With the Author's Comps

R. RATHBUN.

[DECEMBER, 1891.]

THE

SCIENTIFIC TRANSACTIONS

OF THE

ROYAL DUBLIN SOCIETY.

VOLUME IV. (SERIES II.)

XIII.

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BY PROFESSOR A. C. HADDON, 1888–1889.

ACTINIÆ. I. ZOANTHEÆ.

BY PROFESSOR ALFRED C. HADDON, M.A. (Cantab.), M.R.I.A., Professor of Zoology, Royal College of Science, Dublin; and MISS ALICE M. SHACKLETON, B.A. Plates LXI., LXII. LXIII., LXIV.

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[Read November 19, 1890.]

The following is the first instalment of an investigation on the structure and systematic relations of the Actiniæ collected by one of us in Torres Straits. We decided to publish our account of the Zoantheæ first, as it is a well circumscribed group and admits of independent treatment. We took this opportunity of studying the British forms, and have thus had a considerable number of forms under examination at the same time. This has given us a personal knowledge of every genus except Mammilifera, of which genus no authentic specimens exist in any museum.

Our account of the British Zoantheæ is simultaneously published with this as "A Revision of the British Actiniæ," Part II.: The Zoantheæ (Trans. Royal Dublin Society, vol. iv., ser. ii.); and we would refer the reader to that Memoir for a general summary of the anatomy of the group, and a special account of that of the British representatives. We have also given a classification of the Zoantheæ, and as far as is possible have allocated all the species described by other authors to their proper genera. It is impossible at the present time to monograph this group, as there is such a general sameness in external character that it makes it difficult to seize on points which are of descriptive value. The present confusion in which this group lies is mainly due to this fact; the fault is that of the animals themselves rather than that of the zoologists who have described and named them. This similarity of appearance not only affects the species of a genus, but also the species of different genera. Thus it becomes a necessity for every species to be examined anatomically by means of microscopical sections, first to determine its genus, and secondly to discover accurate specific characters. Once a species is thoroughly

known it will generally be possible to identify other specimens belonging to that species by external characters only. Owing to the incrusted nature of most of the Zoantheæ it is very difficult to get satisfactory sections, and for the same reason spirit specimens are often apt to be badly preserved for histological purposes.

It is not unfair to point out that the disorder which has occurred in this group is also partially due to the fact that many zoologists have not paid due regard to the generally recognised rules of zoological nomenclature, and have not taken the trouble to thrash out the synonymy; and some have identified certain forms with pre-existing species in a rather reckless manner.

Owing to the lack of salient external characters, which could be observed in preserved specimens, we have not been able to give diagnostic names to most of the species, and we have consequently associated them with the names of zoologists who have collected in Torres Straits, or who have studied the group. The types of the species have been given to the British Museum, in which institution will also be found a complete set of slides illustrating the anatomy of all the forms described in this and in the preceding Memoir.

CLASSIFICATION OF THE GROUP.

ZOANTHEÆ.

Actiniæ with numerous perfect and imperfect mesenteries, and two pairs of directive mesenteries, of which the sulcar are perfect and the sulcular are imperfect. A pair of mesenteries occur on each side of the sulcular directives, of which the sulcular moiety is perfect and its sulcar complement is imperfect; a similar second pair occurs in one section of the group (Brachycneminæ), or the second pair may be composed of two perfect mesenteries (Macrocneminæ). In the remaining pairs of mesenteries, of both divisions, this order is reversed, so that the perfect mesentery is sulcar and the imperfect is sulcular. The latter series of mesenteries are bilateral as regards the polyp, and arise independently (*i.e.* neither in pairs nor symmetrically on each side) in the exocœle on each side of the sulcar directives, in such a manner that the sulcular are the oldest, and the sulcar the youngest. Only the perfect mesenteries are fertile, or bear mesenterial filaments. A single sulcar œsophageal groove is present; the mesogloea of the body-wall is traversed by irregularly branching ectodermal canals, or by scattered groups of cells; the body-wall is usually incrusted with foreign particles. The polyps are generally grouped in colonies connected by a cœnenchyme, the cœlenteron of each polyp communicating with that of the other members of the colony by means of basal endodermal canals.

Family. ZOANTHIDÆ, Dana, 1846.

(With the definition of the group.)

Sub-family. BRACHYCNEMINÆ, Hadd. & Shackl., 1891.

Zoantheæ in which the sulcar element of the primitive sulco-lateral pair of mesenteries (cnemes) is imperfect:—

GENERA OF THE BRACHYCNEMINÆ.

ZOANTHUS,	Lamarck, 1801.
ISAURUS,	Gray, 1828.
(? MAMMILLIFERA,	Lesueur, 1817. (Not represented in Torres Straits).)
GEMMARIA,	Duchassaing et Michelotti, 1860.
PALYTHOA,	Lamouroux, 1816.
SPHENOPUS,	Steenstrup, 1856.

Sub-family. MACROCNEMINÆ, Hadd. & Shackl., 1891.

Zoantheæ in which the sulcar element of the primitive sulco-lateral pair of mesenteries (cnemes) is perfect:—

GENERA OF THE MACROCNEMINÆ.

EPIZOANTHUS,	Gray, 1867. (Not represented in Torres Straits).
PARAZOANTHUS,	Haddon & Shackleton, 1891.

Sub-family. BRACHYCNEMINÆ.

ZOANTHUS, Lamarck, 1801.

ZOANTHUS, Cuvier, 1817.

ZOANTHUS (RHYZANTHUS), Andres, 1884.

Brachycnemic Zoantheæ with a double mesoglœal sphincter muscle. The body-wall is unincrusted; the ectoderm is usually discontinuous; a well developed ectodermal canal system in the mesoglœa. Dicœcious or monœcious. Polyps connected by a thin cœnenchyme.

Cuvier (1798) was the first to recognise some distinction between the Zoantheæ and other Actiniæ, but in an indefinite sort of way; he refers to "1. Le zoanthe à cinq pétales (*Actin. dianthus*); 2. Le zoanthe à drageons (*Actin. sociata*)."

Lamarck (Système, 1801) first divided the Actinæ into the genera Actinia and Zoantha; he says (1801, p. 363): "II^e. genre. Zoanthe, Zoantha—*Zoantha sociata*, *Act. sociata*, Sol. et Ellis, *Hydra sociata*, Gmel."

Bosc (1802, p. 261) refers to "Zoanthe, Zoantha, Lam.; *Z. ellisii; Hydra sociata; Act. sociata*, S. & Ell."

Cuvier, in 1817 (p. 53), speaks of *Zoanthus sociatus*.

In Deshayes and Milne-Edwards' revised and augmented edition of Lamarck's Hist. des anim. sans vert. (1836, 2nd ed., p. 77), three species are acknowledged: "Zoanthe (Zoantha).—1. *Zoantha ellisii*, Bosc (*Act. sociata*, etc.); 2. *Zoantha solanderi*, Les.; 3. *Zoantha bertholetii*, Ehr."

Dana is the only later author who adheres to Zoantha instead of Zoanthus. According to the generally accepted rules of zoological nomenclature the Greek ανθος would have to be written *anthus*, it being agreed that, "in writing zoological names, the rules of Latin orthography must be adhered to."

TORRES STRAITS SPECIES OF THE GENUS ZOANTHUS.

Z. coppingeri, n. sp.
Z. jukesii, n. sp.
Z. macgillivrayi, n. sp.

Zoanthus coppingeri, n. sp.

(Pl. LXI., figs. 1, 2; Pl. LXII., fig. 1; Pl. LXIV., figs. 1–4.)

Form.—Body smooth, pyriform when contracted, rather elongated when expanded. Polyps in clusters, the buds springing from the bases of the polyps themselves; cœnenchyme, thin, encrusting. Tentacles, in two rows, similar.

Colour.—Pinkish below, greenish or bright green above, sometimes entirely pinkish; always with brown streak-like spots; disc, burnt sienna, with darker spots; rim of mouth, brown; tentacles, gray, with a single row of black spots; there is a black spot between each tentacle, and these are continued as black lines on the capitulum.

Dimensions.—Length of a contracted specimen, 15 mm.; diameter of upper portion, 5 mm.

Locality.—Fringing Reef, Mabuiag. Oct. 19, 1888. Numerous specimens.

We have named this species in honour of Dr. Coppinger, who, when surgeon on board H.M.S. "Alert," collected some marine zoological specimens from Torres Straits.*

Body-wall (Pls. LXII., LXIV.).—The wall of the column is bounded externally by a distinct cuticle. Between this cuticle and the ectoderm lies a thin peripheral layer of mesoglœa, the "subcuticula" of Andres and M^c^Murrich. The ectoderm forms an almost continuous layer, but is crossed by numerous delicate strands of mesoglœa, which unite to form the peripheral layer. In addition to the ordinary columnar cells, nematocysts of an oval shape are present. Numerous branching and anastomosing canals arise from the ectoderm, and run through the mesoglœa, generally in a radial direction. They vary greatly in size. Sometimes they run along close to the endoderm, but we have never observed any connexion with it. Many of these canals pass into the mesenteries, where they form large sinuses. Nematocysts, similar to those in the ectoderm, are found in these canals. The mesoglœa, which constitutes the chief thickness of the body-wall, is homogeneous and clear, and is permeated by the usual minute cells, which are drawn into fine protoplasmic strands. These have a radial direction, and extend right across the mesoglœa, from endoderm to ectoderm. The endoderm is crowded with zooxanthellæ. There is a slight diffuse endodermal muscle.

Capitulum.—The ectoderm becomes continuous in the capitulum, and in contracted specimens is thrown into deep folds. Nematocysts are very numerous.

Sphincter muscle.—The double sphincter muscle is a powerful one, the upper portion being slightly shorter than the lower one (Pl. LXIV., fig. 3). It consists of numerous irregularly shaped cavities, the mesoglœa being arranged in complicated plaitings.

Tentacles (Pl. LXIV., fig. 2).—The ectoderm of the tentacles is normal and ciliated. The nuclei form a distinct central band in section. Outside the band are numerous, small, thin nematocysts, whilst between the band of nuclei and the mesoglœa small irregular cells may be discerned, which are probably nerve cells. There is a diffuse ectodermal muscular layer. The fibres, which are longitudinal in direction, are supported on simple plaitings of mesoglœa. The mesoglœa forms a thin layer without canals or enclosures of cells. The endoderm, which is crowded with zooxanthellæ, is very thick, so that the lumen of the tentacles is almost obliterated. Nematocysts, similar to those found in the capitulum and other parts of the ectoderm, are abundant in the endoderm of the tentacles. The endodermal muscle fibres are circular in direction.

* See "Report on the Zoological Collections made in the Indo-Pacific Ocean during the Voyage of H. M. S. 'Alert,' 1881–1882" (1884).

Disc.—The structure of the disc is very similar to that of the tentacles, but we have not found nematocysts in the endoderm of this region.

Œsophagus.—The ectoderm of the œsophagus forms a simple layer. The groove is visible, although not very well marked. The mesoglœa is extremely thin, and of uniform thickness.

Mesenteries.—The arrangement of the mesenteries is brachycnemic. They are coiled and folded, almost entirely filling up the body-cavity. The ectoderm of the œsophagus is reflected upwards and continued downwards into the mesenterial filaments, forming numerous folds along each mesentery (Pl. LXIV., fig. 4), in a manner which will be more fully described in our account of *Z. macgillivrayi*. The mesoglœa is extremely thin in the upper part of the mesentery, although thicker in the immediate neighbourhood of the wall, where it usually contains a "basal" canal. Lower down the mesoglœa is thicker throughout, and here the canal expands to form the large sinus, which, as we have previously mentioned, is connected with the ectodermal canal system of the body-wall (Pl. LXII., fig. 1). The endoderm of the mesenteries forms a deeper layer than that of the body-wall, and zooxanthellæ, though present, are not nearly so numerous. The nuclei of the columnar cells form a peripheral band, leaving a clear space next to the mesoglœa. Nematocysts are also to be found in the endoderm of this region. The parieto-basilar muscle is diffuse and feebly developed. The longitudinal muscle fibres are also very feeble, being scarcely discernible. There is no special thickening of the endoderm in the lower part of the mesenterial filaments as in *Z. macgillivrayi*.

Gonads.—The sexes are distinct. We have sections of both male and female specimens (Pl. LXIV., figs. 3, 4). The gonads appear to be distributed on the mesenteries in irregular rows.

Zoanthus jukesii, n. sp.

(Pl. LXI., figs. 3–5; Pl. LXII., fig. 2; Pl. LXIII., fig. 1.)

Form.—Body short and thick; body-wall smooth and delicate; cœnenchyme forming stolons: tentacles in two cycles of about 20–24 in each.

Colour.—Body and stolon translucent gray, the endoderm shining through with a brown tint (owing to the presence of zooxanthellæ); capitulum pink, with 24 dark lines; disc brown, with, usually, pairs of pale lines (mesenteries) for inner cycle of tentacles; mouth with greenish lip; œsophagus gray. Tentacles: inner cycle green, with dark rings or marks on the oral aspect; outer cycle opaque pale pink; all the tentacles with a dark spot at the tip; the base of the tentacles of the outer cycle is in some specimens tinged with green.

Dimensions.—Height 7–12 mm.; diameter of disc, 6 mm.

Locality.—Fringing Reef, Mer (Murray Islands), Jan. 29, 1889. Numerous specimens.

We associate this species with the name of the late Prof. Beete Jukes, at one time Professor of Geology in the Royal College of Science, Dublin, who was also the author of the interesting Voyage of the "Fly."* To this day the name of this genial naturalist is still remembered in the Murray Islands and in Erub.

Body-wall (Pl. LXII., fig. 2).—A cuticle and peripheral mesoglœa are present as in *Z. coppingeri.* The cells of the ectoderm are not distinct but appear to have become fused, as in the specimen of *Z. sociatus*, described by M'Murrich (1889A, p. 63). For the most part they appear to form a quite continuous and narrow layer, but in some parts the contents of the cells, adhering closely to the mesoglœa on either side, leave an empty space, across which, irregularly placed and exceedingly delicate strands of mesoglœa are seen to pass. Anastomosing canals, connected with the ectoderm, are present, though not at all so numerous as in *Z. coppingeri.* Lacunæ, clearly of similar origin, but completely surrounded by the mesoglœa, are more frequently to be met with. The canals and lacunæ are most abundant in the lower part of the column, and here their connexion with the basal canals of the mesenteries can be demonstrated (Pl. LXII., fig. 2). The mesoglœa is of the usual character. Zooxanthellæ also abound in the endoderm of this species. There is a diffuse endodermal muscular layer, supported by acute mesogleal prominences.

Capitulum.—The ectoderm of the capitulum is thrown into folds, as in *Z. coppingeri*, and rather opaque oval cells, with a clear outline (probably nematocysts, are here very numerous, being generally embedded singly in in the mesoglœa.

Sphincter muscle.—The sphincter muscle is not so strongly developed as in *Z. coppingeri.* Of the two parts of the muscle the upper one is in this case the longer. The muscle cavities are larger and less filled up with cells, the plaitings of the mesoglœa being simpler than in *Z. coppingeri.*

Disc and tentacles.—The ectoderm of the disc and tentacles closely resembles that described for *Z. coppingeri.* The endoderm is crowded with zooxanthellæ, but contains no nematocysts.

The ectoderm of the œsophagus is thrown into slight folds. The groove is well marked (Pl. LXIII., fig. 1).

Mesenteries (Pl. LXIII., fig. 1).—The arrangement of the mesenteries is of the usual brachycnemic type. The reflected ectoderm of the œsophagus forms a smaller

* Narrative of the Surveying Voyage of H. M. S. "Fly," commanded by Captain F. P. Blackwood, R.N. (during the years 1842–1846). 1847. By J. Beete Jukes.

number of folds than in the last species described. The mesenterial filaments also appear shorter in transverse section. The mesoglœa is thicker throughout, and usually contains more than one canal in each mesentery.

These canals appear to run from the base of the mesenteries to the œsophageal region. Near the base they appear to be connected with ectodermal spaces in the body-wall. The endoderm of the mesenteries is very similar to that of the body-wall.

The longitudinal muscles are better developed than in *Z. coppingeri*, the mesoglœa being thrown into slight plaitings to support the fibres. The parieto-basal fibres, though distinct, are rarely supported by plaitings.

Gonads.—The sexes appear to be distinct in this species also. All the specimens examined by us containing mature reproductive organs were female. The gonads are irregularly arranged as in *Z. coppingeri*.

This species somewhat resembles the preceding one; spirit specimens can be distinguished externally by the following characters:—*Z. coppingeri* is larger; markedly pyriform when contracted, and the brown spots persist (for at least three years).

Zoanthus macgillivrayi, n. sp.

(Pl. LXI., fig. 6; Pl. LXII., fig. 3; Pl. LXIII., fig. 2; Pl. LXIV., figs. 5–8).

Form.—Body smooth, transversely wrinkled, with a thick cuticle, upper part of column slightly swollen, disc large; tentacles small, 32 in number, in two cycles; mouth very small. The capitulum in expanded specimens exhibits two encircling grooves, which indicate the double sphincter muscle, cœnenchyme forming a flattened stolon.

Colour.—Not determined when alive; yellowish in alcohol.

Dimensions.—Height of large specimens, 18 mm.; average diameter of colour, 3 mm.; diameter of disc, 6.5 mm.

Locality.—Fringing reef, Mabuiag, Sept. 21, 1888. Six specimens.

We acknowledge in the specific name we have given to this species the zoological labours in Australasia of the late J. Macgillivray, author of the valuable "Voyage of the Rattlesnake."*

Body-wall.—The wall of the upper part of the column is comparatively thin. Lower down it is much thicker. The cuticle is thick, and foreign bodies,

* Narrative of the Voyage of H. M. S. "Rattlesnake," commanded by the late Captain Owen Stanley, R.N., F.R.S., during the years 1846–1850 (1852).

foraminifera, diatoms, &c., are occasionally to be found embedded in it, and in the peripheral layer of mesoglœa. The latter can be very distinctly seen in this species. As in *Z. jukesii* the cells of the ectoderm appear to have become fused, and crossing strands of mesoglœa can only be seen in those few places where the ectodermal space is nearly empty. Anastomosing ectodermal canals, very similar to those found in *Z. coppingeri*, run through the mesoglœa and are connected with the basal canals of the mesenteries near the union of the column with the cœnenchyme (Pl. LXII., fig. 3). The surface of the column is thrown into numerous folds, which appear in cross-section as deep ectodermal bays lined with cuticle.

Sphincter muscle.—The sphincter muscle is somewhat similar to that in *Z. jukesii*, the upper being the longer of the two parts (Pl. LXIV., fig. 5). The cavities are simpler than in *Z. coppingeri*, but they are not so large as in *Z. jukesii*.

Disc and tentacles.—The structure of the disc and tentacles is very similar to that of the preceding species. There are no nematocysts in the endoderm.

Œsophagus.—There is a well marked œsophageal groove.

Mesenteries.—Of the two specimens which we have cut transversely, one shows the usual brachycnemic arrangements. In the other there are four imperfect mesenteries at the sulcular side of the œsophagus, instead of the usual pair of imperfect directives. The reflected œsophageal ectoderm and the structure of the mesenterial filaments can be well studied in this species. As can be seen in a longitudinal section, such as that figured (Pl. LXIV., fig. 5), the ectoderm of the œsophagus passes continuously on to the mesentery, where it suddenly becomes greatly thickened, and is thrown into transverse folds, the whole thickening having a crescentic form, first curving upwards and then downwards, losing itself, in the mesenterial filament. The ectoderm is reflected on both sides of every one of the perfect mesenteries, presenting in transverse section a characteristic pinnate appearance (Pl. LXIV., fig. 6). As above mentioned, the reflected ectoderm passes gradually into the mesenterial filament, the characteristic V shape of the latter (Pl. LXIV., fig. 7) being continuous with the peripheral folds of the former. The lateral elements of the mesenterial filaments gradually become shorter, so that as it descends only the median portion is left. Numerous nematocysts are found in this lower portion of the filament (Pl. LXIV., fig. 8). In this species the mesenterial filaments are confined to the upper part of the column, gradually disappearing about the middle of the column. As the filaments disappear the mesenteries also become much narrower (appearing in transverse section to shorten), projecting but a little way into the cœlenteron (Pl. LXIII., fig. 2). Lower down they again widen and project further, finally uniting in the centre at the base of the polyps to form the cœlenteric canals of the stolon (Pl. LXII., fig. 3). The mesoglœa of the mesenteries is well developed, especially near the base.

Canals are present from the œsophageal region downwards, frequently two or three in the perfect mesenteries. These canals are connected with the canals of the body-wall at the base of the column. Nematocysts are numerous in the endoderm of the mesenteries. The longitudinal muscle fibres form a simple layer, the parieto-basal muscles are better developed and supported upon slightly branched plaits of mesoglœa.

Gonads.—No gonads were present in the specimens we examined.

This species cannot be mistaken for either of the two previously described.

ISAURUS, Gray, 1828.

Antinedia, Duch. & Mich., 1866.

Polythoa (Monothoa) (pars), Andres, 1884.

Zoanthus (Monanthus) (pars), Andres, 1884.

Large brachycnemic Zoantheæ with a single mesoglœal sphincter muscle. The body-wall is unincrusted; the ectoderm discontinuous; ectodermal and endodermal bays and small canals in the mesoglœa. Monœcious or dicœcious. Polyps in small clusters or solitary.

The genus Isaurus was established by J. E. Gray in 1828 (Spic. Zool., 1828, p. 8) to include a species not before described, specimens of which from an unknown locality were in the British Museum. He named this species *Isaurus tuberculatus* on account of the tubercles on its surface. The name Isaurus is a Latinized version of Isaure, a name applied by Savigny (Description de l'Egypte, Polypes, pl. 2, figs. 1–4, 1811, ined.) to four species figured by him in 1811, and supposed by Gray to be of the same genus as his *I. tuberculatus*. Savigny published, however, neither the characters of the genus nor descriptions of the species. Lamouroux mentions the genus as Isaura, but neither does he define it in any way.

The genus Isaurus must therefore be regarded as Gray's, and *Isaurus tuberculatus* as the type species.

In 1860 Duchassaing and Michelotti found specimens at St. Thomas and Guadaloupe, which closely agreed with Gray's account of *Isaurus tuberculatus*. Although unaware of the existence of Gray's species, they gave to their specimens the same specific name, calling them *Zoanthus tuberculatus*, and subsequently in 1864 (forming for the species a new genus), *Antinedia tuberculata*. Andres considered that Gray's *I. tuberculatus*, and Duchassaing and Michelotti's *A. tuberculata*, were distinct species, and consequently renamed the latter *A. duchassaingi*.

In 1889 M^{c}Murrich described specimens from the Bermudas, evidently belonging to Gray's species and also agreeing closely with *A. tuberculata*, Duch. & Mich., which he considers to be identical with it. Anatomical examination of these specimens showed that they possessed most of the characters which Erdmann has ascribed to the genus Mammillifera. M^{c}Murrich therefore identified his specimens as *Mammillifera tuberculata* (Gray).

From Erdmann's Paper, however, we cannot find that he has sufficient reasons for concluding that the characters attributed by him to Mammillifera are possessed by any of the species for which that genus was erected by Lesueur in 1817. The specimens found by Erdmann in the museum at Bonn, from which he deduced these generic characters, were not referred to any species.

The generic name Mammillifera was adopted in 1817 by Lesueur for two species from the West Indies, named by him *M. auricula* and *M. nymphæa*. His definition of the genus is "A large cuticular expansion serving as a base for numerous animals, which, when contracted, assume the form of mammæ" (p. 178). From the dimensions given by Erdmann for his unnamed specimen, it seems possible that it agrees to some extent with this description, but the same might be said of *Zoanthus jukesii ;* whilst both Gray's *I. tuberculatus* and our *I. asymmetricus* entirely disagree with it in outward form. It therefore appears that it is impossible to determine the true characters of the genus Mammillifera until the type species *M. auricula* has been recovered and submitted to anatomical examination. Until this is done we must therefore retain the name Isaurus for those species which undoubtedly belong to the same genus as *I. tuberculatus* and *I. asymmetricus.*

Although, as above stated, Gray instituted the genus Isaurus for *I. tuberculatus*, we find that in 1867 (P. Z. S., p. 234) he erects a new genus, Pales, for a closely allied form. In his "Solitary, rarely irregularly aggregate" division of the "*Zoanthi malacodermi*, or soft-skinned Zoanthi, or Zoanthinæ," he recognises three genera: "Isaurus, Gray, Spic. Zool., 8, 1825 [the copy we have seen is dated 1828] ? Orinia, Duchassaing and Michelotti, Mém. Coral. des Antilles, 54. Pales [which he defines thus]—Body cylindrical, isolated, solitary, clustered, or sometimes proliferous, but each specimen having a separate base; outer skin smooth, thin, olive-brown, slightly concentrically wrinkled; the tentacles numerous, the internal laminæ numerous, slender, only slightly elevated, straight and parallel above, with a thickened edge, and sinuous below. *Pales cliftoni* (fig. 1, p. 236)—Hab. Western Australia (Mr. Clifton). The bodies are from $\frac{1}{3}$ to $\frac{1}{2}$ inch in diameter; but they vary greatly in length, some being as much as 2 inches long; but the general length [in spirits] seems to be about an inch. . . . . They are found attached to shells, both isolated and in clusters, and the larger ones are attached to the base of each other, forming a somewhat stellate cluster, as if they were free, floating in the sea."

It seems probable that the two genera are coterminous, and, if so, *I. cliftoni* will rank as a second Australian species of Isaurus.

In 1877 Andres described (p. 226) a new genus and species, *Panceria spongiosum* from Port Natal; but in 1884 (p. 315) he abandoned the genus, and re-named it *Polythoa* (*Monothoa*) *spongiosa*. We regard this as belonging to the genus under discussion.

TORRES STRAITS SPECIES OF THE GENUS ISAURUS.

I. asymmetricus, n. sp.

Isaurus asymmetricus, n. sp.

(Pl. LXI., figs. 7–9; Pl. LXII., fig. 4; Pl. LXIII., figs. 4–6; Pl. LXIV., fig. 9.)

Form.—Body elongated; upper portion of column, in retracted specimens, with usually four rather irregular longitudinal rows of tubercles, arranged in such a manner that there is a longitudinal area free from them. In some specimens there are intermediate tubercles, which may even form one or two rows. Young specimens are entirely smooth. The smooth side is somewhat shorter than the tuberculated, so that the body bends over to the former, and the introverted mouth is rarely terminal. The contracted capitulum exhibits radiating furrows from 18 in number upwards.

The polyps grow either singly or in small clusters. In the latter case there is a common, firm, fleshy, incrusting cœnenchyme, occasionally forming stolons, from which new buds arise.

Colour.—Whitish below, passing into brownish above; the darker portion is variously mottled with cream, or greenish cream, and occasionally diversified with darker spots; the tubercles are somewhat pinkish in colour.

Dimensions.—Average size of retracted specimens, 45 mm. in length; greatest diameter, 7 mm. The longest specimen measured 56 mm. in length when retracted.

Locality.—Torres Straits; on fringing reef between tides, Mabuiag, Oct., 1888, numerous specimens; 15–20 fathoms, between reefs, Murray Islands, Jan. 5, 1889, two specimens.

The specific name is derived from the marked asymmetry of the polyp. It is undoubtedly nearly allied to the *Mammillifera tuberculata* of M^{c}Murrich (1889, p. 117). The specific differences are the lesser number and greater size of the tubercles, though their diameter is about the same, and their asymmetrical arrangement; the height of our species is about double that of the West Indian form.

Our deeper water specimen was shorter and relatively much more tuberculated. In the "Special volume of the Proceedings of the Geographical Society of Australasia" (Sydney, 1885), under a section designated as "New Guinea Exploration," there is a letter from Dr. J. W. Haacke, concerning a collection of Anthozoa from Thursday Island, Torres Straits, in which he refers to "a species belonging probably to a new genus closely allied to the genera Polythoa and Zoanthus. This genus would be characterized by showing, even externally, a very obvious bilateral symmetry, better, I believe, than any other Anthozoon" (p. 225). There is no doubt that this is our new species.

We have copied Gray's account of the other Australian representative in our account of the genus, the absence of tubercles readily distinguishes it from our species. The same also holds good for the Port Natal species, *I. spongiosa.*

Body-wall (Pl. LXII., fig. 4).—The thick body-wall is covered by a cuticle as in the species of Zoanthus described. The ectoderm is not continuous, but is broken up into fairly uniform groups of cells by well developed strands of mesoglœa, which connect the peripheral with the general mesoglœa (Pl. LXIII., fig. 6). Amongst the ordinary columnar cells of the ectoderm are to be found numerous zooxanthellæ, as well as occasional large nematocysts. Bays of ectoderm, in which the cuticle may to a greater or less extent be involved, often occur. Canals and lacunæ of much smaller diameter than the anastomising canals which occur in the species of Zoanthus we have described, are also present. Some of these can be shown to be continuous with the ectoderm, whilst others have an equally clear connexion with the endoderm (Pl. LXIII., fig. 5). Endodermal bays, which may be quite shallow, or may extend to a greater or less extent into the mesoglœa as large open canals, are not unfrequent (Pl. LXII., fig. 4; Pl. LXIV., fig. 9). Occasionally these are slightly branched. A few nematocysts, smaller than those found in the ectoderm, as well as zooxanthellæ, are present in the endoderm. The endodermal muscular layer is well developed.

Sphincter muscle.—The single mesoglœal sphincter muscle is extremely thick and powerful. The cavities are well filled with muscle cells (Pl. LXIII., fig. 4).

Capitulum.—The cuticle and peripheral layer of mesoglœa, as well as the strands of mesoglœa which break up the ectoderm, are present in that part of the capitulum, which in contracted specimens is thrown into folds, but the cuticle disappears, and the ectoderm becomes continuous as the tentacles are approached.

Disc and tentacles.—The usual small nematocysts are found in the outer part of the ectoderm of the tentacles. The nuclei do not form a distinct central band, but are diffused, leaving, however, a clear band next to the muscle fibres. The ectodermal muscular layer is remarkably well developed. The fibres are supported on fine and complicated mesoglœal plaitings, forming in some cases a band nearly equal to one-third of the entire thickness of the wall of the tentacle.

In some places these plaitings appear to unite to form a distinct band of mesoglœa, outside the muscle fibres, so that here the muscle may be regarded as mesoglœal. The endodermal muscular layer is well developed, especially at the bases of the mesenteries, but it is not at all so remarkable as is that of the ectoderm. The endoderm, as well as mesoglœa, is relatively thin in the tentacles. The endoderm contains numerous zooxanthellæ.

Œsophagus.—The ectoderm of the œsophagus is thrown into slight and irregular folds. The groove is only indicated by a slight depression in the region of the sulcar directives. Both mesoglœa and endoderm form very thin layers. Nematocysts are present in the endoderm similar to those found in the endoderm of the mesenteries and column in this region.

Mesenteries.—The arrangement of the mesenteries is brachycnemic. The imperfect mesenteries are well developed, sometimes extending about half way from the body-wall to the œsophagus (Pl. LXIV., fig. 9). The ectoderm of the œsophagus is reflected a short way above the lower opening of the œsophagus, and forms the mesenterial filaments in the usual way. The mesoglœa of the mesenteries is comparatively well developed even in the œsophageal region, but it becomes much thicker as it descends. Several canals run vertically through each mesentery. Some of those appear to be connected in the cœnenchyme with the endoderm (Pl. LXIII., fig. 5). It is possible that others are connected with ectodermal canals or lacunæ, but we have not been able to trace any to the ectoderm. The endoderm of the mesenteries is very similar to that of the body-wall. It contains numerous small oval nematocysts. The muscles are fairly well developed. The mesoglœa on each side of the mesentery, close to the body-wall, is thrown into numerous and often branching plaits, which support the fibres of the parieto-basilar muscle (Pl. LXIV., fig. 9). On one side of each mesentery the mesoglœa is thrown into very slight plaits all the way up. These plaits support the longitudinal fibres. On the other side, the parieto-basilar fibres (cut obliquely in transverse section) extend considerably beyond the mesoglœal plaitings. In the imperfect mesenteries the mesoglœal plaitings extend the whole way on both sides, and it is hardly possible to distinguish two distinct sets of fibres.

Gonads.—In only one of our specimens did we find gonads. These were all female; but they were few and not fully developed. We cannot say with certainty whether this species is monœcious or diœcious, though our evidence leads us to suppose it to be the latter.

Gemmaria, Duch. & Mich., 1860.

Solitary brachycnemic Zoantheæ with mesoglœal sphincter muscle. The body-wall is incrusted with grains of sand and spicules. The ectoderm is usually

discontinuous, but may be continuous. Lacunæ and cell-islets are found in the mesoglœa. Dicœcious.

This genus was recovered by M°Murrich (1889), who identified a Zoanthid from the Bermudas as *Gemmaria rusei*, Duch. & Mich. (p. 124), and in a previously written, but subsequently published, Paper (1889A, p. 65), he describes *G. isolata*, n. sp., from the Bahamas. We are able to extend the geographical distribution of the genus, and at the same time give ourselves the pleasure of associating one of our new species with the name of our esteemed colleague, Prof. J. Playfair M°Murrich, of Haverford College, Pa., U. S. A., to whom we have so often referred in these pages.

Besides the type species, *G. rusei*, from St. Thomas, Duchassaing and Michelotti (1860) describe *G. clavata*, Duch. (St. Thomas and Guadeloupe), *G. swiftii*, D. & M. (St. Thomas), and *G. brevis*, Duch. (Antilles).

In 1866 they state that "perhaps *G. swiftii* may be better placed in the genus Bergia." From the figure (1860, pl. viii., pp. 17 and 18) it appears to closely resemble a Sarcodictyon, but in the later Memoir the authors state that it has 24 biserial tentacles. It is certain that this is not a synonym for *Parazoanthus axinellæ*, as Andres suggests (1884, p. 311). Anyhow it is clear that these authors had no very definite conception of their own genus, for neither *G. swiftii* nor *G. brevis* would appear to belong to the same genus as the type species, nor is it certain that *G. clavata* does either.

It is difficult to understand why Andres (1884, p. 318) has regarded *G. brevis* as a synonym of two or three species of Epizoanthus. Gray (1867, p. 238) has added to the confusion by placing *Z. sulcatus*, Gosse, in this genus; but it is probable as M°Murrich suggests, that *Triga philippinensis*, Gray (1867, p. 239), may belong to the genus in question. Gray's description of the genus Triga:—"The coral sub-cylindrical, solitary, attached, with a rather expanded base; outer coat coriaceous, sandy, concentrically wrinkled"; and of the type species:—"Coral sub-cylindrical, clavate, rather narrowed near the base, concentrically wrinkled; end convex, obscurely radiately striated; hab. Philippines, attached to small pebbles (*Cuming*). The coral varies from an inch to an inch and a-half in length"—agrees very well, except for size, with our new species; but without microscopical examination it would be impossible to determine with certainty even the genus of Gray's species.

The only known species of this genus are *G. rusei*, D. & M., *G. isolata*, M°M., *G. macmurrichi*, n. sp., and *G. mutuki*, n. sp.

TORRES STRAITS SPECIES OF THE GENUS GEMMARIA.

G. macmurrichi, n. sp.
G. mutuki, n. sp.

Gemmaria macmurrichi, n. sp.

(Pl. LXI., fig. 11; Pl. LXIII., fig. 7.)

Form.—Erect, rigid, wider above than below; upper portion of contracted specimen with minute radiating corrugations.

Colour.—Sandy.

Dimensions.—Height, 13 mm.; diameter, 3·5 mm. above, 2 mm. below.

Locality.—Channel between Mer and Dauar, Murray Islands. 20 fathoms. Mar. 16, 1889. One specimen only.

Body-wall (Pl. LXIII., fig. 7).—The ectoderm is discontinuous, being broken up by thick, irregular strands of mesoglœa, which unite to form a distinct peripheral layer lying beneath the cuticle. The ectodermal cells are for the most part disintegrated in our specimen, their contents adhering to the surrounding mesoglœa and leaving an empty space in the centre. The incrustations consist chiefly of coarse grains of calcareous sand, but a few silicious sponge spicules are also present, and are left after decalcification. Beneath the incrustations lies an encircling sinus, which is, however, so much interrupted by the mesoglœa as to appear in horizontal section as a circular series of lacunæ, each lacuna lying immediately below the union of a mesentery with the body-wall, two or three lacunæ being occasionally united by a fine canal. As the base of the polyps is approached the lacunæ gradually become smaller and finally disappear. It thus appears that the body-wall is pierced by a number of canals, which run vertically upwards from near the base to the disc of the polyps; these canals being occasionally connected with each other by much finer crossing canals. Similar fine canals are occasionally to be found running from the vertical canals outwards towards the ectoderm. Cell islets are scattered abundantly through the mesoglœa, as also are single cells elongated into delicate fibrils connected both with endoderm and mesoglœa, such as we have described in other species of Zoantheæ. Large lacunæ, densely filled with deeply staining granules, are numerous at the base of the polyp. These are clearly connected with the mesenterial canals which arise in this region. They seem to be of ectodermal origin. The endoderm which lines the column is not very well preserved, but it appears to form a regular layer of medium thickness. The muscular layer is well developed in the upper part of the column. Lower down it is weaker.

Sphincter muscle.—The sphincter muscle is single, mesoglœal, and is well developed.

Disc and tentacles.—Unlike the two species of Gemmaria described by M'Murrich, the ectoderm of the disc and tentacles contains no zooxanthellæ, nor have we observed them in the endoderm either. The ectodermal muscular layer is fairly

well developed in our specimen, whilst in his it is very weak (1889, p. 124). Cell enclosures (similar to those described and figured by M°Murrich) are found in the disc of *G. macmurrichi*. Foreign bodies are occasionally found embedded in the mesoglœa of this region.

Œsophagus.—The tissues of the œsophagus are badly preserved in our specimen. There is a slight thickening of the mesoglœa at the groove, but we are unable to give further particulars.

Mesenteries.—The mesenteries are arranged as in other Brachycneminæ. The mesoglœa is well developed in both imperfect and perfect mesenteries. The muscular layer appears to be feebly developed, the mesoglœal plaitings not being well marked. A vertical canal runs through each mesentery, from the base of the polyps to the disc; in many cases it appears to divide, giving rise to two or more canals in the œsophageal region. The reflected ectoderm and the filaments are so badly preserved that it is impossible to make out the particulars of their arrangement. The endoderm of the mesenteries is very similar to that which lines the body-wall.

Gonads.—There were no gonads in our specimen.

This species can easily be distinguished anatomically from the two species investigated by M°Murrich, but externally they appear to be very similar.

Gemmaria mutuki, n. sp.

(Pl. LXI., fig. 10.)

Form.—Erect, wider above than below; upper portion of retracted specimens with a large number (24–30) of fine radial ridges, which are continued some way down the column; lower portion of column wrinkled in spirit specimens. Basal gemmation occurs.

Colour.—Grayish-white in spirit.

Dimensions.—Height, 10–12 mm.; average diameter, 4.5 mm.

Locality.—Mabuiag, 6th October, 1888; 5 specimens.

We have named this species after a local hero, Mūtūk by name, whose adventures are recorded in the Journal of the Folk-lore Society, "Folk-lore," I., 1890, p. 56.

Body-wall (fig. 1, p. 690).—The ectoderm is continuous, and is covered by a thin cuticle to which numerous diatoms adhere. Occasional zooxanthellæ are to be found in the ectoderm. The mesoglœa is rather thin relatively to the diameter of the polyp. Numerous incrustations are embedded in the mesoglœa. They are chiefly spicular; ascidian as well as sponge spicules being frequently found. Grains of sand are

also present. Cell enclosures consisting for the most part of lacunæ are very numerous in the mesoglœa. There is no regular series of canals or of lacunæ lying at the union of each mesentery with the body-wall, such as we have described for *G. macmurrichi*. In some parts of the wall, the lacunæ lie so close together beneath the incrustations, as to suggest an interrupted encircling sinus; but for the most part they are irregularly scattered through the mesoglœa. Zooxanthellæ are found in many of these lacunæ. The endoderm forms a uniform layer of moderate thickness in which zooxanthellæ are very numerous. The muscular layer is well developed.

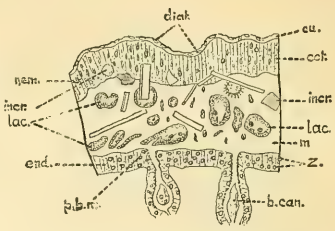


Fig. 1.—*Gemmaria mutuki*. Transverse section of body-wall.

Sphincter muscle.—The usual single mesoglœal sphincter muscle is present.

Disc and tentacles.—As in the body-wall, zooxanthellæ are present in both ectoderm and endoderm in this species, though they are much less abundant in the former than in the latter layer. The ectodermal muscular layer is rather weak. In both these features it will be seen that *G. mutuki* differs from *G. macmurrichi*, and resembles M^{c}Murrich's two West Indian species. The mesoglœa of the disc in this species also contains cell enclosures.

Œsophagus.—The groove is well marked, and of the truncated form described and figured by M^{c}Murrich for *G. isolata* (1889 A, p. 66, Pl. IV., fig. 20).

Mesenteries.—The mesenteries have the usual brachycnemic arrangement. The mesoglœa is fairly well developed; the musculature is rather weak. Each mesentery contains a single basal canal, which does not divide in the œsophageal region as in *G. macmurrichi*, but runs up vertically from the base of the polyp almost to the disc. The tissues in the lower part of the cœlenteron in our specimen are unfortunately not sufficiently well preserved for us to give details regarding the mesenterial filaments.

Gonads.—Numerous ripe sperm cells are present in the cœlenteron of the specimen cut by us.

Externally this species may be distinguished from *G. macmurrichi* by its shorter, more stumpy form. Anatomically it differs from *G. macmurrichi* in the presence of numerous zooxanthellæ, in the continuous ectoderm, and in various other points, which will be seen by comparing our description of the two species. Outwardly, *G. mutuki* may also be readily distinguished from the two West Indian species, but in several anatomical points, referred to above, it seems to agree more nearly with them than with *G. macmurrichi*.

PALYTHOA, Lamx., 1816.

Corticifera, Lesueur, 1817.
Mammillifera (pars), Blainville, 1830.
Polythoa, Andres, 1884.
Polythoa (Corticithoa), Andres, 1884.

Brachycnemic Zoantheæ with a single mesoglœal sphincter muscle. The body-wall is incrusted. The ectoderm is continuous (?); the mesoglœa contains numerous lacunæ, and occasionally canals. Dicœcious. Polyps immersed in a thick cœnenchyme, which forms a massive expansion.

The genus Palythoa was founded by Lamouroux (**1816**, p. 359) for the reception of two species which had previously been described and figured by Ellis and Solander as *Alcyonium mammillosum* and *A. ocellatum* (**1786**, pp. 179, 180, Pl. I., figs. 4–6). Palythoa is thus defined by Lamouroux :—"Polypier en plaque étendue, couverte de mamelons nombreux, cylindriques, de plus d'un centimètre de hauteur, réunis entre eux; les cavités ou cellules isolées, presque cloisonnées longitudinalement et ne contenant qu'un seul polype."

Palythoa mammillosa is evidently regarded by Lamouroux as the type species of the genus. He reproduces Solander's figure of this species, but not that of *P. ocellata*, of which he merely gives a description. Unfortunately a Latinized version of the French name "Palythoé Etoillée," given by Lamouroux to *P. mammillosa*, has been added at the bottom of his plate—a circumstance which has given rise to some confusion.

In 1817 Lesueur, being evidently unacquainted with Lamouroux's work, erected the genus Corticifera for two West Indian species which he named *C. glareola* and *C. flava*. These species are evidently very nearly allied to *P. mammillosum* and *P. ocellata:* indeed Lesueur queries whether *C. flava* is not synonymous with *Alcyonium ocellatum*, Ellis and Sol.; and his definition of the genus Corticifera agrees very nearly with that of Lamouroux for Palythoa.

Subsequent naturalists have, with very few exceptions, recognized the priority of Lamouroux's genus, and have applied the name Palythoa to all those Zoantheæ which are incrusted with sand, and are immersed to a greater or less extent in the cœnenchyme, forming corticiferous expansions. In this sense Verrill used the term in 1869, and Hertwig in 1882 adopted the same classification.

Unfortunately the genus Palythoa has also been occasionally extended to include Zoantheæ which are incrusted with sand, but which are united only at the bases, forms which are included in the genus Epizoanthus, as defined by Verrill (**1869**, p. 437). Amongst the species to which the name Palythoa was thus mistakenly applied was a form with ribbon-like cœnenchyme and exsert polyps, described by Schmidt as *P. axinellæ* (**1862**, p. 61).

In 1885 Erdmann, investigating the anatomy of a number of forms which, to judge from their outward characters, should all be relegated to the genus Epizoanthus, discovered that, in reality, they belonged to two distinct natural genera, distinguished by the circumstance that some of them possessed a single mesoglœal sphincter muscle, whilst in others the sphincter was endodermal. Amongst the latter was Schmidt's species *P. axinellæ*. Those species which possessed a mesoglœal sphincter muscle Erdmann retained in the genus Epizoanthus. Those which had an endodermal sphincter, he placed in the genus Palythoa, ignoring *P. mammillosa*, and adopting *P. axinellæ* as typical of the genus, thereby excluding the type species, as well as numerous closely allied forms which had hitherto borne the name *Palythoa*.

It was now necessary to find another name for these forms, and Erdmann consequently revived Lesueur's genus Corticifera, a genus which, as we have pointed out above, was synonymous with Palythoa, but had to give place to that genus on the grounds of priority. To the former definition of the genus Corticifera Erdmann added certain anatomical characters—namely, the "microtypal" (brachycnemic) arrangement of the mesenteries and the presence of a single mesoglœa sphincter muscle. These anatomical characters have been shown to be present in all the species recently investigated which are included in Lamouroux's Palythoa and in Lesueur's Corticifera, including the type species *C. glareola* (re-examined by M'Murrich, 1889, p. 122). It therefore appears that they all belong to one and the same morphological genus, which, as we have shown, must, according to the laws of priority, be known as Palythoa. To sum up, the argument may be briefly stated as follows:—Palythoa, Lamx. = Corticifera, Les. = Palythoa, Verrill, &c. Schmidt and others extended Palythoa to include *P. axinellæ* and similar species, thus, unconsciously, making the genus Palythoa both macro- and brachycnemic.

Erdmann restricted the genus Palythoa to the non-typical macrocnemic extension, and revived Corticifera for the typical brachycnemic species. We restore Lamouroux's genus, discard Corticifera, and erect a new genus, Parazoanthus, for *P. axinellæ* and allied species.

As regards *P. mammillosa*, the type species of Palythoa, we may say that we are strongly inclined to regard *C. lutea* of Hertwig (1888, p. 44, Pl. I., fig. 6) as being synonymous with *P. mammillosa*. M'Murrich agrees with us in regarding Hertwig's identification of his West Indian form with Quoy and Gaimard's *Mammillifera lutea*, from the Fiji Islands, as doubtful in the extreme; but he is inclined to believe Hertwig's species to be identical with *C. glareola*, which he describes (1889, p. 122). However this may be, we feel quite justified in assuming that the anatomical characters of *P. mammillosa* are similar to those of all the other species possessed of similar outward characters, which have been anatomically examined.

TORRES STRAITS SPECIES OF THE GENUS PALYTHOA.

P. howesii, n. sp.
P. kochii, n. sp.
P. cæsia (?), Dana.

Palythoa howesii, n. sp.

(Pl. LXI., fig. 13; Pl. LXIII., fig. 8.)

Form.—Polyps scarcely projecting above the surface of the cœnenchyme when contracted, and then, in most cases, only the one side is prominent; in other words, the side is almost invariably entirely sunk. Cœnenchyme, thick, incrusting. The polyps are arranged in indefinite, roughly parallel rows. Owing to the partial immersion of the polyps the prominent portions of contiguous polyps have a tendency to form zigzag lines. The whole surface is very rigid and rough, owing to the incrustation of sandy particles.

Colour.—Sandy.

Dimensions.—Average diameter of polyps, 7 mm.

Locality.—Fringing reef, Thursday Island. One colony.

Named after Prof. G. B. Howes, of the Royal College of Science, London. [I would like to take this opportunity of acknowledging the assistance which my friend Professor Howes has rendered me from first to last in the storing and distribution of my Torres Straits collections.—A. C. H.]

Body-wall (Pl. LXIII., fig. 8).—As in other species of Palythoa, the body-wall and cœnenchyme are indistinguishable. The ectoderm which covers the surface of the colony is much torn, fragments of it alone adhering to the mesoglœa; these pieces are further broken by irregular projections of the mesoglœa, which somewhat resemble the mesoglœal strands found in various other species of Zoantheæ, but they do not appear to unite in this case to form a peripheral layer of mesoglœa. In most cases no cuticle is to be seen, but in one or two places we have found a thin cuticle, and it seems probable that in a normal condition such a cuticle covers the surface of the ectoderm. The mesoglœa is very thick, and the incrustations are chiefly found in the outer portion. The incrustations consist of coarse grains of sand, and are very numerous. Lacunæ, some of which are clearly connected with the ectoderm, are scattered through the mesoglœa. In some cases

the canals in the mesenteries, which are extremely well marked, are distinctly connected with the spaces in the body-wall. Large yellowish nematocysts are present in the outer ectoderm, in many of the lacunæ of the mesoglœa, and in the mesenteric canals, being especially numerous in the latter. A very few zooxanthellæ are also present. Besides the lacunæ, numerous isolated cells are enclosed in the mesoglœa, many of them being drawn out into the fine protoplasmic threads found in other species of Zoantheæ. The endoderm is granular, of uniform thickness, and contains occasional zooxanthellæ. The usual diffuse muscular layer is present.

Sphincter muscle.—The single mesoglœal sphincter muscle is well developed.

Disc and tentacles.—The ectoderm is thick, and in the tentacles the ectodermal muscular layer is well developed, the mesoglœal folds being complicated and branching. The mesoglœa also forms a thick layer and often contains cell enclosures. The endoderm is very thin.

Œsophagus.—The ectoderm of the œsophagus was not well preserved in our specimens, so that it was not possible to determine its nature or arrangement in a normal condition. There is a well marked groove, and the mesoglœa, which elsewhere is thin, becomes much thickened in this region.

Mesenteries.—The mesenteries present the usual microcnemic arrangement. The imperfect mesenteries are usually well developed. The ectoderm of the œsophagus appears to be reflected in the usual manner, but owing to its bad preservation it is not possible to determine the exact nature of its arrangement. The mesoglœa is well developed, and in each mesentery it contains one or more sinuses or canals which extend throughout the entire height of the mesentery. These sinuses contain numbers of large nematocysts, similar to those found in the ectoderm of the body-wall. The muscles of the mesenteries are not strongly developed. They form almost simple layers.

Gonads.—The sexes are distinct; we found female, but no male gonads, in several of the polyps which we examined. They were all taken from the same colony.

Palythoa kochii, n. sp.

(Pl. LXI., fig. 12; Pl. LXIII., fig. 9.)

Form.—Polyps projecting slightly above the surface of the cœnenchyme; cœnenchyme incrusting, of moderate thickness. Polyps so crowded as to usually have a polygonal contour. The whole surface is incrusted with calcareous particles, etc. Twenty capitular ridges and furrows. Tentacles, 40. Mouth large.

Colour.—Colour of colony, finely speckled buff and cream, each polyp demarcated by a pale border; tentacles similar, but translucent. Disc thin, translucent,

the dark interval cavity shining through; very finely dotted with brown and opaque white. Œsophagus gray, furrowed. Capitular ridges whiter than the rest of the polyp.

Dimensions.—Diameter of polyps about 5 mm.

Locality.—Fringing reefs, Thursday Island, and Mabuiag.

This species is named in honour of our distinguished German colleague, who was the first to discover the precise arrangement of the mesenteries in the Zoantheæ.

Body-wall (Pl. LXIII., fig. 9).—As in the last species the body-wall and cœnenchyme may be regarded as one. The ectoderm, where present, is continuous, and is covered by a thin cuticle. Incrustations, consisting of spicules and grains of sand (the latter being for the most part less coarse than those found in *P. howesii*), form a dense border at the union of the ectoderm with the mesoglœa. They are scattered more sparingly through the deeper parts of the mesoglœa. Lacunæ, canals, and cell islets are found throughout the mesoglœa. Nematocysts are present in both the ectoderm and the lacunæ. Zooxanthellæ are also found in the ectoderm and lacunæ, as well as in the endoderm. The endodermal muscle is well developed. The endoderm forms a uniformly thin layer.

Sphincter muscle.—The mesoglœal sphincter is long and well developed.

Disc and tentacles.—The structure of the disc and tentacles is very similar to that found in *P. howesii.*

Œsophagus—The ectoderm of the œsophagus is not well preserved, but it appears to be thrown into well marked folds. There is a very slight groove, and no appreciable thickening of the mesoglœa in this region.

Mesenteries.—The mesenteries are arranged as in other Brachycneminæ. The imperfect mesenteries are well developed. The reflected ectoderm is not well preserved, but is evidently arranged in the ordinary manner. Sinuses, similar to those found in *P. howesii*, are found in the mesenteries of this species also. The muscular layers are very simple, there being apparently no mesoglœal plaitings.

Gonads.—We found male gonads in several of our specimens, but no female organs were present.

Palythoa cœsia (?), Dana.

(Pl. LXI., fig. 14.)

Palythoa cœsia:

Dana, 1846, Zoophytes, U. S. Exploring Expedition, p. 40. pl. xxx., figs. 3, 3*a*. Milne Edwards, 1857, Hist. Nat. Coralliaires, I., p. 305. Andres, 1884, Le Attinie, p. 332.

Form.—Polyps slightly projecting above the surface of the cœnenchyme when contracted. Cœnenchyme incrusting in small, ovoid, concavo-convex masses of

moderate thickness. Polyps large, not crowded, of rounded contour. The whole surface is incrusted with calcareous particles. About twenty capitular ridges.

Colour.—Grayish-white in spirit specimens.

Dimensions.—Diameter of polyps about 9 mm. The colonies in the specimens before us average about 50 cm. by 40 cm.

Locality.—Reefs, Torres Straits.

We have doubtfully referred this species to *P. cœsia*, which was collected by the United States Exploring Expedition at Fiji. The size and disposition of the polyps are fairly similar in the two forms; but the cœnenchyme of ours is less convex. From the specimen figured (Pl. LXI., fig. 14), it would seem that the colony divides after it has attained a certain size.

Body-wall.—In its anatomy this species is in most respects very similar to that of *P. kochii*. The ectoderm is covered by a thin cuticle, and is continuous. It contains nematocysts and zooxanthellæ. Incrustations are even more numerous than in *P. kochii*, and they penetrate the mesoglœa, which separates the polyps to a greater extent than in that species. They consist of sponge and ascidian spicules, foraminifera, &c., as well of great numbers of grains of sand. Lacunæ of variable size are very numerous in the mesoglœa. In some cases a great number of these lacunæ placed close together form a sort of spongy or vesicular sheath round an individual polyp. Nematocysts are commonly to be met with in the lacunæ. The endoderm is not very well preserved, but it appears to form ridges between the mesenteries, rather than a thin uniform layer as in *P. kochii*. The endodermal muscular layer appears to be well developed.

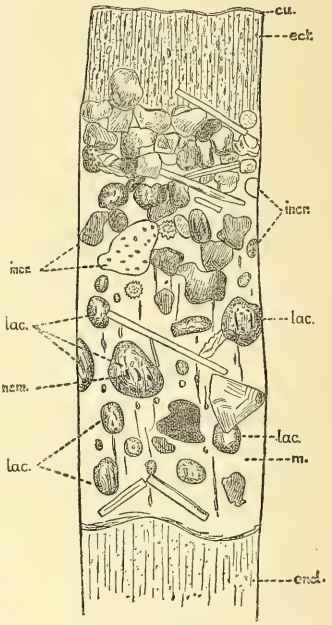


Fig. 2.—*Palythoa cœsia* (?). Transverse section of body-wall.

Sphincter muscle.—The single mesoglœal sphincter is a strong one.

Disc and tentacles.—The disc and tentacles are very similar in structure to those in the last two species, the ectoderm being remarkably thick.

Œsophagus.—Nematocysts are very numerous in the ectoderm of the œsophagus. There is a well marked groove.

Mesenteries.—The arrangement of the mesenteries is brachycnemic. The

mesenteries in other respects seem to be very similar to those of *P. howesii* and *P. kochii*. Well marked sinuses extend through each mesentery from the base to the disc.

Gonads.—We have found no generative organs in this species.

The more irregular disposition of the polyps distinguishes *P. kochii* from *P. howesii*, in which they are arranged more or less in rows. The zigzag appearance due to the partial immersion of the polyps is very characteristic of *P. howesii*. It would require considerable care to distinguish between *P. kochii* and certain other species of the genus. *P. cæsia*, as identified by ourselves, is easily distinguishable from the preceding species on account of the large and non-crowded polyps and the apparently smaller size of the colonies; but we would like to add another warning as to the extreme difficulty in identifying the species of this genus.

SPHENOPUS, Steenstrup, 1856.

Free, solitary, brachycnemic Zoantheæ, with a single, very long, mesoglœal sphincter muscle. The body-wall is incrusted. Cell islets present in the mesoglœa.

Sphenopus arenaceus, Hertwig.

Sphenopus arenaceus:

Hertwig, 1882, Voy. H. M. S. "Challenger," Zoology. Report on the Actiniaria, p. 120, pl. II., fig. 10; pl. XIV., fig. 8. Also, 1886, *ibid.*, Supplement, p. 52.

Hertwig says, in his first report of this species:—"Habitat—Cape York? (the title of the label enclosed with the preparation was nearly entirely destroyed by the rough surface of the animal, and could not be exactly made out), one specimen." In the Supplement he says:—"Habitat—Station 187, Torres Strait, Australia, September 9, 1874; 6 fathoms. Two specimens. . . . In the 'Challenger' material I have found four further examples of the genus Sphenopus; two of these I have determined as *Sphenopus arenaceus*, on account of their rusty red tint, and other two *Sphenopus marsupialis*, in consequence of the earthy-gray colour and the absence of a stalk." The last being a character of his other new species, *S. pedunculatus* (*l. c.* p. 49), from off Panay, Philippine Islands.

This is the only Zoanthean previously recorded from Torres Straits, and it does not occur in our collection. Thanks to the kindness of Professor F. Jeffrey Bell, of the British Museum, we have been able to examine some specimens of *S. marsupialis* which were given to him by Edgar Thurston, Esq., of the Central Museum, Madras, who collected them at Madras.

Hertwig gives no characters by which this species can be distinguished from

S. marsupialis, and we agree with him when he says it is "desirable that with an opportunity of more abundant and fresh material, a renewed study should be undertaken to decide whether the received specific characters are variable, and whether all three species should not be united in the single *Sphenopus marsupialis* (*l. c.* p. 52).

Sub-family. Macrocneminæ.

PARAZOANTHUS, Hadd. & Shackl., 1891.

Macrocnemic Zoantheæ with a diffuse endodermal sphincter muscle. The body-wall is incrusted. The ectoderm is continuous; encircling sinus as well as ectodermal canals; lacunæ and cell-islets in the mesoglœa. Diœcious. Polyps connected by thin cœnenchyme.

This genus is established by us in our second part of the Revision of the British Actiniæ (**1891**, p. 653), to which the reader is referred for fuller details.

TORRES STRAITS SPECIES OF THE GENUS PARAZOANTHUS.

P. dichroicus, n. sp.

P. douglasi, n. sp.

Parazoanthus dichroicus, n. sp.

(Pl. lxi., fig. 15; Pl. lxii., fig. 5.)

Form.—Body short, encrusted with sand and spicules. Capitulum with about eighteen distinct ridges. Cœnenchyme encrusting a specimen of *Plumularia ramsayi*.

Colour.—Body and cœnenchyme, gray; capitulum, pale-yellow.

Dimensions.—2–2·5 mm. in height; 1·25–1·5 mm. in diameter.

Locality—Channel between Mer and Dauar, about 20 fathoms, Jan. 6, 1889. One colony.

This species rendered the alcohol in which it was preserved strongly dichroic—the colours being yellow and violet; we have emphasised this fact in its name, which is also appropriate on account of the gray and yellow colour of the polyps.

Body-wall.—The body-wall is thickly incrusted with foreign bodies, particles of sand, diatoms, ascidian and sponge spicules, &c. (Pl. lxii., fig. 5). These are embedded in the mesoglœa, the ectoderm having for the most part disappeared from

the surface of our specimens. Where present the ectoderm appears to be continuous. It is not penetrated by strands of mesoglœa, nor is there a peripheral layer of mesoglœa. The cuticle is very delicate, and difficult to discern. Beneath the incrustations, and separated from the endoderm by a narrow band of mesoglœa, is an encircling sinus filled with dark brown granular pigment. It is crossed at intervals by strands of mesoglœa. A few branching canals connected with the sinus run outwards through the mesoglœa among the incrustations. Small, round or oval groups of cells, the cell-islets of Erdmann, are scattered throughout the mesoglœa; a very few pigment granules can be seen in some of them. We have not observed any connexion between the sinus or the canals connected with it and these islets. The endoderm is richly pigmented. We have seen no zooxanthellæ.

The capitulum, which in contracted specimens is thrown into deep folds, is also incrusted; but there is a much larger proportion of spicules and relatively fewer sand particles than in the column. The encircling sinus is not continued into the capitulum.

Sphincter muscle.—The endodermal sphincter is supported on slightly branched plaitings of mesoglœa. Near the upper extremity (in contracted specimens) it appears to become embedded in the mesoglœa, a few simple cavities being visible in our sections.

Tentacles.—The ectoderm of the tentacles is thick. The nuclei are scattered diffusely through the outer part, leaving a clear band next the muscular layer. Small nematocysts of the usual description are present. The mesoglœa is thin and almost homogeneous, a very few cell-islets being present. The endoderm contains a few zooxanthellæ, and occasional pigment granules.

Disc.—The ectoderm of the disc is very similar to that of the tentacles, but it contains some pigment. Numerous cell-islets occur in the mesoglœa.

Œsophagus.—The ectoderm of the œsophagus stains more deeply than that of the disc or tentacles. It forms a simple layer, not being thrown into folds. The mesoglœa is fairly thick, especially in the region of the groove, which is well marked.

Mesenteries.—The mesenteries are arranged as in other Macrocneminæ. The imperfect mesenteries are very slightly developed, projecting but little beyond the endoderm. The mesoglœa of the mesenteries is thick, and contains cell-islets, but no canals or sinuses. The longitudinal muscles are well developed and supported on mesoglœal folds. The endoderm resembles that which lines the body-wall.

Gonads.—In one of the specimens cut by us male gonads were found.

Parasites.—Small, oval, deeply pigmented bodies occur in many parts of the body in this species. They are evidently parasites, but we are unable to say anything further about them.

Parazoanthus douglasi, n. sp.

(Pl. LXI., figs. 16–22; Pl. LXII., fig. 6.)

Form.—Body when growing on hydroids often somewhat long and relatively narrow, but when growing on a flat surface, usually short and thick; capitular ridges not well marked; texture gritty; cœnenchyme incrusting.

Colour.—Sand colour.

Dimensions.—Height variable; largest specimens 8–9 mm.; diameter, 2–2·5 mm. The shorter specimens growing on flat surfaces are from 3–5 mm. in height, and 2 mm. in diameter.

Locality.—Albany Pass, Cape York. 10 fathoms. August 29, 1888. Numerous specimens.

[I have named this species in honour of the Hon. John Douglas, K.C.M.G., Government Resident at Thursday Island, Torres Straits, who assisted me as far as was in his power during my stay in Torres Straits.—A. C. H.]

Body-wall.—As in *P. dichroicus*, but little ectoderm remains on the body-wall of our specimens of *P. douglasi*, and that which does remain is continuous and covered by a very delicate cuticle. The incrustations, which penetrate the greater part of the thickness of the mesoglœa, consist chiefly of sponge spicules (some of them being triradiate) with a few grains of sand, foraminifera, &c., amongst them. There is an encircling sinus which contains a few dark granules similar to those which are so abundant in *P. dichroicus*, but it is for the most part almost empty. It is crossed at intervals by the strands of mesoglœa, and is connected with a system of branching canals, which run outwards through the incrustation. Cell-islets, though present, are not at all so numerous as in *P. dichroicus*. The endoderm forms a thin layer of uniform thickness. The muscular layer is feebly developed.

Capitulum.—The incrustations in this region are almost entirely confined to sponge spicules. The ridges, although not externally conspicuous, can be well seen in our transverse sections.

Sphincter muscle.—The spincter muscle is entirely endodermal. The mesoglœal plaitings are regular and simple.

Disc and tentacles—The structure of disc and tentacles is very similar to that of *P. dichroicus*, but there appear to be no enclosures of any kind in the mesoglœa.

Œsophagus.—The ectoderm of the œsophagus is thrown into slight folds. There is a distinct groove, the mesoglœa being much thickened in this region.

Mesenteries.—The arrangement of the mesenteries is brachycnemic. The imperfect mesenteries are even more feebly developed than in *P. dichroicus*, being in many cases hardly discernible. The mesoglœa forms a fairly thick layer,

without enclosures of any kind. It is thrown into very slight plaitings to support the longitudinal muscles, which are not well developed. The parieto-basal muscles are also feebly developed. The endoderm of the mesenteries forms a thin layer similar to that which lines the body-wall.

Gonads.—No gonads were found in our specimens.

Parasites.—We found that many of our specimens of this species were infested by a copepod which deposits its egg in the cœlenteron or cœlenteric canals of the polyp. The capsules are paired, and contain a large number of ova. We have found them in the nauplius stage, as well as in other stages of development. We have two specimens of the copepod, but are unable to say whether these are adult or not. The capsules form distinct swellings of the body-wall of the actinian. This fact leads us to suppose that the copepod remains within the cœlenteric cavities while the capsule is developing, and when the latter is ripe it breaks away from it (Pl. LXI., figs. 19–22).

Small oval parasites, similar to those found in *P. dichroicus*, are also found in *P. macmurrichi.*

The larger size and uniform colouration of *P. douglasi* enable it to be easily distinguished from *P. dichroicus.*

EXPLANATION OF PLATE LXI.

PLATE LXI.

Fig.

1. *Zoanthus coppingeri*, n. sp. (p. 676). Natural size; spirit specimens.

2. *Zoanthus coppingeri*. Drawn from living specimen by A. C. H.

3–4. *Zoanthus jukesii*, n. sp. (p. 678). Sketched from life by A. C. H.

5. *Zoanthus jukesii*. Natural size; spirit specimens.

6. *Zoanthus macgillivrayi*, n. sp. (p. 680). Twice natural size; drawn from spirit specimens by A. C. H.

7. *Isaurus asymmetricus*, n. sp. (p. 684). Natural size; drawn from life by A. C. H.; one specimen is drawn, showing the smooth side.

8. *Isaurus asymmetricus*. Entirely smooth specimen.

9. *Isaurus asymmetricus*. Small variety from Murray Island; natural size; drawn from life by A. C. H.

10. *Gemmaria mutuki*, n. sp. (p. 689). Natural size; spirit specimens.

11. *Gemmaria macmurrichi*, n. sp. (p. 688). Twice natural size; drawn from spirit specimen by A. C. H.

12. *Palythoa kochii*, n. sp. (p. 694). Portion of colony; natural size; spirit specimen.

13. *Palythoa howesii*, n. sp. (p. 693). Portion of colony; natural size; spirit specimen.

14. *Palythoa cæsia*? (Dana) (p. 695). Portion of a bilobed colony; natural size; spirit specimen.

15. *Parazoanthus dichroicus*, n. sp. (p. 698). Natural size; spirit specimen.

16–17. *Parazoanthus douglasi*, n. sp. (p. 700). Natural size; spirit specimens.

18. *Parazoanthus douglasi*. Natural size; portion of a dried colony incrusting stones; dried specimen.

19–22. Copepod Galls on *P. douglasi*—

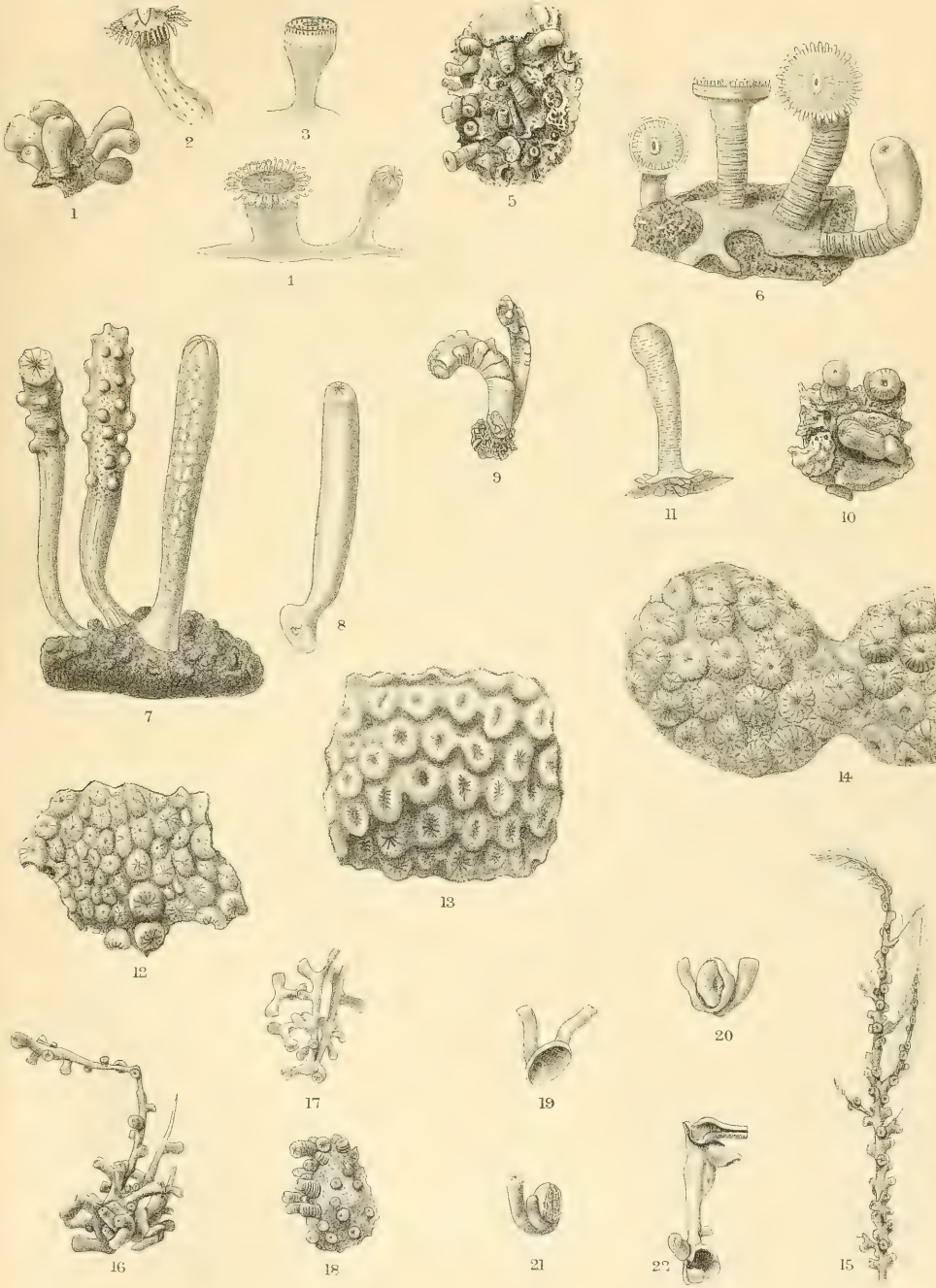
19. Portion of cœnenchyme-wall of gall.

20. Side view of one of the egg-capsules *in situ*.

21. Showing a pair of egg-capsules *in situ*.

22. Two empty galls in base of polyps.

[All the above are in the British Museum, with the exception of fig. 11, of which the single specimen obtained was utilised for anatomical examination.]



M.P.Parker del. et lith. West,Newman imp

EXPLANATION OF PLATE LXII.

PLATE LXII.

LETTERING ADOPTED IN THE FIGURES.

c.i., ... cell-islets.	*mes. lac.*, . . mesenterial lacuna.
cu., ... cuticle.	*mes. sin.*, . . mesenterial sinus.
ect., ... ectoderm.	*m. f.*, ... mesenterial filament.
ect. can., . . ectodermal canal.	*nem.*, ... nematocyst.
enc. sin., . . encircling sinus.	*ov.*, ... ovum.
end., ... endoderm.	*par.*, ... parasite.
incr., ... incrustation.	*x.*, ... axial support of incrusting forms.
m., ... mesoglœa.	*z.*, ... zooxanthella.

[The axial support in fig. 5 is a Hydroid.]

Fig.

1. *Zoanthus coppingeri*, n. sp. (p. 676). Transverse section through the base of the body-wall, $\frac{2}{A}$.*

2. *Zoanthus jukesii*, n. sp. (p. 678). Transverse section through the base of the body-wall, $\frac{2}{A}$.

3. *Zoanthus macgillivrayi*, n. sp. (p. 680). Transverse section through the base of the body-wall, $\frac{2}{A}$.

4. *Isaurus asymmetricus*, n. sp. (p. 684). Transverse section through the base of the body-wall, $\frac{4}{a^* \ 10}$.

5. *Parazoanthus dichroicus*, n. sp. (p. 698). Transverse section through the base of the body-wall, $\frac{2}{B}$.

6. *Parazoanthus douglasi*, n. sp. (p. 700). Transverse section through the base of the body-wall, $\frac{2}{B}$.

* These letters of magnification refer in all cases to Zeiss' system.

A. M. S. del. ad. nat.
M. F. Parker chr. lith.

West, Newman, imp.

EXPLANATION OF PLATE LXIII.

PLATE LXIII.

LETTERING ADOPTED IN THE FIGURES.

br. cn. mes.,	brachycnemic mesentery (the sulco-sulcar lateral mesentery).	*m.*,	mesoglœa.
cœl.,	cœlenteron.	*mes. can.*,	mesenterial canal.
cu.,	cuticle.	*m. sph. m.*,	mesoglœal sphincter muscle.
decal.,	lacuna due to the decalcification of an incrustation.	*nem.*,	nematocyst.
		œs.,	œsophagus.
ect.,	ectoderm.	*s. d.*,	sulcar directive mesenteries.
ect. b.,	ectodermal bay.	*s. gr.*,	sulcar groove.
end.,	endoderm.	*sl. d.*,	sulcular directive mesenteries.
end. can.,	endodermal canal.	*vert. can.*,	vertical canal.
incr.,	incrustation.	*z.*,	zooxanthella.

Fig.

1. *Zoanthus jukesii*, n. sp. (p. 678). Transverse section through the œsophageal region of the column, $\frac{4}{a^* 10}$.

2. *Zoanthus macgillivrayi*, n. sp. (p. 680). Transverse section through the lower portion of the column, $\frac{3}{a^* 8}$.

3. *Isaurus tuberculatus* (Gray), (p. 617 of British Zoantheæ). Section through an ectodermal bay, $\frac{2}{B}$.

4. *Isaurus asymmetricus*, n. sp. (p. 684). Vertical section through a sphincter muscle, $\frac{2}{a^* 10}$.

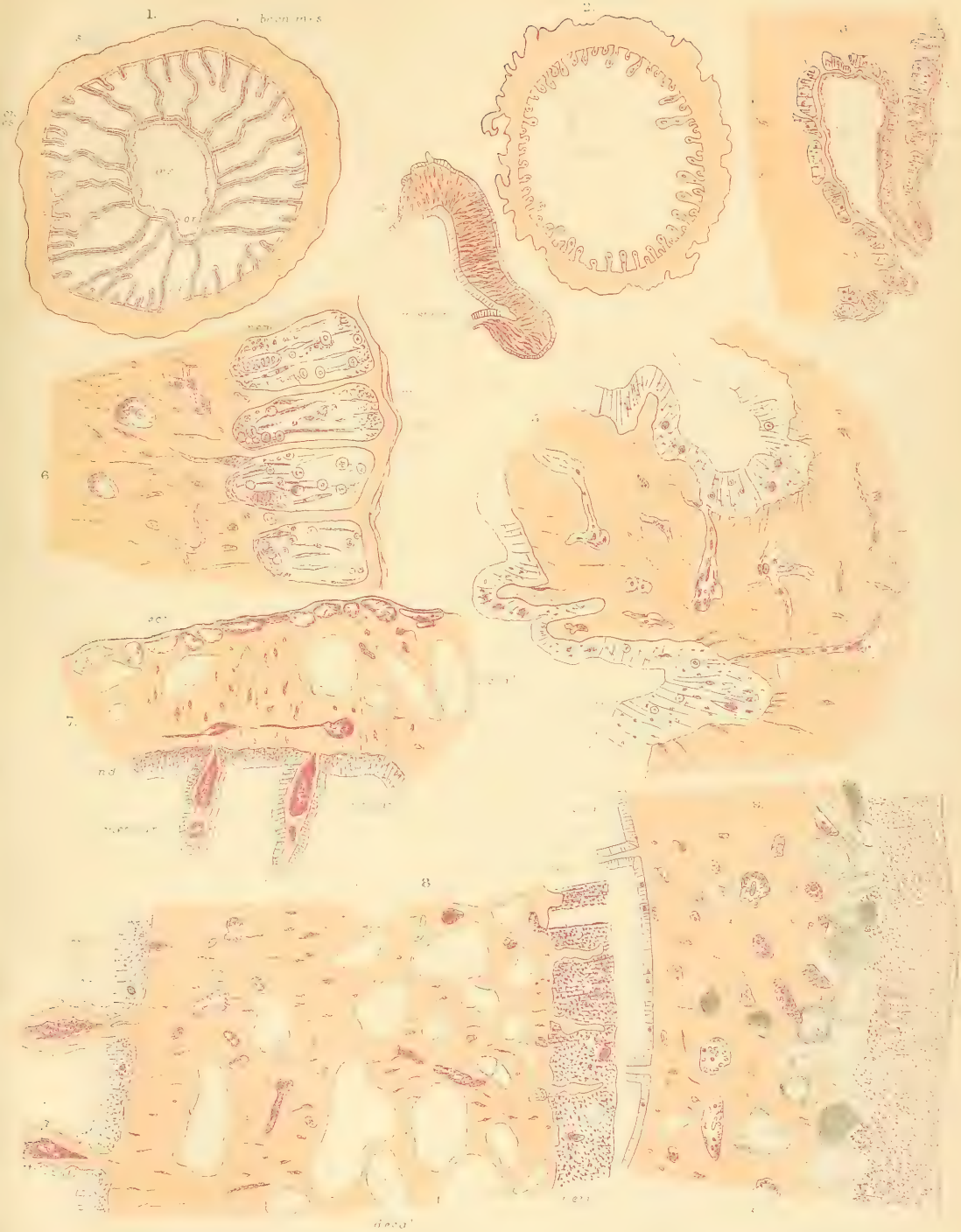
5. *Isaurus asymmetricus*. Transverse section through a portion of the centre of the base of the column, $\frac{2}{D}$.

6. *Isaurus asymmetricus*. Transverse section through the periphery of the body-wall, $\frac{2}{D}$.

7. *Gemmaria macmurrichi*, n. sp. (p. 688). Transverse section through the body-wall (decalcified), $\frac{2}{B}$.

8. *Palythoa howesii*, n. sp. (p. 693). Transverse section through the body-wall (decalcified), $\frac{2}{B}$.

9. *Palythoa kochii*, n. sp. (p. 694). Transverse section through the body-wall, $\frac{2}{B}$.



A.M.S del ad nat.
M.P.Parker chr lith

West,Newman,imp.

EXPLANATION OF PLATE LXIV.

PLATE LXIV.

LETTERING ADOPTED IN THE FIGURES.

cu.,	cuticle.	*mes. can.*,	mesenterial canal.
d. m. sph.,	double mesoglœal sphincter muscle.	*mes. sin.*,	mesenterial sinus.
ect.,	ectoderm.	*m. f.*,	mesenterial filament.
ect. can.,	ectodermal canal.	*n. c.*,	nerve-cell.
end.,	endoderm.	*nem.*,	nematocyst.
end. b.,	endodermal bay.	*œs.*,	œsophagus.
end. canl.,	endodermal canaliculus.	*ov.*,	ovum.
end. m.,	endodermal circular muscle of tentacle.	*p. b. m.*,	parieto-basilar muscle.
		r. ect.,	reflected ectoderm.
f. b.,	food-ball (?).	*sp.*	sperm-cell (testis).
l. m.,	longitudinal muscle.	*t.*,	tentacle.
m.,	mesoglœa.	*z.*,	zooxanthella.

Fig.

1. *Zoanthus coppingeri*, n. sp. (p. 676). Transverse section through the body-wall, $\frac{2}{D}$.

2. *Zoanthus coppingeri*. Transverse section through the wall of a tentacle, $\frac{2}{D}$.

3. *Zoanthus coppingeri*. Verticle section through the half of a polyp; slightly diagrammatic; the ectoderm, ectodermal canals, mesoglœa, mesenteric canals, gonads, and sphincter muscle are coloured red; the endoderm and the endodermal canals are coloured blue, $\frac{3}{a^* \ 6}$.

4. *Zoanthus coppingeri*. Transverse section through a perfect mesentery, $\frac{2}{B}$.

5. *Zoanthus macgillivrayi*, n. sp. (p. 680). Vertical section through a portion of a polyp, $\frac{3}{a^* \ 8}$.

6. *Zoanthus macgillivrayi*. Transverse section through part of a perfect mesentery, with reflected ectoderm, $\frac{2}{C}$.

7. *Zoanthus macgillivrayi*. Transverse section through a perfect mesentery, showing the upper portion of the mesenterial filament, $\frac{2}{C}$.

8. *Zoanthus macgillivrayi*. Transverse section through a perfect mesentery, showing the lower portion of the mesenterial filament, $\frac{2}{C}$.

9. *Isaurus asymmetricus*, n. sp. (p. 684). Transverse section through two perfect and one imperfect mesenteries in the œsophageal region; also showing an endodermal bay, $\frac{2}{A}$.

West, Newman, imp.

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