mayer, 1900.

Generic Character. Eucopidae with many marginal sensory vesicles; one or more between every two tentacles, each having a single otolith. No marginal cirri. Five radial canals, each with a single gonad. Stomach not on a peduncle.

Mayer established the genus *Pseudoclytia* for a new species (*P. pentata*), which he found in great abundance at the Tortugas, off Florida, U.S.A. This species is pentamerous, possessing five radial canals, five gonads, and a mouth with five lips. Among 1000 individuals Mayer found 70·3 p.c. to be pentamerous with radial canals at equal distances apart. Hitherto among the Eucopidae four radial canals were always regarded as the normal number and any

numerical change was the sign of a variation from the normal type. The British Eucopidae very rarely show a numerical variation in the radial canals. There can be but little doubt that this pentamerous species has arisen from a *Phialidium*-like medusa, which had four radial canals, four gonads, and a mouth with four lips.

In the Maldive collection there are two specimens belonging to the Eucopidae, with five radial canals. If Mayer had not instituted the genus *Pseudoclytia*, the species would have been placed in the genus *Phialidium* and regarded as a variation from the normal type. I think, on the whole, it will be best to place this new species in the genus *Pseudoclytia*. The two specimens are practically identical, and the chances of catching two abnormal *Phialidium* exactly alike are very remote so far as my experience goes.

Pseudoclytia gardineri, species nova. (Pl. LV. figs. 1—3.)

Description of the Species. Umbrella broader than high (? watch-glass-shaped). Stomach short with a pentagonal base. Mouth with five small lips. Five radial canals (four nearly at right angles and one in between). Gonads very small (globular in the female and oval in the male), one situated on each radial canal about midway between the stomach and the margin. About 13—14 tentacles, with globular basal bulbs. Usually one or two marginal bulbs between every two tentacles, except in one segment where there is a conspicuous group of six bulbs (three on each side of a tentacle). Sense organs numerous, usually two or three between every two tentacles, with probably one otolith.

Size. Diameter of the umbrella about 5 mm.

Distribution. Indian Ocean; Maldive Islands, Miladumadulu (Gardiner).

Neither of the specimens is in very good condition, so that the exact shape of the umbrella is doubtful, but it seems fairly thin and without a thick mass of jelly over the cavity of the umbrella. The mouth of one specimen is closed, and it has five distinct lips; in the other specimen it is expanded and has a quadrangular aperture with a sinuous margin. The ovaries are very small, globular in shape and containing about four to six ova. The gonads of the male are a little nearer the margin of the umbrella than those of the female. The characteristic feature of this species and that upon which the specific character is based is the group of six large marginal bulbs adjacent to one of the tentacles. This group is very conspicuous on the margin of the umbrella and is at once seen. The tentacle is in the centre of the group (fig. 3), and has three bulbs on each side. A marginal sense organ lies between each of the outer two bulbs, but there is not one next the tentacle. On the inner side of the circular canal a series of bays exists, corresponding in position to the bulbs and tentacles. In the male specimen (fig. 1) there are indications of two more groups of bulbs being formed, each with two bulbs on either side of a tentacle.

It is a pleasure to me to associate this new species with the name of Mr J. Stanley Gardiner.

Family **Aequoridae**, Eschscholtz, 1829.

Genus *Aequorea*, Péron et Lesueur, 1809.

Generic Character. Aequoridae with numerous simple unbranched radial canals. Stomach circular, with the lower wall fully developed. Mouth capable of closing up.

The type species of the genus *Aequorea* was described and figured by Forskål (1775), under the name of *Medusa aequorea*. Péron placed it in the genus *Aequorea* under the name of *Aequorea forskâlea*, where it has since remained. There will always be some doubt about the identity of the type species, as the figure and description omit just the details which are essential. I think it will be best to follow Forbes (1851) and consider the medusa, which he described and figured as *Aequorea forskâlea*, to be identical with the type species.

The shape of the basal bulbs of the tentacles is a valuable guide for the determination of the species. I have found it to be quite different in six species of the Aequoridae. As the shape is constant in each species it facilitates the identification of the early and intermediate stages.

Aequorea maldivensis, species nova. (Pl. LVI. figs. 4—12.)

Description of the Species. Umbrella saucer-shaped, about four to six times as broad as high, moderately thick. Stomach circular, its diameter about half the diameter of the umbrella, its lower wall large enough to allow the mouth to close up. Mouth with numerous short lips, closely packed together. Radial canals numerous (50—70). Gonads occupying nearly the whole length of every radial canal, and hanging down from the sub-umbrella, bilamellar. Tentacles less numerous (30—50) than the radial canals, having a large hollow basal bulb, which curls over a thickening of the ex-umbrella. Marginal bulbs about one to four between every two tentacles. Sense organs very numerous, about 15—20 between every two tentacles (or 2—4 between every two bulbs).

Size. Umbrella 75 mm. in width and 35 mm. in height (largest specimen).

Distribution. Indian Ocean; Maldive Islands, Haddumati (Gardiner).

The collection contains three specimens:

A. Umbrella about 35 mm. in diameter and about six times as broad as high. Stomach about 20 mm. in diameter. Radial canals, 52. Tentacles, 21. Marginal bulbs, usually one large and 2—4 smaller ones between every two tentacles. Sense organs, 16—24 between every two tentacles (or 2—4 between every two bulbs). Female gonads.

B. Umbrella about 45 mm. in diameter and about five times as broad as high. Stomach about 23 mm. in diameter, its lower wall fairly flat and the mouth nearly closed. Mouth circular, 6 mm. in diameter, and the margin with about 54 lips. Radial canals, 69. Tentacles, 34. Marginal bulbs, usually one large and two small bulbs between every two tentacles. Sense organs, 12—14 between every two tentacles. Male gonads.

C. Umbrella about 75 mm. in diameter and about four times as broad as high. Stomach about 35 mm. in diameter. Radial canals, 54. Tentacles, 50. Marginal bulbs, usually one between every two tentacles. Sense organs, 15—20 between every two tentacles. Female gonads.

The lower wall of the stomach varies in width in the different specimens. In one specimen the mouth is certainly capable of closing up. In the other two specimens the mouth appears to be fairly wide open, but its exact size is doubtful, as the wall of the stomach is torn away in places. The oral lips (figs. 8—9) are short and stumpy, with a sinuous margin. A longitudinal rib runs down the outer side of each lip and on the inner side there is a groove. The radial canals are deeper than they are broad, and hang down from the sub-

umbrella. The gonads (fig. 6) extend along nearly the whole length of the radial canals, leaving both ends free. In the male the portion of the canals bearing the gonads is more tubular than in the female. In the female (fig. 7) the gonads hang down from the wall of the sub-umbrella and are distinctly bilamellar.

The basal bulbs of the tentacles (figs. 10—12) are broad hollow sacs and are characterized by curling over a thickening of the margin of the umbrella. There is an excretory pore opening from the circular canal opposite each of the basal bulbs of the tentacles and each of the largest marginal bulbs. The marginal bulbs also curl over the margin of the umbrella and some of them probably develop tentacles at a later stage in the growth of the medusa. The sensory vesicles are very minute; their otoliths are not visible.

Genus *Mesonema*, Eschscholtz, 1829.

Aequoridae with numerous simple, unbranched radial canals. Stomach circular, with lower wall quite rudimentary. Mouth nearly as large as the diameter of the stomach and cannot be closed.

Mesonema pensile (Modeer), 1791. (Pl. LV. fig. 4, Pl. LVII. figs. 2—9.)

Medusa, sp. Forskål (1776, p. 9, Tab. XXVIII. fig. *B*); *Medusa coelum pensile*, Modeer (1791, p. 32); *Aequorea mesonema*, Péron (1809); *Mesonema coelum pensile*, Eschscholtz (1829); *Mesonema pensile*, Haeckel (1879).

In Forskål's *Icones rerum naturalium*, 1776, there is a good figure of a medusa about which nothing is stated, except in the description of the figure. There occurs this very brief statement, "*Medusa non descripta*. Color coerulescens."

Modeer gave a short description of the medusa from Forskål's figure, and called it *Medusa coelum pensile*. Péron placed the species in a new genus under the name of *Aequorea mesonema*. Eschscholtz removed it from the genus *Aequorea* to the genus *Mesonema* and restored Modeer's specific name. These early authors suggested the locality for Forskål's medusa to be in the Mediterranean, but it must be remembered that Forskål did not state where he found his specimen, and that his book contains the descriptions of the animals which he found in the Red Sea, as well as in the Mediterranean.

Haeckel adopted the name *Mesonema pensile* for Forskål's medusa, but he gives among the synonyms *Mesonema coerulescens*, Kölliker, 1853, and *Stomobrachium mirabile*, Kölliker, 1853; both taken by Kölliker in the Mediterranean. I fail to see the connection between Forskål's medusa and Kölliker's two species. These are young and intermediate stages, probably belonging to the genus *Aequorea*. Haeckel's description of *Mesonema pensile* is based upon the description of three species, and consequently is of little value.

In the Maldive collection there are four medusae which have all the characters of the medusa figured by Forskål.

Description of the Species. Umbrella almost a solid mass of jelly, rather like a plano-convex lens in shape, about twice to three times as broad as high. Sub-umbrella forming only a fringe round the periphery. Stomach completely rudimentary, its lower wall about 2 mm. in length, and its diameter about two-thirds the diameter of the umbrella. Mouth circular, nearly as large as the diameter of the stomach; non-contractile, and always wide

open; its margin furnished with a large number of long narrow lips, which are strengthened by an external rib. Radial canals about 100—150 in number, very short. Gonads upon all the radial canals, extending nearly from the stomach to within a short distance of the circular canal. Tentacles about 10—15, with basal bulbs having a long lateral extension along the margin of the umbrella. Numerous marginal bulbs, closely packed together, about two to three between every two radial canals. Marginal sense organs very numerous, about two to four between every two marginal bulbs.

Size. Umbrella about 60 mm. in length and about 30 mm. in height.

Distribution. Indian Ocean, Maldive Is., Haddumati and Goifurfehendu (Gardiner).

The collection contains four specimens:

A. Umbrella 45 mm. in width and 20 mm. in height. Stomach 26 mm. in diameter. Radial canals about 120. Tentacles, 10. Marginal bulbs about 12 between every two tentacles.

B. Umbrella about 60 mm. in width and 25 mm. in height. Radial canals about 100. Tentacles 10, perhaps more. This specimen is in bad condition; the margin of the umbrella damaged and the mouth torn away.

C. Umbrella about 60 mm. in width and 30 mm. in height. Radial canals estimated at 150. Tentacles 15. The specimen is in bad condition.

D. Umbrella about 60 mm. in width and about 20 mm. in height. Mouth 43 mm. in diameter. Radial canals about 148, their length about 10 mm. Tentacles 13.

The thickness of the umbrella (fig. 2) is so great that the sub-umbrella cavity is reduced to a mere shallow depression round the margin of the umbrella. The oral lips (fig. 9) are long and thin, about 3 mm. in length, without a sinuous margin. On the external side of every lip there is a longitudinal rib, which extends into the wall of the stomach, and on the inner side a corresponding groove. There are about as many oral lips as radial canals. The gonads (fig. 4) are situated on both sides of every radial canal and do not hang down in bands or folds. The tentacles are few in number and are not arranged at equal distances apart. Their basal bulbs (figs. 6—8) have long lateral extensions along the margin of the umbrella. The marginal bulbs (fig. 5) are very minute and have at their apex a circular cluster of nematocysts.

In my account of *Aequorea norvegica* (1903) I made the following statement: "The exact shape of the stomach and whether the mouth is open or closed are scarcely suitable for generic characters. The fact that an Aequorid is occasionally caught with its mouth open is no evidence that it is permanently kept open." This statement must now be modified. It referred to the genera *Aequorea* and *Polycanna* and with them it probably holds good, as neither has a rudimentary stomach. All the species of the Aequoridae, which I had then seen, possessed a mouth capable of closing up, but since I have seen these Maldive specimens my statement about the exact shape of the stomach for a generic character becomes untenable.

The stomach is quite rudimentary and is practically absent, as its lower wall is only about 2 mm. in length, so that the mouth must always remain wide open. It appears to me that the function of the stomach has been removed to the canal system. The medusa probably lives upon organisms of microscopic dimensions, such as unicellular algae and protozoa, which are picked up by the endoderm cells lining the canal system. The water containing these organisms, after circulating in the canal system, probably passes out through the numerous

pores on the circular canal. The Aequoridae which have a large funnel-shaped stomach and a closeable mouth may also have the radial canals functioning as digestive organs. The contraction of the stomach, when the mouth is closed, would drive water into the canal system and expel the stale water through the pores on the circular canal. The hypothesis that the radial canals function as the digestive organs would perhaps account for the large number usually present in the Aequoridae, some of which are the largest Leptomedusae known.

Order TRACHOMEDUSAE.

Family **Petasidae**, Haeckel, 1877.

Family Character. Trachomedusae with four radial canals, upon which are situated cylindrical, globular, or papilliform gonads. Stomach without a peduncle. Either external sensory clubs, or external or internal sensory vesicles.

Haeckel (1879) divided the Petasidae into two subfamilies, namely:

Petnachnidae, without blind centripetal canals. Genera: *Petasus, Dipetasus, Petasata, Petachnum, Aglauropsis* and *Gossea.*

Olindiadae, with blind centripetal canals. Genus: *Olindias.*

Since Haeckel published his *System der Medusen* three more genera must be added to the family, namely, *Gonionemus* (placed by Haeckel among the Thaumantidae under a wrongly spelt generic name *Gonynema*), *Gonionemoides* and *Vallentinia.*

A more natural classification of the Petasidae can, I think, be obtained by taking the structure of the sense organs instead of the centripetal canals for the characters of the two subfamilies.

There are two distinct types of sense organs:

A. *Sensory clubs* (Hörkölbchen) with a short stalk, which project from the margin of the umbrella; with a single otolith and with external sensory hairs. These sensory clubs are present in the genera *Petasus, Diptasus, Petasata, Petnachnum?* (species not figured).

B. *Sensory vesicles* (Hörbläschen) situated either in the mesogloea (internal) or on the margin of the umbrella (external); sessile and without external sensory hairs. These sensory vesicles are present in the genera *Aglauropsis, Gossea, Olindias, Gonionemus, Gonionemoides* and *Vallentinia.*

On this classification the arrangement of the genera would be as follows:

Subfamily **Petachnidae,** Haeckel, 1877.

Petasidae with sensory clubs containing an otolith and with external sensory hairs.

Genus *Petasus.* Species—*P. atavus, P. tetranema.*

Genus *Dipetasus.* Species—*D. digonimus.*

Genus *Petasata.* Species—*P. eucope.*

Genus *?Petachnum.* Species—*P. tiaropsis.*

All the above genera and species were described by Haeckel (1879), and I have not succeeded in finding any notice of their being recorded by any other person.

Subfamily **Olindiadae,** Haeckel, 1877.

Petasidae with sensory vesicles situated either in the substance of the umbrella (internal), or on the margin of the umbrella (external); sessile, and without external sensory hairs.

Genus *Aglauropsis,* F. Müller, 1865.

Generic Character. Petasidae with numerous uniform tentacles, without adhesive disks, and not arranged in groups.

A. agassizii, Müller, 1865. South Atlantic; Brazil.

A. conantii, Browne, 1903. South Atlantic; Falkland Is.

Müller's description of *Aglauropsis agassizii* is very incomplete, in fact, he only gives generic characters. The specific name should either be attached to the next *Aglauropsis* found on the coast of Brazil, or else placed on the obsolete list.

Maeotias inexpectata, Ostroumoff, 1896. Ostroumoff has published a brief preliminary Latin description of this genus and species in the *Zool. Anzeiger,* 1896, and a full description with figures, in the *Bulletin of the Imperial Academy of Sciences of St Petersburg,* 1896. Unfortunately the text of the latter publication is wholly in Russian, and the chief figure is rendered useless by the tentacles being represented merely by a series of closely ruled lines. Ostroumoff points out that the genus differs from *Olindias* in possessing only flexible tentacles, which all hang down from the margin of the umbrella. There are about 300 hollow flexible tentacles, about 100 marginal bulbs, about 200 internal sense organs arranged in pairs, about 13 to 15 centripetal canals in each quadrant, and gonads along nearly the whole length of the radial canals. Distribution. Europe; Sea of Azov. As I am uncertain about the structure of the tentacles I have not included this species in the genus *Aglauropsis,* as it may perchance belong to one of the other genera.

Genus *Gossea,* L. Agassiz, 1862.

Generic Character. Petasidae with uniform tentacles arranged in eight groups (four perradial and four interradial) and a few small isolated tentacles between the groups.

G. corynetes (Gosse), 1853. North Atlantic, British Isles. Syn. *G. circinata,* Haeckel, 1879. North Atlantic; France.

Genus *Olindias* F. Müller, 1861.

Generic Character. Petasidae with numerous tentacles, of which there are two distinct kinds. A series (primary) of short stiff tentacles, which are carried outwards and have their bases attached to the ex-umbrella; and a series (secondary) of long flexible tentacles, which hang downwards from the margin of the umbrella. No adhesive disks on any of the tentacles.

O. sambaquiensis, Müller, 1861. South Atlantic; Brazil.

O. mülleri, Haeckel, 1879. Mediterranean.

O. tenuis (Mayer), 1900. Tropical Atlantic; Florida. Syn. *Halicalyx tenuis*, Mayer (1900, p. 63, Pls. V.—VI.). ? *Halicalyx tenuis*, Fewkes (1882, p. 277, Pl. VII.).

There is a disagreement in the descriptions given by Fewkes and by Mayer of *Halicalyx tenuis*. Fewkes states that the medusa has twelve tentacles, uniform in shape, with a single otolith at the base of each one. Mayer describes his specimens with two distinct kinds of tentacles and a pair of sense organs at the base of each primary tentacle, and also with many centripetal canals, which are not mentioned by Fewkes. Fewkes's specimen cannot be an early stage because the gonads are described and figured, though it may be an intermediate stage in growth. I can understand Fewkes's instituting a new genus for his species, because it does not agree with the generic character of *Olindias*, and at that date the genus *Aglauropsis* was very vaguely described on an incomplete description of a single species. It is just possible that Fewkes's specimen belongs to the genus *Aglauropsis*. Mayer's beautiful figures of *Halicalyx tenuis* show all the characters of an *Olindias*.

Olindias singularis, species nova. (Pl. LVI. fig. 2, Pl. LVII. fig. 1.)

Description. Umbrella hemispherical, with thick walls, about one and a half times as broad as high. Stomach about half as long as the cavity of the umbrella: mouth with four lips having a sinuous margin. Four radial canals: four to five blind centripetal canals in each quadrant. Gonads on the outer half of each radial canal, and separated into isolated papilliform clusters. Two kinds of tentacles; primary tentacles which are carried outwards and have their bases attached to the margin of the ex-umbrella, and secondary tentacles which hang downwards from the margin of the umbrella. About 7—10 primary tentacles and 4—5 secondary tentacles in each quadrant. About 8—10 globular marginal bulbs containing nematocysts in each quadrant. One internal sensory vesicle containing a single otolith at the base of each primary tentacle.

Size. Umbrella 13 mm. in width and 8 mm. in height.

Distribution. Indian Ocean: Maldive Is., Suvadiva (Gardiner).

The collection contains a single specimen in a good state of preservation. It mainly differs from the species hitherto described in possessing only one sense organ at the base of each primary tentacle, instead of a pair of sense organs. The possession of a pair of sense organs has been considered by Haeckel to be a part of the generic character. I think that the position of the sense organs, external or internal, and the number of sense organs had better not be included in the generic characters, but would be of more use for specific characters. Haeckel states that *Olindias mülleri* found in the Mediterranean has, in addition to the internal paired sensory vesicles, a series of club-shaped ocelli situated between the marginal bulbs. I have examined large adult specimens from Naples and have failed to find any ocelli.

In *Olindias singularis* the primary tentacles are curved outwards from the margin of the umbrella. Their bases are partly enclosed by an overgrowth of the ex-umbrella, to which they are attached for a short distance. These tentacles have either oblong or short spiral bands of nematocysts, and at their free end there is a claw-shaped termination, which has its margin closely packed with very long nematocysts. The secondary tentacles are hollow (like the primary ones) and hang down from the margin of the umbrella. They have a large basal bulb and numerous bands of nematocysts, forming about three-quarter circular

loops, but not meeting on the inner side. The marginal bulbs are large hollow balls in direct communication with the circular canal, and are externally covered with nematocysts.

Genus *Gonionemus*, A. Agassiz, 1862.

Generic Character. Petasidae with numerous uniform tentacles, each having an adhesive disk.

G. vertens, A. Agassiz, 1862. North Pacific; British Columbia.

G. suavaensis, Agassiz and Mayer, 1899. Tropical Pacific; Fiji.

G. aphrodite, Mayer, 1894 and 1900. Tropical Atlantic; Florida.

G. agassizii, Murbach and Shearer, 1903. North Pacific; Aleutian Is. and Japan (Kirkpatrick, 1903).

G. murbachii, Mayer, 1901. North Atlantic; Massach. U.S.A.

G. pelagicus, Bigelow, 1904. Indian Ocean; Maldive Is.

Genus *Gonionemoides*, Mayer, 1900.

Generic Character. Petasidae with numerous tentacles, of which there are two distinct kinds. A series (primary) with adhesive disks and another series (secondary) without adhesive disks and with more numerous and larger bands of nematocysts.

G. geophila, Mayer, 1900. Tropical Atlantic; Florida.

Genus *Vallentinia*, Browne, 1902.

Generic Character. Petasidae with two distinct kinds of tentacles. Four solid perradial tentacles with terminal suckers, and many hollow tentacles with bands of nematocysts, but without suckers.

V. falklandica, Browne, 1902. South Atlantic; Falkland Is.

Family **Geryonidae**, Eschscholtz, 1829.

Trachomedusae with four or six radial canals, in the course of which are situated leaf-shaped gonads. Blind centripetal canals. Stomach on a long peduncle. Internal sensory vesicles.

Genus *Liriope*, Lesson, 1843.

Generic Character. Geryonidae with four radial canals and with four or eight tentacles.

Liriope tetraphylla (Chamisso et Eysenhardt), 1820. (Pl. LIV. fig. 3.)

Geryonia tetraphylla, Chamisso et Eysenhardt (1820, p. 357, Pl. XXVII.). *Liriantha tetraphylla*, Haeckel (1879). *Liriope tetraphylla*, Vanhöffen (1902, p. 82, Taf. x.).

There is only one specimen in the collection, and a figure is given of it because I am not certain about the correctness of the identification. *Liriope tetraphylla* has, according to Vanhöffen, a very wide geographical distribution, as it was found by the "Valdivia" in the Atlantic, Indian Ocean, and the Red Sea. The specimens showed a considerable variation in the shape and size of the umbrella, in the length of the peduncle, and in the position and shape of the gonads; all of which have been used by other authors for specific characters.

Description of the specimen. Umbrella hemispherical, very thick, about twice as broad as high. Stomach on a cylindrical peduncle. Gonads rhomboidal, broader than long, on the distal half of the radial canals and extending nearly to the margin of the umbrella. The distance between the gonads about equal to their breadth. Four perradial tentacles. Three centripetal canals in each quadrant. Eight sense organs.

Size. Umbrella 7 mm. in width and 4½ mm. in height. Peduncle 3 mm. in length.

Locality. Indian Ocean; Maldive Is. (Gardiner).

Family **Aglauridae**, L. Agassiz, 1862.

Trachomedusae with eight radial canals, in the course of which are situated eight gonads. Stomach on a peduncle. Numerous uniform tentacles. Sense organs external and free.

Genus *Aglaura*, Péron et Lesueur, 1806.

Generic Character. Aglauridae with gonads situated upon the peduncle of the stomach.

Aglaura hemistoma, Péron et Lesueur, 1809.

Aglaura hemistoma, Gegenbaur (1856, p. 248, Taf. VII.); Haeckel (1879, p. 275, Taf. XVI.); Maas (1893, p. 25, Taf. I.); Mayer (1900, p. 65, Pl. XXV.); Vanhöffen (1902, p. 78).

The collection contains a single small specimen, which is not in very good condition. The shape of the umbrella is very much like that of the figures given by Haeckel and by Mayer.

Description. Umbrella with a short conical summit, about 2½ mm. in length and width. Stomach roundish, on a very short peduncle. Mouth with four lips. Eight sausage-shaped gonads, about 1 mm. in length, situated on the peduncle and adjacent to the stomach. Ova visible. Tentacles estimated at about 64. Sense organs not seen; the margin of the umbrella is damaged.

Distribution. In the warm waters of the Atlantic, Indian Ocean, and the Red Sea.

Amphogona, genus novum.

Generic Character. Aglauridae with gonads situated upon the sub-umbrella. Gonads bisexual. Umbrella much broader than high.

Amphogona apsteini (Vanhöffen), 1902. (Pl. LIV. fig. 5, Pl. LV. fig. 5, Pl. LVI. fig. 1, Pl. LVII. figs. 10—15.)

Pantachogon apsteini, Vanhöffen (1902, p. 65, Taf. x. fig. 18, Taf. xi. fig. 28).

The genus Pantachogon was instituted by Maas (1893) for a species (*P. haeckelii*) found in the North Atlantic. This medusa has a series of spindle-shaped gonads along nearly the whole length of the radial canals. The stomach is not situated upon a peduncle, and the genus belongs to the Trachynemidae. Vanhöffen has slightly altered Maas' original definition of the genus for the inclusion of his new species, *P. apsteini*, found on the west coast of Sumatra. This species has oval gonads near the margin of the umbrella, and the stomach is situated upon a distinct peduncle. It has the characters of the Aglauridae.

The specimens in this collection agree very closely with the description and figures of *Pantachogon apsteini*, and I believe that they belong to that species. According to the classification adopted by Haeckel, and by Maas, the Maldive specimens would belong to the genus *Agliscra*, as the eight gonads are upon the sub-umbrella. But in one respect, however, there is a considerable difference. The shape of the umbrella is unlike that of the Aglauridae, and is more like that of the Trachynemidae. In *Agliscra* the umbrella is about twice as high as broad, whereas in the Maldive specimens the umbrella is about two to three times as broad as high. If one imagined an *Agliscra* with its umbrella flattened out then it would resemble this species. I do not think that the Maldive specimens or Vanhöffen's specimens belong to the genus *Pantachogon* of Maas, as they are not like the type species, *P. haeckelii*. They show a nearer relationship to *Agliscra*. I think it is best to institute a new genus, to which I give the name *Amphogona* (*ἄμφω-γονή*) and place it in the family Aglauridae.

Specific Characters. Umbrella saucer-shaped, with thin walls, about twice to three times as broad as high. Velum fairly broad. Stomach small, situated on a short peduncle. Mouth with four thick lips. Eight radial canals. Eight globular or oval gonads, situated upon the radial canals near the margin of the umbrella; bisexual, male and female gonads upon alternating canals. About 70 or more tentacles, uniform in shape. Sense organs external, ?16.

Size. Umbrella $4\frac{1}{4}$ mm. in width and $1\frac{3}{4}$ mm. in length (the largest specimen).

Distribution. Indian Ocean; West coast of Sumatra (Vanhöffen); Maldive Islands, Miladumadulu (Gardiner).

The collection contains three specimens.

A. An intermediate stage. Umbrella $2\frac{1}{2}$ mm. in width and $1\frac{1}{2}$ mm. in height. Stomach a little longer than the peduncle, which measured 0·25 mm. Gonads just beginning to develop and varying slightly in size. About six tentacles and one sense organ in each octant.

B. An immature adult. Umbrella 4 mm. in width and $1\frac{1}{2}$ mm. in height. Stomach on a peduncle, which measured 0·6 mm. in length. Eight globular gonads, male and female on alternating canals, all about the same size and shape. Tentacles, 57. Sense organs, 10 (six octants with one sense organ and two octants with two sense organs).

C. An adult. Umbrella $4\frac{1}{4}$ mm. in width and $1\frac{3}{4}$ mm. in height. Stomach on a peduncle, which measured about 0·5 mm. in length, and twice as long as the stomach. Eight oval gonads, male and female on alternating canals. Tentacles, 74 (the following numbers in each

octant: 9, 10, 9, 9, 10, 9, 9, 9). Sense organs, 14 (the following numbers in each octant: 1, 1, 2, 2, 3, 1, 2, 2). In this specimen the gonads vary very much in size. Two pairs, male and female, oppositely situated and fully developed, are large; the other two pairs are very small.

Vanhöffen's figures show that the gonads are very unequal in size. Four are large and four are very small, looking as if they were just beginning to develop. The large and small gonads occur on alternating radial canals. Vanhöffen does not state the sex of the gonads, but the largest look immature in his figure. In the smallest Maldive specimen, much younger than Vanhöffen's specimens, the gonads are just beginning to develop. They vary slightly in size, showing that they have not all started to develop at the same time, but the sizes are not arranged in any definite order. In the second specimen the gonads are all about the same size and shape, but not quite fully developed. In the largest specimen there is a well-marked difference in the size of the gonads, which are arranged in pairs, male and female, two large and two small, so that the large and small are not upon alternating canals. The male and female gonads are always upon alternating canals, but in these specimens there is no evidence to show that one sex is in advance of the other, though the gonads are not all of a size.

The occurrence of both male and female gonads upon the same individual is the most interesting character of this species, for, so far as I know, hermaphroditism has not been hitherto recorded for any Craspedote medusa.

Order Narcomedusae.

Family **Aeginidae**, Gegenbaur, 1856.

Genus *Solmundella*, Haeckel, 1879.

Generic Character. Aeginidae with two tentacles and with a stomach having eight pouches.

Solmundella bitentaculata (Quoy et Gaimard) 1833. (Pl. LVI. fig. 3.)

Charybdea bitentaculata, Quoy et Gaimard (1833, Tom. iv. p. 295, Pl. xxv. figs. 4—5). *Aeginella bitentaculata*, Haeckel (1879).

Description. Umbrella somewhat cone-shaped, a little broader than high. Stomach circular, nearly as wide as the umbrella, having lateral pouches about twice as broad as high, containing the gonads. Four radial canals. Two opposite, non-contractile tentacles, which are situated above the stomach and are about three times longer than the diameter of the umbrella. Sixteen sense organs, each with a single otolith.

Size. Umbrella $3\frac{1}{2}$ mm. in width and about 3 mm. in height.

Length of the tentacles about 6—10 mm.

Distribution. Indian Ocean; Maldive Islands, Minikoi (Gardiner, 3 Aug. 1899). Australasian Seas; Amboina Is. (Quoy et Gaimard).

Maas (1904) has just published a preliminary revision of the genera belonging to the Cunanthidae and Aeginidae, but a revision of their species is not given. Maas proposes to unite the genera *Aeginella* and *Solmundella*, and to transfer the latter genus from the Solmaridae to the Aeginidae. This classification I have adopted. (See p. 745.)

SIPHONOPHORA.

Order Calycophorae, Leuckart.

Family **Diphyidae**, Eschscholtz, 1829.

Genus *Diphyes*, Cuvier, 1817.

Generic Characters. Diphyidae with two angular, slenderly pyramidal nectophores, of similar form and subequal size, one placed behind the other. The first nectophore with a conical or campanulate hydroecium. Cormidia without special nectophores. Bracts pyramidal, conical or spathiform, with a pointed apex. Phyllocyst simple, usually large and ovate, without radial canals.

Diphyes chamissonis, Huxley, 1859. (Pl. LIV. fig. 6.)

Diphyes chamissonis, Huxley (1859, p. 36, Pl. I. fig. 3).

There are five anterior nectophores in the collection and as they are more like Huxley's figures of *Diphyes chamissonis* than any other species that I know of, I have placed them under this name.

Description of the Specimens. The nectophore is about 10—12 mm. in length, 4 mm. in width and 3 mm. in depth. It is a long slender pyramid, slightly more curved on the posterior side than on the anterior. The ex-umbrella has three prominent ridges without serrations; one anterior and two lateral which are situated over the nectosac. The posterior side of the ex-umbrella is flat. The shape of nectophore is not exactly like Huxley's figure; as it is not quite so broad and it tapers more towards the apex.

The nectosac is nearly as long as the umbrella, cylindrical and tapering towards its apex almost to a point. The nectocalycine canal runs a considerable distance down the hydroecium and enters the nectosac not far from its mouth. Here it joins a pair of radial canals which run up nearly to the top of the nectosac, then curve over and descend to the circular canal. There is also a short radial canal which runs down from the junction of the nectocalycine canal to the circular canal. The mouth of the nectosac is protected by three short triangular teeth, which have slightly serrated edges.

The hydroecium extends about half way up the umbrella. It is somewhat triangular in shape and has a conspicuous constriction near its mouth. At this point the aperture is nearly circular.

The somatocyst is cylindrical in shape and tapers down towards the hydroecium. One specimen has a small oval somatocyst, but in the other specimens the somatocyst is cylindrical and shows only a slight variation in length and shape. At the top of the somatocyst there is a small yellowish body, irregular in shape, which is probably the remains of an oleocyst.

The siphosome in nearly all the specimens is contracted within the hydroecium, but in one specimen it is more expanded, so that the cormidia are more easily seen. The eudoxomes have a spathiform bract, just like Huxley's figure in shape, a siphon and a contracted tentacle.

Distribution. Pacific Ocean; East coast of Australia, and the Louisiade Archipelago (Huxley). Indian Ocean; Maldive Is. Minikoi (Gardiner, 3rd Aug. 1899).

Genus *Diphyopsis*, Haeckel, 1888.

Generic Characters. Diphyidae with two angular, slenderly pyramidal nectophores of similar form and subequal size, one placed behind the other. First nectophore with a conical or campanulate hydroecium. Each cormidium with a special nectophore. Bracts pyramidal, conical or spathiform, with a pointed apex. Phyllocyst simple, ovate, without radial canals.

Diphyopsis campanulifera (Eschscholtz), 1829.

Diphyes campanulifera, Eschscholtz (1829, p. 137). *Diphyopsis compressa*, Haeckel (1888, p. 153, Pl. XXXIII.). *Diphyopsis campanulifera*, Chun (1897, p. 26). *Diphyopsis campanulifera*, Mayer (1900, p. 75, Pl. XXVIII.).

Sexual generation. *Ersaea lessonii* (Huxley), 1859. *Eudoxia lessonii*, Huxley (1859, p. 57, Pl. III.). *Ersaea compressa*, Haeckel (1888, p. 123, Pl. XXXIV.).

There are about a dozen specimens in the collection and all have the anterior and posterior nectophores isolated.

The shape of the anterior nectophore is like the figure given by Mayer. The teeth round the mouth of the nectosac have nearly a smooth edge, with just a few fine denticulations near the apex. The largest nectophore measured 13 mm. in length. A few of the specimens have the siphosome well expanded and the cormidia are clearly shown.

The largest posterior nectophore measured 17 mm. in length, 7 mm. in breadth and 5 mm. in thickness. The teeth of the nectosac are smooth.

A few specimens of the Eudoxia stage were found. One resembles Huxley's figure of *Eudoxia lessonii*.

Distribution. Atlantic Ocean; Tropical and subtropical regions. Australasian Seas; Amboina Is. (Bedot). Indian Ocean; Minikoi (Gardiner, 3rd Aug. 1899).

Genus *Abyla*, Quoy et Gaimard, 1827.

Abyla trigona, Quoy et Gaimard, 1827.

Abyla carina, Haeckel (1888, p. 156, Pl. XXXV.). *Abyla trigona*, Chun (1897, p. 31).

There is a single anterior nectophore resembling very closely Haeckel's figure (Haeckel, Pl. XXXV. fig. 5). It differs only in having a slightly flatter apex and the lateral wings project a little further out. The positions of the nectosac, the somatocyst, and the hydroecium correspond exactly to the position of these organs in Haeckel's figure of *Abyla carina*. The posterior nectophore was not found.

Distribution. Atlantic Ocean, Tropical and subtropical regions. Indian Ocean; Maldive Is. Miladumadulu (Gardiner).

Order Physophorae, Eschscholtz, 1829.

Family **Agalmidae.**

Genus *Agalmopsis*, Sars, 1846.

There is only one specimen. It is badly contracted and has lost all the nectophores and bracts. The tricornuate tentilla are large. I have not been able to identify the species. Bedot has found *Agalmopsis sarsi* off the Amboina Islands.

Family **Physalidae,** Brandt, 1835.

Physalia utriculus, Eschscholtz, 1829.

Physalia utriculus, Huxley (1859, p. 101, Pl. X., Pl. XII. fig. 12).

About two dozen specimens in the collection. The float of the smallest specimen is about 4 mm. in length and 2 mm. in depth. It has one tentacle and a few siphons and palpons. A specimen with a float measuring 8 mm. in length and 4 mm. in depth has a crest on the top of the float and a few internal transverse septa; one main tentacle and one secondary tentacle much smaller in size; several siphons and palpons; and the gonophores just beginning to develop. The largest specimens are about 20—25 mm. in length and 15—20 mm. in depth and have one main tentacle and several secondary tentacles. Numerous siphons and palpons. The gonophores are fairly well advanced in development. These large specimens resemble Huxley's figure of *Physalia utriculus*.

Distribution. Tropical and Pacific and Indian Oceans (Huxley). Maldive Is., Minikoi. Laccadive Is. (Gardiner).

Family **Velellidae,** Eschscholtz, 1829.

Genus *Velella*, Lamarck, 1819.

The collection contains a single small specimen about 13 mm. in length having a triangular sail about 7 mm. in height. The tentacles are arranged in a single row round the margin of the umbrella. The gonophores are beginning to develop on the gonostyles. The specimen from its size and the appearance of the gonophores is an intermediate stage. Until the Velellidae have been revised it is impossible to identify an intermediate stage.

University College, London, 22nd April, 1904.

A paper by H. B. Bigelow on "Medusae from the Maldive Islands," published in the *Bulletin of the Museum of Comparative Zoology at Harvard College* (Vol. xxxix. No. 9, April, 1904) arrived in London whilst I was revising the proofs of my paper. The author, along with Prof. A. Agassiz, visited the Maldive Islands during the months of December, 1901 and January, 1902. Special attention was given to the Medusae and the drawings of the species were made from life. The list of Hydromedusae contains 22 species, eleven of which are described and figured as new species. Not one of the species, which I have described as new, was taken during this expedition.

I have also just received from the *Concilium Bibliographicum* at Zurich the title of the following paper, "The Craspedote Medusa *Olindias* and some of its Natural Allies," 1903, in *The Mark Anniversary Volume*, pp. 1—22, 3 pls. I have been unable to find a copy of this book in the Scientific Libraries in London.

Whilst my manuscript was in the hands of the printer I examined about 40 specimens of *Solmundella bitentaculata* taken by Prof. Herdman at Ceylon. These specimens show that the shape of the umbrella is variable. One of them has the top of the umbrella very much like the original figure of the species given by Quoy and Gaimard. In the largest specimens there are three sense organs in each octant, but the smaller ones have only two sense organs in each octant. I consider the Maldive specimens to be an intermediate stage in development. Bigelow found *Aeginella dissonema*, Haeckel, at the Maldives, and as this species is widely distributed, it is probably identical with *Solmundella bitentaculata*. Maas (1904) has pointed out that *Aeginella* is the name of a Crustacean genus and that it cannot be used for a medusa.

24*th May*, 1904.

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DESCRIPTION OF THE PLATES.

Reference Letters.

CC. = Circular canal.	*St.* = Stomach.
G. = Gonads.	*S.* = Sense organ.
Or. = Oral lips.	*T.* = Tentacle.
N. = Nematocysts.	*U.* = Umbrella.
P. = Excretory pore.	*V.* = Velum.
R. = Radial canals.	*X.* = Ex-Umbrella.

All the figures were made from specimens in formalin.

PLATE LIV.

FIG. 1. *Proboscidactyla varians* sp. n. Oral view. × 25. (p. 728.)

FIG. 2. Lateral view of a tentacle of *Proboscidactyla varians*.

Fig. 3. *Liriope tetraphylla* (Chamisso et Eysenhardt). × 10. (p. 738.)

Fig. 4. *Phialidium tenue* sp. n. Oral view. × 5. (p. 730.)

Fig. 5. Lateral view of the peduncle, stomach and mouth of *Amphogona apsteini*. × 65. (p. 739.)

Fig. 6. *Diphyes chamissonis*, Huxley. × 5. (p. 743.)

PLATE LV.

Fig. 1. *Pseudoclytia yardineri* sp. n. Male. Oral view. × 40. (p. 731.)

Fig. 2. *Pseudoclytia yardineri* sp. n. Female. Oral view. × 40. (p. 731.)

Fig. 3. Optical section of the group of bulbs on the margin of the umbrella of *Pseudoclytia*. × 55.

Fig. 4. *Mesonema pensile* (Modeer). × $1\frac{1}{2}$. (p. 733.)

Fig. 5. *Amphogona apsteini* (Vanhöffen). Oral view. × 18. (p. 739.)

PLATE LVI.

Fig. 1. *Amphogona apsteini* (Vanhöffen). Lateral view. × 21. (p. 739.)

Fig. 2. *Olindias singularis* sp. n. Lateral view. × 5. (p. 737.)

Fig. 3. *Solmundella bitentaculata* (Quoy et Gaimard). × 15. (p. 741.)

Figs. 4—12. *Aequorea maldivensis* sp. n. (p. 732.)

Fig. 4. The bulbs on the margin of the umbrella. Outer view. × 8.

Fig. 5. A portion of the margin of the mouth showing the lips. × $3\frac{1}{2}$.

Fig. 6. A portion of the sub-umbrella and stomach, oral view, showing the oral lips, the lower wall of the stomach, the gonads (male), and the marginal organs. × 3.

Fig. 7. Radial canals and the gonads (female). × 3.

Fig. 8. The oral lips. Outer view. × 10.

Fig. 9. The oral lips. Inner view. × 10.

Fig. 10. A tentacle, showing the outer view of the basal bulb. × 10.

Fig. 11. A tentacle, showing the inner view of the basal bulb. × 10.

Fig. 12. A tentacle, showing the lateral view of the basal bulb. × 10.

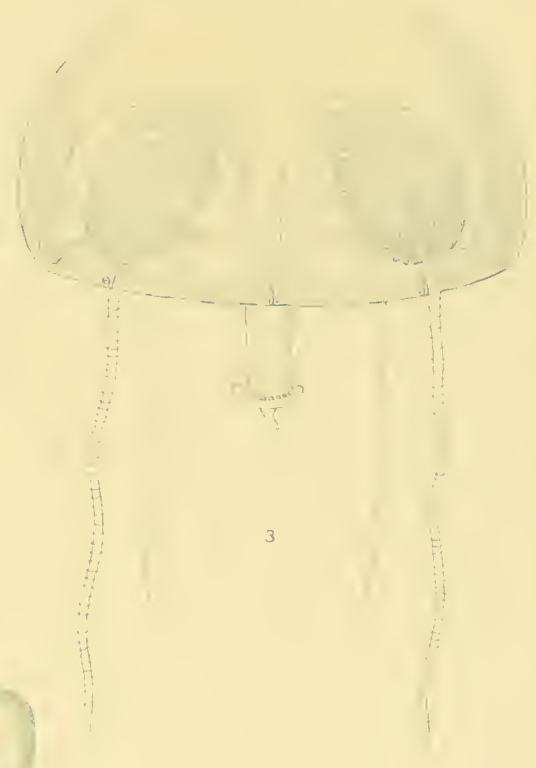
PLATE LVII.

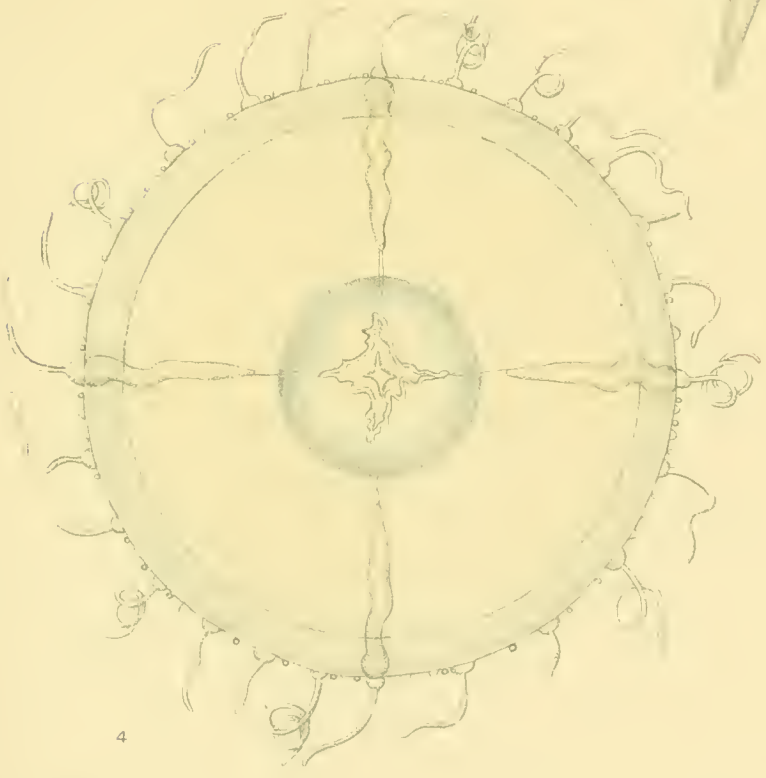
Fig. 1. The tentacles of *Olindias singularis*, the marginal bulbs, and sense organs. Outer view.

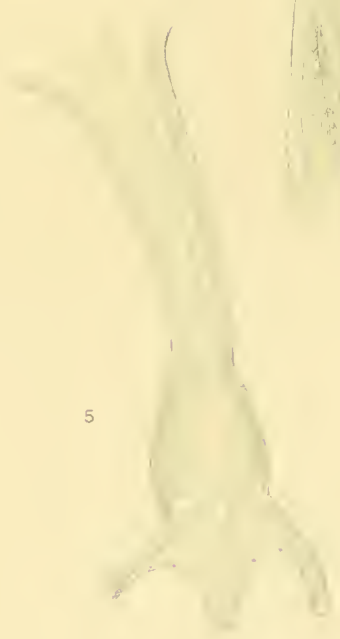
Figs. 2—9. *Mesonema pensile* (Modeer). (p. 733.)

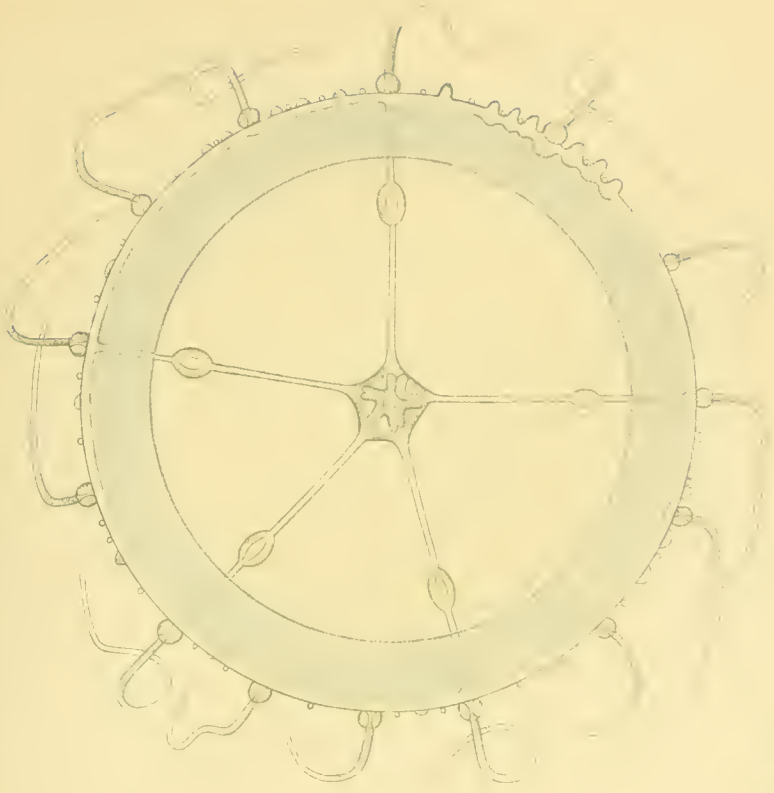
Fig. 2. Diagram showing a transverse section of the umbrella. Nat. size.

Fig. 3. A portion of the sub-umbrella and stomach, oral view, showing the oral lips, the lower rudimentary wall of the stomach, the gonads (male), and the marginal organs. × 3.









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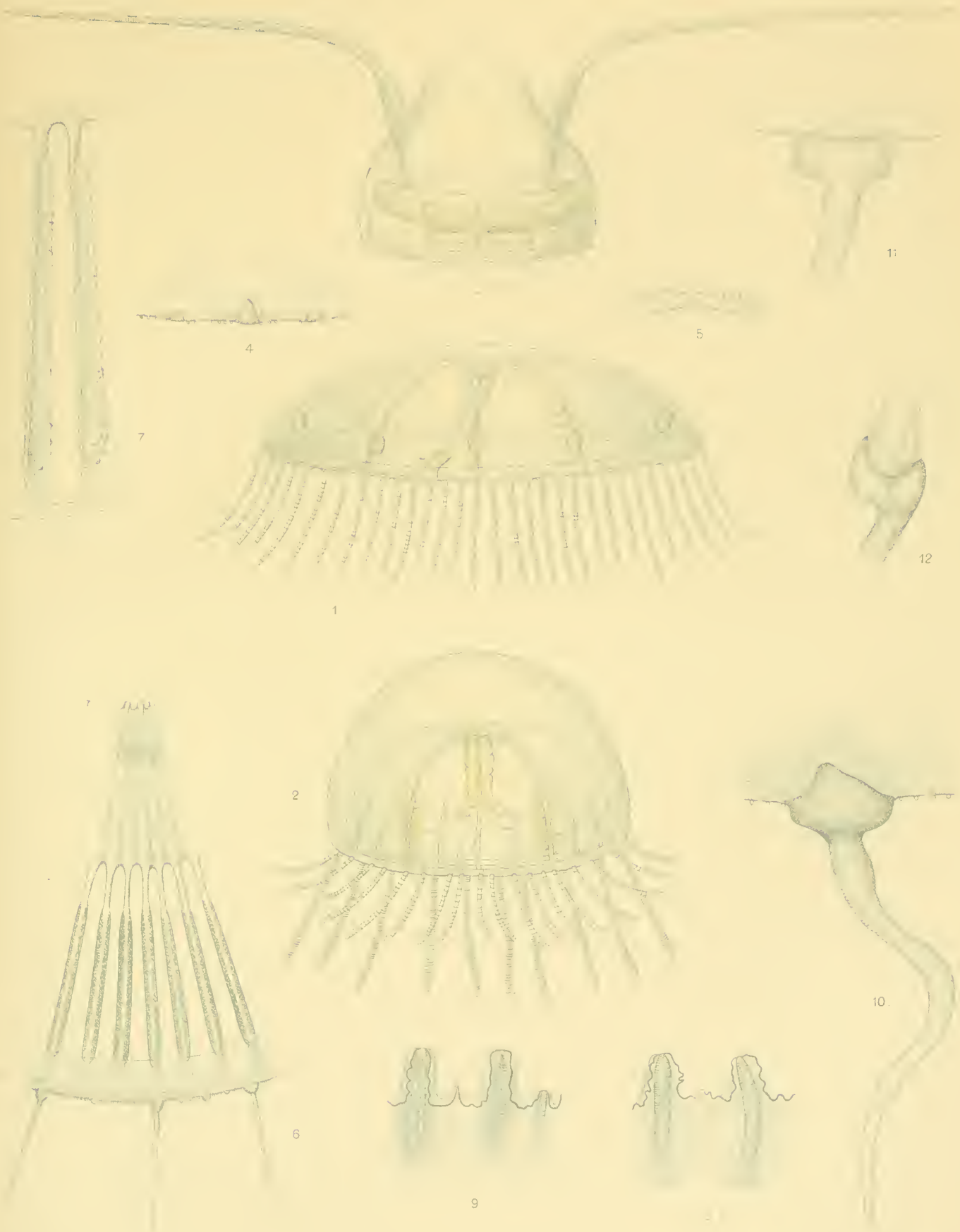


Fig. 4. Radial canals and the gonads (female). × 5.

Fig. 5. The bulbs on the margin of the umbrella. Outer view. × 25.

Fig. 6. A tentacle showing the inner view of the basal bulb. × 10.

Fig. 7. A tentacle showing the outer view of the basal bulb. × 10.

Fig. 8. A tentacle showing the lateral view of the basal bulb. × 10.

Fig. 9. The oral lips. Outer view. × 10.

Figs. 10—15. *Amphogona apsteini.* (p. 739.)

Fig. 10. A tentacle of *Amphogona apsteini.* Outer view.

Fig. 11. The external view of the spermary.

Fig. 12. A section of the spermary.

Fig. 13. The external view of the ovary.

Fig. 14. A section of the ovary.

Fig. 15. A sense organ, optical section. × 300.

Fig. 16. Basal bulb of a tentacle of *Phialidium tenue.* Outer view. × 65.

MARINE CRUSTACEANS.

XIII. THE HIPPIDEA, THALASSINIDEA AND SCYLLARIDEA.

By L. A. Borradaile, M.A., *Lecturer in Natural Sciences at Selwyn College, Cambridge.*

(With Plate LVIII.)

Fourteen species belonging to various groups of reptant decapods are enumerated in the following lists. Two of them are new. All the rest have already been recorded from the Indopacific region, with the exception of a species of *Callianassa* which I am unable to distinguish from a Martinique form.

Suborder Anomura. Tribe Hippidea.

The members of this group are all shallow water forms which live buried in the sand. They are particularly plentiful at the very edge of the water on beaches of loose sand, retreating with the outgoing tide and burrowing with extraordinary rapidity by means of their flat legs with sickle-shaped ends. Garstang has described[1] the way in which the antennules of *Albunea* are adapted to this habitat, forming a filter to keep the sand out of the breathing stream. In the case of most species of *Remipes* a sort of chamber is formed by the long hairs on the short antennae and inner flagella of the antennules[2]. The animal lies in the sand with the eyes just showing and this chamber at the surface to filter the water. It may easily be caught by a bait of crab at the end of a line, pouncing on it with its sharp maxillipeds and allowing itself to be flicked out of the sand if the rod be sharply lifted.

Quite a number of the peculiarities of other sand Decapoda are repeated independently in the Hippidea. The so-called subchelate hands of *Albunea* are found, as we have seen (p. 683), in various Oxystomes and Parthenopidae and in *Kraussia*, and the flattened legs of all Hippidea in *Ranina*, *Matuta* and *Kraussia*. The overlapping carapace of *Remipes* is also common among Oxystomes and Parthenopidae. The outward channel from the gill-chamber is carried, in Hippidea as in Oxystomata, by the endopodite of the first maxilliped. The antennules of *Albunea* are analogous to the antennae of the Corystidae. And the smooth surface

[1] *Q.J.M.S.* xl. p. 224. I regret the accidental omission of a reference to this paper from the article on the Oxystomata, in the course of which some interesting suggestions of Mr Garstang were confirmed.

[2] This is not conspicuous in the species figured below.

of the back of most Hippidea, marked with fine transverse ridges, is repeated in *Kraussia* and, more coarsely, in some species of *Calappa*. It is such striking and quite independently evolved likenesses as these which lend strength to the view that the resemblances between Hippidea and Oxystomes are due to convergence only, and not genetic.

Family **Albuneidae**[1]. Genus *Albunea* Fabr., 1798.

1. *Albunea microps* Miers, 1879. *J. Linn. Soc.* XII. p. 328.

Dredged in Mahlosmadulu Atoll in 20 fathoms of water.

2. ?*Albunea speciosa* Dana, 1852. *U.S. Expl. Expd. Crust.* I. p. 405.

The telson in my specimen is more oval than in Dana's figure, and is pointed. This, however, may be only a sexual difference (Dana does not state the sex of his specimens; mine is a male) or the species may be variable or varietal in this respect. Dana refers to and figures the eye-scales as one triangular plate between the eyes.

The *Blepharipoda fauriana* of Bouvier (*Ann. Soc. Ent. France*, 1898) seems to be allied to this species. Probably the genera *Albunea* and *Blepharipoda* meet near here.

Taken at Hulule, Male Atoll.

Family **Hippidae.** Genus *Remipes* Latr., 1806.

3. *Remipes testudinarius* Latr., 1806. De Man, *Zool. Jahrb.* VI. *Syst.* p. 476.

Taken at Hulule, Male Atoll, between tide-marks.

4. *Remipes pacificus* Dana, 1852. De Man, *loc. cit.*

Taken between tide-marks in Male and Minikoi Atolls, and dredged in Hulule Velu and Mahlosmadulu Atoll in 7 and 6 fathoms respectively.

5. *Remipes granulatus* n. sp. (Pl. LVIII. fig. 1.)

Definition: "A *Remipes* with the carapace finely granular all over and raised into little irregular lumps; the front notched but without a middle tooth in the notch; the outer teeth of the fore edge not quite so long as those of the front and passing evenly into the side edge of the carapace without an angle; the post-frontal groove fairly distinct, behind this a low irregular hollow on each side of the middle line, about a third of the length of the carapace from its fore edge, and behind these again two half-moon shaped cracks in the same position; about 35 pits along each side of the carapace; the eyestalks short; the 'flagellum' of the 2nd antenna of one joint only; the end-joint of the first leg as long as the propodite, slightly compressed, smooth on the inside, tufted with hairs here and there on the outside, fringed above, below, and at the end; and the last joint in the 2nd and 3rd legs short, broad, bent at an obtuse angle."

[1] *Key to the families of the Hippidea.*

I. First pair of legs subchelate. Carapace flattened, without wings to cover the legs. 3rd maxilliped narrow, with exopodite. *Albuneidae.*

II. First pair of legs simple. Carapace subcylindrical, with wings which cover the legs. 3rd maxilliped broad, without exopodite. *Hippidae.*

Length of single specimen: 9 mm. Colour in spirit: dead white. Differs from all other species in the granular surface of the back.

One female, taken between tide-marks at Hulule, Male Atoll.

Tribe Thalassinidea.

With the exception of a few Axiidae[1] which hide in weed, and such species as *Callianassa lignicola*, taken from the hollow of a submerged twig, all the members of this tribe are either burrowers, making galleries, which are often long and deep, in sandy or muddy bottoms, or at least live in burrows made by other animals. Those which burrow between tide-marks usually retire to the bottom of their holes when the tide is out, but they can sometimes be seen just within the opening, when it is almost covered by the water. At such times some at least of them may often be made to seize a bait but are very wary and hard to catch. In spite of certain primitive characters which really remove them from the Nephropsidea, they are at first sight very lobster-like in habit of body, but the abdomen, which is usually softened, the compressed carapace and last pair or more of legs carried close against the sides, and the reduced eyes are easily seen to be consequences of their peculiar mode of life.

Family **Axiidae.** Genus *Axiopsis* Borradaile, 1903.

For a definition of this genus see *Ann. Mag. Nat. Hist.* (7) xii. p. 538.

1. *Axiopsis affinis* (de Man), 1887. *Arch. Naturges.* liii. i. p. 469.

A specimen was taken between tide-marks at Hulule, Male Atoll. It was of a purple colour and lived in a purple weed.

Family **Callianassidae.** Subfamily **Gebiinae.**

Genus *Upogebia* Leach, 1814.

2. *Upogebia* sp.

A damaged specimen of a *Upogebia* allied to *U. major* (de Haan), but differing from it in having no row of small teeth on the outside of the hand, was dredged in Mulaku Atoll in 30 fathoms of water.

Subfamily **Callianassinae.** Genus *Callianidea* H. M.-Edw., 1837.

3. *Callianidea typa* H. M.-Edw., 1837. *H. Nat. Crust.* ii. p. 320.

Taken between tide-marks at Goidu, Goifurfehendu Atoll.

Genus *Callianassa* Leach, 1814.

4. ?*Callianassa* (*Callichirus*) *longiventris* A. M.-Edw., 1870. (Pl. LVIII. fig. 2.) *Nouv. Arch. Mus.* vi. p. 92.

[1] For a key to the families, etc. of the Thalassinidea see *Ann. Mag. Nat. Hist.* (7) xii. p. 549.

This species is recorded by Milne-Edwards from Martinique, but I am unable to find any difference between our Maldive specimen and his description. Milne-Edwards gives no figure, but a comparison will be made more easy by that in the accompanying plate.

Taken between tide-marks at Goidu, Goifurfehendu Atoll.

5. *Callianassa* (*Callichirus*) *novae-britanniae* Borradaile, 1900. Willey's *Zool. Results* IV. p. 419.

The specimen is small and the carapace very soft, so that the lines on it are not easily seen. Fig. 125, on p. 691 above, is from the New Britain specimen, and shows well the two longitudinal lines—*linea thalassinica* and *linea anomurica*—which, by a very rare exception, are here found together.

Taken between tide-marks at Goidu, Goifurfehendu Atoll.

6. *Callianassa* (*Trypaea*) *maldivensis* n. sp. (Pl. LVIII, fig. 3.)

Definition: "A *Callianassa* with the eyestalks short, flattened, pointed, with the cornea on the outside; the rostrum sharp, reaching to the end of the cornea; no antennal tooth on the carapace; the segments of the abdomen about equal, but the first rather shorter, and the second rather longer than the rest; the third joint of the antennular stalk longer than the others, as long as the flagella; the third maxillipeds with the ischiopodite and meropodite broad, but the last three joints narrow; the palm of the great chela as broad as, and about twice as long as, the wrist, both wrist and palm sharp-edged above and below, scantily hairy except on the fingers, the lower edge of the palm saw-like within at the base, that of the ischiopodite and meropodite with strong curved teeth; the telson as long as the sixth abdominal limb."

Length of the single specimen: 19 mm. Colour in spirit: white.

Taken between tide-marks at Hulule, Male Atoll.

Suborder Macrura. Tribe Scyllaridea.

The members of this group are for the most part large and have heavy, well-armoured bodies which are generally somewhat flattened, at least in the abdomen, and almost, or quite, unprovided with a rostrum. They are distinguished from nearly all other Decapoda by having none of their legs chelate, except sometimes the last pair, but they are not on this account defenceless, for the abdominal segments usually carry at each side a sharp point, and the abdomen thus becomes a powerful weapon which can be used with great effect. They mostly live in water which is at least several fathoms deep, but the rock-lobsters may be taken between tide-marks at night in the tropics, and small specimens are found in the same place in daylight. Of the two families[1], the Scyllaridae or bear crabs are found on sandy bottoms, where they probably use as shovels the broad, flat plates which represent their antennae, but the Palinuridae, or rock-lobsters, like rocky ground, often living on the outer slopes of coral reefs, but never in the lagoons. The antennae of this family have very long, stout, stiff flagella, and generally a special roughened surface on the first free

[1] *Key to the families of the Scyllaridea.*

I. Carapace cylindrical. Eyes in incomplete orbits. Antennae with long, stiff flagella. *Palinuridae.*

II. Carapace flat. Eyes in complete orbits. Flagellum of antenna represented by a flat plate. *Scyllaridae.*

joint, with which they can make a sound by rubbing it against the head. It would be interesting to know the use of this noise.

Family **Palinuridae.** Genus *Panulirus* White, 1847.

1. *Panulirus penicillatus* (Oliv.), 1791. Ortmann, *Zool. Jahrb.* VI. *Syst.* p. 28.

Dried shells found on the outer beach at Minikoi. These dried shells of rock-lobsters are strangely more common on the beach than those of other Decapoda. Whether this be due, as the natives say, to the creatures coming up to the surface to shed them, or to their getting killed on the reef in some way, is hard to say, but I have never seen one with the soft parts inside.

2. *Panulirus polyphagus* (Hbst.), 1793. Ortmann, *Zool. Jahrb.* X. *Syst.* p. 266.

My specimens have no white band across the abdominal segments, and the white markings on the legs are in stripes running lengthwise, but broken and somewhat wandering. This form would seem to be the one to which Fabricius gave the name of *ornatus* (*Ent. Syst. Suppl.*, p. 400, 1798).

One dried shell from the beach and one very small individual taken alive on the reef at Minikoi. Common in the Maldives.

Family **Scyllaridae.** Genus *Scyllarus* Fabr., 1793.

3. *Scyllarus martensi* (Pfeffer), 1881. (Pl. LVIII. fig. 4.) Ortmann, *Zool. Jahrb.* VI. *Syst.* p. 44.

The four or five teeth on the inner edge of the second joint of the antenna in this species are each more or less deeply cleft into two in most of my specimens, so as to give a saw-like edge with twice the number of teeth.

Dredged in Mulaku, Kolumadulu, Mahlosmadulu, and South Nilandu, in depths of 20—40 fathoms, always on a bottom of sand or mud.

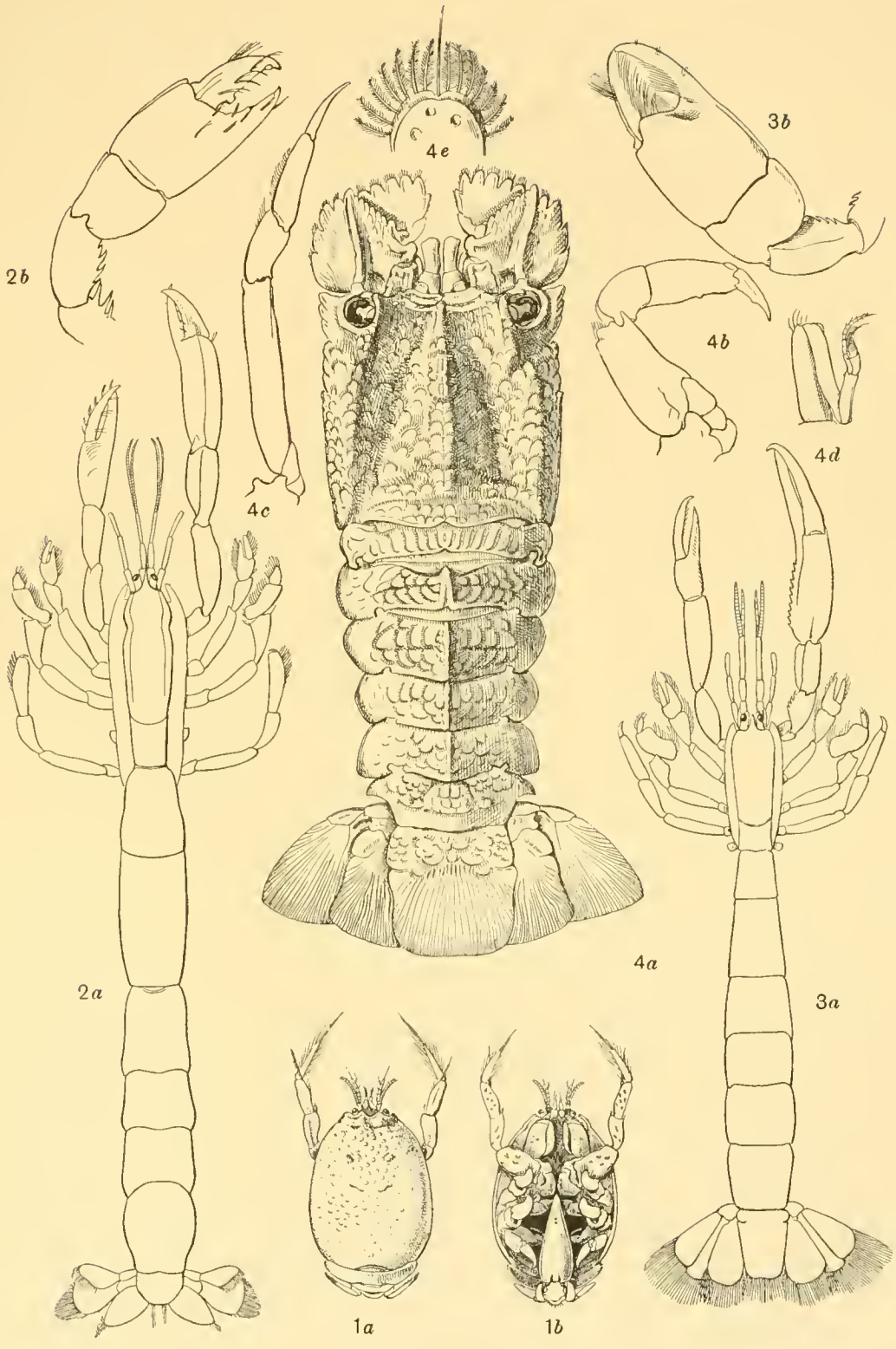
EXPLANATION OF PLATE LVIII.

Fig. 1. *Remipes granulatus* n. sp. *a.* from above, *b.* from beneath.

Fig. 2. ?*Callianassa longiventris* A. M.-Edw. *a.* whole animal from above, *b.* outside of greater hand. The lash of the antenna and the fourth leg on each side are lost.

Fig. 3. *Callianassa maldivensis* n. sp. *a.* whole animal from above, *b.* outside of greater hand. The lash of the antenna and the last leg on each side are lost.

Fig. 4. *Scyllarus martensi* Pfeffer, var. *a.* whole animal from above, *b.* first leg, *c.* third leg, *d.* antennule, folded up, *e.* one of the scales on the back greatly enlarged.



E. W. del.

BORRADAILE——MACRURA AND ANOMURA.

MADREPORARIA.

PARTS I. AND II.

By J. Stanley Gardiner, M.A., *Fellow of Gonville and Caius College, and Demonstrator in Animal Morphology in the University of Cambridge.*

(With Plates LIX.—LXIV.)

I. INTRODUCTION WITH NOTES ON VARIATION.

The present collection contains over 1,000 specimens of dried corals besides a large number in spirit and formalin and a quantity of smaller pieces for comparative purposes. The reef forms are mainly from the following localities: (*a*) Minikoi, the most southern bank of the Laccadive Group; (*b*) Goidu, the east island of Goifurfehendu atoll: and (*c*) Hulule, the most south-easternly island of N. Male atoll. An attempt was made to collect as thoroughly as possible—particularly at Minikoi and Hulule—for the comparison of the localities with one another, and specimens were not generally taken from reefs elsewhere. In addition, dredgings yielded a considerable number of specimens, although few hauls were taken on the outer slopes of the reefs.

The colours of the living colonies were noted at Minikoi, and both at Minikoi and Hulule careful records were kept of the situations where the various species grew. In many cases rough notes were added so as to show the actual positions in which the living corals stood, both for comparison with the upheaved reefs of the locality and so far as possible to ascertain how far mode of growth is dependent on light and environmental conditions. These observations were of immediate value in my study of the coral reef question, and have been of great assistance in working out the collection. I had intended to have given an account of the variability due to these causes, but the limited interest of the subject and the cost of suitable illustrations have reluctantly compelled me to forgo the task. I have under each species indicated as briefly as possible the variation that is found in the several colonies due to these causes.

I divide the *variation* shown by corals into three classes: (*a*) that referred to above, *i.e. vegetative*; (*b*) *continuous*; and (*c*) *discontinuous* or *specific*. Of the latter the only instances definitely known in corals, so far as I am aware, are those of Flabellum rubrum and stokesi and of the two forms of Heterocyathus[1]. Below I have suggested certain additional variations as belonging to this class, such as that shown by the two varieties of Acanthastraea hirsuta, lobed and massive forms of Hydnophora microcona, and three similar species of

[1] *Vide Marine Investigations in S. Africa*, 1902, p. 211 *et seq.* and 1904 in the Press; also *Proc. Camb. Phil. Soc.*, vol. xi. p. 463, 1902.

Echinopora. I am aware that they are very doubtful, at least 500 or 1000 specimens being required to establish any case, but I am of opinion that the phenomenon is much commoner in corals than has been previously supposed.

A species in one locality may show definite *discontinuous* variations in one or more characters, but it by no means follows that the same discontinuous variations will be shown by the same species in a different locality. The specimens may, indeed, show none of the same discontinuous variations, though others may be clearly indicated. It is not improbable that a large collection of one and the same species from many localities would appear to vary in a perfectly continuous manner, and thus all idea of its true variability would be lost. Work on a collection from a single locality is best calculated to bring out the phenomenon, but one requires a collection from some other locality for comparison. This I have to some extent had in my Rotuma and Funafuti collections, but unfortunately they are not nearly large enough for the purpose.

Mr Bernard's method of cataloguing the corals of the British Museum (Vol. IV.) appears to me to be well calculated to throw light on discontinuous variability, but we require a still further development of his system of tables, comparisons of two, three, or as many characters as possible, those particularly that are capable of being expressed in numerical terms[1]. Mr Bernard was in my opinion unfortunate in starting on Goniopora, though he has got results of great value, because there are relatively few specimens of the genus in the Museum. The fact that Mr Bernard is able to place the specimens of each single locality under so many forms, whereas the species are in his present collections impossible to determine, points to the probability of discontinuous variability being, as I have above inferred, from my own collections. Later on, no doubt the species will be determinable with their various discontinuous variations. It will then be possible to see how far the environment and the physical conditions of the localities have affected the parent corallites to cause them to vary their gametes. For this purpose sedentary organisms and particularly corals are peculiarly favourable, because they can, so far as we are aware, in no way make choice of their environment, and must all be affected in any region by the same physical conditions. Larvae of neighbouring localities, such as Ceylon and the Maldives, would certainly be interchanged to some extent, but the immensely greater number of coral colonies in a locality would presumably be produced from larvae of the same locality. Yet, unless there is a real action of the environment in each region in producing its peculiar discontinuous variations in the gametes of the new immigrants it will be obvious that the species must remain approximately constant.

The second class of variation referred to is the *continuous*. That it exists in a very definite form is shown in some species below, but it is exceedingly complex and almost impossible to satisfactorily distinguish from the vegetative. The physical conditions of the Red Sea, Maldives, and Rotuma differ very markedly, and if their action is of any great importance in natural selection, we should not unnaturally expect to find considerable differences between the corals of the three regions. Yet the opposite is the case—more especially between the Red Sea and the Maldives, which are the most different—very many species being precisely the same, *i.e.* showing no dissimilarities in their specific characters. Yet, there does appear to be a real difference. The Red Sea specimens of Astraeidae, considered in their entirety, have larger corallites and calices, and are smoother with less exsert and less toothed septa than the Maldivan, which in the same characters lie intermediate to those

[1] Anyone working at the question could to a large extent do this for himself from Mr Bernard's last catalogue.

from Rotuma and Funafuti, in each species however the specific characters being clearly recognisable. Indeed, there would appear to be a locality mode for certain characters in each genus, a fact which Mr Bernard's catalogue of Goniopora certainly illustrates. The characters, which thus vary, may be all to some extent vegetative, but can they be entirely so? They do not, so far as my study has gone, seem to include the characters on which the species in any genus are founded, whereas discontinuous variation chiefly affects these characters. The differences in the specimens between the different localities referred to are small, but, if they be due to natural selection, the logical result of its action would be to produce ultimately fresh genera with parallel species. There is no sign of any such action going on at the present time. Coral genera are extremely widely spread, and the same species are found in widely separated regions. If, as seems probable, such species are not found in intermediate regions, this fact would point to their presence in these distant regions as due either to the fixation of such a number of discontinuous variations as form their specific characters, in a word to the parallel formation of discontinuous variations, or on the other hand, to the particular species having once extended over the whole area and been killed out or altered in the intermediate areas. The difficulties in respect to the last view are obvious, when one considers the W. and E. Indies, or the Red Sea or Maldives and the Philippines, but it is useless discussing the matter further until we have definite accounts of considerable collections of several genera from different localities.

With regard to the *species question in corals* I can only say that I have not found the same difficulty with the Astraeidae that Mr Bernard has *certainly* experienced in the perforate genera. The species seem definitely separated and constituted, and I feel reasonably certain that I am dealing with definite species or varieties. Before attempting to name, I sorted each genus into its species, a task in which I was much assisted by my notes above referred to, placing under each specimen a paper with measurements and notes of all such characters as seemed to me to be specific in its genus. I then proceeded in the usual way, but I have been much aided by criticism from Prof. Jeffrey Bell and Mr Bernard, and the kindness of these gentlemen in assisting me on many occasions in examining the British Museum collections. The difficulties of the work can only be appreciated by those who have examined sedentary organisms. Many of the so-called species are described on extreme vegetative varieties, or on single small specimens from unknown localities, very commonly without figures, while in many descriptions all reference to half or more of the specific characters is omitted. Considering the dates of their publication, I can only pay a high tribute to Milne-Edwards and Haime's great work, *Histoire des Coralliaires*, and Klunzinger's *Die Korallthiere des Rothen Meeres*, in referring to each of which I have merely mentioned the page and figures under their authors' names. I have also adopted the same course in reference to Dana's *Zoophytes* and my paper on my Pacific Ocean Astraeidae (*Proc. Zool. Soc.*, 1899, p. 734). References to other literature will be found in the above works; I have in the majority of cases not given other references unless they throw some definite light, that the above do not, on the species under consideration. I am particularly indebted to Klunzinger's interpretation and photo-figures of Ehrenberg's specimens. It is to be hoped that the same may be done for Duchaissaing and Michelotti, and also that Prof. Verrill will figure the species that he has described. However, I am not much affected by the work of these authors, since the American species, on which they principally worked, are taken altogether widely different from the Maldivan.

II. ASTRAEIDAE.

The specimens of this family number about 400; many are small fragments, or from the same colony, or young colonies, so that only about half are enumerated as being of use for comparative purposes. They are divided into 69 species of 21 genera. The number of the latter is remarkable as compared with the 12 genera obtained by me in the Pacific and the 16 genera (omitting synonyms) described by Klunzinger from the Red Sea. Definite comparisons and general observations on the family I defer until the whole collection has been worked out.

I have with certain exceptions arranged the genera according to Duncan's classification (*Linn. Soc. Journ.*, vol. XVIII. pp. 1—204), which is in need of thorough revision. Where no references to the genera are given, they are implied to this work. As defined by Duncan I use the term *corallite* as an individual member of a colony, *calice* as the upper opening of the corallite within the theca (or epitheca if it extends to the opening), and *columella* as the structure which fills up the axis of the corallite or calice. When a definite structure is laid down covering the outermost sides of a colony or a simple coral, it is termed *epitheca*; it has everywhere a morphological character in that it is deposited from one side only, *i.e.* the inner, no part of the living tissues extending outside it. The *wall* is the structure which separates a calice from the exterior, or two calices from each other. The *depth of the calice* is the vertical distance between the top of the theca and that of the columella. *Dissepiments* are of two kinds, exothecal and endothecal, outside and within the theca.

I. Genus *Antillia*.

1. Antillia constricta Brüg., var. maldivensis nov. (Pl. LIX. figs. 4 and 5.)

Brüggemann, *Ann. Mag. Nat. Hist.*, ser. 4, vol. XX. p. 309 (1877).

The species has a columella formed of trabeculae flattened parallel to the long axis of the corallum, while var. maldivensis has a spongy columella with a rather papillose surface.

My three specimens measure (1) 75 mm. long, 43 mm. broad, narrowest 19 mm., and 57 mm. high, (2) 74 × 48, narrowest 18, and 52 mm. high, the corallum rather bent at the base, and (3) 69 × 42, narrowest 18, and 37 mm. high. The epitheca varies from 6 to 25 mm. from the edge of the cup. The smallest specimen closely agrees with the type in its shape and septal arrangements. In neither of the others is there any marked elevation of the walls on either side of the central constriction, and (2) is rather irregular at one end as if a second constriction was commencing to form. Septal cycles I—IV join the columella, and in the larger specimens the paliform lobes of III often approach in size and appearance those of the first two cycles. The specimens are 20, 20, and 15 mm. deep from top of theca to top of columella; the septa are 2·5—3 mm. exsert.

Locality. Suvadiva, 31 *f.*

II. Genus *Cylicia*.

2. Cylicia ?stellata Dana. Dana, p. 377, XXVIII. 5.

I have not seen sufficient specimens of the genus—the British Museum has Ed. and H.'s type of C. excavata = C. tenella, but it has never been properly cleaned, and I can

find few other species—to venture on any determination of the species. The corallites of my specimens are extremely variable, but most show the *star* of the above species formed by the six primaries. The genus appears to me to be a very doubtful member of the Astraeidae, and would probably repay morphological investigation (both corallum and polyps).

Locality. Common under overhanging coral or rock masses of the boulder zone, reef-flat and lagoon reefs throughout the Maldives (not Minikoi). The corallites are only found in comparative darkness, and appear to shun the light. *Polyps* colourless.

III. Genus *Tridacophyllia.*

3. Tridacophyllia lactuca (Pallas). Dana, p. 195, IX. 10.

A single specimen from S. Nilandu, 30 *f.*, and a smaller piece, Felidu, 20 *f.*, seem to belong to this species as understood by Dana. The surface of the first is so distorted by worms and capsules of Pyrgoma, standing up for 1—2 cm., that identification is extremely difficult.

IV. Genus *Euphyllia.*

4. Euphyllia glabrescens (Chamisso). Ed. and H., II. p. 192 and Gard., p. 735.

The specimens differ from the Rotuma ones in that the septa very seldom rise above the wall. Fission takes place by a pinching in and fusion of the two opposite walls of an elongated corallite. The calices are often much distorted by the round tubular dwellings of Pyrgoma.

Locality. The colonies of this species may generally be found in hollows towards the inner side of the reef-flat or in protected situations, where there is no sand or mud, both at Minikoi and throughout the Maldive group. Where it occurs, as to the S. of Hulule, it is exceedingly abundant, but is nowhere a reef-builder. **Colour,** dull green.

5. Euphyllia turgida (Dana). Dana, p. 167, and Ed. and H., II. p. 193 (and *Ann. des Sc. Nat.*, t. X. pl. 6, fig. 1, 1848).

Three branched specimens with calices varying up to 4 cm. long by 2 cm. broad, closely agree with Ed. and H.'s description and figure, especially the section. The septa are scarcely exsert, and the corallites have a tendency to be constricted round their open ends.

Locality. North Male, 28 *f.*, and S. Nilandu, 36 *f.*

V. ? Genus *Mycetophyllia*, Ed. and H.

6. A small specimen with five calicular centres may belong to this genus. It presents a striking resemblance to Ed. and H.'s figure of M. lamarckana (*Ann. des Sc. Nat.*, t. X. pl. 8, fig. 6*a*), and does not agree with the young specimens of Mussa that I have seen.

Locality. Suvadiva, 40 *f.*, bottom covered with coarse rubble.

VI. Genus *Mussa*.

7. Mussa corymbosa (Forsk.).

Mussa corymbosa and cactus, Dana, pp. 177—8, VII. 1. M. corymbosa, Ed. and H., p. 333, and Klz., p. 6, I. 4 and 9. M. cactus, Gard., p. 737.

Locality. Sparingly on lagoon reefs and in holes of the reef-flat in the Maldives (six specimens). **Colour,** a brown padded edge, surrounding a green peristomial valley.

VII. Genus *Symphyllia*.

8. Symphyllia sinuosa (Q. and G.). (Pl. LIX. figs. 1, 2 and 3.)

Meandrina sinuosa, Quoy and Gaimard, *Voy. de l'Astr., Zooph.*, p. 227, Pl. XVIII. figs. 4 and 5 (1833); Symphyllia sinuosa, Ed. and H., II. p. 370, and Gard., p. 738.

I refer seven specimens to this species, and I have two further specimens from Rotuma and the Singapore region before me. They show clearly that the genus is formed by the fusion together of series such as are found in Mussa. The species is simply a massive Mussa closely related to M. corymbosa.

Internal structure. The dividing wall of the series in all the specimens possesses a distinct furrow or groove. In parts of some of the colonies it is a valley in the upper edge of the wall, but over the greater part of their surfaces is merely a narrow deep notch between the outer edges of the septal plates (septa + costae), which are only secondarily continuous between the calicular rows. This can be clearly seen from the surface owing to the fact that the septa of neighbouring rows are seldom exactly opposite to one another, and that the thicker septa rather tend to alternate than lie opposite. In section it is clear that the septa are not continuous, and in places one can distinguish between their outer edges a thin, vertically rising plate. The latter is much fenestrated, and is incomplete; it may be a secondary formation, but appears to be continuous right down to the epitheca of the colony, and in my view represents the remains of the fused epitheca of neighbouring rows. The exothecal dissepiments are 1·5—3 mm. apart in accordance with the thickness of the wall; they are not continuous between the theca of neighbouring rows, but are arched, convex side uppermost, from the theca to the centre of the wall, *i.e.* to the fused epithecal line above mentioned. The morphology appears to be the same in all the specimens, but there is great variation in the thickness of the walls (2·5—8 mm.), and in the thinner their structure may be almost obliterated so that they appear relatively solid. The endothecal dissepiments are lightly arched from the theca to the columella; they are thin and often form large vesicles about 2 mm. broad by 5—10 mm. long. The septa may be almost complete or much fenestrated, near their edges passing into flattened, upstanding plates, the innermost and smallest of which form the columella.

Variation. The specimens in their internal structure show little variation except what is dependent on the thickness of the walls and the distinctness of the furrows, both already referred to. There are two classes of septa, (*a*) coarse, upstanding, 3—5 mm. exsert, 1—2 mm. thick over the theca, with 1—3 great pointed teeth near their upper edges, passing internally into blunter lobes or relatively fine teeth, and (*b*) fine, not more than 2 mm. exsert nor 1 mm. thick, closely set internally with fine pointed teeth. In the Rotuma specimen there

is less difference in the two classes than in any of the present collection, though all the characters of the latter vary considerably in different parts of the colonies. The two classes of septa may alternate with one another in any series, or the larger septa may be separated by an average, in parts even of the same colonies, of 2, 3 up to 8 smaller septa. On opposite sides of the walls the septa may lie against one another but more frequently alternate to some degree; the larger septa throughout are much more frequently arranged contiguous to the smaller, but there is every variation. The septa range from 6—10 in 1 cm.; the series are 1·5—3 cm. wide by 1—2 cm. deep. The longitudinal septa joining calicular centres range from 1—5 in number.

The specimens undoubtedly belong to Symphyllia sinuosa, of which S. grandis appears to me to be only a vigorously growing form, though Ed. and H.'s figure is peculiar. The descriptions (no figures) of S. agaricia, radians, and valenciennesi are not sufficient to separate them, though they may be really different species. The same remark applies to S. subtilis, Rehberg (*Abth. Nat. Ver.*, Hamburg, Bd XII. p. 16, Pl. I. fig. 6, 1892).

Locality. The species is fairly common on the lagoon shoals and reefs of the Maldives. I have also seen it in the outer slope, and it is not improbably in places an important reef-builder. The specimens come from Hulule, Goidu and Minikoi. **Colour** of the Minikoi specimen (fig. 4), a large mass several feet in diameter, in central upper part of the colony, over walls transparent, peristome very light green dotted with dark green, edge of stomodoeum white, and at sides, over walls very dark green, peristome white slate, edge of stomodoeum white.

VIII. Genus *Coeloria*.

Ed. and H., II. p. 411; Klz., p. 15, and Gard., p. 740. Ulophyllia, Ed. and H., II. p. 377; and Quelch, *Report on the Reef Corals of H.M.S. Challenger*, p. 88 (1886).

I still consider that Coeloria and Macandrina are quite separate genera, the latter having, so far as we know, a true columella, and the former merely trabeculae extending out from the septa to fill up the axial fossa. The species appear to me to fall into three types, which may be best indicated by C. pachychila, daedalea, and magna. C. cooperi shows a transition to the last, which would formerly have been placed in the genus Ulophyllia. The regular method of division of the series, or of the circumscribing of the calices in the genus, is by the enlargement and fusion of septa from their two walls or ridges. The septa on either side in their further growth bend away from the new walls, thus removing to some distance the columellar trabeculae, to which the septa give rise. Later, the new walls themselves get septa, and form the end walls of series or the circumscribing walls of calices. The first part of this process takes place very early in Ulophyllia, but it is no different to what occurs in Coeloria, and the gap between the species of the two genera—if there was any before—is bridged by C. cooperi and magna as well as the Challenger species. Ulophyllia is undoubtedly, so far as its recent species are concerned, a synonym of Coeloria.

Distribution. The genus is the most abundant of all Astraeids on the reef-flat and outside the edge of the reef to 5 *f.*, where the immediate force of the breakers is felt. It also occurs abundantly on the outer slope down to 15 *f.* and one specimen comes from 28 *f.* It may be found occasionally on the sand flat behind the boulder zone, but it evidently loves neither this position nor shoals in enclosed lagoons. **Colour,** generally some shade of green.

9. Coeloria pachychila (Ehrb.). Klz., p. 15, I. 6.

A single half ball-shaped specimen agrees with this species in every respect. The width of the valleys from the tops of the ridges is generally about 7 mm., and depth 5 mm.

Locality. Maldives, brought to me by a native who stated that he obtained it from the Male reef-flat.

10. Coeloria sinensis (Ed. and H.).

Ed. and H., II. p. 416, and Gard., p. 742, XLVI. 3. Coeloria edwardsi, Gard., p. 744, XLVI. 6.

I refer fourteen specimens with some doubt to this species, the mode of which lies much nearer C. edwardsi. The species shows almost as much variation as C. arabica, Klz., but it differs from it in its regularly smaller sized (breadth and depth) calicular rows, which show no tendency to vary in their mode so as to approach C. arabica.

In their characters the specimens vary between the two above-cited species, most rather approaching towards C. edwardsi. The *series* are generally long and increase by their outpushing at the edges of the colony over its basis of support; subsequently they are divided up by transverse partitions, but, where growth is not luxuriant, this may be compared almost to a process of budding from the ends of the series. Their breadth varies from 3—6 mm., average across parallel valleys 3—4 mm., sinuous valleys 4·2 mm., where growth unfavourable larger but never more than 5 mm. The *theca* is quite perfect, ·5—1 mm. thick varying up to 2 mm. owing to deposition of endotheca. *Septa*, 11—16 in 1 cm. (average of 55 being 13·5), 8—13 reaching columella (average 10·4), ·5 mm. exsert, continuous over walls, square above rather than pointed. finely toothed, precipitous slope to the bottom of the valleys. *Columella* seldom more than 3 mm. below upper edges of theca, at first fused thickenings of septal sides, often at this stage ending in spines flattened parallel to the direction of the valley, and varying with its depth. When a valley is very shallow, owing to boring organisms underneath or other causes, the *columella* may approach in appearance the condition in Leptoria, though generally it is quite inconspicuous. When growth is slow and the valleys are broad, the line of fusion of the septal edges may be joined by additional processes from the septal sides, so that the columella may appear to consist of a relatively broad line of trabecular substance. The *endothecal dissepiments* number 15—18 in 1 cm., but vary in individual specimens.

Locality. Common over the reef-flats of Minikoi and the Maldives; found also on the outer slopes and occasionally on the lagoon shoals.

11. Coeloria daedalea, Ell. and Sol. Gard., p. 741, XLVI. 1 and 2.

Three specimens from Hulule, W. reef and passage through same.

12. Coeloria astraeiformis, Ed. and H. Gard., p. 743, XLVI. 4.

Two specimens from Minikoi, reef-flat and lagoon to the south. This species is possibly only a facies of the last.

13. Coeloria cooperi, n. sp. (Pl. LX. fig. 9.)

Colony massive, with distinct costae but no epitheca showing at the edge. *Series* of moderate length (longest 6 cm.) and twisted, average breadth about 11 mm., 4—9 mm. deep (average 6 mm.), calices rarely circumscribed. *Walls* solid, thin and pointed, often at upper ends a little fenestrated, apparently formed by thickenings of the septal sides. *Septa*, thin,

continuous over ridges, 1—2 mm. exsert, upper ends more or less horizontal up to 5 mm. broad, subequal, about 1 mm. apart, sometimes more crowded, sides granulated; teeth very irregular, often small above, near the bottom of the valley passing into fine pointed teeth or into blunt upstanding lobes, the latter from opposite ridges often fusing and forming the first stages of the division into separate calices. *Columella* varying greatly in amount in the valleys, being cut up where opposite septa fuse, either formed of the innermost pointed teeth or of rounded trabeculae from most of the septa, always very loose and open. In *section* endothecal dissepiments thin, very oblique 1—2 mm. apart, often at edge or where growth is unfavourable causing the walls to appear exceedingly thick, extending up to within 2 mm. of the edges of the septa.

The colony is very peculiar in the frequent fusion of large septa across the bottom of the series. The septa on either side of these may curve a little away from them thus giving an appearance in some parts of the series of the calicinal centres being distinct.

Locality. A single specimen, the edge of a large flattened mass from the west reef of Hulule, showing a much rounded living surface of 38 by 19 cm.

14. Coeloria magna, n. sp. (Pl. LX. figs. 7 and 8.)

Colony massive, underside, up to within 1 cm. of the edges, clothed with wavy epitheca, at edge strongly costate. *Series*, short, longest 4 cm., average breadth about 15 mm., very shallow, almost superficial or up to 7 mm. deep, calicular centres generally distinctly recognisable. *Walls* thin at edge, in most parts appearing very bluntly pointed, and thick below owing to the oblique character and superficial position of the top exothecal dissepiments. *Septa* thin, continuous (in some parts very irregular—often thickened almost vesicular—owing to boring animals or small cirripedes), irregularly exsert (about 1 mm.), generally pointed, but with scattered septa flat-topped (3 mm.) up to 3 mm. high, about 40 round a circumscribed calice, from 6—10 in 1 cm. in accordance with the presence or absence of minute septa alternating with the larger, more crowded at edges of colony, sides granular; teeth minute, towards the inner ends of the smaller septa more pointed and longer, merging into blunt, often two or three toothed paliform lobes on 12—18 of the septa of circumscribed calices; in the series septa occasionally joined across the valleys, dividing them up into fairly distinct calicinal centres. *Columella* small, sometimes formed of the innermost pointed teeth but more often of rounded, very lax trabeculae from at least half of the septa. *Endothecal dissepiments* oblique to 30°, thin, 1·5—2·5 mm. apart, rather vesicular.

The species, even more markedly than the last, shows the division of the valleys into separate calices by the fusion of the larger septa from either side. It differs from Ed. & H.'s species of Ulophyllia as described and figured. With the Challenger specimens, which seem to me to be of one species, it has greater resemblances, but its shallow cells, breadth of series, and septal characters serve to separate it, so far as our knowledge of variation at present goes. Figs. 7 and 8 show two different parts of the colony.

Locality. Addu, outer slope, 28 *f.*, a flattened massive colony, 41 cm. long by 27 cm. broad and 7 cm. thick.

IX. Genus *Leptoria*.

15. Leptoria gracilis, Dana.

Dana, p. 261, XIV. 6; Ed. and H., p. 407; Klz., p. 13, II. 5, IX. 11*a—d*; Gard., p. 739.

Four specimens belong to this species. They differ from Dana's description and my own Rotuma specimen in being everywhere more delicate, septa less exsert and rough, and all parts thinner. They show little variation, and that mainly due to the presence of boring animals, all kinds of which appear to love their corallum; from this cause the fused theca may appear thick, in section hollowed out, and the plates of the columella thick and pushed up so as to reach the level of the top of the theca. The surface is studded with the round holes of a crab, Cryptochirus, but barnacles do not occur.

Locality. Rather sparsely distributed, especially at Minikoi, mainly reef-flat and outer slope, a specimen from a shoal near the W. passage of Minikoi, and specimens from Hulule and Goidu. **Colour,** brown with green lines, where the peristome series occur.

X. Genus *Hydnophora*.

The several species of this genus show perhaps as much variation as those of any other in the collection. I did not, however, study the variability of its colonies *in situ*, the genus being rare at Minikoi, and I have no notes on the variation of the specimens in the British Museum. Although I have more than 50 specimens before me I am quite unable to determine with any certainty out of all the species mentioned by Ed. and H. and Klunzinger, more than H. microcona. H. maldivensis would appear to be a truly explanate form, but I have explanate and massive specimens of H. lobata below, which as also the lobed forms in places approach H. microcona. There are, however, no intermediates, though all as well as the specimens of H. microcona grew in more or less the same environment. This fact then suggests that of H. microcona we have two real varieties, *i.e.* explanata and lobata.

Distribution. The genus is found on any reefs in the Maldives, and we observed it forming considerable masses on the outer slope of Goifurfehendu Atoll. It may hence be an important reef-builder. It varies in depth to 32 *f.*, the deeper specimens very markedly differing from all described reef-forms.

16. Hydnophora grandis, n. sp. (Plate LX. fig. 11.)

Colony massive and thick but exceedingly light, edges explanate but coarse, clothed underneath by a thin epitheca. *Monticules* ending above in fine points or in thin plates, in the colony not more than 6 mm. long, 2—3 mm. high, varying from 4 to 9 mm. wide from valley to valley, average about 7 mm. The *septa* on the monticules number from 6 to 18, the most pointed 6 or 8, those most elongated 14—18, mode 10 or 12; they are not exsert, slightly granular at the sides, rough edged but not toothed, and appear more distinct than in any other species owing to the lowness and breadth of the monticules; around calicular centres the septa number 6 or less. There is no definite *columella* but the septa at the bottom of the valleys bend towards the calicular centres, and may be thickened, while between the lower ends sometimes rough pillars arise, especially where the septa round a centre number less than six. *In section* the monticules are seen to have the very thin, narrow or

broad theca in the centre, from which the septa appear to radiate; the loculi are filled up with vesicles or cells not more than ·75 mm. apart and scarcely longer, extending to within 1 mm. of the edges of the septa; the valleys are filled up in the same way but with rather larger vesicles, so that there is obviously no columella.

The species differs from all others in its large monticules and few septa, as well as its light structure. The theca is very difficult to see in section; it is often a mere rod from which the septa radiate as from a rod-like columella.

Locality. S. Nilandu, 25 *f.*, and Haddumati, 32 *f.*

17. Hydnophora microcona, Lmk. Ed. and H., II. 423, and Gard., p. 744.

There are nine specimens of this species in the collection. It is fairly common, though rather local, throughout the Maldives, but scarce at Minikoi, where it was only obtained from the reef-flat. The Maldive specimens were collected at Hulule, Goidu, Addu, and Turadu (S. Mahlosmadulu) from reef-flat and lagoon. **Colour,** olive green, polyps noticeable for their large amount of mucus.

18. Hydnophora ?lobata (Lmk.). Ed. and H., II. p. 421.

Two moderate sized specimens, the largest 17 by 14 cm. by 13 cm. high, may belong to this species. They are extraordinarily variable on their thin edges, lobes and valleys, in parts appearing to represent a lobate variety of C. microcona, but I have seen no intermediates.

Locality. Two specimens from the west reef of Hulule. [H. lobata mihi (p. 745) from Rotuma is probably not the same species as the above specimens, though it resembles them in its light texture. H. exesa mihi (p. 745) from Funafuti is probably a new species.]

19. Hydnophora maldivensis, n. sp. (Pl. LX. fig. 12.)

We dredged 27 pieces, all small, of an explanate coral of this genus, which I am bound to refer to a new species. It comes close to H. gyrosa, Ed. and H., but the only indication of lobing that it gives is in an elevation over two barnacles 15 mm. high by 12 mm. broad. Even in its thickest part it is less than 10 mm., averaging in different parts 3—6 mm. Its characters are as follows:

Colony, explanate, thin, covered underneath to within 1 cm. or so of the edge with a delicate epitheca, through which the ridge-like, untoothed costae (14 in 1 cm.) are clearly visible. *Monticules* towards the centre of the colony more rounded and much larger, 2—3 mm. high and 6—7 mm. between the valleys, passing gradually into long (6—7 cm. at edges), slightly sinuous collines 1—2 mm. high and 4—5 mm. broad, separating series of calices, of which the centres are not visible except near the centre of the colony, where they have generally 6 septa; theca only visible in places as a thin line. *Septa* not exsert, near the edges sloping up very obliquely on the walls of the series, subequal about 1 mm. apart but sometimes alternating with very minute septa; teeth not noticeable near upper edges, within very low, distant and blunt. *Columella* a few irregular, rough, twisted trabeculae from the lower ends of the septa, varying considerably in amount, in some places forming a distinct base to the valleys, but in others very irregularly massed, probably not a true columella. *In section* extremely vesicular, the vesicles extending to within 1 mm. of the edges of the septa and forming the monticules; theca not visible.

Locality. S. Nilandu, 24 *f.* and 30 *f.*, Haddumati, 32 *f.*, and Suvadiva, 25 *f.*

XI. Genus *Favia*.

Ed. and H., II. p. 426. Klz., p. 25. Astraea, Gard., p. 747.

The genus is in many respects a most unsatisfactory one. On the one side it almost merges into Coeloria (*vide* C. astraeiformis, Ed. and H.), and on the other into Goniastraea. Indeed, many species are in parts at any rate indistinguishable from the latter, save in microscopical sections. Again, Orbicella approaches close to it in that some of its species show fission moderately freely and some intracalicular gemmation (which may simulate fission) as well as the more regular extracalicular. The presence of a valley or sulcus between the corallites is really no test, and the septa are often continuous in Orbicella between the calices and within the walls.

The species in the collection are most variable, even more so than those of Orbicella and Prionastraea. Attention may be particularly drawn to F. denticulata, in 16 specimens of which I have attempted to work out the variability, both normal and vegetative, and also to F. hululensis. The species fall naturally into three groups: (*a*) those with rather rounded calices, sulcus on walls, theca distinct, paliform lobes more or less prominent, and exsert portions of septa generally horizontal; (*b*) angular calices, thin walled and no sulcus, marked paliform lobes, exsert parts of septa rounded or rough; and (*c*) gyrose calices. No. (*a*) includes F. cavernosa, denticulata, hululensis and hombroni, a very close series, a gap in size only between the last two, with offshoots in F. affinis and laccadivica. In (*b*) we have F. halicora and parvimurata, which might almost be placed in Goniastraea, and in (*c*) F. versipora and adduensis, the former particularly recalling certain Coeloria.

Distribution. The genus is essentially dominant over all other massive forms on lagoon shoals in Minikoi and throughout the Maldives; it is also, with the possible exception of Prionastraea, the most abundant in the waters of the outer slope to about 15 *f.* It is seldom found on the reef-flat, and generally shuns all sandy spots, or where sediment may collect. Its colonies on the lagoon shoals of Minikoi form enormous, overhanging masses, several feet in thickness, often dead in the centre but living on the sides. Numerous boring organisms, particularly Sipunculoids, find a home in its coralla, but seldom distort its surface. Only one specimen was dredged, that of F. adduensis, from 25 *f.* **Colour** of the living colonies almost invariably some shade of green.

20. Favia versipora (Ehrb.).

Favia ehrenbergi = F. versipora (Ehrb.), Klz., p. 29, III. 5, 7 and 8, and IX. 1 *a* and *b*. Favia bertholleti, Ed. and H., p. 431.

A single specimen from the edge of the reef at Minikoi belongs to Klunzinger's typical form of this species. Its walls are, indeed, more rounded, septa thicker and less numerous (18 to 26), and calices rather smaller, but these appear to me to be vegetative variations. Here and there I find a calice with its septa having relatively long teeth, and this fact, coupled with the number of septa, causes me to consider F. bertholleti to be merely a synonym, as indeed I deem all those suggested by Klunzinger.

21. Favia adduensis, n. sp. (Pl. LXII. fig. 6.)

Colony massive, or somewhat incrusting. *Calices* irregular, seldom rounded, angular, elongated, twisted or gyrose, largest 10 by 5 mm., average 6 to 7 by 4 mm., 3 to 4 mm.

deep. *Walls*, either—over the greater part—rounded or slightly pointed above, not more than 1·5 mm. thick, with septa ·5 mm. exsert, not generally extended horizontally, continuous between calices, or—a few places at the edges—3 mm. or more thick with distinct furrows but theca never visible. *Septa* irregular, often 2 or 4 (presumably primaries) very much thicker (·5 mm.) with exsert parts horizontally extended—evidently showing where division is ultimately to take place—in the average calice about 21 in number, often the smaller curving round to fuse with the larger, all thin with the exception of the large primaries, granular on the sides, finely but very irregularly toothed, the lowest teeth of about 12 of the largest rough, pointed and perpendicular, forming a more or less conspicuous pali-crown. *Columella* always distinct, rather dense, commonly at least a quarter of the breadth of the calice, formed by finely anastomosing trabeculae from at least one half of the septa. *In section* (which is not very clear) the exo- and endothecal parts appear rather vesicular, walls compact.

Locality. From the outer slope of the reef of Addu, 25 *f.* The specimen (15 × 11 × 7 cm.) is more or less incrusting and relatively thin. The species is nearest allied to the last, but markedly differs from all known forms of the genus.

22. Favia cavernosa (Forsk.). (Pl. LXI. fig. 13.) Klz., p. 26, III. 4.

I refer to this species a rounded mass, 22 cm. in diameter, dead in centre but surrounded by a belt 14 cm. broad, still living when obtained, and a second, dead in places, 15 cm. in diameter by 13 cm. high. The second has rather thinner walls, higher calicular edges, thicker costae and septae than the first. Both, especially the second, show recognisable, paliform lobes in a few calices. The septa may be thickened or not, where they join the theca. Traces of costae without corresponding septa are often present. Only in isolated calices can the columella be termed "sehr wenig entwickelt," being generally nearly as well marked and of the same nature as in F. denticulata.

There appears to me to be little or no doubt as to the identity of these specimens with Klunzinger's species, the figure of which is good. I accept the latter's synonymy, but I am doubtful as to Favia okeni.

Locality. Minikoi, larger from the flat behind the boulder zone, and smaller from a lagoon shoal.

23. Favia affinis Ed. and H. (Pl. LXII. figs. 22 and 23.)

Ed. and H., II. p. 429. Gard., p. 750.

Three quite small specimens with ordinary calices (not undergoing fission) varying up to 13 mm. long and 9·5 broad, and walls up to 3 mm. in thickness but averaging about half this. The *theca* of the separate calices is not generally distinct, their exothecal connections usually in the form of vesicles, convex above, and not mere dissepiments. The *septa* are 1 to 2 mm. exsert above the theca. The line of junction of the costae of neighbouring corallites is shown by a very distinct notch or furrow, and in this position delicate, transverse connections tend to form between them, where growth is vigorous. The edges of the septa over the theca may be thickened, and are edged with fine teeth. They vary in number up to 30, of which about half extend into the calice to form with fine, twisted trabeculae from their edges a small *columella*, against which they end in relatively thick, blunt, often spined, paliform teeth.

The septa, where they pass into the theca, are often quite hollow. The endothecal dissepiments, distant 1·5 to 2 mm., commonly extend downwards from the theca at an angle of about 45°. All parts tend to be excessively thin and delicate, though the hollow, rough nature of the septa, together with their small number in the large calices, gives the species a coarser and more open appearance than any other in the collection. It differs in the vesicular exotheca (difficult generally to distinguish, chambers about 1 mm. high) from F. cavernosa, the possible variation of which in most other points might well cover it. Its form of growth is bigger but otherwise closely related to F. denticulata.

Locality. Hulule, W. reef (calices slightly smaller than in the other specimens, distinct furrow, septa less exsert but thicker edged, paliform lobes less marked), Minikoi, lagoon shoal (very light and of most vigorous growth) and a doubtful fragment from the reef-flat.

24. Favia denticulata (Ell. and Sol.). (Pl. LXI. figs. 14—18.)

Madrepora denticulata, Ell. and Sol., *Zooph.* p. 166, pl. 49, fig. 1 (1786), Favia denticulata, Ed. and H., II. p. 428 (non Astraea denticulata, Dana, p. 234, 1846, Gard., p. 748), Favia denticulata, Klz., p. 27, 1879. ? syn. F. urvilleana, F. doreyensis, F. geoffroyi, F. aspera, all Ed. and H.

The characters of this extraordinarily variable species are as follows: *Colonies* very markedly massive in growth, closely incrusting at edges with a quite determinate, transversely marked epitheca. *Walls* always with upper edges of theca distinct and slightly raised above the top dissepiments, 2 to 4 mm. thick. *Calices* always rounded, elongated, or a little distorted where dividing, often somewhat oval, average size varying from 6 to 10 mm. in diameter and 2 to 6 mm. in depth. *Costae* commonly continuous between calices, always sloping below level of top of theca (hence very distinctly furrowed appearance, or series of notches on the walls), and equal in number to the septa, but sometimes additional ones marked by fine linear ridges or lines of granules or spinules (especially where septa are less numerous). *Septa* always somewhat exsert (·5 to 2·5 mm.), always arched above, upper end almost horizontal, 20 to 40 (generally 24 to 34) in number, no distinct cycles, outer halves almost perpendicular, closely set with small, fine, subequal teeth, commonly on 10 to 20 of the larger septa passing below into 1 or more upstanding paliform lobes, or at least ending perpendicularly against the axial fossa. *Columella* $\frac{1}{4}$ to $\frac{1}{5}$ breadth of calice, flat-topped, spongy, formed by very fine, much twisted trabeculae from the 10 to 20 larger septa. *In section* exothecal dissepiments 1 mm. apart, horizontal, endothecal same, often rather oblique to 50°.

It will be obvious even from the above description that the corallum varies extraordinarily in external appearance, a form with calices averaging 10 mm. in diameter by 5—6 in depth, with marked furrows, thick, rough septa with broad, paliform lobes, superficially having little resemblance to one averaging 7 mm. by 3 mm., no furrows, thin, smooth septa and little or no paliform lobes. Yet all are clearly joined by their distinct, never angular nor gyrose calices, thick walls with larger or smaller furrows above, septa arched and of similar shape, mode 25 to 29, and spongy columella. In my specimens all other characters show variation, a little in each colony but in most characters far more in the series. Any one character may become definitely fixed *in any locality* in any type of the series and give a definite species. I affix a name and a list of synonyms, but I recognise my temerity in so doing partly for the above-mentioned reason, and partly because the descriptions commonly given by older authors were quite inadequate, often from single specimens or from unknown localities.

The only purely vegetative variations appear to me to be thickness of walls, distance apart, obliquity and thickness of dissepiments, degree of spinulation of faces of septa and costae, though all others undoubtedly show a certain amount of this class of differences. In the accompanying Table I have attempted to show the variations for the average sized corallites of the several specimens, taking in each case what appear to be their most vigorously growing, *i.e.* upper surfaces, and finding the average size from a measured patch (excluding obviously young forms) and in each measurement taking an average. Some of the smaller specimens are young colonies.

Locality. Found commonly everywhere in the Maldives and in Minikoi, on the outer slope, any flat reasonably bare of sand and on the lagoon shoals. Nos. 1 and 2 in the Table have septa thickened up to 1 mm., where they pass into the theca. **Colour,** brown to green, darker over walls.

25. Favia laccadivica, n. sp. (Pl. LXII. fig. 24.)

Colony massive, edges closely encrusting, thick transversely marked epitheca. *Walls* thick, except where fission taking place, generally not less than 2 mm., top exothecal dissepiment level with top of theca. *Calices* always rounded, often oval, average diameter in different parts 8 to 9 mm., depth 2·5 to 4·5 mm. *Costae*, equal, finely toothed, almost flat-topped between calices (no notch), slight tendency to join transversely, on thicker walls smaller costae often shown by a few or a row of spines, represented by septa IV. *Septa*, 1 to 1·5 mm. exsert, very flat-topped, 4 cycles, not very distinct or regular, 12 to 16 reaching columella, 12 to 16 intermediate, equal in thickness, two-thirds way to columella, often fusing to the first series, and 24 to 32 generally minute, angular ridges between the larger, often wanting; septa I., II. and III. fine pointed teeth, not crowded, passing into ridges on their slightly granular sides, commonly 12 to 16 with the lowest a larger pointed tooth rising about 2 mm. above the fossa, forming a pali-crown. *Columella* quite distinct, $\frac{1}{4}$ width of calice, flattened twisted plates from about 12 septa. *In section* exothecal dissepiments thin, flattened or arched, the convexity above, 1 mm. apart, endothecal thin, oblique (60°), 1 to 1·5 mm. apart.

The specimens are very markedly different from any other Favia I have in the collection owing to the great regularity in thickness of all their parts, exsertness, teeth, etc. of the septa and the complete absence of a furrow. I cannot find any described species, which in any way resembles it. The specimens show singularly little variation, those on the sides merely have thicker walls and costae IV. accordingly more distinct.

Locality. Three specimens from lagoon shoals, Minikoi. **Colour,** grey over walls, dark green peristome.

26. Favia hululensis, n. sp. (Pl. XLI. 19—21.)

I refer four massively growing, complete colonies and two smaller pieces to this species. It differs from F. denticulata in the following characters: *Walls*, thin (1 to 2 mm.), theca very distinct above the top exothecal dissepiment. *Calices* more compressed, sometimes angular or oval, average size 5—7·5 mm. in diameter, 3—4 mm. deep. *Costae* continuous between calices, notched, generally no furrow, sometimes traces of transverse connections, equal in number to *septa*. Latter ·5—2 mm. exsert, flat-topped, about 20, cycles more or less distinct, outer part of slope perpendicular; teeth variable, on the exsert part small, pointed, round, and inside the calice generally none or only 2 or 3, small, well separated and pointed, often the lowest on 6 to 8 of the larger septa blunt, paliform, otherwise these septa perpendicular against axial

TABLE OF MEASUREMENTS
of sixteen specimens of Favia denticulata and five of Favia hululensis.

Number	Size of Specimen in cm.			Diameter of calice in mm.	Depth of calice below theca in mm.	Exsertness, septa over theca in mm.	Total septa	Septa joining columella	Paliform lobes *	Locality
	Length	Breadth	Height							
1	16	12	10	9·3	3·2	1·6	29	19	R P	Minikoi, sand flat
2	15	10	9	9·5	4	1·5	29	17	R	„ lagoon shoal (fig. 14)
3	18	16	11	9	5	2	30	14	D F	Goidu, behind boulder zone (fig. 15)
4	15	9	10	8·8	5	1·8	29	14	?	„ outer slope
5	8	4	3	8·6	4·5	1·7	29	14	?	„
6	10	8	6	9·1	4	1·8	29	15	D P	Hulule, sand flat
7	15	13	9	8·4	3·5	1·5	28	14	D P	Minikoi, lagoon shoal
8	18	13	11	8	3·5	1	24	11	D P	„ (fig. 16)
9	19	15	10	7	3·2	1·2	27	14	R P	„
10	21	18	11	6·8	2·8	1·2	26	14	D P	„ (fig. 17)
11	9	6	7	8	3	1·5	26	14	D F	Hulule, west reef
12	7	6	5	7·5	2·6	1	26	13	0	„ east reef flat
13	15	13	13	7·3	3	1	22	9	0	„ passage (fig. 18)
14	15	7	10	8·3	3	1	24	12	C P	Minikoi, sand flat
15	6	7	5	6·3	3	1·5	22	11	C P	„ reef flat (Young)
16	8	6	5	6·3	3	1	20	13	D F	Goidu, reef flat (Young)
1	11	10	8	5·5	2·5	1·5	20	9	R P	Hulule, west reef (fig. 19)
2	22	15	11	5	3	·75	18	8	0	„ south reef (fig. 20)
3	5 / 4	3 / 3	3 / 2	6	2·5	1·25	19	10	R P	„ east reef flat
4	10	9	7	6	4	·75	22	8	0	„ passage (fig. 21)
5	7	7	5	5·5	3·5	1·25	17	8	?	Goidu, reef flat

* R=recognisable, D=distinct, C=conspicuous, P=pointed, F=flattened.

fossa. *Columella* not more than $\frac{1}{6}$ breadth of calice, generally very small, often rudimentary, formed by the much flattened trabecular ends of 6 to 8 septa. *In section* rather massive, exothecal dissepiments thick, 1 mm. apart, endothecal thin, horizontal, about 6 mm.

The species is rather like a small edition of F. denticulata, but differs in its thin walls, number of septa, number of septa forming the columella, and character of last. The specimens show similar variability, and I likewise enumerate them in tabular form. No. 1 differs somewhat from the rest; it has some rather larger calices with very exsert septa, and a greater number reach the columella and have paliform lobes, but these differences are due to the fact that the colony is evidently growing very vigorously and its corallites rapidly dividing. No. 4 is possibly a little doubtful on account of its deeper calices, septa larger in number (last 6 to 10 exceedingly minute), little exsert (·75 mm.), costae little notched and transversely connected; it is growing on a column of horny sponge, 10 cm. high by about the same thick, which itself was attached to a muddy bottom.

27. Favia hombroni (Rousseau). (Pl. LXII. fig. 27.) Ed. and H., p. 435.

Two specimens which differ only in not being "en masse gibbeuse et sublobée," but massive and rounded and in the columella not being "assez distincte," but the distinct, rather flattened, trabecular junctions of about 6 septa. I give certain characters of my specimens.

Calices rounded, oval or angular, averaging about 3 mm. in diameter, though varying up to 6 mm., theca generally quite distinct above the top exothecal dissepiment. *Walls* ·75—1 mm. thick, except at the edges, where this may be doubled, covered by thin, smooth, sub-equal *costae* (·5—·75 mm. exsert), continuous between calices, horizontal, no furrow nor distinct notch. *Septa* almost smooth-sided and thin, cycles I. and II. and about half of III., scarcely visibly toothed, I. rather broader over wall and with a crown of fine, pointed, paliform teeth, often joined by 1 to 3 septa of cycle II. *Columella* generally as above at the surface, underneath much larger and of a more solid appearance.

Locality. Hulule passage, a small colony 10 by 8 by 7 cm., and Minikoi, almost in boulder zone, a head dead in the centre.

28. Favia halicora (Ehrb.) Klz.

Goniastraea halicora Klz., p. 32, iv. 1 and 2, and x. 3 *a* and *b*.

Four specimens, two large ones approaching *forma obtusa* Klz. and two pieces with smaller calices rather more doubtful, more like *forma acuta* Klz., the pali in reality being only teeth and the theca of neighbouring calices not fused though the walls are very dense, perhaps almost solidified by the exotheca.

The specimens are as follows: (1) half a large head, 22 cm. wide, 13 cm. broad, and 18 cm. high, walls rounded, though not so much as in Klz.'s fig. 1, septa 28 to 36, half with blunt, thick pali, Minikoi, lagoon shoal; (2) a colony dead above, 16 × 14 × 8 cm., part like last, part very obtuse walls, columella then often papillated above, Minikoi, inner part reef-flat to south; (3) a colony, 8 × 6 × 5 cm., calices about 8 mm., very rapidly dividing, resembles part of (1) but nearer *acuta* in walls, Turadu, S. Mahlosmadulu, reef-flat; (4) a colony 12 × 6 × 6 cm., calices 7·5 mm., rapidly dividing, very acute walls, Goidu, reef-flat.

29. Favia parvimurata, n. sp. (Pl. LXII. fig. 25.)

Colony massive, covered underneath by a thick, transversely marked epitheca. *Calices* generally pentagonal or hexagonal, 8—12 mm. (mode 9—9·5 mm.) in diameter, 3 mm. deep or

less. *Walls* exceedingly thin at edge, sometimes fenestrated or not completely formed, thicker below but except at the edge of the colony not more than 1 mm., covered by the continuous unnotched, rather pointed and strongly toothed, exsert (1—2 mm.) ends of the *septa*. Latter, 16—26 (average 21) in number, generally hollowed where they pass through the walls, rather thick, with rough granular or spiny sides, a few coarse, pointed teeth, about half ending against the axial fossa with great, thickened and pointed teeth, or all variants to a thick, perpendicular edge or thick teeth merging into the *columella*. Latter $\frac{1}{4}$ to $\frac{1}{6}$ diameter of calice, formed by the anastomosis of flattened trabeculae from half to two-thirds of the septa (as many as can crowd round the fossa), commonly ending above in more or less flattened rods. *In section*, walls almost solid save for spaces due to the hollow septa, endothecal dissepiments very oblique, 30° to wall, thin, 1—2 mm. apart.

Locality. Hulule; reef-flat to east. The species approaches closest perhaps to F. halicora (Ehrb.), but the wall, largely formed by the lateral fusions of the hollow septa, is exceedingly remarkable.

XII. Genus *Goniastraea*.

Ed. and H., II. p. 444, and Gard., p. 746.

By the removal of G. halicora I have restricted the genus to forms of which the theca of neighbouring calices completely fuse, and which have true pali, not mere paliform teeth.

The genus is of little importance from its number of species, but possesses in G. retiformis a form of wide distribution and great importance on the coral reefs of the Maldives, and so far as I saw, of still greater abundance off Ceylon, both at Tondimanar and also at Weligama.

30. Goniastraea retiformis (Lmk.). Klz., p. 35, IV. 5, G. eximia Gard., p. 747.

I refer fourteen specimens to this species, which I have no doubt Klunzinger has identified correctly. The *columella*, which he does not describe, appears in some of the specimens like a small solid mass in the centre of the calice, but in others is clearly made up of a dense mass of trabeculae from the paliform septa. My specimens vary somewhat in the size of the calice, averaging about 4 by 3 mm., the longest not as yet showing division being 6 by 4 mm. The *pali* average in different specimens 7, 8, 9 or 10, but 8 is the mode; occasionally they are not present as upstanding rods, but yet are clearly represented by the much thickened edges of the septa. G. eximia from Fiji, Rotuma, etc. is the same species, but the mode of its pali is 9 or 10, and its appearance in section is rather more delicate than in most of my specimens.

Locality. This golden-green coloured species is common on the outer slope, occasionally occurs on the reef-flat in small heads, and is abundant in the lagoon both at Minikoi and in the Maldives. It often forms immense masses, which on the shallow flat behind the boulder zone die in the centre but spread linearly, the blocks in growth resembling massive Porites. Two specimens came from the passage into Hulule.

31. Goniastraea solida (Forsk.). (Pl. LXII. fig. 28.) Ed. and H., II. p. 455.

A specimen agrees in every respect with the description of this species, which is not, as Klunzinger supposed, synonymous with G. pectinata or G. favus. It resembles the first

in the columella and in the nature and shape of its septa, but their upper edges over the theca are often rather pointed than flattened. The pali are the thickened, perpendicular, inner edges of 8—12 septa. The endothecal dissepiments are thin and practically horizontal, generally ·5—·6 mm. distant, seldom or never more. The walls in section are about 2 mm. thick, but on the surface in any rapidly growing part may be quite thin, evidently thickening later by a deposition of solid endotheca between the septa.

Locality. A single specimen from the passage at Hulule. It is No. 5, p. 331 of Vol. I. of this publication; its specific gravity 2·11 is greater than that of any other Astraeid that I have taken.

32. Goniastraea pectinata (Ehrb.). Klz., p. 34, IV. 6.

Three specimens, the third very small, are undoubtedly referable here, though Ehrenberg's specimen is, I consider, scarcely typical of the species. The *wall* is thin, though the whole ridge with its very slightly exsert (never more than ·5 mm.) septa, horizontally edged above, varies from 2 to 4 mm. The *septa* are occasionally very thin, but in most parts, to the lens, appear rough-sided and relatively thick; they are more often continuous between calices than alternating, and are subequal in size, but in some places very rudimentary ones of cycle IV. are found between the larger. The *pali* are rough sided plates in front of, but not in surface view connected with, the septa; their number varies with the length of the corallites, but in rounded calices their mode is 10 or 11. At the edge and on the under side of the colonies the walls may become much thicker, but the whole ridge (including the septa) varies but little; the pali sometimes are spiniform. The *columella* is merely the junction of the paliform septa to one another, and may be scarcely visible, plate-like or obviously formed by flattened trabeculae.

Locality. Goidu, reef-flat, Turadu, S. Mahlosmadulu, flat behind boulder zone, and S. Male, 18 *f.* The latter is a little colony with 35 rather shallow calices, with very thick walls (3 mm.) having traces of a grove.

33. ? Goniastraea favus (Forsk.). Klz., p. 34, IV. 4 and X. 7.

The broken-off edge of a colony, 7·5 × 3 cm. by 4 cm. thick, possibly belongs to this species, with the characters of which it is in general agreement. It does not show clearly its mode of increase though sections lead me to believe that it is by fission. The specimen was dredged from 20 *f.*, Suvadiva.

XIII. Genus *Aphrastraea.*

34. Aphrastraea deformis (Lmk.). (Pl. LXIII. fig. 31.) Ed. and H., II. p. 452.

I refer four specimens to this species, nos. 1 and 2 of which agree closely with one another and correspond in all described characters with the species and also genus, of which it was in Ed. and H.'s catalogue the sole representative. The *walls* have a distinct theca which may show as a very thin, polygonal ridge between the calices, but their greater part is formed by the small vesicles or cells of the endotheca, which rise to within ·5 mm. of the upper edges of the septa; they thus appear enormously thick up to 5 mm. The *septa* are continuous between the calices or stop at the theca; they lie in four cycles of which I. and II. typically have rough upstanding, pointed, paliform lobes, though II. is not in this respect always complete. Septal cycles III. and IV. are scarcely separable and mere little

spined ridges between the larger; more than half of IV. is seldom present. The teeth of all are rough, low, saw-like but not crowded, rather irregular. The *columella* is formed of flattened trabeculae from septa I. and II.

Locality. (1) A flattened mass 8·5 × 3 cm. by 4 cm. thick, Minikoi, coral flat near Wiringili; (2) a similar mass 14 × 12 cm. by 4 cm. thick, Suvadiva, 40 *f.*; (3) a flattened piece of a colony, deformed with barnacles and worms, 7 × 6 cm., with smoother septa and rather deeper calices, and with endotheca more solid, Suvadiva, 20 *f.*; (4) a flat, thin, rough, little colony with wavy epitheca underneath, 4 × 4 cm., quite similar to 1 and 2 but rougher in appearance owing to the longer septal teeth, cycle IV. larger and more regular, often cycles fusing, columella relatively larger, South Male, 30 *f.*

XIV. Genus *Orbicella*.

I must still assert my inability to find characters which clearly separate Plesiastraea and Leptastraea from this genus (*P. Z. S.* 1899, p. 751). Generic characters are presumably more ancient than specific, or at any rate have become absolutely fixed. Such may be crystallising between the three genera, but at present the process is quite incomplete.

Distribution. The genus has two very common reef-species, O. ehrenbergana and transversa, capable of living absolutely under the breakers where also O. annuligera dwells. O. laxa forms great masses on the lagoon shoals at Minikoi, where O. minikoiensis is very common in one small area. One specimen of the genus was dredged, but that from 4 *f.* only. *Colour* invariably some shade of green.

35. Orbicella annuligera Ed. and H.[1] (Pl. LXIII. fig. 32.) Ed. and H., II. p. 471. Astrea annularis Q. and G., *Zooph.* p. 210, Pl. 17, figs. 17—18, 1833.

Four specimens correspond in every respect with the above descriptions. The septa and costae are rough and the latter thick, septal teeth very low except the innermost, which is always paliform, thickened and pointed, the series forming a well-defined crown 1—2 mm. above the columella. Ordinarily 12 fuse in the centre of the calice and have paliform lobes, but in the larger corallites there may be 14 or 16, the increase entailing the presence of septa of the fourth cycle. The columella is dense, formed by trabeculae from the septa, which often fuse even outside the level of the pali so that the latter may appear to arise from its surface. The corallites vary up to 7·5 mm. in diameter and the calices to 4·5 mm.

Locality. Minikoi, reef-flat, and Goidu, E. reef, breaker zone. The former specimens have deeper calices, in some places a little distorted, and smoother septa and costae than the latter. All are quite thin and small, mere living fragments, probably of once much larger spreading masses. **Colour** a brilliant yellow all over.

36. Orbicella minikoiensis, n. sp. (Pl. LXIII. fig. 35.)

Colony massive, under the overhanging edges longitudinally ridged costae, no distinct epitheca. *Corallites*, 11—14 mm. in diameter, almost flat, often somewhat distorted by the intercalicinal budding. *Calices* generally round, 8—10 mm. in diameter, varying from flat to

[1] I fully accept Vaughan's synonymy of O. acropora, *U.S. Fish Commission Bulletin*, vol. II. p. 301, 1900. The specimens identified by me from Rotuma are rather different from the present ones of annuligera, but scarcely exceed the limits of its variability. There is a close connection between the two species, however, and one could have wished that Vaughan, after having made certain of O. acropora, had redescribed it.

2 mm. in depth. *Walls* up to 3 mm. thick, sharp edged against the interseptal loculi but no distinct theca, slightly grooved in the centre. *Septa* much thicker, up to 1 mm. where they pass through the theca, slightly different in size, those of the lowest (I. and II.) cycles largest, 1—3 mm. (commonly about 2 mm.) exsert. *Costae* relatively thick, with low blunt teeth, sometimes passing from calice to calice, but always with a distinct notch over the furrows of the walls. *Septa* varying in number, typically 24, thinning out within the calice, alternately larger and smaller, with granular sides; each provided with about six bluntly pointed teeth, the third or thereabouts often longest and sometimes representing the most exsert portion of the septum, no distinct paliform teeth, sometimes tertiaries fused to secondaries or primaries, otherwise all merging below into the *columella*. The latter ranging in size from one-third to one-half the diameter of the calice, from the surface looking fasciculated, but really formed by coarse, anastomosing and uprising trabeculae from the septal edges. *In section* the walls appearing relatively compact, partly owing to thick costae but also to the relatively thick, horizontal, exothecal dissepiments, endothecal dissepiments sloping into the columella at an angle of about 55° to the thecal walls, about 1 mm. apart, rather varied. *Increase* only by intercalicinal budding.

The form is most distinct owing to its very shallow calices, large columella and thick, exsert septa. The only real variation is in the depth of the calices, those near the edges being rather deeper. Of Ed. and H.'s species the specimens are closest to O. lamarckana, but the costae are different.

Locality. Minikoi, three specimens, not common, sand-flat behind boulder zone to west and south of the atoll.

37. Orbicella laxa Klz. (Pl. LXIII. fig. 33.) Klz., p. 49, v. 3 and x. 9.

Four specimens closely corresponding to the above description and the sections shown in Pl. X. fig. 9, but differing from Pl. V. fig. 3, in having a considerably more solid and massive appearance with calices a trifle larger (8 mm.). Budding in my specimens is intra- as well as extracalicinal.

The corallites vary considerably. In the most vigorously growing parts their thecal edges may be upstanding (calices 4 mm. deep from top of theca to top of columella); septa very thin, 1—1·5 mm. exsert, about 18 reaching the columella, most with fine paliform lobes. In other parts the calice is more pad-like at the edge, no visible theca, 1—3 mm. deep, often with additional, very small costae not represented by septa; latter thick and rough, less than 1 mm. exsert, 10—12 reaching columella with thick, blunt, paliform lobes, sometimes projecting above the level of the theca.

Locality. (1) Lagoon, flat behind Ragandi Islet, Minikoi; (2) lagoon shoal, Minikoi; (3) Hulule, west reef; (4) Goidu, sand-flat behind boulder zone. No. (3) is a separate, rounded colony, 13 cm. in diameter by 8 cm. high; the rest are larger blocks from the living edges of great massive colonies, most parts of which have for some cause or other been killed. **Colour,** light green over the theca, very dark orange-green on the peristome.

38. Orbicella borradailei, n. sp. (Pl. LXIII. fig. 34.)

Colony massive, rather irregular, covered under the edges by a distinct, transversely waved epitheca. *Corallites,* 11—15 mm. in diameter, edges raised into broad, padded rings 2—5 mm. high, somewhat crowded together and distorted, especially on the inequalities. *Calices* also distorted, 9—11 mm. in diameter, 3—6 mm. deep, no theca visible from surface

view, separating furrow naturally very marked. *Costae* low, thick and broad, alternately thicker and thinner, hence in two series, the thinner very commonly with no corresponding septa visible, all set on their edges with low, transversely extending granulations. *Septa*, 35—40 in number, alternately larger and smaller, yet both series varying somewhat in size, roughly granular at the sides, 1—2 mm. exsert, all rather thickened on passing into the theca, here and there septa of the second series curving towards and uniting with one of the first; edges sometimes no distinct teeth, sometimes about six low, rough ones, generally about 15 with prominent, broad (1 mm.), thicker, uprising paliform teeth forming a definite crown. *Columella*, 2—3 mm. below the paliform crown, $\frac{1}{4}$—$\frac{1}{3}$ of the calice in width, flat above, formed by rather coarse, flattened trabeculae from about half of the septa. *In section*, the theca of the calices very distinct, costae often continuous, exothecal dissepiments horizontal, thin, 1 mm. apart; endothecal dissepiments thin, about 1 mm. apart, almost horizontal, in transverse section not more than one visible between the theca and the columella. *Increase* generally by intercalicinal budding, occasionally intra-calicinal close to the margin, very rarely fission.

The species is very distinct from all previously described. There can be no doubt about its being an Orbicella, but it closely resembles in its corallites some of the tubuliferous Favia. The fact that the costae are about twice as numerous as the septa (about 76 to 42 in large calices) is most characteristic, but in places near the edges the septa and costae often become quite thin, the smaller series of costae almost absent, paliform lobes little marked and corallites less projecting.

Locality. Breaker zone of reef-flat close to Ragandi Islet, Minikoi.

39. Orbicella ?curta Dana. *Zooph.* p. 209, x. 3, Gard., p. 754.

A small fragment from N. Mahlosmadulu, 4 *f.*, comes near this species, but the septa are rougher toothed and more equal.

40. Orbicella (Leptastraea) immersa Klz. Klz., p. 47, vi. 1.

A rounded mass, 7 cm. long, once completely covered by living polyps, now dead in places, certainly belongs to this species, though the calices are in parts slightly smaller with rougher septa.

Locality. From the passage at Hulule.

41. Orbicella (Leptastraea) ehrenbergana (Ed. and H.), Klz.

Ed. and H., ii. p. 494, D. 7. 4, Klz., p. 46, vi. 3 and Leptastraea transversa Klz., p. 46, vi. 2, Orbicella klunzingeri Gard., p. 755.

Nineteen specimens, some of which agree absolutely with the one description of Klunzinger and some with the other, but most of which are intermediate in some of their characters. Ed. and H.'s description and figures differed so widely from Klz.'s that I did not consider that these authors were referring to the same species when I examined my collections from the Pacific. My present large series, together with my two Pacific Ocean specimens, shows the variation to be so great that there can be no doubt of the identity.

It appears to me useless to attempt to re-describe the species from any central form, especially as any large collection is likely to have forms almost exactly similar to Klz.'s ehrenbergana or the same author's transversa from precisely the same locality or even environment, certainly at any rate from the breaker zone or flat of any reef. Yet, in certain calices of these forms variations may be found connecting them together, though one part of

a colony does not apparently belong distinctly to one form and one to the other. We have here accordingly both classes of variation, (1) the *vegetative*, mainly seen in the thickness of the walls, sizes of calices, number and shape of septa and the size of the columella, and (2) the *normal*, seen in the shapes of corallites, characters of dividing furrows, depth of calices, nature of columella, besides in some of the characters of (1), indeed in most of those which caused Klunzinger to separate ehrenbergana and transversa. There is no trace of discontinuous variation in my specimens, though Klunzinger is probably dealing with it. In the remarks on the variation of the individual organs which I have to offer below, it is certain that I am dealing mainly with the normal, though it is clear that one cannot as yet, with a study of only 21 specimens, draw a line between the variations. Between each form of any organ mentioned I have found numerous intermediates.

The *colonies* are of two indistinctly divided types, (*a*) flattened incrusting, often rising up into rounded hillocks which tend to become loosened, and covered all over with the living tissues, and (*b*) massive, more rounded, frequently of considerable thickness and always very dense and heavy. Though there are marked exceptions (*a*) certainly approach closer in their other characters to Klunzinger's ehrenbergana and (*b*) to transversa. The *corallites* are quite rounded, or even angular or distorted, or crowding over one another; dividing furrows very narrow, not visible to the unaided eye or 1 mm. broad, depth ·1—1 mm., where very small a mere flat area between neighbouring calices. *Costae* never continuous between calices, often not visibly present. *Calices* varying in shape according to the corallites, theca visible or not, depth from 1 to 4 mm. *Septa* 24—44, mode about 28 or 30, not at all or very little exsert, generally thickened where they join the theca, quite smooth, thin, somewhat distant to very densely crowded, sometimes arched at their sides and upper ends, sometimes flattened above and falling perpendicularly; generally no determinable cycles, I. and II. occasionally distinct and then equal. *Columella* formed by trabeculae from 12—20 septa, one-fourth diameter of calice or scarcely visible, finely papillate or fasciculate above or merely a few twisted trabeculae. *Increase* by extra- or intracalicinal budding. Fission extremely rare. *In section* all more or less the same, little apparent variation.

Locality. The species is fairly common on the reef-flat near the breaker zone and on the Maldive lagoon reefs, but seldom forms very large masses. Loose heads are frequently found on the boulder zone, where there is little or no sand or in hollows between other corals. When split open, their centres usually consist of their own remains, a good deal broken down by boring animals, often with Lithodomus and Gastropods. Their surfaces are frequently broken by the shield-like ends of Pyrgoma and the smaller oval openings of another barnacle in the walls. Generally the extreme forms are less affected than the intermediates.

42. Orbicella (Leptastraea) bottai (Ed. and H.). (Pl. LXIII. fig. 36.)

Cor. II. p. 486. Klz., p. 44, v. 9 and x. 13 *a* and *b*. Leptastraea inequalis Klz., p. 45, v. 6.

I refer sixteen specimens to this species, with which Klunzinger's second species is undoubtedly synonymous. The specimens vary greatly in their different parts, and as compared with one another. The *colonies* are mostly rather flat and incrusting, but there is one large, round one, and one smaller and oval, almost completely covered with polyps. The *corallites* are round or compressed, and have their edges scarcely rising above the general level, or 1 mm. upstanding above the furrows, isolated ones rising to 2 or 3 mm., or on hillocks, etc.,

pressing over one another, to the last belonging the round form which in this respect is exactly as described by Klunzinger for L. inequalis. The *calices* of flat specimens and of the round one average 2·5 mm. in diameter, or somewhat more hilly 3·5 mm., the living edge of a once large mass 4 mm.; here and there a giant calice may be found, one rather rough specimen with low calices averaging 3 mm. having a number of these standing up for 2 or 3 mm. and being 4·5—6 mm. in diameter[1]. The *costae* may be distinct or not visible, distance between the calices ·5—2 mm. or more, especially on the under side. *Septa* rough or quite smooth, in giant calices 38—40 down to 20 in the smaller ones, very rough sided or almost smooth; in the round and most forms with larger calices, cycles I. and II. quite equal, or in many of the smaller caliced flat forms I. distinctly larger than II. *Columella* well developed or scarcely visible, in some cases in surface view clearly formed by trabeculae which end above in fine points, in others like the end of a bundle of thick rods, formed from 12 septa or more in the first case (round and most forms) and from 10, 8 or even 6 (one specimen) in the flat forms.

Locality. Common on the reef-flat at Minikoi and throughout the Maldives, rare on lagoon reefs. **Colour,** a dark but brilliant green.

XV. Genus *Cyphastraea*.

Cyphastraea and Solenastraea Ed. and H., Cyphastraea Klunzinger.

The growth of the genus is mainly incrusting, though it frequently attains a thickness of several inches to a foot. It closely follows any inequalities on its base of attachment, and tends, if it gets free, to round itself off and become completely covered with polyps. More massive growths on any colony may rise into hillocks, which themselves frequently become rounded off. The corallum below the living tissue forms a home for all sorts of boring animals, and tends to become much broken up and hollowed even to within 3 or 4 mm. of the living polyps.

Distribution. Occasionally found incrusting on the reef-flat, or breaker-zone, or on lagoon shoals; free masses in protected situations of the same, but never on sand. Depth, 0 to 40 *f.* **Colour,** grey-green.

43. Cyphastraea forskaelana (Ed. and H.). Ed. and H., II. p. 497.

Two colonies, both of which form masses much bored into and killed at the base, and covered with convexities and humps, not free. The *calices* (2 mm. in diameter) are thick edged and crowded together except underneath and near the edges of the colonies, rounded, not distorted, commonly projecting for at least 1 mm. *Exotheca* appearing vesicular from the surface, fairly dense in section, with a few, rough, pointed spinules, generally clearly connected with the costae, which are little prominent and very rough, varying up to 24 in number. *Septa* little exsert, sides covered with low, rough spinules, scarcely toothed, systems and cycles quite distinct, primaries much more prominent and rougher, running right into a well-developed, rather shallow, finely trabecular columella. Secondaries commonly much thinner, and occasionally simulating the primaries and fusing with the columella, especially near the edges, where the calices are more distant. Tertiaries very small.

[1] Cp. Prof. Bell's description of Variation in Turbinaria, *Quar. Jour. Micros. Soc.*, 1895, p. 148, pl. 1 and 2.

The species has a much rougher appearance than C. savignyi, from which it differs markedly in its septa. With Solenastraea forskaelana Ed. and H. the specimens agree in all respects except in the different sizes of their septal cycles, but this is a variable character.

Locality. Hulule, (1) W. reef, and (2) passage through same.

44. Cyphastraea savignyi (Ed. and H.).

Ed. and H., II. p. 485. Klz., p. 51, and Gard., p. 761.

Four specimens, all more or less rounded and completely covered by living polyps, of the identity of which with the above no doubt can be entertained. One specimen, a ball, completely corresponds to Klunzinger's description, differing somewhat from his figure, to which a second rather irregular specimen, evidently grown under bad conditions, completely answers. The other specimens have slightly larger corallites, in exsertness intermediate to my Rotuma specimen, but more crowded together. The costae are always very prominent and not rough. The exotheca has tiny, somewhat scattered spinules, but in the second specimen referred to appears from surface view to be vesicular. Twelve rather smooth septa typically fuse in the columella, and are equal sized. The theca of the calices is often very delicate, giving their edges a thin appearance.

Locality. Goidu, all from hollows of the reef-flat and boulder zone.

45. Cyphastraea hemprichana (Ed. and H.). Ed. and H., II. p. 495.

A single specimen, almost completely surrounded by the corallites, a free edge showing in one place covered by a dense epitheca. Calices on the upper surface crowded, about 1·5 mm. in diameter, half this breadth distant from one another underneath, edges always distinct, appearing more prominent owing to the slightly exsert upper ends of the septa. Exotheca with a few, almost smooth spinules above, lower and scarcely visible below, not clearly connected with the costae, which are quite distinct at the edges of the corallites. Septa relatively smooth and very little toothed, edges almost perpendicular, 6 clear systems and 3 cycles quite distinct from one another, primaries meeting in the centre of the calice so deep down as scarcely to be visible from the surface, shallower calices underneath.

Locality. Hulule, from the reef-flat of the south end.

46. Cyphastraea microphthalma (Esper). Ed. and H., II. p. 485.

I refer to this species three specimens, which agree with the descriptions in all essential characteristics. The *corallites* may be crowded or separated by half their diameter from one another on the outgrowing edges, slightly (·5 mm.) or not at all projecting, but always distinct owing to the arched, slightly exsert, upper ends of the septa. *Costae* sunk in the exotheca, edged with numerous, very rough, low spinules, giving a granular appearance. *Septa* similarly very rough, as described by Ed. and H. Paliform teeth present or absent. *Columella* always distinct, ending in papillae, or of a trabecular appearance. *Exotheca* very dense, in places almost solid, with here and there relatively large cavities.

Locality. (1) Turadu, S. Mahlosmadulu, W. reef, near breaker-zone, a rather smooth incrusting mass, much studded with Pyrgoma up to the pores of which the corallum extends; (2) S. Male, 25 *f.*; (3) Suvadiva, 31 *f.*, and (4) Addu, 40 *f.* on the outer slope, both the latter rough with trabecular columella and very indistinct paliform lobes.

47. Cyphastraea suvadivae, n. sp.

Colony flat, incrusting, but probably showing all the regular shapes found in other species of the genus, covered with round, scarcely projecting *corallites*. The latter 1—1·5 mm. broad, from 1·5—3 mm. distant from one another, joined by a vesicular exotheca covered with small, low, blunt spinules, which near the calices may be arranged in lines leading to the low spines, which represent the costal plates. *Theca* scarcely raised above the exotheca around the edge of the calice, the ring-form being mainly due to the slightly exsert, upper edges of the *septa*. Latter numbering 24, those of cycle III. very thin but generally distinct, projecting half-way to the columella; those of cycles I. and II. nearly equal, with rough, spiny sides, giving them a coarse appearance, edges bluntly notched, the inner teeth not distinguishable from the two or three rough rods of the columella. Calices quite shallow, with a closed in appearance below. The *exotheca* is formed by minute cell-like vesicles. In some sections it almost simulates the appearance found in Galaxea, but is clearly dependent on the costae. The endothecal dissepiments are very thin, close together and almost horizontal.

The species approaches nearest to C. microphthalma, but differs in its more distant calicles and much lighter and more open method of growth.

Locality. Six small pieces from Suvadiva, 20 *f.* They are somewhat distorted on the surface with barnacles and worm tubes, and the structure underneath more or less destroyed to within 4 mm. of the surface by boring animals.

48. Cyphastraea maldivensis, n. sp.

Colony consisting of thin, incrusting masses, but probably showing all the shapes found in the genus. *Corallites* round, practically not projecting, not more than 1·5 mm. broad, generally separated by at least two or three times their diameter from one another, joined by a glabrous looking exotheca, obviously even from the surface formed by very small, flattened vesicles, often with their walls incomplete on the surface, but where complete studded with low rounded granules. *Costae* practically non-existent, but tops of the septa a little projecting over the upper ends of the calices, giving an appearance of rings slightly raised round their edges. *Septa* 24, tertiaries distinct at edge of calice, projecting about one quarter way to columella, ending perpendicularly inside with small, pointed teeth; primaries and secondaries nearly equal, rather thin, slightly exsert, a few spines on the sides, ending inside with long, thick, pointed, spiny teeth, extending almost at right angles over the axial fossa, the inner parts of the septa by their fusion presenting sometimes a fenestrated appearance. *Columella* formed by open trabeculae from the septal edges, a quarter to a third the width of the calice, sometimes with points above but never papillary. The calices, owing to the small breadth of the tertiary septa, the thin septa and large columella, appear relatively open.

The exotheca is more abundant and vesicular than it is in the last species, and still more closely resembles Galaxea; the piling up of the vesicles on the surface between the corallites is very distinct. The species more closely resembles the last than any other, but differs in its surface appearance, thinner septa with long pointed teeth and trabecular columella.

Locality. S. Nilandu, 25 *f.*, and Felidu, 20 to 25 *f.*

Characters	*Echinopora rosularia* (Lmk.)	*Echinopora solidior* (Ed. & H.)	*Echinopora tertia*, n. sp.
1. Size of Calices.	3 × 4 mm. or round.	6 × 5 mm. or round.	5—7 mm. × same.
2. Depth of Calices.	1 mm.	2 mm.	1·5 mm.
3. Edges of Calices.	Little cones, 1—3 mm. high. Septal spines thin, 1 mm. high.	Flat. Thick spines from about 15 septa, 2 mm. high, subequal.	Flat. Septa not more than 1 mm. exsert, thin.
4. Costae.	Very close set, fine lines, made up of fine, low (·5 mm.), rounded spinules.	Edge of colony lines of flattened rough spinules, 1 mm. high; central part irregular.	At edge lines centre irregular; vary from round, smooth to characters of last, always thinner, ·75 mm. high.
5. Number of Septa.	16—24	24—30	36—48
6. Character of Septa.	I and II cycles subequal, rough and thick at edge of calice with 3 blunt, rough teeth, 2 on exsert upper edges, the 3rd and innermost, only present on about half, quite paliform; III very minute and thin.	About 18, larger, rough, thick at edge of calice, no distinct teeth, rather more than half with a small thick paliform tooth. Between last about 10 very minute septa.	Typically I and II larger and subequal, rough, uppermost tooth over theca longest, lowest where present very fine and subpaliform, III similar but thinner; IV minute, commonly bend round and fuse with III at middle of their breadth.
7. Columella.	About $\frac{1}{4}$ breadth of calice, spongy, dense, very fine trabeculae from about 10 septa.	Similar to last, but much less dense and from about 18 septa.	Similar to last, rather hollowed in centre from about 14 septa.
8. Section *a*. Exotheca.	Scarcely visible, very dense.	Dense, vesicular.	Very dense, vesicular.
b. Endotheca.	Not clear, horizontal (?).	Horizontal, 5 mm. apart, thin.	Irregular, little vesicular, dense.
c. Septa.	Fenestrated; especially line outside pali lobes which are hence true pali.	As last.	Perforated at edges; no true pali.
9. Growth characters and epitheca.	14 specimens, largest a foliated cup 13 × 18 × 9 cm. deep, ·5 cm. thick, most merely folia, one incrusting 3·5 cm. thick. Epitheca 2·5 cm. from edge which is evenly costulated, smooth or minute spines.	A single folium 7 × 10 cms. by 18 mm. thick in centre. Epitheca to 5 mm. of edge, otherwise same as last.	Two thick masses, largest 10 × 14 cm. by 4 cm. thick, incrusting thin at edges. Epitheca, etc. same as last.
10. Locality.	Common, W. Reef, Hulule, foliated masses 2 feet or more across, and a small piece from Felidu, 14 *f*.	Passage into Hulule.	Edge of S.W. Reef, Hulule.
11. Colour.	Green.	Brown.	Green-brown.

Comparison and Characters of Echinopora rosularia, solidior and tertia (see p. 782).

XVI. Genus *Echinopora*.

Dana, p. 278. Ed. and H., II. p. 621. Klz., p. 54.

A genus closely allied to Trachypora (syn. Echinophyllia), which has been generally confused with it. No specimens come from Minikoi. E. rosularia is alone abundant, but it is very local and scarcely a reef-builder.

49. Echinopora rosularia (Lmk.). (Pl. LXIII. fig. 37.) Ed. and H., II. p. 623.

50. Echinopora solidior (Ed. and H.). (Pl. LXIII. fig. 38.) Ed. and H., II. p. 626.

51. Echinopora tertia, n. sp. (Pl. LXIII. fig. 39.)

The three above-mentioned species are evidently so closely allied that it seems most useful to represent their characters in tabular form (p. 781). They are from the same locality and also environment, but I cannot see that they show any signs of merging into one another. One is naturally inclined to suspect a relationship to Klunzinger's 3 species from the Red Sea E. ehrenbergi, concamerata and carduus, but, if the characters of these forms be tabulated and compared with the above, the whole six would appear to be different.

Doubtless all the three forms grow into the same shape under favourable conditions, incrusting base rising into flat or rounded folia, on one side covered with polyps, but occasionally folia fusing so that both sides may appear to be so. The calices on the folia often have their lower edges higher, where also the costae are more marked and longer spined than on the incrusting base; otherwise variation is very slight and mostly vegetative. Increase takes place as in other Echinopora.

52. Echinopora magna, n. sp. (Pl. LX. fig. 10.)

Colony foliate, epitheca thin, underside covered with rounded, radiating ridges, 8 in 1 cm. *Calices* round, 7—9 mm. in diameter, lower sides much raised on folia so that the whole opens upwards. *Costae* large and very thick alternating with much smaller and finer; the larger with a few broad, blunt, low spines, at the lower edge of the calices much thicker and with two or three blunt spines or lobes, 2—3 mm. long. *Septa* very thick, especially at lower edges of calices, thin inside, about 12 subequal with often near their lower ends two or three pointed teeth alternating with very small ones, corresponding to the smaller series of costae. *Columella* about $\frac{1}{4}$ breadth of calice, rising little below level of theca, appearing finely paliform, really somewhat spongy and formed of trabeculae from half of the septa. In *section* exo- and endothecal dissepiments more or less horizontal, thick or thin, somewhat vesicular, 1—2 mm. apart.

The specimen is merely part of the foliated edge of a much larger colony. It appears to be a true Echinopora, approaching the so-called E. aspera which is, according to Klunzinger, a Trachypora (Fungidae).

Locality. S. Nilandu, 30 *f.*

XVII. Genus *Galaxea*.

The genus is mainly interesting from the fact that of the fourteen specimens obtained nine were dredged from various depths down to 36 *f.*, outer slope and lagoon. Among Maldivan reef forms the genus is rare.

53. Galaxea fascicularis (Linn.).

G. fascicularis et irregularis Ed. and H., II. pp. 227 and 229; Klz., p. 78.

I refer eight specimens to this species from which I am unable to separate G. irregularis, since they all show variations intermediate to the previously given characters of the two species. The variation is well dealt with by Klunzinger for G. irregularis. One specimen in places recalls G. musicalis, but elsewhere clearly belongs to facies irregularis.

Locality. Reef-flat, Addu and Turadu, S. Mahlosmadulu; west reef, Hulule; velu, Hulule, 6 *f.*; N. Male, 18 *f.* and 21 *f.*; Suvadiva, 20 *f.*

54. Galaxea musicalis (Linn.). Ed. and H., II. p. 225.

I cannot define any specific characters beyond those given by Ed. and H. The larger septa are 1—1·5 mm. exsert, all are represented by costae, and all three cycles are generally clearly visible; those of cycle I. are larger than II., but both I. and II. fuse by trabeculae in the axial fossa.

Locality. N. Male, 25 *f.*; S. Male, 26 *f.*, and Addu, outer slope, 25 *f.*

55. Galaxea hexagonalis, Ed. and H. Ed. and H., II. p. 226.

A very much more delicate coral than G. fascicularis with septa 2—3 mm. exsert, much more marked costae and a well-developed columella, formed of coarse trabeculae, quite distinct even in the smallest corallites, besides all the other characters given by Ed. and H. The perithecal vesicles are thinner walled and appear rather larger than in G. fascicularis.

Locality. Inner part of reef-flat of Minikoi and N. Male, 25 *f.*, a few corallites. **Colour,** transparent, hence appearing white, with peristome dark olive.

56. Galaxea lamarcki, Ed. and H. Ed. and H., II. p. 225.

Milne-Edwards published excellent figures of this species (*Le Règne Animal de Cuvier, Atlas,* pl. 85, figs. 1, 1*a*—*b*) from which my specimen differs in having the corallites averaging 2—2·5 mm. in diameter, the primary septa ·5—1 mm. exsert, in most calices 6 septa as in fig. 1 fusing to form the columella, though certain rather larger and more upstanding calices exactly resemble fig. 1 *a*, perithecal cells quite distinct on the surface, continuous throughout and not in bands. The separate vesicles are larger than in any of the other species in the collection, and the corallum is extremely light. Its under surface is covered by a distinct epitheca.

Locality. S. Nilandu, 36 *f.*

57. Galaxea, sp.?

A fragment with 20 corallites with perithecal vesicles very similar to the last but smaller, corallites slightly larger and rising for less than 1 mm. above the peritheca, septa scarcely exsert, fusion of primaries only in the axial fossa, septal cycle III. scarcely represented, corallites 6—9 mm. distant.

Locality. Felidu, 25 *f.*

XVIII. Genus *Stephanocoenia*.

58. Stephanocoenia maldivensis, n. sp. (Pl. LXII. figs. 29 and 30.)

Colony at first incrusting, then massive, covered up to the edge with a distinct epitheca. *Calices*, polygonal, often somewhat elongated or distorted, 4—6 mm. in diameter, 2—4 mm. deep. *Walls*, ·5—2 mm. thick, pointed or not, covered by the exsert (·1—1 mm.) rather angular or slightly flattened ends of the septa, which may be continuous between the calices or alternating. *Septa*, two series, 6—12 larger, subequal, scarcely toothed save for a crown of low, rather pointed perpendicularly rising teeth against the axial fossa, and 6—12 very minute, more or less alternating with the larger. *Columella*, a single fine, possibly somewhat bent rod, occasionally branched once or twice, joined here and there by trabeculae to the septa. In *section* walls solid or with a line of small vesicules in the centre; endothecal dissepiments ·5 mm. apart, thin, rather irregular, almost horizontal, occasionally joined forming vesicles; columella continuous from base; septa fenestrated, especially in a line behind their thickened edges, which probably represent true pali. *Increase* by marginal budding.

Locality and variation. (1) The greater part of a colony 14 × 8 cm. by 6 cm. thick from outer edge to the fissure zone of Minikoi reef; colour, living, olive-brown; a heavy rounded colony, walls 1—1·5 mm. thick, calices 4—4·5 mm. deep, 4·5 mm. in diameter, budding vigorous. (2) Five pieces, all from Hulule, the largest an edge of an incrusting mass 12 × 9 × 3 cm. from the S.-W. reef; light, often very thin walls, rather irregular on surfaces, calices smaller in hollows, generally about 4 mm. in diameter, rather shallow loculi, septa often only 6—9 of the paliform series. (3) Four fragments from fissure zone of W. reef of Maradu, Addu; heavy, rather approaching (1) but calices 5—5·5 mm. in diameter, not more than 3 mm. deep and columella tending to become compound. (4) A small colony from the passage into Hulule; large, elongated (5·5 mm.) calices, top endothecal dissepiments rising to within 1 mm. of edges of septa and obliterating the columella.

XIX. Genus *Acanthastraea*.

59. Acanthastraea hirsuta, Ed. and H. Ed. and H., II. p. 502, D. 5, 4.

Var. microstoma, Klz. (Pl. LIX. fig. 6.) Klz., p. 42, V. 2.

Var. megalostoma, Klz. Klz., p. 42, V. 1.

In section my specimens have solid thick walls, 2—3 mm. thick, and dissepiments thin, rather oblique, tending to be vesicular, 1·5—2 mm. apart. I can see no true columella, but the section shows a mass of relatively large, blunt, obliquely upstanding teeth from about a third of the septa, filling up the axial space. My specimens in every part so distinctly belong to one or other of the two forms as to suggest that Klunzinger is here dealing with true varieties and not merely *facies*.

Locality. Minikoi, reef-flat (var. microstoma) and Hulule passage (var. megalostoma), rare, only two specimens.

XX. Genus *Prionastraea.*

The genus is in its definition a most unsatisfactory one. It shows many resemblances to Goniastraea, from which, owing to budding sometimes taking place close to the columella, individual specimens can only be separated with difficulty. It assumes, indeed, the same position in respect to it as Orbicella does to Astraea.

The species in the collection shows very distinct variation, which is mentioned under each. In all characters it seems to be very largely correlated with environment, *i.e.* vegetative. The edges, the upper sides and lower parts perhaps of the several species, differ somewhat from one another in the sizes, depth, thickness of walls, spinulation, etc. of the calices. Yet the colonies of P. crassior and P. fusco-viridis clearly show that there are limits to this variation, and that it follows along distinct lines for the several species. The two types of calices described in P. robusta and P. magnistellata are also in this respect remarkable. The number of the septa is fairly variable for each species, but the number which run into the columella is about the same in all (18—24) owing to physical causes. The septa preserve their type in each species, though this shows considerable variation in P. fusco-viridis, apparently in this case largely connected with the several localities from which the specimens were obtained.

Distribution. A common reef-builder, great masses on the outer slope to 15 *f.*, small colonies on the reef-flat even under the breakers, very common on lagoon shoals, often forming overhanging masses; vertical to 30 fathoms. **Colour,** generally brown to green. The colonies tend to be much bored into by worms and other destructive organisms at the base, but the surface is usually entire.

60. Prionastraea pentagona Klz. Klz., p. 39, IV. 7, and X. 5.

A small specimen, 8 × 6 cm., from the breaker zone of the reef at Minikoi, closely resembles Klunzinger's description and figures of this species. The calices are rather smaller, averaging about 6·5 × 5 mm., largest 8·5 × 5 mm.

61. Prionastraea spinosa Klz. Klz., p. 39.

A small specimen from S. Nilandu, 30 *f.*, with a dozen corallites answering in every respect to the above species save that it would appear to be in its structure rather more delicate. The septal sides are a little rough and spiny.

62. Prionastraea robusta (Dana). (Pl. LXIV. fig. 42.) Dana, p. 248, XIII. 10.

A specimen similar to P. crassior in shape, with similar rough-sided septa with blunt, spiny teeth (a little higher and more regular than Dana's fig. 10 *b*), with nearly solid walls, endothecal dissepiments about ·5 mm. apart (in longitudinal section 3 cells in 2 mm.), not very oblique. The *columella* is one-fourth to one-fifth the diameter of the calice, almost flat-topped, dense, very finely trabeculate, spongy, and the innermost teeth of the septa, especially in the deeper calices, simulate a paliform crown.

The specimen is part of a mass, one side and much of the top of which had been killed apparently by sediment, while the other side was growing out vigorously underneath, with a longitudinally striped, almost costate, lower surface, with no distinct epitheca such as is generally found in the genus. Budding takes place near the centre of the calice so as almost to simulate fission, a character considerably enhanced by the rapid formation of

the dividing walls. All the calices are polygonal with thin edges but may be divided into two classes, (*a*) those on the top scarcely showing any budding, 10—14 mm. in diameter, walls thin edged but 1—3 mm. thick at level of columella, septa about 34, alternately larger and smaller, more than two-thirds reaching the columella, each with 6—10 low, subequal, blunt, rough teeth, the innermost commonly larger and forming a little crown rising 1·5—2 mm. above the top of the columella, and (*b*) those to the sides, vigorously budding, 6—9 mm. in diameter, crowded, more irregular, less polygonal, walls thin, at level of columella not more than 1 mm., same depth or even up to 5 mm. (hence appearing very markedly different), septa about the same number alternately larger and smaller, less than two-thirds reaching the columella, with 2—7 (commonly 3 or 4) much higher, irregular, very blunt and spiny teeth, those round the pali narrower but not more marked than the rest, though rising to the same height above the columella.

This extraordinary variation of the calices represents types as distinct as P. abdita and profundicella, or P. sulfurea and quoyi (see Ed. and H.), and throws a considerable light on the variability of the genus. It distinctly suggests that mere size has nothing to do with the number of septa in adult calices.

Locality. Hulule, reef-flat to south-west.

63. Prionastraea crassior (Ed. and H.). (Pl. LXIV. figs. 45, 46.) Ed. and H., II. p. 515.

I refer a specimen about 38 cm. long by 20 cm. high and the same in thickness, and probably having more than 2000 corallites, to this species, with the description of which it corresponds in every particular.

The *colony* is a very large, heavy mass, rough and uneven (hilly) on the surface but not in any way gibbous. It is covered with *calices*, the older of which average between 10 and 11 mm. in diameter, with younger ones of 5—7 mm. between. On the upper part the calices are more or less polygonal, relatively deep (5—6 mm.), thin walled (seldom less than 1 mm. except where a new calice has formed), but on the sides are more rounded or oval, shallower, and much thicker walled (2—3 mm.). The *septa* are continuous over the walls (1 mm. exsert), always slightly thickened, but quite markedly so towards the base of the mass, where, on the top of the walls, they alternate with fine ridges, not generally represented by any trace of septa within the corallites, and rise somewhat at the edges of the calices giving an appearance almost of furrowed walls. The septa number about 25—30 in the fully formed calices, approximately equal in size, no cycles distinguishable, often one or two groups of three fusing together, 20—24 joining in to the *columella* which is formed of fine trabeculae from their edges, closely packed together (spongy) in a mass about 1·5 mm. in diameter. The septa are narrow above and fall almost perpendicularly at the edges of the calices; they are thin and not granulated laterally, and their teeth are relatively low and blunt but increase in size towards the centre, the ring of teeth on the separate septa of the shallower calices simulating a crown of pali. *In section* the endothecal dissepiments are a little inclined, about ·8 mm. apart. The walls of the separate corallites are to a considerable extent welded together, but are more rapidly than other parts penetrated by boring organisms, so that they may appear relatively cavernous.

The colony was attached to the overhanging edge of a lagoon shoal by a narrow, dead base, on which part were growing Lithothamnion, Halimeda, red Polytrema, a colonial

The species has a much rougher appearance than C. savignyi, from which it differs markedly in its septa. With Solenastraea forskaelana Ed. and H. the specimens agree in all respects except in the different sizes of their septal cycles, but this is a variable character.

Locality. Hulule, (1) W. reef, and (2) passage through same.

44. Cyphastraea savignyi (Ed. and H.).

Ed. and H., II. p. 485. Klz., p. 51, and Gard., p. 761.

Four specimens, all more or less rounded and completely covered by living polyps, of the identity of which with the above no doubt can be entertained. One specimen, a ball, completely corresponds to Klunzinger's description, differing somewhat from his figure, to which a second rather irregular specimen, evidently grown under bad conditions, completely answers. The other specimens have slightly larger corallites, in exsertness intermediate to my Rotuma specimen, but more crowded together. The costae are always very prominent and not rough. The exotheca has tiny, somewhat scattered spinules, but in the second specimen referred to appears from surface view to be vesicular. Twelve rather smooth septa typically fuse in the columella, and are equal sized. The theca of the calices is often very delicate, giving their edges a thin appearance.

Locality. Goidu, all from hollows of the reef-flat and boulder zone.

45. Cyphastraea hemprichana (Ed. and H.). Ed. and H., II. p. 495.

A single specimen, almost completely surrounded by the corallites, a free edge showing in one place covered by a dense epitheca. Calices on the upper surface crowded, about 1·5 mm. in diameter, half this breadth distant from one another underneath, edges always distinct, appearing more prominent owing to the slightly exsert upper ends of the septa. Exotheca with a few, almost smooth spinules above, lower and scarcely visible below, not clearly connected with the costae, which are quite distinct at the edges of the corallites. Septa relatively smooth and very little toothed, edges almost perpendicular, 6 clear systems and 3 cycles quite distinct from one another, primaries meeting in the centre of the calice so deep down as scarcely to be visible from the surface, shallower calices underneath.

Locality. Hulule, from the reef-flat of the south end.

46. Cyphastraea microphthalma (Esper). Ed. and H., II. p. 485.

I refer to this species three specimens, which agree with the descriptions in all essential characteristics. The *corallites* may be crowded or separated by half their diameter from one another on the outgrowing edges, slightly (·5 mm.) or not at all projecting, but always distinct owing to the arched, slightly exsert, upper ends of the septa. *Costae* sunk in the exotheca, edged with numerous, very rough, low spinules, giving a granular appearance. *Septa* similarly very rough, as described by Ed. and H. Paliform teeth present or absent. *Columella* always distinct, ending in papillae, or of a trabecular appearance. *Exotheca* very dense, in places almost solid, with here and there relatively large cavities.

Locality. (1) Turadu, S. Mahlosmadulu, W. reef, near breaker-zone, a rather smooth incrusting mass, much studded with Pyrgoma up to the pores of which the corallum extends; (2) S. Male, 25 *f.*; (3) Suvadiva, 31 *f.*, and (4) Addu, 40 *f.* on the outer slope, both the latter rough with trabecular columella and very indistinct paliform lobes.

47. Cyphastraea suvadivae, n. sp.

Colony flat, incrusting, but probably showing all the regular shapes found in other species of the genus, covered with round, scarcely projecting *corallites*. The latter 1—1·5 mm. broad, from 1·5—3 mm. distant from one another, joined by a vesicular exotheca covered with small, low, blunt spinules, which near the calices may be arranged in lines leading to the low spines, which represent the costal plates. *Theca* scarcely raised above the exotheca around the edge of the calice, the ring-form being mainly due to the slightly exsert, upper edges of the *septa*. Latter numbering 24, those of cycle III. very thin but generally distinct, projecting half-way to the columella; those of cycles I. and II. nearly equal, with rough, spiny sides, giving them a coarse appearance, edges bluntly notched, the inner teeth not distinguishable from the two or three rough rods of the columella. Calices quite shallow, with a closed in appearance below. The *exotheca* is formed by minute cell-like vesicles. In some sections it almost simulates the appearance found in Galaxea, but is clearly dependent on the costae. The endothecal dissepiments are very thin, close together and almost horizontal.

The species approaches nearest to C. microphthalma, but differs in its more distant calicles and much lighter and more open method of growth.

Locality. Six small pieces from Suvadiva, 20 *f.* They are somewhat distorted on the surface with barnacles and worm tubes, and the structure underneath more or less destroyed to within 4 mm. of the surface by boring animals.

48. Cyphastraea maldivensis, n. sp.

Colony consisting of thin, incrusting masses, but probably showing all the shapes found in the genus. *Corallites* round, practically not projecting, not more than 1·5 mm. broad, generally separated by at least two or three times their diameter from one another, joined by a glabrous looking exotheca, obviously even from the surface formed by very small, flattened vesicles, often with their walls incomplete on the surface, but where complete studded with low rounded granules. *Costae* practically non-existent, but tops of the septa a little projecting over the upper ends of the calices, giving an appearance of rings slightly raised round their edges. *Septa* 24, tertiaries distinct at edge of calice, projecting about one quarter way to columella, ending perpendicularly inside with small, pointed teeth; primaries and secondaries nearly equal, rather thin, slightly exsert, a few spines on the sides, ending inside with long, thick, pointed, spiny teeth, extending almost at right angles over the axial fossa, the inner parts of the septa by their fusion presenting sometimes a fenestrated appearance. *Columella* formed by open trabeculae from the septal edges, a quarter to a third the width of the calice, sometimes with points above but never papillary. The calices, owing to the small breadth of the tertiary septa, the thin septa and large columella, appear relatively open.

The exotheca is more abundant and vesicular than it is in the last species, and still more closely resembles Galaxea; the piling up of the vesicles on the surface between the corallites is very distinct. The species more closely resembles the last than any other, but differs in its surface appearance, thinner septa with long pointed teeth and trabecular columella.

Locality. S. Nilandu, 25 *f.*, and Felidu, 20 to 25 *f.*

Characters	*Echinopora rosularia* (Lmk.)	*Echinopora solidior* (Ed. & H.)	*Echinopora tertia*, n. sp.
1. Size of Calices.	3 × 4 mm. or round.	6 × 5 mm. or round.	5—7 mm. × same.
2. Depth of Calices.	1 mm.	2 mm.	1·5 mm.
3. Edges of Calices.	Little cones, 1—3 mm. high. Septal spines thin, 1 mm. high.	Flat. Thick spines from about 15 septa, 2 mm. high, subequal.	Flat. Septa not more than 1 mm. exsert, thin.
4. Costae.	Very close set, fine lines, made up of fine, low (·5 mm.), rounded spinules.	Edge of colony lines of flattened rough spinules, 1 mm. high; central part irregular.	At edge lines centre irregular; vary from round, smooth to characters of last, always thinner, ·75 mm. high.
5. Number of Septa.	16—24	24—30	36—48
6. Character of Septa.	I and II cycles subequal, rough and thick at edge of calice with 3 blunt, rough teeth, 2 on exsert upper edges, the 3rd and innermost, only present on about half, quite paliform; III very minute and thin.	About 18, larger, rough, thick at edge of calice, no distinct teeth, rather more than half with a small thick paliform tooth. Between last about 10 very minute septa.	Typically I and II larger and subequal, rough, uppermost tooth over theca longest, lowest where present very fine and subpaliform, III similar but thinner; IV minute, commonly bend round and fuse with III at middle of their breadth.
7. Columella.	About $\frac{1}{4}$ breadth of calice, spongy, dense, very fine trabeculae from about 10 septa.	Similar to last, but much less dense and from about 18 septa.	Similar to last, rather hollowed in centre from about 14 septa.
8. Section *a*. Exotheca.	Scarcely visible, very dense.	Dense, vesicular.	Very dense, vesicular.
b. Endotheca.	Not clear, horizontal (?).	Horizontal, 5 mm. apart, thin.	Irregular, little vesicular, dense.
c. Septa.	Fenestrated; especially line outside pali lobes which are hence true pali.	As last.	Perforated at edges; no true pali.
9. Growth characters and epitheca.	14 specimens, largest a foliated cup 13 × 18 × 9 cm. deep, ·5 cm. thick, most merely folia, one incrusting 3·5 cm. thick. Epitheca 2·5 cm. from edge which is evenly costulated, smooth or minute spines.	A single folium 7 × 10 cms. by 18 mm. thick in centre. Epitheca to 5 mm. of edge, otherwise same as last.	Two thick masses, largest 10 × 14 cm. by 4 cm. thick, incrusting thin at edges. Epitheca, etc. same as last.
10. Locality.	Common, W. Reef, Hulule, foliated masses 2 feet or more across, and a small piece from Felidu, 14 *f*.	Passage into Hulule.	Edge of S.W. Reef, Hulule.
11. Colour.	Green.	Brown.	Green-brown.

Comparison and Characters of Echinopora rosularia, solidior and tertia (see p. 782).

XVI. Genus *Echinopora*.

Dana, p. 278. Ed. and H., II. p. 621. Klz., p. 54.

A genus closely allied to Trachypora (syn. Echinophyllia), which has been generally confused with it. No specimens come from Minikoi. E. rosularia is alone abundant, but it is very local and scarcely a reef-builder.

49. Echinopora rosularia (Lmk.). (Pl. LXIII. fig. 37.) Ed. and H., II. p. 623.

50. Echinopora solidior (Ed. and H.). (Pl. LXIII. fig. 38.) Ed. and H., II. p. 626.

51. Echinopora tertia, n. sp. (Pl. LXIII. fig. 39.)

The three above-mentioned species are evidently so closely allied that it seems most useful to represent their characters in tabular form (p. 781). They are from the same locality and also environment, but I cannot see that they show any signs of merging into one another. One is naturally inclined to suspect a relationship to Klunzinger's 3 species from the Red Sea E. ehrenbergi, concamerata and carduus, but, if the characters of these forms be tabulated and compared with the above, the whole six would appear to be different.

Doubtless all the three forms grow into the same shape under favourable conditions, incrusting base rising into flat or rounded folia, on one side covered with polyps, but occasionally folia fusing so that both sides may appear to be so. The calices on the folia often have their lower edges higher, where also the costae are more marked and longer spined than on the incrusting base; otherwise variation is very slight and mostly vegetative. Increase takes place as in other Echinopora.

52. Echinopora magna, n. sp. (Pl. LX. fig. 10.)

Colony foliate, epitheca thin, underside covered with rounded, radiating ridges, 8 in 1 cm. *Calices* round, 7—9 mm. in diameter, lower sides much raised on folia so that the whole opens upwards. *Costae* large and very thick alternating with much smaller and finer; the larger with a few broad, blunt, low spines, at the lower edge of the calices much thicker and with two or three blunt spines or lobes, 2—3 mm. long. *Septa* very thick, especially at lower edges of calices, thin inside, about 12 subequal with often near their lower ends two or three pointed teeth alternating with very small ones, corresponding to the smaller series of costae. *Columella* about $\frac{1}{4}$ breadth of calice, rising little below level of theca, appearing finely paliform, really somewhat spongy and formed of trabeculae from half of the septa. In *section* exo- and endothecal dissepiments more or less horizontal, thick or thin, somewhat vesicular, 1—2 mm. apart.

The specimen is merely part of the foliated edge of a much larger colony. It appears to be a true Echinopora, approaching the so-called E. aspera which is, according to Klunzinger, a Trachypora (Fungidae).

Locality. S. Nilandu, 30 *f.*

XVII. Genus *Galaxea*.

The genus is mainly interesting from the fact that of the fourteen specimens obtained nine were dredged from various depths down to 36 *f.*, outer slope and lagoon. Among Maldivan reef forms the genus is rare.

53. Galaxea fascicularis (Linn.).

G. fascicularis et irregularis Ed. and H., II. pp. 227 and 229; Klz., p. 78.

I refer eight specimens to this species from which I am unable to separate G. irregularis, since they all show variations intermediate to the previously given characters of the two species. The variation is well dealt with by Klunzinger for G. irregularis. One specimen in places recalls G. musicalis, but elsewhere clearly belongs to facies irregularis.

Locality. Reef-flat, Addu and Turadu, S. Mahlosmadulu; west reef, Hulule; velu, Hulule, 6 *f.*; N. Male, 18 *f.* and 21 *f.*; Suvadiva, 20 *f.*

54. Galaxea musicalis (Linn.). Ed. and H., II. p. 225.

I cannot define any specific characters beyond those given by Ed. and H. The larger septa are 1—1·5 mm. exsert, all are represented by costae, and all three cycles are generally clearly visible; those of cycle I. are larger than II., but both I. and II. fuse by trabeculae in the axial fossa.

Locality. N. Male, 25 *f.*; S. Male, 26 *f.*, and Addu, outer slope, 25 *f.*

55. Galaxea hexagonalis, Ed. and H. Ed. and H., II. p. 226.

A very much more delicate coral than G. fascicularis with septa 2—3 mm. exsert, much more marked costae and a well-developed columella, formed of coarse trabeculae, quite distinct even in the smallest corallites, besides all the other characters given by Ed. and H. The perithecal vesicles are thinner walled and appear rather larger than in G. fascicularis.

Locality. Inner part of reef-flat of Minikoi and N. Male, 25 *f.*, a few corallites. **Colour,** transparent, hence appearing white, with peristome dark olive.

56. Galaxea lamarcki, Ed. and H. Ed. and H., II. p. 225.

Milne-Edwards published excellent figures of this species (*Le Règne Animal de Cuvier, Atlas*, pl. 85, figs. 1, 1*a*—*b*) from which my specimen differs in having the corallites averaging 2—2·5 mm. in diameter, the primary septa ·5—1 mm. exsert, in most calices 6 septa as in fig. 1 fusing to form the columella, though certain rather larger and more upstanding calices exactly resemble fig. 1 *a*, perithecal cells quite distinct on the surface, continuous throughout and not in bands. The separate vesicles are larger than in any of the other species in the collection, and the corallum is extremely light. Its under surface is covered by a distinct epitheca.

Locality. S. Nilandu, 36 *f.*

57. Galaxea, sp.?

A fragment with 20 corallites with perithecal vesicles very similar to the last but smaller, corallites slightly larger and rising for less than 1 mm. above the peritheca, septa scarcely exsert, fusion of primaries only in the axial fossa, septal cycle III. scarcely represented, corallites 6—9 mm. distant.

Locality. Felidu, 25 *f.*

XVIII. Genus *Stephanocoenia*.

58. Stephanocoenia maldivensis, n. sp. (Pl. LXII. figs. 29 and 30.)

Colony at first incrusting, then massive, covered up to the edge with a distinct epitheca. *Calices*, polygonal, often somewhat elongated or distorted, 4—6 mm. in diameter, 2—4 mm. deep. *Walls*, ·5—2 mm. thick, pointed or not, covered by the exsert (·1—1 mm.) rather angular or slightly flattened ends of the septa, which may be continuous between the calices or alternating. *Septa*, two series, 6—12 larger, subequal, scarcely toothed save for a crown of low, rather pointed perpendicularly rising teeth against the axial fossa, and 6—12 very minute, more or less alternating with the larger. *Columella*, a single fine, possibly somewhat bent rod, occasionally branched once or twice, joined here and there by trabeculae to the septa. In *section* walls solid or with a line of small vesicules in the centre; endothecal dissepiments ·5 mm. apart, thin, rather irregular, almost horizontal, occasionally joined forming vesicles; columella continuous from base; septa fenestrated, especially in a line behind their thickened edges, which probably represent true pali. *Increase* by marginal budding.

Locality and variation. (1) The greater part of a colony 14 × 8 cm. by 6 cm. thick from outer edge to the fissure zone of Minikoi reef; colour, living, olive-brown; a heavy rounded colony, walls 1—1·5 mm. thick, calices 4—4·5 mm. deep, 4·5 mm. in diameter, budding vigorous. (2) Five pieces, all from Hulule, the largest an edge of an incrusting mass 12 × 9 × 3 cm. from the S.-W. reef; light, often very thin walls, rather irregular on surfaces, calices smaller in hollows, generally about 4 mm. in diameter, rather shallow loculi, septa often only 6—9 of the paliform series. (3) Four fragments from fissure zone of W. reef of Maradu, Addu; heavy, rather approaching (1) but calices 5—5·5 mm. in diameter, not more than 3 mm. deep and columella tending to become compound. (4) A small colony from the passage into Hulule; large, elongated (5·5 mm.) calices, top endothecal dissepiments rising to within 1 mm. of edges of septa and obliterating the columella.

XIX. Genus *Acanthastraea*.

59. Acanthastraea hirsuta, Ed. and H. Ed. and H., II. p. 502, D. 5, 4.

Var. microstoma, Klz. (Pl. LIX. fig. 6.) Klz., p. 42, V. 2.

Var. megalostoma, Klz. Klz., p. 42, V. 1.

In section my specimens have solid thick walls, 2—3 mm. thick, and dissepiments thin, rather oblique, tending to be vesicular, 1·5—2 mm. apart. I can see no true columella, but the section shows a mass of relatively large, blunt, obliquely upstanding teeth from about a third of the septa, filling up the axial space. My specimens in every part so distinctly belong to one or other of the two forms as to suggest that Klunzinger is here dealing with true varieties and not merely *facies*.

Locality. Minikoi, reef-flat (var. microstoma) and Hulule passage (var. megalostoma), rare, only two specimens.

XX. Genus *Prionastraea.*

The genus is in its definition a most unsatisfactory one. It shows many resemblances to Goniastraea, from which, owing to budding sometimes taking place close to the columella, individual specimens can only be separated with difficulty. It assumes, indeed, the same position in respect to it as Orbicella does to Astraea.

The species in the collection shows very distinct variation, which is mentioned under each. In all characters it seems to be very largely correlated with environment, *i.e.* vegetative. The edges, the upper sides and lower parts perhaps of the several species, differ somewhat from one another in the sizes, depth, thickness of walls, spinulation, etc. of the calices. Yet the colonies of P. crassior and P. fusco-viridis clearly show that there are limits to this variation, and that it follows along distinct lines for the several species. The two types of calices described in P. robusta and P. magnistellata are also in this respect remarkable. The number of the septa is fairly variable for each species, but the number which run into the columella is about the same in all (18—24) owing to physical causes. The septa preserve their type in each species, though this shows considerable variation in P. fusco-viridis, apparently in this case largely connected with the several localities from which the specimens were obtained.

Distribution. A common reef-builder, great masses on the outer slope to 15 *f.*, small colonies on the reef-flat even under the breakers, very common on lagoon shoals, often forming overhanging masses; vertical to 30 fathoms. **Colour,** generally brown to green. The colonies tend to be much bored into by worms and other destructive organisms at the base, but the surface is usually entire.

60. Prionastraea pentagona Klz. Klz., p. 39, IV. 7, and X. 5.

A small specimen, 8 × 6 cm., from the breaker zone of the reef at Minikoi, closely resembles Klunzinger's description and figures of this species. The calices are rather smaller, averaging about 6·5 × 5 mm., largest 8·5 × 5 mm.

61. Prionastraea spinosa Klz. Klz., p. 39.

A small specimen from S. Nilandu, 30 *f.*, with a dozen corallites answering in every respect to the above species save that it would appear to be in its structure rather more delicate. The septal sides are a little rough and spiny.

62. Prionastraea robusta (Dana). (Pl. LXIV. fig. 42.) Dana, p. 248, XIII. 10.

A specimen similar to P. crassior in shape, with similar rough-sided septa with blunt, spiny teeth (a little higher and more regular than Dana's fig. 10 *b*), with nearly solid walls, endothecal dissepiments about ·5 mm. apart (in longitudinal section 3 cells in 2 mm.), not very oblique. The *columella* is one-fourth to one-fifth the diameter of the calice, almost flat-topped, dense, very finely trabeculate, spongy, and the innermost teeth of the septa, especially in the deeper calices, simulate a paliform crown.

The specimen is part of a mass, one side and much of the top of which had been killed apparently by sediment, while the other side was growing out vigorously underneath, with a longitudinally striped, almost costate, lower surface, with no distinct epitheca such as is generally found in the genus. Budding takes place near the centre of the calice so as almost to simulate fission, a character considerably enhanced by the rapid formation of

the dividing walls. All the calices are polygonal with thin edges but may be divided into two classes, (*a*) those on the top scarcely showing any budding, 10—14 mm. in diameter, walls thin edged but 1—3 mm. thick at level of columella, septa about 34, alternately larger and smaller, more than two-thirds reaching the columella, each with 6—10 low, subequal, blunt, rough teeth, the innermost commonly larger and forming a little crown rising 1·5—2 mm. above the top of the columella, and (*b*) those to the sides, vigorously budding, 6—9 mm. in diameter, crowded, more irregular, less polygonal, walls thin, at level of columella not more than 1 mm., same depth or even up to 5 mm. (hence appearing very markedly different), septa about the same number alternately larger and smaller, less than two-thirds reaching the columella, with 2—7 (commonly 3 or 4) much higher, irregular, very blunt and spiny teeth, those round the pali narrower but not more marked than the rest, though rising to the same height above the columella.

This extraordinary variation of the calices represents types as distinct as P. abdita and profundicella, or P. sulfurea and quoyi (see Ed. and H.), and throws a considerable light on the variability of the genus. It distinctly suggests that mere size has nothing to do with the number of septa in adult calices.

Locality. Hulule, reef-flat to south-west.

63. Prionastraea crassior (Ed. and H.). (Pl. LXIV. figs. 45, 46.) Ed. and H., II. p. 515.

I refer a specimen about 38 cm. long by 20 cm. high and the same in thickness, and probably having more than 2000 corallites, to this species, with the description of which it corresponds in every particular.

The *colony* is a very large, heavy mass, rough and uneven (hilly) on the surface but not in any way gibbous. It is covered with *calices*, the older of which average between 10 and 11 mm. in diameter, with younger ones of 5—7 mm. between. On the upper part the calices are more or less polygonal, relatively deep (5—6 mm.), thin walled (seldom less than 1 mm. except where a new calice has formed), but on the sides are more rounded or oval, shallower, and much thicker walled (2—3 mm.). The *septa* are continuous over the walls (1 mm. exsert), always slightly thickened, but quite markedly so towards the base of the mass, where, on the top of the walls, they alternate with fine ridges, not generally represented by any trace of septa within the corallites, and rise somewhat at the edges of the calices giving an appearance almost of furrowed walls. The septa number about 25—30 in the fully formed calices, approximately equal in size, no cycles distinguishable, often one or two groups of three fusing together, 20—24 joining in to the *columella* which is formed of fine trabeculae from their edges, closely packed together (spongy) in a mass about 1·5 mm. in diameter. The septa are narrow above and fall almost perpendicularly at the edges of the calices; they are thin and not granulated laterally, and their teeth are relatively low and blunt but increase in size towards the centre, the ring of teeth on the separate septa of the shallower calices simulating a crown of pali. *In section* the endothecal dissepiments are a little inclined, about ·8 mm. apart. The walls of the separate corallites are to a considerable extent welded together, but are more rapidly than other parts penetrated by boring organisms, so that they may appear relatively cavernous.

The colony was attached to the overhanging edge of a lagoon shoal by a narrow, dead base, on which part were growing Lithothamnion, Halimeda, red Polytrema, a colonial

Tunicate, Polyzoa, sponges, as well as a Madrepora, a Montipora and two Paracyathus. The coral itself is much bored into by worm tubes and apparently Achyla. Its edges are explanate, covered below by a dense wavy epitheca, the colony evidently attempting to grow out at the base in competition with the various organisms there settled.

Locality. Minikoi. The brownish-green colonies are fairly common on the lagoon shoals, though I only brought home a single specimen, not at the time recognising its specific identity from other species.

64. Prionastraea fusco-viridis (Q. and G.). (Pl. LXIV. figs. 43, 44.)

Quoy and Gaimard, *Voy. de l'Astrol.* IV. Pl. XVII. fig. 8. Dana, p. 229, Pl. XI. fig. 7. Gard., p. 759, Pl. XLVII. fig. 5.

I refer twenty-nine specimens, more than half of which are of relatively large size, to this species. In shape the masses vary from convex, with low elevations due to the surface on which they are seated, to flat or convex with upstanding, almost perpendicularly rising hillocks, sometimes flat with a corallite on the top, but more often ending in a thick ridge, all with calices on the sides.

The *calices* are generally polygonal in shape, about 11 mm. in diameter, but where about to bud may be narrow, up to about 20 mm. long, and in the valleys very small, 8 mm. or less in diameter; in depth they vary greatly, typically perhaps about 8 mm., shallower on the walls and near the edges. Their *walls* in the valleys of the colony are generally sharp pointed or ridged above, thicker below, 1 mm. or less, rising over the general surface to about 2 mm., and at the edges, or on elevations, or ridges to 3—4 mm. The *septa* are generally continuous between the calices, their exsert portions similar in every respect, not rising more than ·5 mm. over the walls, arched, giving the thicker an appearance of rounded off ridges. They vary in the average sized calices from 35—55 in number, but in the more elongate rise to 75 or more. No systems are distinguishable, the smaller occasionally fuse with the larger, and about 18 or 20 run into a spongy *columella* of 2—2·5 mm. in diameter, generally formed of very small, densely packed trabeculae from the septal edges. The sides of the septa may be almost smooth or spiny. The septal teeth are always bluntly pointed and low near the walls, generally 8—11 in number; they may be subequal, very little longer at the inner ends of the septa, or may become relatively long (2 mm.) and more pointed. The innermost may rise perpendicularly for 2—2·5 mm. above the columella, simulating a crown of pali but more commonly such is absent, the septal edges appearing almost to merge into the columella.

The edge of the colony, wherever visible, is covered with a thick, transversely wrinkled epitheca. The walls are exceedingly dense, in *section* often quite solid, sometimes with a line of cells in their centres. The endothecal dissepiments are thin, oblique (45° to the walls) ·5—1·5 mm. apart. *Increase* is by intercalicinal budding near the edges of the calices, but fission not infrequently occurs, especially in the valleys.

Locality. Very common on lagoon shoals and outer slope, often forming immense masses, both at Minikoi and in the Maldives, and one piece from N. Mahlosmadulu, 24 *f.* **Colour,** transparent or brown to dark green over the walls, brown-green peristome, edge of stomodoeum brilliant green.

The specimens vary considerably in their septal sides and teeth and the nature of their columella, *i.e.* (1) an incrusting mass without hillocks, septa smooth sides, low teeth, and columella typical; (2) numerous low hillocks, septa rough sides, teeth low, columella rising into points; (3) almost flat, few hillocks, septa nearly smooth sides, long teeth may simulate a pali crown, columella with points; (4) almost same as (1) with a few hillocks, septa tending to be alternately larger and smaller; (5) Goidu, very hillocky and ridged, septal sides smooth or low spinules, medium teeth, septa merging into a dense or slightly spiny columella; (6) Hulule, rounded or hummocky, septal sides smooth or very low spines, teeth longer than in (5), columella dense or almost appearing as if formed by the inner septal teeth; (7) rounded, septa thin sides, smooth, teeth long, distinct crown round columella; (8) rounded, sides of septa smooth, teeth very long and numerous, merging below into the papillated columella.

The species may be identical with P. obtusata Ed. and H., over which it has priority. It is considerably denser, heavier and shallower than P. abdita Ed. and H., which scarcely can be the same species described by Ell. and Sol. Of Klunzinger's species it differs from P. tesserifera in the character of its walls and septa, from P. vasta in the same and paliform crown, from P. spinosa in its very spiny septa and their number, while the size of the calices at once separates P. pentagona. P. gibbosa Klz. resembles it greatly, and indeed may well be a dwarf form with fewer septa.

65. Prionastraea magnistellata (Ed. and H.). (Pl. LXIV. figs 40, 41.) Ed. and H., II. p. 516.

Two specimens agree with the above-cited species in form of growth, size, shape and depth of calices, number and characters of septa, though there are two distinct sets, and in the distances between the endothecal dissepiments. The *columella* is not "bien développée, d'un tissu assez dense," but of rather coarse trabeculae, a character which in P. fusco-viridis may be seen to vary very considerably, and the *calices* are often relatively thick walled, and elongated or irregular in shape, largely owing to budding taking place near the inner ends of the septa.

The larger calices in my specimens range up to 23 mm. in length by 13 in breadth, but the average are about 17 by 14 mm.; in depth they vary up to 14 mm., averaging 11—12 mm., only edge or young ones less than 10 mm. The septa vary in number, in the largest calices 60—70, average sized ones 40—50, and occasionally fuse with one another; the systems are irregular and not distinguishable, 16—24 larger meeting in the central part of the calice. The dividing walls vary from 1—2·5 mm. in thickness; over them the septa are slightly thickened, about 1 mm. exsert, flat, finely toothed edges, over the thickened walls tending to have distinct notches or to be broken in the centre, almost giving the appearance of a furrow. The septal sides are slightly granulated, and their edges, falling at first almost perpendicularly into the calices, end in pointed teeth, which near the centre, where they are very crowded, increase in length up to 3 mm. The columella typically consists of a mass of rather coarse, twisted trabeculae from the septal edges 2—3 mm. across.

The specimens, two in number, differ considerably, though certain calices in each are not distinguishable. The Minikoi one is a convex mass 13 × 11 cm. with generally thick walls (2 mm.), septa about 55 in number, exsert portions of same notched, calices relatively larger and distinct columella, while the Hulule one is the edge of a mass killed in the centre, with quite thin walls over which the septa (about 42 in number) are very distinctly

thickened, calices narrower and hence appearing deeper, septal teeth not so markedly increasing in size towards the axial fossa, sometimes meeting over, sometimes merging into the smaller and less distinct columella.

Locality. Minikoi and Hulule, E. and W. reefs.

66. Prionastraea suvadivae, n. sp.

A rounded head, 9 cm. across × 6 cm. high, stalk covered by organisms, the greater part dead but calices quite distinct and 18 still alive when obtained.

Corallites varying up to 28 mm. long but the actual cavities much less, the calices not, indeed, averaging more than 15 mm. broad, 8—10 mm. deep. Dividing *walls* appearing from the surface a little hollowed out and exceedingly thick, 2—10 mm., but the greater thickness is made up of endothecal vesicles and very oblique dissepiments, reaching to within ·5 mm. of the granulated tops of the septa which are continuous between the calices. *Septa* numbering 30—40, smooth sided, set with 8—12 blunt, low, subequal teeth which on about 18 of the larger, merge into the trabeculae of the rather small, coarse columella. *Endothecal dissepiments* about 1 mm. apart, exceedingly oblique. Only one *bud* showing and that from about half way down the septa.

It is obvious that the circumstances controlling the growth of this specimen were eminently unfavourable—it was probably growing on the edge of a lagoon shoal and fell off into deeper water, the muddy bottom of which was slowly killing it—its very thick walls being a character associated generally with the edges or less vigorously growing parts of colonies. Yet it exhibits this last character to a degree more extreme than described in any other species. Its nearest ally is, in my opinion, P. favosa, but it is a distinct species. I give it a geographical name, as I am uncertain as to which of its characters are really of specific importance, although certain suggest other and more appropriate names.

Locality. Suvadiva, 25 *f.*

Genus *Merulina*.

67. Merulina ampliata Ell. and Sol. (Pl. LXIV. figs. 47, 48.)

Ell. and Sol., *Zooph.* p. 157, Pl. XLI. figs. 1 and 2; Esper, *Pflanz.* t. I. p. 96, Pl. LXXVII.; Dana, p. 272, xv. 2; Ed. and H., II. p. 628.

A single large specimen and several small pieces, all from the W. Reef of Hulule, which agree in every respect with the above descriptions. Off the outer slope at Goidu this or a similar species is very abundant forming foliaceous colonies two or three yards across and high.

68. Merulina prolifera Quelch.

Quelch, *Challenger Report on Reef Corals*, p. 110, Pl. II. fig. 1.

Three small specimens from Suvadiva 35 *f.*, S. Nilandu 36 *f.*, and N. Male 24 *f.*, appear to belong to this species, the type of which I have examined.

EXPLANATION OF PLATES.

(*All the photographs show the natural sizes of the different coralla.*)

PLATE LIX.

FIGS. 1—3. Symphyllia sinuosa.
FIGS. 4, 5. Antillia constricta.
FIG. 6. Acanthastraea hirsuta.

PLATE LX.

FIGS. 7, 8. Coeloria magna.
FIG. 9. „ cooperi.
FIG. 10. Echinopora magna.
FIG. 11. Hydnophora grandis.
FIG. 12. „ maldivensis.

PLATE LXI.

FIG. 13. Favia cavernosa.
FIGS. 14—18. Favia denticulata.
FIGS. 19—21. „ hululensis.

PLATE LXII.

FIG. 22. Favia affinis (Minikoi).
FIG. 23. „ „ (Hulule).
FIG. 24. „ laccadivica.
FIG. 25. „ parvimurata.
FIG. 26. „ adduensis.
FIG. 27. Favia hombroni.
FIG. 28. Goniastraea solida.
FIGS. 29, 30. Stephanocoenia maldivensis.

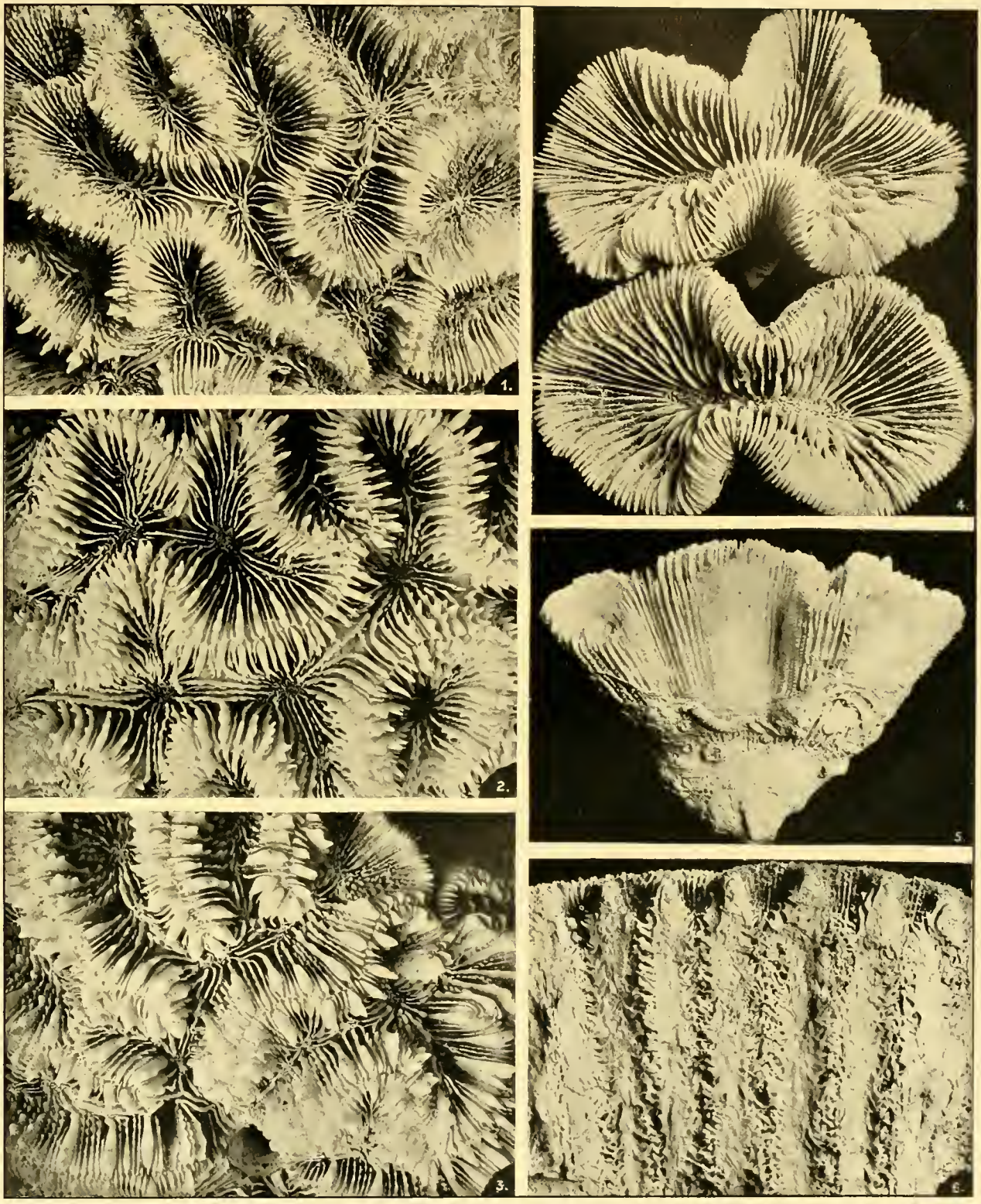
PLATE LXIII.

FIG. 31. Aphrastraea deformis.
FIG. 32. Orbicella annuligera.
FIG. 33. „ laxa.
FIG. 34. „ borradailei.
FIG. 35. „ minikoiensis.
FIG. 36. „ bottai.
FIG. 37. Echinopora rosularia.
FIG. 38. „ solidior.
FIG. 39. „ tertia.

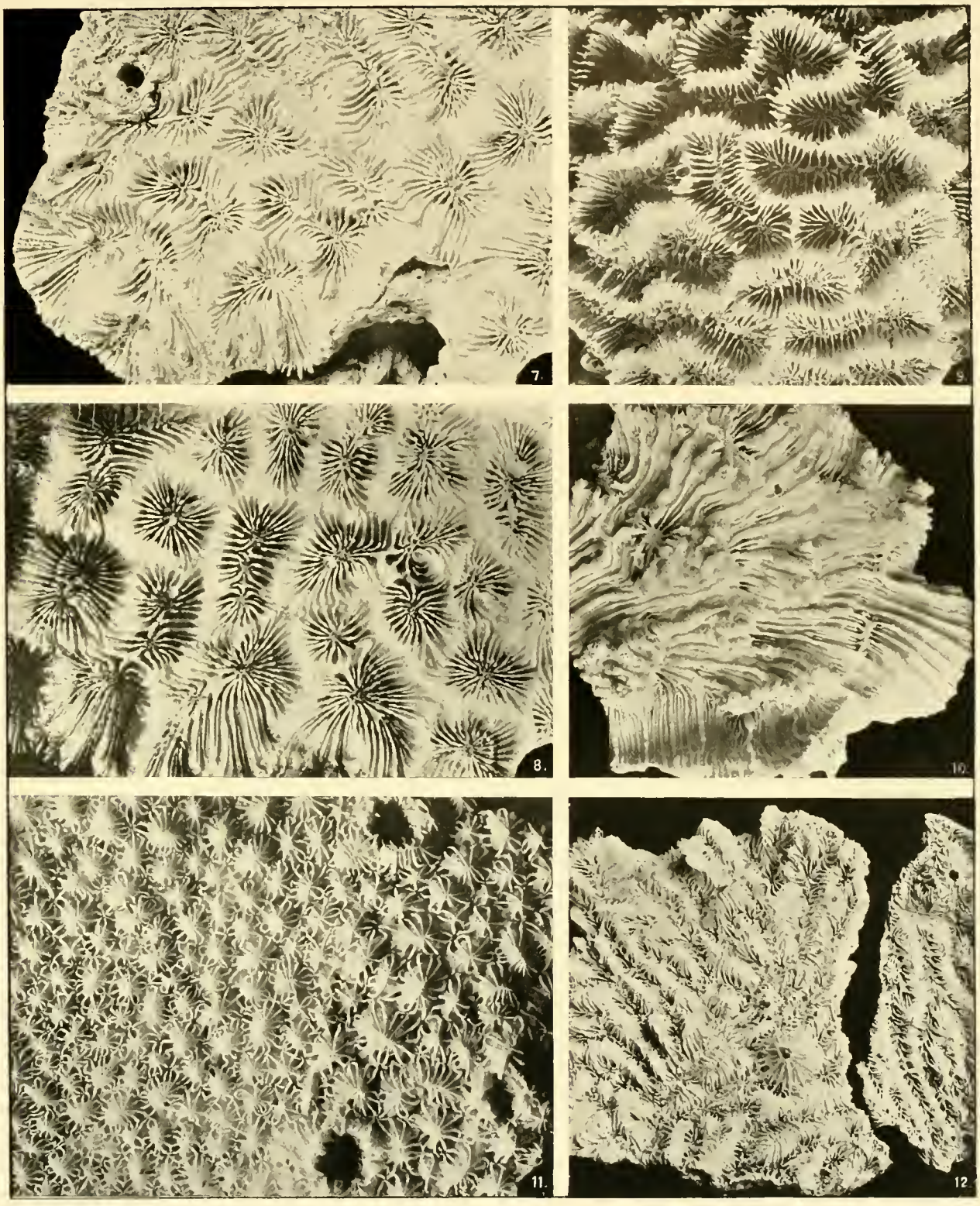
PLATE LXIV.

FIGS. 40, 41. Prionastraea magnistellata.
FIG. 42. Prionastraea robusta.
FIGS. 43, 44. „ fuscoviridis.
FIGS. 45, 46. „ crassior.
FIG. 47. Merulina ampliata.
FIG. 48. „ „ (from beneath).

[I hope in a subsequent Part to publish figures of the two new species of Cyphastraea, the previously known species of which scarcely require further illustration. J. S. G.]



STANLEY GARDINER——ASTRAEIDAE (I).



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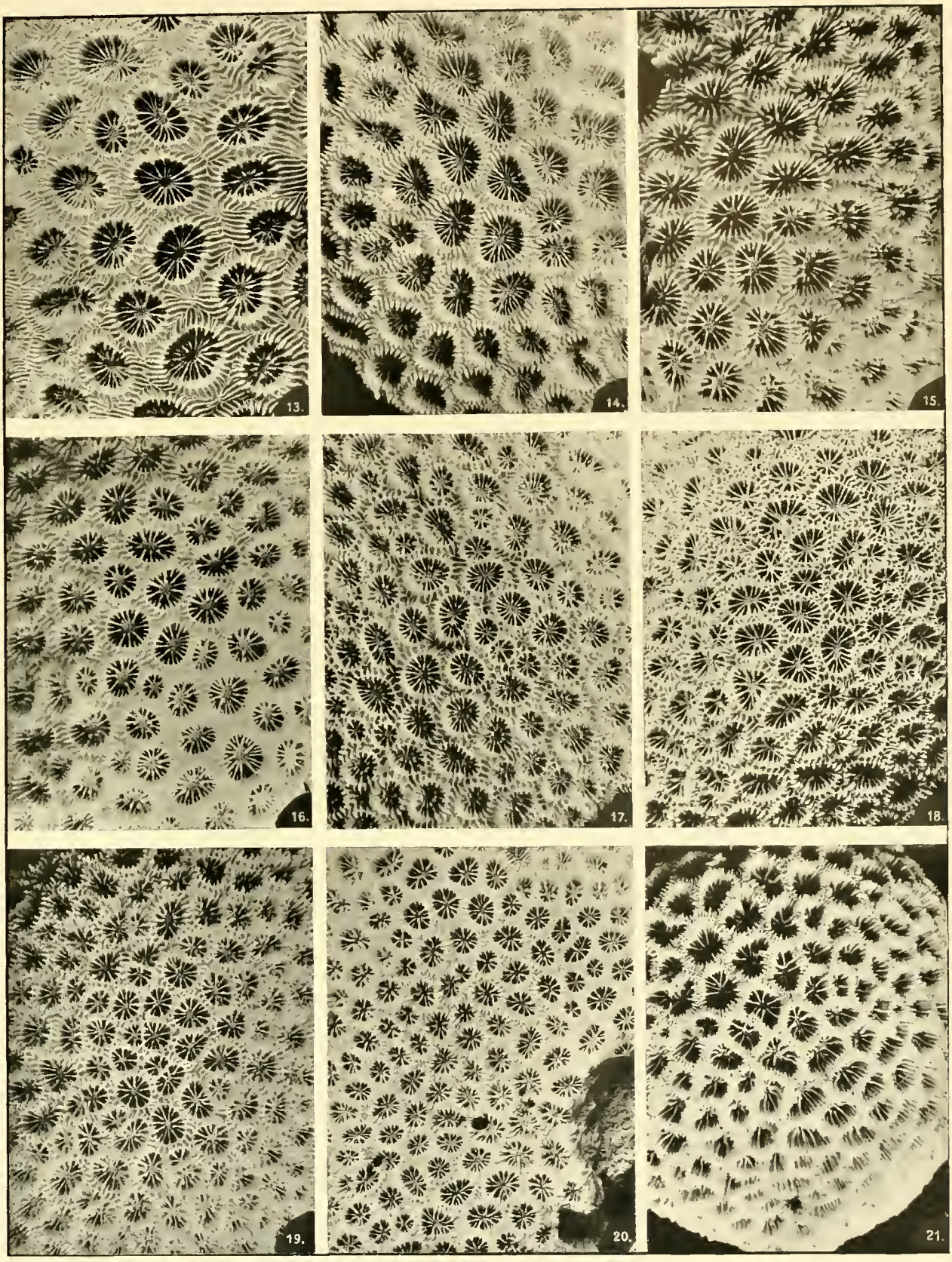
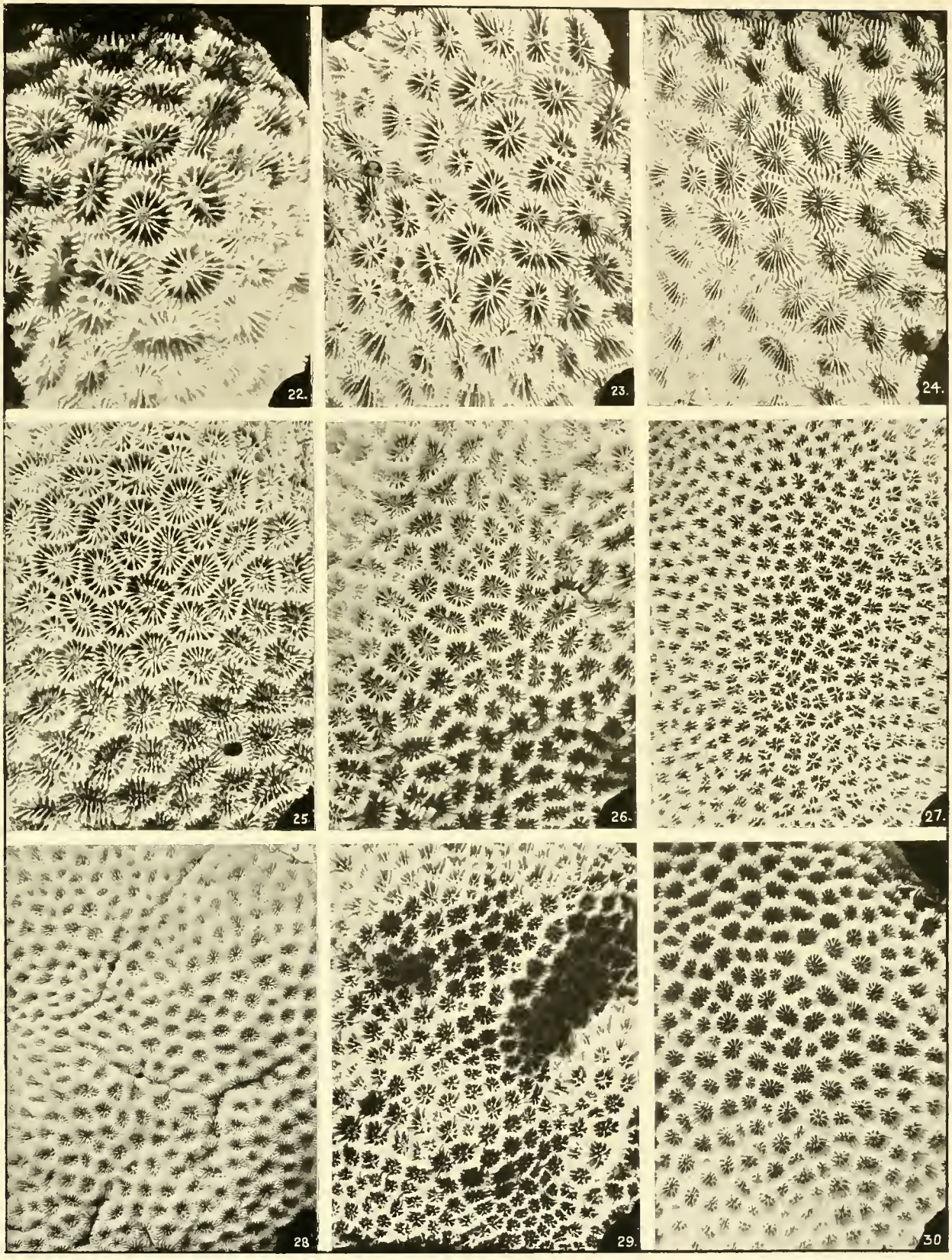


STANLEY GARDINER— —ASTRAEIDAE (III).



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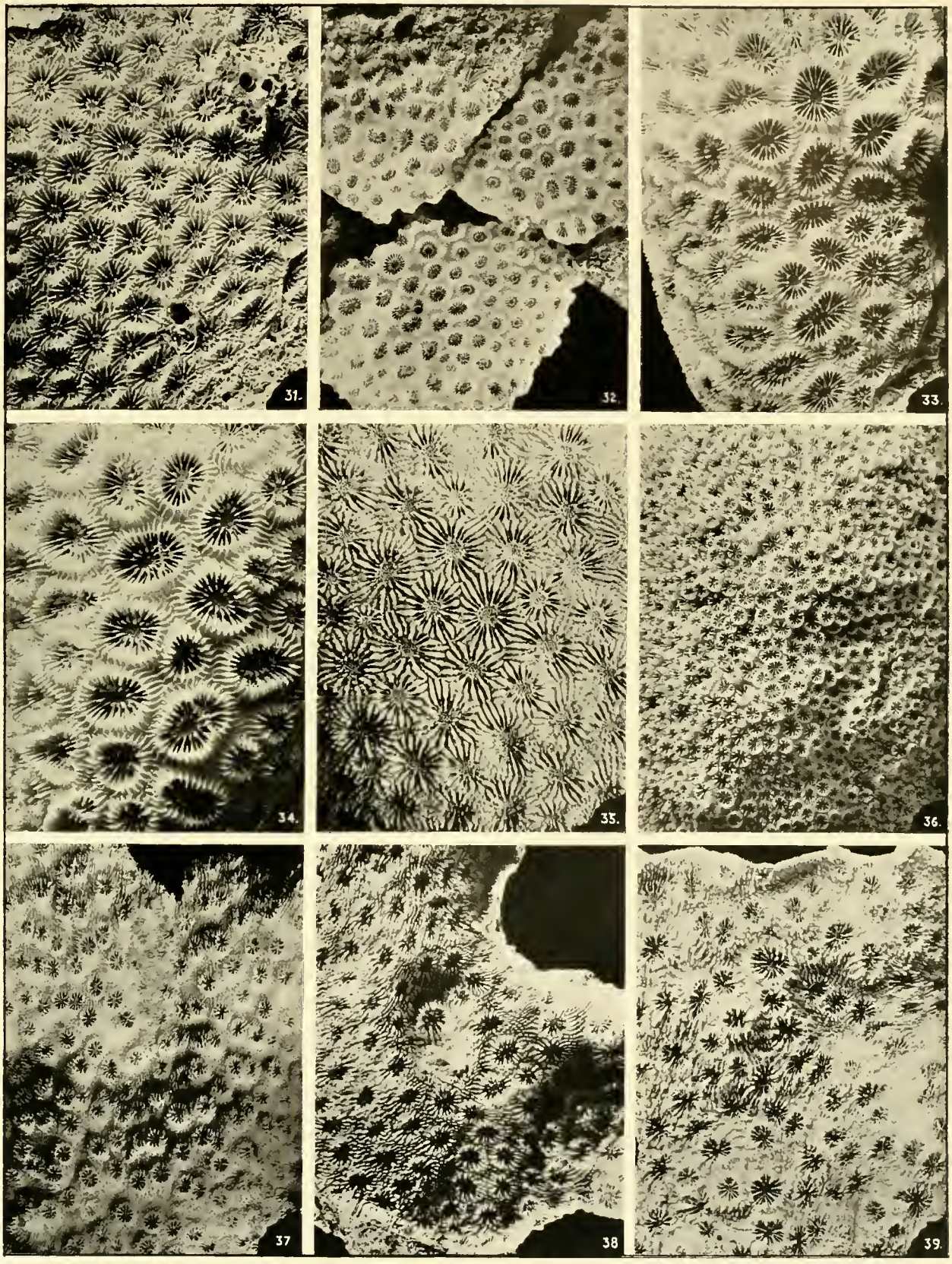
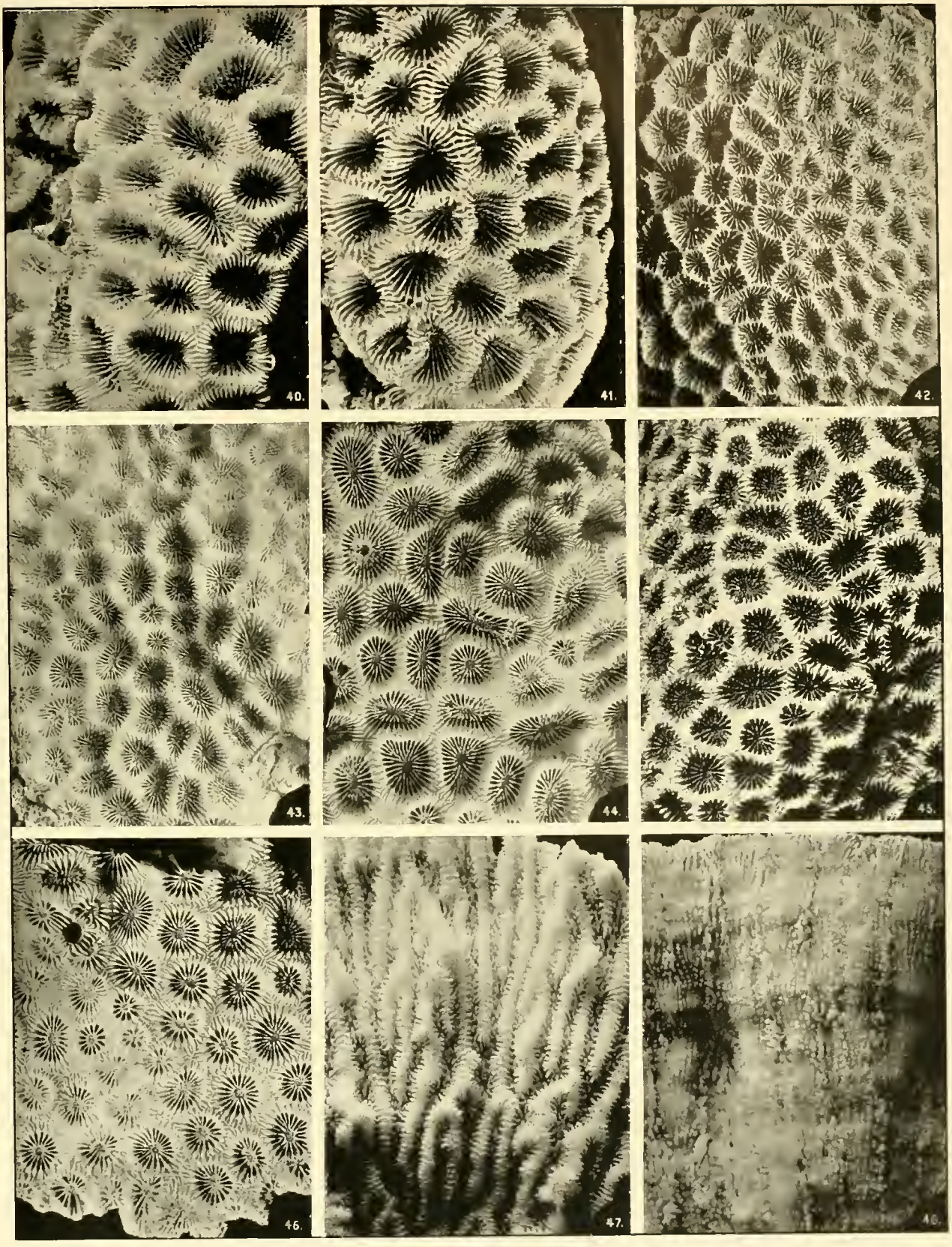


STANLEY GARDINER— ASTRAEIDAE (V).



STANLEY GARDINER——ASTRAEIDAE (VI).

ANTIPATHARIA.

By C. Forster-Cooper, M.A., *Trinity College, Cambridge.*

(With Plate LXV.)

The collection of Antipatharia obtained in the Maldive islands consists of eleven species all belonging to the subfamily Dekamerota (Schultze[1]) and to the subtribes Indivisae and Ramosae (Brook[2]).

As in many other groups of the Coelenterata, in the Antipatharia it is very difficult to decide what characters constitute a "species." In the main divisions there are characters of indisputable value sufficient to clearly mark off the subfamilies Dodekamerota, Dekamerota, and Hexamerota[3]. But, on considering the forms within some of these groups, we find not only a considerable amount of variation in the characters but also annectent forms between specimens, which might otherwise be regarded as distinct species. We are here only concerned with one subfamily, the Dekamerota, and with four of its suborders, Cirripathes, Stichopathes, Antipathes and Aphanipathes, within which all the specimens in the Maldivan collection are comprised.

The anatomy of the forms in these four groups yields us very few, if any, characters of assistance. The major anatomy is precisely similar for all of them, that is to say they have the ten mesenteries in the upper division of the coelenteron, the invariable six tentacles, and the gonads are formed in the usual way on the larger mesenteries. Further in the minute anatomy of those species which I have been able to study, this similarity is the same even

[1] Schultze, F. E., "Beit. zur System der Antipatharia." Ergebnisse einer zool. Forschungsreise von Kükenthal in *Abhandl. der Senckenberg. Naturf. Gesellsch.*, Bd xxiii. 1896.

[2] Brook, G., *Challenger Reports*, Vol. xxxii.

[3] The following is Schultze's classification which is used here.

Antipathidae (Verrill em Br.).

1. Subfamily Dodekamerota (Sch.).

12 mesenteries arise in the upper coelenteric space.

Leiopathes (Gray em Br.).

2. Subfamily Dekamerota (Sch.).

10 mesenteries arise in the upper coelenteric space.

Tribe I. Involutions of peristome wanting.

Order Crustosae.

Colonies cover foreign bodies with a crust, only the end branches being free.

Savagliopsis.

Order Indivisae.

Colony free, in the form of a simple unbranched stem.

Cirripathes,

Stichopathes.

Order Ramosae.

Colony free, branched.

Antipathes,

Aphanipathes,

Parantipathes.

Tribe II. Peristome in the form of two short involutions penetrating into the coelenteric space.

Schizopathes,

Bathypathes,

Taxipathes.

3. Subfamily Hexamerota.

6 mesenteries arise in the upper coelenteric space.

Cladopathes.

down to the distribution of the nematocysts on the tentacles, but unfortunately the preservation of many of the specimens, especially those with smaller polyps, was too bad for minute examination. The damage was probably done right at the beginning, the polyps owing to their extreme delicacy being quickly spoilt in the short time between their capture by the trawl and their preservation.

We have left then a certain number of characters on which to found our species, all of which are of a type in which we may expect, and usually find, great variation. They may be briefly summarised as follows:

1. Method of growth.
2. Colour.
3. Size of polyps, and their distribution on the corallum.
4. Shape of polyp and its tentacles.
5. Size, shape, and distribution of spines, and presence, or absence, of secondary spines.

Taken separately these characters are not of much use, for instance the growth of a colony may be easily altered by outside influences, such as currents, temperature or locality. Schultze quotes the case of *Savaglia* (*Gerardia*), which in its normal condition grows as a slender, well branched bush, a metre or more in height. In regions, however, where coral fishing is carried on, the fishing nets continually dragged over the bottom break down these tall colonies, and as a result forms of stunted growth with thick bases, sending out a large number of short branches, are found. If such a cause as this can alter the form of growth of a colony it is extremely probable that the many natural physical differences of environment, which obtain in different localities, must act in the same way and produce different forms of growth. The same author also points out that from this very reason forms, which have the same type of growth, must not of necessity be closely allied, since it may be the result of convergence due to these causes.

Of the value of colour we are in this group more or less ignorant, the only specimens obtained with a distinctive colouration being *Antipathes rubra* and *Cirripathes anguina*.

The shape of the polyp in the groups under consideration shewed too great similarity to enable any conclusion to be arrived at; all were either round or oval or both on the same corallum, but the younger polyps were frequently found to be more oval than the more fully grown ones. The height of the polyp is also so much a matter of relative contraction that too much stress must not be laid upon it. There is, however, a certain difference in absolute size between different forms, by which several groups may be roughly arranged.

There is left, then, the spines—their shape and arrangement—and here there seems to be a character of more promise. However, they will only serve to differentiate between species, there being no type of spine entirely confined to one group so as to mark off that group from all others. Also two forms differing in method of growth, size of polyp and other particulars, may yet have very similar spines, so that it is only by combining all these characteristics that we can form a working classification. Whether it will ultimately prove a natural one is doubtful.

All the figures are magnified 8 diameters unless otherwise specified. I have to thank Mr Crossland for three specimens from E. Africa.

ANTIPATHIDAE.

Subfamily **Dekamerota** Schultze.

Polyps in which ten mesenteries arise in the upper coelenteric space.

Order Indivisae Brook.

Colony free, in the form of a single unbranched stem.

Genus *Cirripathes* Blainv. em Brook.

An elongate unbranched corallum around which the polyps are distributed subspirally in several irregular rows, never in a single linear series.

1. *Cirripathes diversa* Brook. Pl. LXV. figs. 1, 1 *a*.

A small colony attached to a piece of nullipore, about 25 cm. long, subequally curled. Diameter of corallum 3 mm. at the base, tapering only very slightly to the top.

The spines are of two kinds, the primary stout, long and blunt at the end, slightly roughened and arranged in longitudinal rows, from eight to twelve rows being seen in the total circumference. The secondary spines are small and triangular, disposed quite irregularly among the larger ones.

Locality. Miladumadulu atoll, 24 *f.* Also recorded from Galle, Ceylon (Brook). Wasin island, E. Africa (coll. Crossland).

2. *Cirripathes anguina* (Dana). Pl. LXV. fig. 2.

A long sinuous unbranched stem, 40 cm. long (incomplete at basal end), greatest diameter 7 mm. tapering to the point. Corallum jet black.

Polyps dark rose pink, thus differing in colour from Dana's species in which they were green. There are six rather long tentacles. The size of the polyps varies from 2 mm. in oral diameter in the larger specimens down to small young ones 1 mm. across. The distribution of the polyps on the corallum is also irregular being generally one sixth of an inch apart; towards the top, however, they are more crowded together.

The spines are conical and equal in size, fairly stout and with a tendency to be arranged in spirals. They are, however, somewhat irregular in the lower part of the corallum. There are no secondary spines.

Locality. S. Nilandu, 30 *f.* Also from the Red Sea, Seychelles, and Ceylon.

3. *Cirripathes gardineri* n. sp. Pl. LXV. figs. 3, 3 *a*.

An incomplete stem 30 cm. long, sinuous with rough annular joints at rare intervals. Greatest diameter 3 mm. Corallum jet black.

Polyps straw yellow (in spirit). The latter are large, averaging 3 mm. high and 2 mm. in oral diameter. There is, however, variation in this respect, some being larger and some (younger intercalated polyps) being much smaller. Their distribution is all round the corallum but quite irregular as to position. The anatomy was found to be quite normal. There are six equally inserted tentacles, the two lateral ones being a little the longer.

The spines are irregularly placed, and bluntly conical with here and there a tendency to be knobbed at the end. A few exceedingly small triangular secondary spines are scattered irregularly among the larger ones.

This form is not unlike *C. anguina* in general appearance. The polyps are a good deal larger and the spines of slightly different shape; the colour is also different, a point however of very doubtful specific value. The presence of secondary spines, which are not found in *C. anguina*, is sufficient to distinguish the two forms.

Locality. Suvadiva atoll, 40 *f.*

Genus *Stichopathes* Brook.

An elongate unbranched stem with the polyps arranged on one side of the stem only.

4. *Stichopathes maldivensis* n. sp. Pl. LXV. fig. 4.

A single straight corallum 85 cm. long, tapering from 4 mm. at the base. Corallum jet black. The polyps were unfortunately in very bad condition. Enough could be made out, however, to shew that they were arranged on one side of the stem only, white in colour and with six long digitiform arms.

The spines were of two kinds, the primary ones stout, bluntly conical with rough sides and knobbed at the end. They are arranged in irregular spirals. The secondary spines are exceedingly small triangles scattered quite irregularly.

Locality. Haddumati atoll, 37 *f.*

Order Ramosae Brook.

Colony free and branched.

Genus *Antipathes* (Pall. em Schultze—*Antipathella* Brook).

5. *Antipathes spinosa* (Carter). Pl. LXV. fig. 5.

A small colony 7 cm. high, main stem erect giving off secondary branches at intervals of 2—3 mm. apart, which again bear very slender alternate pinnules.

The polyps are exceedingly small, arranged on one side of the pinnule only, white in colour.

The spines are rather long, sharp and hooked upwards, with a distinct spiral arrangement, which is somewhat obscured in places.

Locality. Hulule, 25 *f.*

6. *Antipathes chota* n. sp. Pl. LXV. figs. 6, 6 *a*, *b*.

The colony is erect and consists of a very thin black main stem, which almost immediately gives off other branches at different angles. These latter frequently are further branched. The colonies are small, the largest measuring only 8 cm. in total height.

The polyps are white, of variable size but all exceedingly minute, the average size being not more than ·75 mm. They are arranged on one side of the stem only. They are rather regularly placed at intervals of 1 mm. from one another. The tentacles are for the size of the polyp rather long.

The spines are also very minute and few in number, being conical or triangular, rather blunt and regularly arranged in spirals. About eight spines go to form a complete spiral.

Locality. This form seems to be the commonest in the Maldive islands, several specimens being obtained from different atolls. South Nilandu, 24 *f.*, North Male, 20 *f.*, 25 *f.*, and 30 *f.*, Mulaku, 30 *f.*, Felidu, 35 *f.*, Suvadiva, 37 *f.*

7. *Antipathes regularis* n. sp. Pl. LXV. figs. 7, 7 *a*.

A branch evidently torn off a larger colony. The main stem of the branch, 2 mm. in its widest diameter, is 15 cm. long. Six subsidiary branches varying from 15 to 20 cm. long are given off at irregular intervals, and these again give off long pinnules. The specimen on the whole is very sparsely branched. The corallum is black, turning to light brown in the smaller arms.

The polyps are white, placed very regularly on one side of the stem, and close together. All the full grown polyps are equal in size, but occasionally there are some young ones situated between the others.

The spines are stout, sharp, conical and hooked upwards. The arrangement is roughly eight to ten rows in straight lines. There are no secondary spines.

Locality. Fadifolu, 22 *f.*

8. *Antipathes rubra* n. sp. Pl. LXV. figs. 8, 8 *a*—*d*.

A few simple straight pinnules 10 cm. long, probably torn off a colony. The corallum and polyps are both a dark claret red.

The polyps are minute, 1 mm. in diameter, arranged on one side of the stem at regular intervals of 1 mm. The tentacles are comparatively long and digitiform.

This form obtained from several stations shews a good deal of variability especially in the arrangement of the spines. Unfortunately only small parts of the colony were brought up by the dredge on each occasion, so that the method of growth of the species remains in doubt. It appears, however, that branches are given off at an angle of 25 degrees from the stem.

The spines are of one type only but vary in size from minute conical forms pointing straight out from the stem to fairly stout sharp spines hooked and directed upwards. They are usually arranged in spirals of some regularity, but vary largely in the number of spines going to form a single spiral, and this even in the same specimen. Figures 8 *a* and *b* are from different specimens, while *c* and *d* are from different parts of a third form.

Locality. Suvadiva, 43 *f.*, 42 *f.* and 31 *f.*, Felidu, 35 *f.*, North Male, 28 *f.*

9. *Antipathes nilanduensis* n. sp.? Pl. LXV. figs. 9, 9 *a*, *b*.

Part of the corallum only, 5 cm. long, giving off sinuous branches from 4 to 7 cm. long, some of which again give off secondary branches, roughly at right angles.

Polyps of irregular size, the largest being 2 mm. across, grey in colour and with short tentacles. They are placed on one side of the corallum only.

Spines minute, conical, arranged in eight roughly straight lines, in parts with a tendency towards a spiral arrangement.

Locality. Felidu atoll, 36 *f.* and South Nilandu, 34 *f.* The South Nilandu form had rather larger polyps and the spines arranged in a more markedly spiral fashion.

10. *Antipathes pumila* Brook.

A single colony 25 cm. high, of the "bottle brush" type of growth. The specimen agrees with Brook's description in all particulars except that it is of greater size. There seems to be very little difference of any importance between this form and *A. abies*.

Locality. Kolumadulu atoll, 33 *f.*; also from Kurrachee (Brook).

Genus *Aphanipathes* Brook.

Corallum shrub-like with the branches free, or fan-like and reticulate. Spines elongate, equal or longer in the polyp areas. Polyps small and inconspicuous.

The difference between the two genera *Antipathes* and *Aphanipathes* appears to me to be founded on very slight grounds. The main point distinguishing them lies in the fact that in the latter the spines are longer in the polyp areas and penetrate into the polyps themselves. In view of the fact that in some forms of *Antipathes* the spines are irregular in size and often very variable in different parts of the corallum, it seems that too much stress must not be laid on this point of difference.

The other characters used by Brook to define the genus are also equally useless. "Polyps small and inconspicuous," "more or less oval outline," "tentacles usually very short," can all be applied to different species of the suborders *Antipathes* and *Antipathella*, the latter of which has already been merged into the former by Schultze. Probably further knowledge of the group at present under consideration will lead to the same fate.

11. *Aphanipathes plantagenista* n. sp. Pl. LXV. figs. 10, 10 *a*.

Colony of the "broom" type of growth. Two equal sized main stems 20 cm. in height giving off branches on one side of the corallum only; these again sending off irregular branches.

Polyps very small ·5 to 1 mm. in diameter, very regularly placed on one side only of the corallum at equal distances of ·5 mm.

Spines stout, sharp and triangular with a general tendency to be larger in the polyp areas and on the polyp side of the corallum. They are arranged in spirals and are not very numerous, about eight going to form one spiral.

This form is not unlike the description of *A. sarothamnoides* (Brook) but differs essentially in having smooth spines.

Locality. South Nilandu, 36 *f.*, and Felidu, 35 *f.*

EXPLANATION OF PLATE LXV.

Fig. 1. *Cirripathes diversa*, colony × $\frac{4}{5}$. *a.* Magnified to shew spines × 8.

Fig. 2. *Cirripathes anguina*, stem × 8.

Fig. 3. *Cirripathes gardineri*, part of corallum with polyps × $\frac{4}{5}$. *a.* Stem × 8.

Fig. 4. *Stichopathes maldivensis*, stem × 8.

Fig. 5. *Antipathes spinosa*, stem × 8.

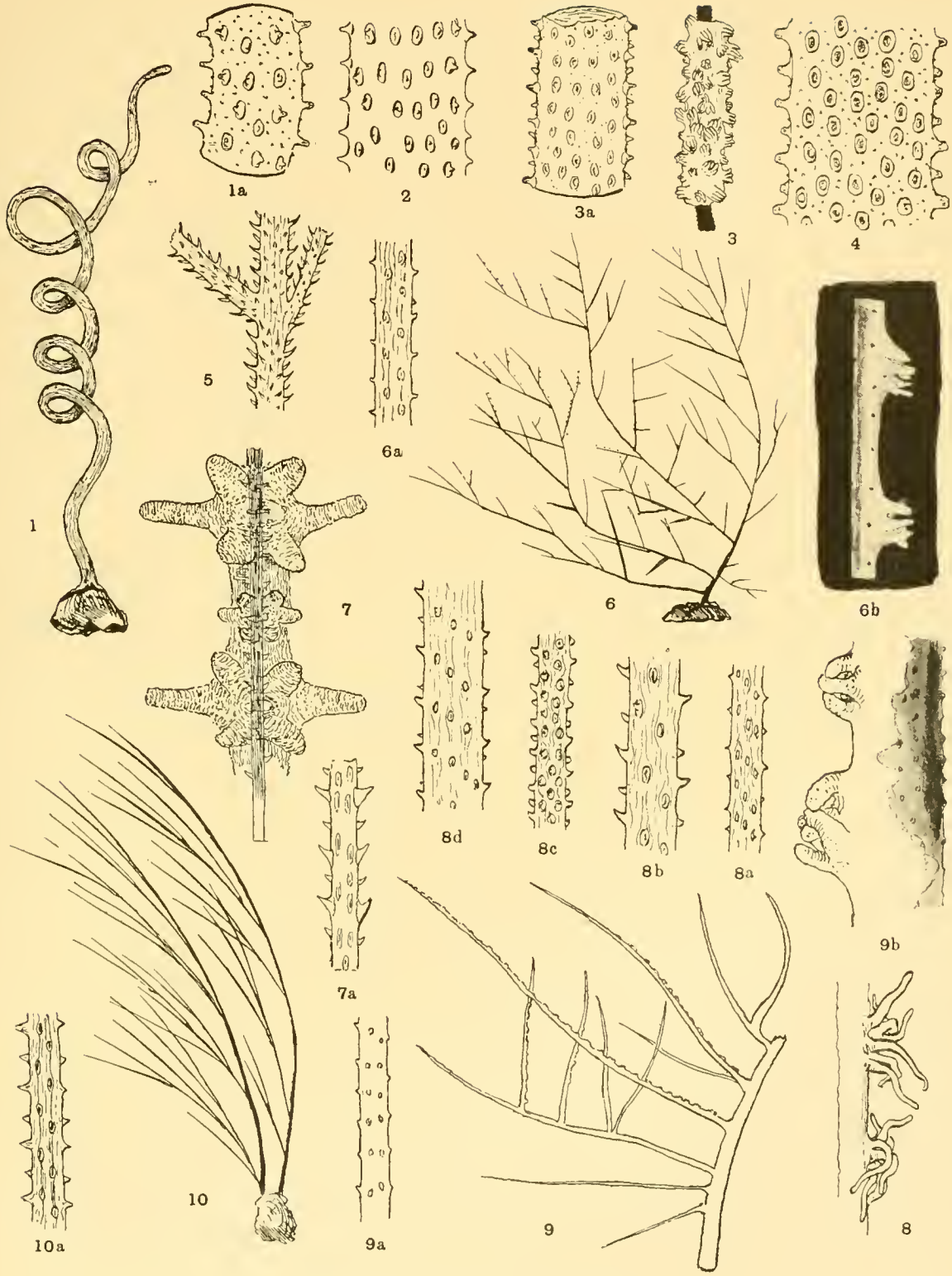
Fig. 6. *Antipathes chota*, colony × $\frac{4}{5}$. *a.* Stem × 8. *b.* Two polyps × 8.

Fig. 7. *Antipathes regularis*, stem with polyps × 8. *a.* Stem × 8.

Fig. 8. *Antipathes rubra*, two polyps near end of a branch × 8. *a*—*d.* Stems × 8.

Fig. 9. *Antipathes nilanduensis*, colony × $\frac{4}{5}$. *a.* Two polyps × 8. *b.* Stem × 8.

Fig. 10. *Aphanipathes plantagenista*, colony × $\frac{2}{5}$. *a.* Stem × 8.



FORSTER COOPER——ANTIPATHARIA.

ARACHNIDA.

By R. I. Pocock, F.Z.S., *Superintendent of the Zoological Society's Gardens, Regent's Park; late Assistant in the Zoological Department of the Natural History Museum, S. Kensington.*

(With Plate LXVI.)

INTRODUCTION.

From the proximity of the Maldives and Laccadives to the coasts of Southern India and Ceylon, coupled with the well-known distributional powers of Spiders, it might have been foretold that the Arachnid fauna of these islands would prove to be essentially similar to that of the western portions of the Oriental Region. This has been demonstrated to the full by the collection brought back by Mr Stanley Gardiner. Some of the species, such as *Isometrus europaeus*, *Heteropoda regia* and *Uloborus geniculatus* which frequent human dwellings, have doubtless been introduced by human agency; but it is probable that the ancestors of the majority of the Spiders reached these islands on floating gossamer threads, the characteristic mode of travelling of the newly hatched young of most species, of the order Araneae. The presence of only one species of Scorpion, and that a form notoriously liable to dispersal by man's instrumentality, suggests that, unless in very remote times, there has been no connection between the Archipelagoes and the mainland of India of a nature suited for the migration of purely terrestrial species from the latter to the former; and this is further borne out by the almost complete specific identity between the faunas. A few species only have been described as new; but in each case there are no strong grounds for supposing the forms to be peculiar, except perhaps the representative of the genus *Desis*. The discovery of this genus is one of the most interesting features of Mr Gardiner's work, so far as Spiders are concerned: for, as stated below, it fills an important and hitherto regrettable gap in our knowledge of the range of this curious marine Spider.

In addition to the material collected by Mr Gardiner, I have been able to examine a small collection from the Suvadiva atoll in the Maldives, which was kindly sent to me by Mr G. P. Staunton, who, undaunted by the trials and hardships incidental to an enforced residence in this atoll as the result of shipwreck, bottled some specimens of spiders and forwarded them to me upon his arrival at a civilised port.

In conclusion, I may add that Mr Gardiner has kindly allowed me to figure certain of the more important structural features, which have never been previously illustrated, of some of the commoner species—a concession which I trust will add something to the value of this paper.

Order Scorpiones.

Family **Buthidae.**

Genus *Isometrus*, Hempr. and Ehrenb.

1. *Isometrus europaeus*, Linn.

Scorpio europaeus, Linn. *Syst. Nat.* ed. 10, p. 625, 1758 (= *maculatus* De Geer and most recent authors).

Locality. Minikoi; Fainu, N. Mahlosmadulu; Hulule, Male; and Havaru Tinadu, Suvadiva. Introduced by human agency from the Oriental Region all over the tropical and subtropical parts of Asia, Africa, and America.

Order Pseudoscorpiones.

Family **Cheliferidae.**

Genus *Garypus.*

2. *Garypus maldivensis* sp. n. (Pl. LXVI. fig. 1 *a*—*e*).

Colour a tolerably uniform testaceous yellow; the carapace from the anterior border as far back as the anterior of the two transverse depressions reddish-brown, the posterior portion marked like the first tergal plate, with a broad median greyish-black stripe, and a patch of the same colour on each side; the succeeding tergal plates marked with four spots, one, frequently broken up, on each side of the middle line and one near the lateral angle: ventral surface uniformly pale except for the presence of a spot on the side of the five posterior sterna; chelicerae brownish; chelae with hands and fingers deep reddish-brown, the latter sometimes bluish at base, the remaining segments pale; legs uniformly pale.

Integument of dorsal and ventral sides covered with fine coriaceous sculpturing which under a $\frac{1}{2}$ inch objective is resolved into a pattern of minute polygonal areas; the fingers of the chelae finely but decidedly granular, and sharply marked off from the hands in that particular; hairs short, simple, delicate and sparsely distributed, longer and coarser on the extremities of the legs than elsewhere.

Carapace much longer than wide, its posterior width scarcely greater than the length from the posterior border to the anterior edges of the anterior eye; ante-ocular portion narrowed and depressed, with rounded frontal lobes and a deep but wide median depression; post-ocular area marked with two transverse depressions, the anterior of the two mesially obsolete, distinct laterally; the posterior, defining the posterior fifth of the carapace, distinct and of almost uniform depth from side to side.

Chelae long: trochanter with a broad stalk, evenly rounded in front; femur slender, not stalked, gradually incrassate; tibia shorter than femur by nearly one-fourth the length of the latter, also slender and incrassate, the posterior border lightly convex, the anterior nearly straight; hand with a definite, short, cylindrical stalk, the expanded portion oval, the inner border more strongly convex than the outer, a little shorter than the tibia; fingers long and curved, the movable digit surpassing the length of the underhand by nearly one-third of its own length.

Chelicerae with basal segments armed with four long setae (as in fig. 1 *b*): a single seta at apex of movable digit; immovable digit arcuate, with hyaline dorsal crest; flagellum of movable digit long, slender with a variable number of longer or shorter digitiform terminal processes.

Measurement in mm. Total length, 5·5 with 2·5, length of chela, 7·5.

Locality. Midu, Addu Atoll.

Judging from its geographical distribution this species will probably prove to be nearly related to *G. personatus* Simon (*Proc. Zool. Soc.* 1901, p. 79) from the Malay Peninsula. The latter, however, was based upon a much smaller example, measuring in fact only 3·5 mm. in length. Moreover the name *personatus* has already been applied by Simon to a quite distinct form from the Sandwich Islands and cannot therefore be used for the Malay species. (*Arach., Faun. Hawaiien.* II. pt. v. p. 518, 1900.)

Order ARANEAE.

Family **Barychelidae.**

Genus *Sason* Simon.

3. *Sason cinctipes* Pocock.

Œcophlœus cinctipes Pocock, *Ann. Mag. Nat. Hist.* (6), IX. p. 49, Pl. III. A, fig. 1, 1892: *Sason cinctipes*, id. *Arachnida of British India*, p. 173.

Locality. Hulule, Male.

The genus *Sason* ranges from the Seychelles to Celebes. *S. cinctipes* has been recorded from Ceylon and doubtfully from Southern India.

Family **Scytodidae.**

Genus *Scytodes* Latr.

4. *Scytodes gilva* Thor.

Dictis gilva Thor., *Ann. Mus. Genova*, XXV. p. 83, 1887.

Locality. Inguradu, N. Mahlosmadulu.

Widely distributed in the Oriental Region.

The specimens collected in the Maldives have been compared with Burmese examples determined as *S. gilva* by Thorell.

Family **Uloboridae.**

Genus *Uloborus* Latr.

5. *Uloborus geniculatus* Oliv.

Locality. Minikoi; and Midu, Addu.

A widely distributed Oriental species.

Family **Arygopidae.**

Genus *Tetragnatha* Latr.

6. *Tetragnatha foveata* Karsch (Pl. LXVI. fig. 2 *a*—*c*).

Tetragnatha foveata Karsch, *Berl. Ent. Zeits.* XXXVI. p. 289, 1892.

Locality. Minikoi; Miladumadulu Atoll; Limbo-Kandu, N. Mahlosmadulu; Goidu, Goifurfehendu; and Suvadiva Atoll.

The specimens I refer to this species agree closely with the description given by Karsch of *T. foveata*, which was based upon an example from Ceylon.

For future verification, figures of the mandibles of the male (2 *a*) and female (2 *b*) and of the palpus of the male (2 *c*) are subjoined.

Genus *Leucauge* White.

Leucauge White (= *Arygroepeira* Emerton, *Tr. Conn. Acad.* VI. p. 331, 1885).

7. *Leucauge ventralis* (Thor.) (Pl. LXVI. fig. 3 *a*—*c*).

Meta ventralis Thorell, *Ann. Mus. Genova*, X. p. 423, 1877; Pocock, *Arachnida of British India*, p. 216.

Locality. Minikoi; Ereadu and Maungudu, Miladumadulu; Limbo-Kandu, Inguradu, Fainu and Kenurus, N. Mahlosmadulu; and Hulule, Male.

This species is very abundant in the Maldive Archipelago. It was originally recorded from Celebes and subsequently from Burma, where it is common, by Thorell.

The Maldive specimens have been compared and found specifically identical with examples from Burma determined by Thorell. Since this species has never been figured, I subjoin three figures showing the essential characters of the male and female (fig. 3).

8. *Leucauge celebesiana* (Walck.).

Tetragnatha celebesiana Walck., *Ins. Apt.* II. p. 222, 1837; *Arygroepeira celebesiana*, of Thorell and other authors.

Locality. Maungudu, Miladumadulu.

This well-known species ranges from India and Ceylon eastwards, at least as far as Celebes. It is far less common in the Maldives than *L. ventralis*.

Genus *Cyclosa* Menge.

9. *Cyclosa insulana* (Costa).

Locality. Maungudu, Miladumadulu; Limbo-Kandu and Inguradu, N. Mahlosmadulu; Kumfinadu, S. Mahlosmadulu; and Hulule, Male.

This species has a wide distribution in the tropics.

Genus *Aranea* Linn.

10. *Aranea punctigera* (Dol.).

Epeira punctigera Doleschall, *Verh. Nat. Vereen Nederland Indië*, III. p. 420, 1857.

Locality. Minikoi.

This species has a wide range in the Oriental Region.

11. *Aranea theïs* Walck.

Epeira theïs, Walck., *Ins. Apt.* II. p. 53, 1837.

Locality. Hulule, Male.

As generally recognised *A. theïs* has a wide tropical distribution in the eastern hemisphere.

12. *Aranea cicatrosa* Stol.

Meta cicatrosa Stolicka, *Journ. As. Soc. Bengal*, XXXVIII. p. 242, t. XX. fig. 5, 1869.

Araneus cicatrosus Pocock, *Arachnida of British India*, p. 226, 1900.

Locality. Maungudu and Manadu, Miladumadulu; Limbo-Kandu, Bodu Faro, Inguradu and Kenurus, N. Mahlosmadulu; Kumfinadu, Madu, Kanifuri, Maduwari and Turadu, S. Mahlosmadulu; Goidu, Goifurfehendu; Hulule, Male; Suvadiva; and Midu, Addu.

Common in India, Burma and Indo- and Austro-Malaysia.

Genus *Argyope* Aud.

13. *Argyope anasuja* Thor.

Argiope anasuja Thorell, *Ann. Mus. Genov.* XXV. p. 162, 1887; Pocock, *Arachnida of British India*, p. 222, 1900.

Locality. Very common throughout the Maldive Archipelago, specimens being taken from fifteen different islands; from Ereadu in Miladumadulu to Midu, Addu Atoll.

This species has been recorded from several localities in Southern India, but has not yet been taken in Ceylon. Although abundant in the Maldive Archipelago, it was not found by Mr Gardiner in Minikoi.

Genus *Gasteracantha*, Sund.

14. *Gasteracantha brevispina* (Dol.).

Plectana brevispina, Doleschall, *Nat. Tijdschr. Nederland Indië*, XIII. p. 423, 1857.

Gasteracantha brevispina Thorell and recent authors.

Locality. Minikoi; and in the Maldive group of wide distribution, but not obtained in Suvadiva or Addu nor indeed south of Hulule, Male.

Common in Ceylon, India, Burma and eastwards thence into Austro-Malaysia.

Genus *Poltys* C. Koch.

15. *Poltys illepidus* Koch.

Poltys illepidus C. Koch, *Die Arachn.* X. p. 97, fig. 21, 1843; Pocock, *Arachnida of British India*, p. 236.

Locality. Minikoi; Inguradu, N. Mahlosmadulu; Kumfinadu, S. Mahlosmadulu; Hulule, Male; and Suvadiva. Previously recorded from Ceylon and Indo- and Austro-Malaysia.

Family **Hersiliidae.**

Genus *Hersilia* Aud.

16. *Hersilia savignyi* Lucas.

Hersilia savignyi Lucas, *Mag. Zool.* 6ème Année, cl. VIII. p. 10, t. XIII. fig. 1, 1836.

Locality. Minikoi. Common in India and Ceylon.

Family **Agelenidae.**

Genus *Desis* Walck.

17. *Desis gardineri* sp. n. (Pl. LXVI. fig. 4 *a*—*e*).

Colour. Mandibles and cephalic region of carapace mahogany-brown; rest of carapace, legs, palpi and sternum, ochre-yellow; abdomen testaceous.

Eyes of anterior line straight by their centres; medians smaller than laterals, less than a diameter apart, distance between median and lateral greater than diameter of the former, about equal to transverse diameter of the latter; eyes of posterior line subequal and subequally spaced, the medians a little farther from each other (about two diameters) than from the laterals; the inner edge of the anterior median situated in the same longitudinal line as the centre of the space between the posterior median and lateral.

Mandibles normal in form, dentition as in *D. crosslandi*, the posterior tooth of the outer row small, separated from the anterior by a space which is equal to about three or four times its own height.

Palpi and *legs* of first and second pairs unspined; 3rd leg: tibia armed with 1 dorsal, 1 anterior, 1 posterior and 2 inferior distal spines, its protarsus with 11—12 spines, its tarsus with 6 inferior spines; 4th leg: tibia armed with 2 posterior and 2 inferior apical spines; protarsus with about 14 spines; tarsus with 6.

Epigyne very like that of *D. crosslandi*, but the orifices of the receptacula seminis less circular, more oval, the paired processes farther from their anterior rims, and with their apices closer together; the terminal linguiform process slightly clavate, much less curved than in *D. crosslandi*, lying indeed nearly in the same plane as the median area of the epigyne. Total length, 8 mm.; length of carapace, 3 mm.

Locality. Minikoi. A single female example was obtained from the reef at low tide, midway between Minikoi and Wiringili Islands.

It is possible that this species may prove to be identical with *D. crosslandi*, but for the present there is not enough material of either form to settle absolutely the constancy of the differential characters pointed out between the two.

The discovery of the genus *Desis* in the Laccadives fills an important gap in our knowledge of the distribution of the genus. Up to the present time it was only known from the Indo-Australian Seas, from New Zealand up to Singapore, and on the coast of South and East Africa from Grahamstown and Natal to Zanzibar. As I have already pointed out (*P. Z. S.* 1902, p. 391), the Zanzibar form, *D. crosslandi*, in spite of its geographical isolation, conforms to the type of species prevalent in the Australian Seas and not to that which is characteristic of South Africa. And Mr Gardiner's discovery of a species of the genus half-way between Singapore and Zanzibar is strong confirmation of the suggestion already put forward that representatives of *Desis* will be found in suitable spots all along the coast of Southern Asia.

Family **Oxyopidae.**

Genus *Oxyopes* Latr.

18. *Oxyopes hindostanicus* Pocock.

Oxyopes hindostanicus Pocock, *Journ. Bombay Nat. Hist. Soc.* XIII. p. 482, 1901.

Locality. Minikoi; Inguradu, N. Mahlosmadulu; Mahrus and Turadu, S. Mahlosmadulu; and Goidu, Goifurfehendu. Common in India and Ceylon.

Family **Thomisidae.**

Genus *Thomisus* Latr.

19. *Thomisus pugilis* Stolicka (Pl. LXVI. fig. 5).

Thomisus pugilis Stolicka, *Journ. As. Soc. Bengal,* XXXVIII. p. 246, 1869.

Locality. Inguradu, N. Mahlosmadulu; Madu, Hedufuri and Turadu, S. Mahlosmadulu; and Goidu, Goifurfehendu. Widely distributed throughout India.

The pearl-like granulation of the face is very characteristic of this species.

Family **Clubionidae.**

Genus *Olios* C. Koch.

20. *Olios lamarcki* (Latr.).

Thomisus lamarckii Latreille, *Gen. Crust. et Ins.* I. p. 113, 1806.

Locality. Minikoi; Fainu, N. Mahlosmadulu; Turadu, S. Mahlosmadulu; Hulule, Male; and Midu, Addu. Previously known from Madagascar, Ceylon and Southern India.

Genus *Heteropoda* Latr.

21. *Heteropoda regia* (Fabr.) (= *H. venatoria* of most recent authors).

Locality. Minikoi; and Inguradu, N. Mahlosmadulu. This species has been artificially distributed throughout the tropics by the agency of shipping.

22. *Heteropoda atollicola* sp. n. (Pl. LXVI. fig. 6 *a*—*c*).

♀. *Colour.* Carapace yellowish-brown, marked with blackish patches, the latter clothed with blackish hair; a posterior transverse pale stripe and a large pale central spot on clypeus; mandibles black, scantily clothed with pale hairs above; legs and palpi yellowish-brown, spotted and banded with blackish-grey patches above; dorsal side of abdomen mouse-brown, mottled with blackish patches above; ventral surface testaceous; sternum and coxae ochraceous. *Carapace* a little longer than wide, its dorsal surface horizontal, as long as tibia of 2nd leg, and as femur of 3rd or 1st. Posterior median *eyes* less than a diameter apart, more than a diameter from the posterior laterals, eyes of anterior line nearly straight by their upper edges, the laterals standing only a little higher, diameter of medians a little exceeding radius of laterals, the latter rather less than their diameter above the edge of the clypeus. Legs 2, 4, 1, 3, the 2nd rather less than four times the length of the carapace, measured from the base of the femur. *Vulva* with the two lobes meeting posteriorly in the middle line and circumscribing a longitudinally elliptical area bearing a narrow median longitudinal crest (fig. 6 *c*).

♂. Like the ♀ in colour except that the *mandibles* are yellow. Smaller and with considerably longer legs. *Carapace* a little shorter than tibia of 3rd leg. *Palpus* with tibial

apophysis (fig. 6 *b*) slender, slightly sinuous, directed forwards, slightly outwards, and slightly curved over at the point; beneath it at the base there is a short but strong angular process. For structure of palpal organ see fig. 6 *a*.

Measurement in mm. ♀. Total length 15, length of carapace 6·5, of 1st leg 24, of 2nd 27, of 3rd 23, of 4th 24. ♂. Total length 10, length of carapace 5, of 1st leg 25, of 2nd 30, of 3rd 22, of 4th 24.

Locality. Minikoi; Madu, S. Mahlosmadulu; Hulule, Male; and Suvadiva Atoll.

It seems improbable that this species will prove to be peculiar to the Maldive and Laccadive Archipelagoes, but I cannot refer the specimens to any Oriental species known to me. Three Ceylonese species, however, which I have not seen, have been described by Karsch (*Berl. Ent. Zeits.* XXXVI. pp. 291—292, 1892), namely *H. umbrato, eluta,* and *subtilis*; but the details given of the tibial apophysis in each case seem to preclude the probability of *H. atollicola* being identical with either of them. It is to be hoped that the publication of the figures of the vulva and of the palpal organ will enable the question to be definitely settled when Karsch's types have been re-examined.

Family **Attidae.**

Genus *Thotmes* F. Cambr. (= *Plexippus* auct. in part).

23. *Thotmes puykulli* Aud. (Pl. LXVI. fig. 7).

Attus puykulli Aud. and recent authors.

Locality. Minikoi. A widely distributed species.

I take the opportunity of illustrating the structure of the vulva (fig. 7), which has never before been figured, I believe.

Genus *Carrhotus* Thor.

24. *Carrhotus viduus* C. L. Koch; Thor. (Pl. LXVI. fig. 8 *a*, *b*).

Carrhotus viduus Thor., *The Spiders of Burma*, p. 378, 1895.

Locality. Minikoi. This species has been previously recorded from Ceylon, Burma, and elsewhere in the Oriental Region.

Fig. 8 *a* shows the tarsus of the palp of the male from the underside and 8 *b* the tibial apophysis of the same appendage, structures which have not been hitherto figured.

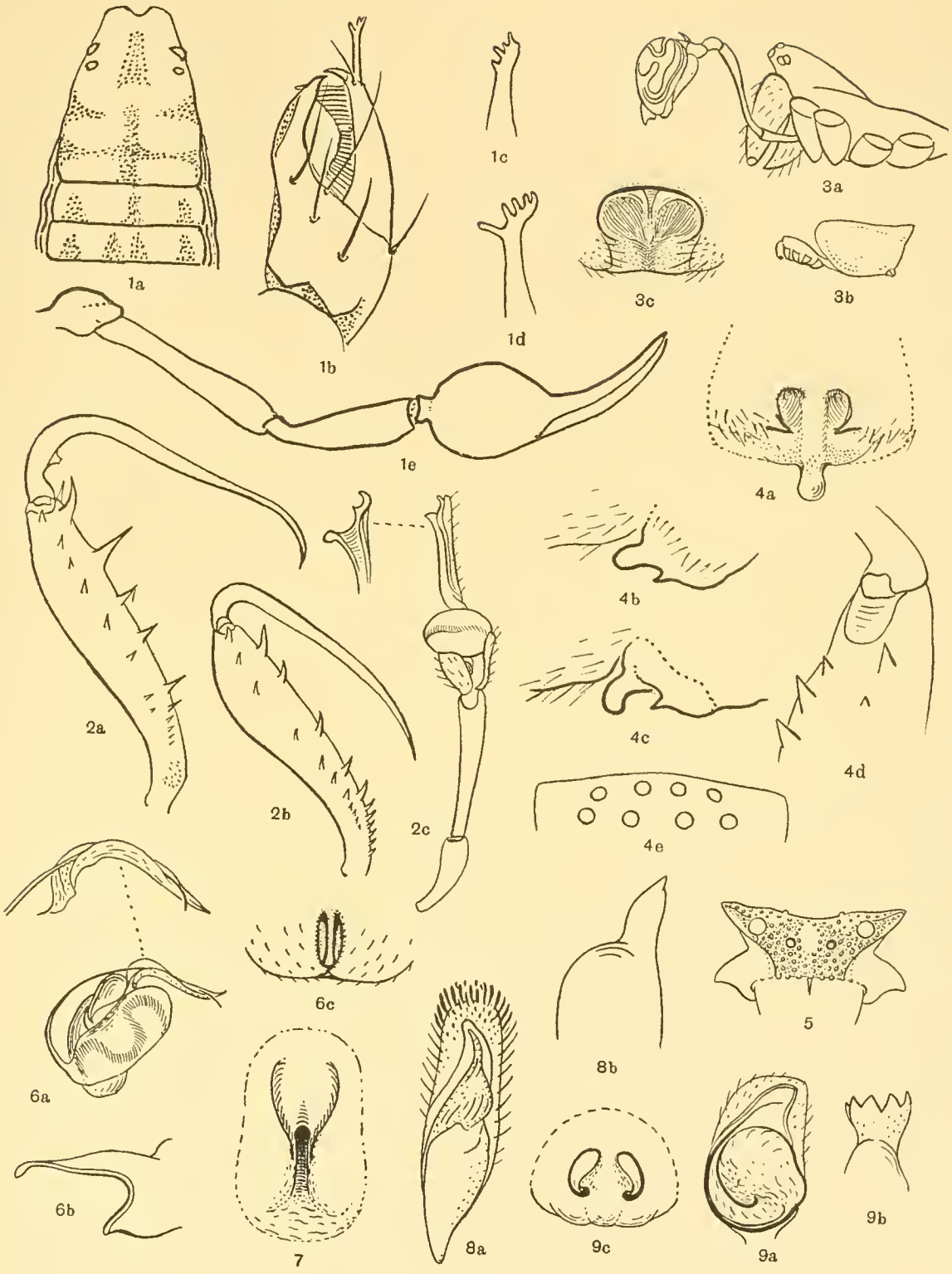
Genus *Hyllus* C. Koch.

25. *Hyllus pudicus* Thor. (Pl. LXVI. fig. 9 *a*—*c*).

Hyllus pudicus Thorell, *The Spiders of Burma*, p. 373, 1895.

Locality. Minikoi. A species hitherto recorded from Burma.

Some important specific characters of this species are shown by fig. 9 *a*—*c*.


1a
1b
1c
1d
1e
2a
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3a
3b
3c
4a
4b
4c
4d
4e
5
6a
6b
6c
7
8a
8b
9a
9b
9c

EXPLANATION OF PLATE LXVI.

FIG. 1. *Garypus maldivensis*; *a.* carapace and anterior two terga, *b.* right chelicera from above, *c.* and *d.* flagella of two specimens, *e.* right chela from above.

FIG. 2. *Tetragnatha foveata*; *a.* right mandible of male from below, *b.* right mandible of female from below, *c.* palpus of male.

FIG. 3. *Leucauge ventralis*; *a.* lateral view of cephalothorax with palpus of male, *b.* lateral view of female to show form of abdomen, *c.* vulva of female.

FIG. 4. *Desis gardineri*; *a.* vulva from below, *b.* vulva from the side, *c.* lateral view of vulva of *D. crosslandi* Poc., *d.* distal end of left mandible from below, *e.* dorsal view of ocular area.

FIG. 5. *Thomisus pugilis*; anterior aspect of the face to show ocular arrangement, granulation and distribution of black pigment.

FIG. 6. *Heteropoda atollicola*; *a.* palpal organ from beneath with a larger illustration of the distal portion of the embolus and its sheath, *b.* the tibial apophysis, *c.* vulva.

FIG. 7. *Thotmes puykulli* ♀; vulva.

FIG. 8. *Carrhotus viduus*; *a.* tarsus of palp of male from beneath, *b.* portion of tibia of same appendage with apophysis.

FIG. 9. *Hyllus pudicus*; *a.* underside of tarsus of palp of male, *b.* tibial apophysis of the same appendage, *c.* vulva of female.