No. VI.—POLYCHÆTA OF THE INDIAN OCEAN, TOGETHER WITH SOME SPECIES FROM THE CAPE VERDE ISLANDS.

The Serpulidæ, with a Classification of the Genera Hydroides and Eupomatus.

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(Plates 8 and 9.)

(Communicated by Prof. J. Stanley Gardiner, M.A., F.R.S., F.L.S.)

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The Serpulids described here belong to five collections. Two of these were made by Prof. J. Stanley Gardiner, F.R.S., one from the Maldive Archipelago in 1899 and the other from the Seychelles and Chagos Groups in 1905.

The three other collections were made by Mr Cyril Crossland, M.A.: the first during 1901—2 in the neighbourhood of Zanzibar, the second during some parts of the years 1904—8 in the Red Sea and the third in the Cape Verde Islands in July and August, 1904.

I take this opportunity ot thanking both Prof. Stanley Gardiner and Mr Crossland for the opportunity of examining these specimens, most of which are beautifully preserved and of considerable interest. I should also like to thank Dr Marett Tims for his help and interest during the preparation of the paper.

The collections consist of 22 species and three varieties belonging to ten genera. To include these forms one new genus has had to be made, viz. *Pomatoleios* but I think two have been shown to be superfluous, viz. *Eucarphus* Mörch and *Glossopsis* Bush. Seven of the species and two varieties seem to be entirely new. The genera *Spirobranchus* and *Hydroides* are especially well represented. The following is a list of the species showing to which collection they belong—the letters M., SC., Z., R., V. representing Maldive, Seychelles or Chagos, Zanzibar, Red Sea and Cape Verde Islands respectively. The previously known distribution is indicated in brackets.

1. *Serpula vermicularis*, Lin. SC. Z. R. V. (very wide distribution).
2. *Hydroides norwegica*, Gunn. Mediterranean? (Mediterranean, English Channel, N. Sea).

3. *Hydroides homoceros*, n. sp. M. Z.
4. ,, *heteroceros*, Grube, Z. R. (Red Sea, Ceylon).
5. ,, *bifurcatus*, n. sp. M.
6. ,, *monoceros*, Gravier, Z. R. (Red Sea).
7. *Eupomatus exaltatus*, Marenz. Z. R. (Japan, Ceylon).
8. ,, *spinosus*, n. sp. R.
9. *Pomatostegus stellatus*, Abildgaard, R. (W. Indies, Florida, Red Sea).
10. *Spirobranchus giganteus*, Pallas, M. Z. R. (W. Indies, Florida, Red Sea).
11. ,, ,, var. *turbinatus*, nov. M.
12. ,, *gardineri*, n. sp. SC.
13. ,, *semperi*, Mörch, Z. R. (Philippine Is., Ceylon).
14. ,, ,, var. *acroceros*, Willey, Z. R. (Ceylon).
15. ,, ,, ,, *aceros* nov. SC.
16. ,, *contierei*, Gravier, Z. R. (Red Sea).
17. ,, *maldiviensis*, n. sp. M.

Pomatoleios, ng.

18. ,, *crosslandi*, n. sp. Z.
19. *Vermiliopsis pygidialis*, Willey, M. Z. R. (Ceylon).
20. *Salmacina dysteri*, Huxley, Z. R. (Atlantic, Mediterranean, Red Sea, English Channel, N. Sea).
21. *Protula tubularia*, Mont. V. (Atlantic, Mediterranean, English Channel, N. Sea).
22. *Protula intestinum*, Lam. SC. Z. (Mediterranean).
23. *Spirorbis papillatus*, n. sp. Z.
24. ,, *lævis*, Quatrefages R. (Mediterranean).
25. ,, *cornuarietis*, Phil. R. (Mediterranean).

Details as to the localities from which specimens were collected have been recorded at the beginning of the general description of each species. With regard to distribution it will be noticed in the above list that several Serpulids common to the Red Sea and Zanzibar have also been recorded by Prof. Willey from Ceylon. The two Mediterranean species of *Spirorbis*, both collected at Suez, may very easily have been brought into the Red Sea by way of the canal, a method of entry which seems quite certain in the case of *Hydroides norwegica*, which was found growing on ships dry-docked in Suez on their arrival from Alexandria. *Eupomatus exaltatus* also has an interesting distribution. This species was founded by Marenzeller on one specimen from Japan in 1885, and was not recorded again until twenty years later, when another single specimen was described by Prof. Willey from the Gulf of Manaar, although previously to this Mr Crossland had collected the three specimens recorded here from the neighbourhood of Zanzibar.

As usual in the Serpulidæ, there is an enormous amount of variation; this is no doubt accentuated by the prolonged action of preservatives, and emphasises the importance of more systematic work being done on fresh material which is sufficiently plentiful to allow numerous specimens to be compared. In this paper which is of necessity almost wholly systematic, I have endeavoured to tabulate at the beginning of the description of

each species the characteristics on which I have based my conclusions in identifying specimens. Doubtless it will be found necessary to emend some of these characteristics when more is known, for there can of course be no certainty with regard to the validity of any one characteristic for systematic purposes.

Where not otherwise stated, the specimens are in Mr Crossland's collections and the quotations as to colour of living specimens, &c. are from his notes.

Genus SERPULA, Linné (**31**) 1767; Philippi (**40**) 1844.

Generic characteristics: 1. Collar setæ bayonet-shaped, with spines at base of blade. 2. Operculum funnel-shaped, with numerous radii ending in serrations on margin. 3. Uncini with only a few teeth.

1. *Serpula vermicularis*, Linné, 1767.

Tubus vermicularis, Ellis (**17**) 1755.

Serpula echinata, Gmelin (**20**) 1789; *imbutiformis* and *infundibulum*, Chiaje (**10**) 1825; *contortriplicata*, Savigny (**47**, p. 73) 1826; *fascicularis*, Lamarck (**30**) 1838; *aspera* and *pallida*, Philippi (**40**) 1844; *vermicularis* and *philippi*, Mörch (**37**) 1863; *narconensis*, Baird (**2**) 1864; *octocostata*, Quatrefages (**42**) 1865; *crater*, Claparède (**12**) 1870; *patagonica*, Grube (**23**) 1877; *narconensis* var. *magellanica*, M'Intosh (**32**) 1885.

The above list includes the authors who originally gave the synonyms. For lists of those who followed them consult Mörch, 1863 (**37**) and Saint-Joseph, 1894 (**44**).

Specific characteristics: 1. Collar setæ with generally two large blunt processes at base of blade. 2. Uncini generally have five teeth; there may be 4—7. 3. Branchiæ (20—32 pairs) long, with numerous pinnæ and bare filamentous extremities. 4. Serrations on operculum vary very much in number; there may be as many as 100. 5. Maximum length recorded is 50 mm. with 157 segments.

Previously known distribution: Atlantic, Mediterranean, English Channel, North Sea, Magellan Strs., Marian Is., Orkney Is., Burdwood Bank, Table Bay.

Localities. Several specimens from Jambiani on the under sides of stones; a few specimens (2—3 cm. long) dredged in Wasin Channel, 7—10 fathoms; three small specimens from the bottom of SS. Juba lying off Zanzibar; also a few specimens from the Red Sea (Suakin?). Mr Crossland collected several other specimens from Porto Praya, Cape Verde Islands.

The largest specimen of all, measuring slightly over 40 mm., came from Diamant Island, Peros Banhos Atoll, Chagos Archipelago.

Nearly all possible variations in tube are to be met with, and there is also extreme diversity in the arrangement of the red colour markings on operculum, branchiæ, thoracic membrane, &c. These variations have however already been described by Saint-Joseph (**44**), Fauvel (**18**), &c., and it is unnecessary to mention them here. Some specimens are undoubtedly in an immature state and show so few as 18 pairs of gills and 16 serrations on the edge of the operculum—some of the uncini have only four teeth. In these and

some other points there is agreement with the two specimens described by Gravier (**21**) from the Gulf of Aden.

Only the one specimen from Diamant Island has as many as 50 serrations round the margin of the opercular funnel, and this is the number given by Saint-Joseph (**44**) as the minimum. The general number in these specimens is 30—40.

Genera Hydroides and Eupomatus.

As so much confusion exists with regard to these genera, it has been necessary to endeavour to draw up some scheme of classification. The definitions given by the authors who established them are so indefinite that it is almost impossible to decide into which, if either, to put many of the recently described species with the characteristic two-tiered opercula.

The operculum, in each case, consists of an outer more or less funnel-shaped part as in the genus *Serpula* with a varying number of radii ending generally in pointed teeth. From the centre, or near the centre, of this arises a crown of spines—these may be all alike (homoceros) or, as very frequently happens, one may be different from the rest (heteroceros). Further, these spines very frequently have secondary processes. The latter may occur internally and, in this case, especially if they are near the base of the spine, be difficult to see from the outside, or they may be lateral and therefore quite noticeable. Mörch points out that such characteristics of the spines are of sub-generic value (**37**, p. 372), but his definitions are not sufficiently definite to distinguish some of the more recently described specimens. Forms having lateral processes to their opercular spines have been already referred to the genus *Hydroides* by Bush (**7**) and some other authors. It seems best therefore to keep to this distinction and the genus *Hydroides* will then include *H. norwegica*, for which Gunnerus (**25**) established the genus (describing the spines as "bacillis teretiusculis, multispinosus"), and also many others. It would include quite well the genus *Eucarphus*, established by Mörch, which appears only to differ in having the lateral processes terminal in position thus giving the condition "bacillis planis...apice arcuato..., utrinque cornuto," described by Mörch (**37**, p. 372). In another place (**37**, p. 378) Mörch draws attention to the fact that these lateral processes of the spines may be sub-terminal ("extremitate utrinque aurita, interdum aculeo intermedio terminali, unde uti cruciati"), and in such a position they are sometimes found in *H. heteroceros* both in the specimens I examined from Zanzibar and the Red Sea and in Grube's specimens (**22**), though the more normal position is about half-way down. Thus either the species *H. heteroceros* and many others should be put in the genus *Eucarphus*, or else *Eucarphus* should be included in the genus *Hydroides* in which the secondary processes (hooks) on the spines may be terminal or not. The latter course, being more consistent with the laws of priority, is the one taken here.

The genus *Glossopsis* also seems to be quite unnecessary. *H. minax*, for which it was established by Bush (**7**), falls quite naturally into place in the Table given below, being in fact closely related to *H. monoceros*, Grav.

The genus *Eupomatus*, Phil. "bacillis simplicibus apice leviter arcuato, acuto," then

includes forms with opercular spines on which hooks are never present laterally and may be absent altogether (figs. 4 and 5).

Except with regard to the shape of the operculum these genera resemble the genus *Serpula* very closely and are for this reason by some authors regarded as sub-genera only. It must be remembered however that the operculum, which is not generally a satisfactory organ on which alone to base distinctions, is here developed as a highly specialised organ of offence as well as of defence. Owing to the way in which the spines can be separated and then brought together by the action of muscles (figs. 2*a* and *b*), the central cavity forms a highly efficient cage in which no doubt small animals are held prisoners and killed by coming in contact with the sharp central spines. Small Crustacea were frequently found imprisoned in this way, and one specimen of *Hydroides heteroceros* was found grasping with its spines a small Serpulid in its tube which had evidently just been torn from its substratum.

The general characteristics of the genera *Hydroides* and *Eupomatus* then are:

1. Collar setæ of bayonet shape with two conical processes at base of blade.
2. Uncini with a few coarse teeth—the most anterior one being larger than the rest.
3. Abdominal setæ trumpet-shaped ("cornet comprimé" Gravier, "Spateln" Marenzeller).

The two genera can easily be distinguished by their opercula, and upon the apparently constant characteristics of these opercula the annexed scheme of classification is suggested.

- *Hydroides* opercular spines with lateral processes
  - All spines alike (homoceros)
    - more than one pair of lateral processes
      - *H. norwegica**, Gunn
      - *H. multispinosa*, Marenz.
      - *H. parvus*, Treadwell
    - one pair of lateral processes only
      - not terminal
        - *H. homoceros*, n. sp.
        - *H. bispinosa*, Bush
        - *H. crucigera*, Mörch
      - terminal (Eucarphus Mörch)
        - *H. lunulifera*, Clpd.
        - *H. serratus*, Bush
        - *H. cumingii*, Mörch
        - *H. dirampha*, Mörch
        - *H. benzoni*, Mörch
  - Spines of 2 kinds (heteroceros)
    - one spine only without lateral processes
      - *H. heteroceros*, Grube
      - *H. bifurcatus*, n. sp.
    - only one spine with lateral processes
      - *H. monoceros*, Grav.
      - *H. minax*, Grube
      - *H. albiceps*, Ehrb.
- *Eupomatus* opercular spines without lateral processes
  - Spines all alike (homoceros)
    - *E. uncinatus*†, Phil.
    - *E. elegantulus*, Bush
    - *E. protulicola*, Bened.
    - *E. spongicola*, Bened.
    - *E. dipoma*, Schm.
  - Spines not all alike (heteroceros)
    - *E. exaltatus*, Marenz.
    - *E. spinosus*, n. sp.

* According to Saint-Joseph *H. pectinata and H. tripanon* are only varieties of *H. norwegica* [46, p. 247], so also apparently are *H.* (*Eupomatus*) *elegans*, Haswell [26 and 27] and *H. abbreviata*, Kr [29].

† The spines vary from 6—11. Bush [8, p. 498] separates Ehler's specimens [15] with 11 spines as *E. floridanus*; this seems to be unnecessary and the forms *E. gracilis* and *E. humilis*, described by this author, are possibly also *E. uncinatus*. *E.* (*Hydroides*) *dianthus*, Verrill, seems to be no more than a variety.

2. *Hydroides norwegica*, Gunn (**25**) 1768; Mörch (**37**) 1863; Marenzeller (**34**) 1893; Saint-Joseph (**45**) 1898.

Specific characteristics: the radii of the operculum form about 22 to 36 rounded lobes on the edge of the funnel: in the centre of this is the crown of (14—20) generally 17 spines with sharp lateral processes.

Locality. Numerous specimens from the bottoms of SS. Thyra and Silda which were dry-docked in Suez after coming through the Canal from Alexandria. This species, common in the Mediterranean and English Channel, has not been recorded before from the Red Sea and it was no doubt in this case brought from the Mediterranean attached to the ships.

Tubes white and delicate with conspicuous lines of growth, more or less adherent but distal end generally erect the whole tube being very much larger than contained animals. The length of these is generally about 20 mm. of which the long branchiæ and thorax together make up about a half; the width varies from 1—2 mm.

The functional double funnel shaped operculum seems more often to be carried on the right the small club-shaped one being on the left, but this is of course subject to reversal after loss (Zeleny **51**), and both fully developed on their very long pedicles is not an uncommon occurrence. The horny transparent spines round the inner funnel have sharp lateral processes which appear to collect debris so that the whole top of the operculum is frequently hidden by it. The lower funnel of the operculum is colourless and opaque, just below it on the slender stem occurs a bright crimson spot.

The collar is entire and the very large thoracic membrane is colourless and transparent. The branchiæ of which there are about 15 pairs are variously "coloured red, violet, yellow with white transverse markings or may be colourless"; there are numerous opposite pinnæ extending almost to their extremities.

A full description of this species is given by Saint Joseph (**45**, pp. 440—443).

3. *Hydroides homoceros*, n. sp. (Plate **8**, fig. 1).

Specific characteristics: the opercular funnel has about 17 teeth with lateral processes (fig. 1*a*) and the central crown consists of seven slender spines, each having a pair of lateral hooks about half-way up and a median basal internal one.

Localities. Two specimens from Miladumadulu Atoll and one from Minikoi in Prof. Stanley Gardiner's Maldive Archipelago Collection; also two from 10—15 fathoms off Ras Osowarmembe and four from the bottom of SS. Juba off Zanzibar in Mr Crossland's collection.

Tube "slightly ribbed, not much bent, mouth simple."

The specimens are from 10—20 mm. long without the branchial crown which is 3—4 mm. high, and composed of 12—17 pairs of gills with only short terminal filaments. The inter-branchial membrane is also very short. The spines of the very beautiful operculum (fig. 1*a*) are transparent and yellowish. So also are the teeth with their lateral processes into which the margin of the lower funnel is produced. One pair of these processes is terminal, the other about half-way down. The pedicle varies in height;

it is always, however, longer than the other branchiæ. There is a small rudimentary operculum on the side opposite the functional one.

The thorax has the usual seven segments, the collar fascicle being composed of about a dozen of the typical setæ (fig. 1*b*) with an equal number of smaller ones with narrow blades. The collar itself is deep, the ventral lobe generally entire, though sometimes notched and variously folded or crumpled. The thoracic membrane is well developed; in two or three of the specimens the posterior ventral free part is nearly as long as the whole thorax.

The abdomen has about 80 segments; its greatest width is 2 mm.

The uncini have the usual shape and five or six teeth; the abdominal setæ (fig. 1*c*) are in groups of eight.

This species has apparently rather close affinities with *H. bispinosa*, Bush (**8**) from Bermuda. There are, however, no figures nor sizes given of this species and from the description there seem to be several points of difference (**8**, p. 496).

4. *Hydroides heteroceros*, Grube (**22**) 1868 (Plate **8**, fig. 2).

Serpula (*Hydroides*) *uncinata*, Gravier (**21**) 1908; non Philippi (**40**) 1844.

Eupomatus heteroceros, Willey (**50**) 1905.

Specific characteristics: the opercular funnel has about 30 well-marked serrations and the central crown nearly always consists of seven long stiff spines; six have lateral hooks; the seventh is generally larger and curved over the others and has no lateral processes (figs. 2*a* and *b*).

Localities. Several specimens from wall of Suez Quay; one from Suakin Harbour obtained by divers; and two from a depth of 10 fathoms off Zanzibar.

Tubes thick, flattened on side of attachment, often coiled, marked by faint longitudinal lines, aperture circular.

Length variable; the largest specimens were about 40 mm. long and 4 mm. wide, but most are only three-fourths of this size.

"The body is generally of a dull yellowish colour; the branchiæ have dark crimson bases but are light yellow distally. There is, however, a great deal of variation in colour, the gills occasionally appearing purple and orange. The pedicle of the operculum is banded with crimson and white alternately." The functional operculum is not necessarily on the right as given by Gravier. In two specimens it appeared on the left and is no doubt subject to reversal after loss (Zeleny **51**).

The rudimentary operculum is short with a terminal knob showing six or seven radial constrictions.

The serrations round the outer opercular funnel have laterally elongated terminal processes sometimes produced into sharp teeth at the sides. In two out of the seven specimens examined there were only five spines with the lateral hooks in addition to the large curved plain one, instead of the usual number six—there is also a great deal of variation in the position of these lateral hooks. In some, they are about half-way down (figs. 2*a* and *b*) as figured also by Gravier* (**21**, fig. 286) and described by Willey (**50**),

* There can be no doubt, I think, that Gravier's figure and descriptions of *H. uncinata* refer to this species; they differ considerably from the true *Eupomatus uncinatus*.

but in others they are quite near the distal end as figured by Grube (**22**), *i.e.* they are sub-terminal and similar to those described by Mörch in his genus *Eucarphus* (**37**, p. 378).

All the spines are provided with interior median basal spines. There is a large thoracic membrane and collar, the latter being very ample and much folded; the ventral lobe seems generally to be entire. The branchiæ, of which there are 16—18 pairs, have very long terminal filiform processes.

The setæ are of the usual shape and resemble Gravier's figures (**15**, text-figs. 463—466), the uncini having 5—7 teeth. The abdomen consists of about 150 segments.

A thin calcareous tube with conspicuous growth lines containing a very young animal of presumably the same species was found firmly grasped by the opercular spines of the largest specimen and the scar on the tube looked very much as though it had been torn away from the substratum on which it had been growing. The total length of this young form is barely 3 mm. and it still retains its original functional operculum with a single row of serrations on the left side—the shorter one which was going to develop into the first adult functional one with the characteristic shape (Zeleny, **51**, p. 934) being on the right. It has the ordinary seven thoracic segments but only about 24 abdominal ones; the latter have tori containing 12 uncini of the usual shape. Each fascicle of ventral setæ consists of three trumpet-shaped ones and one very long fine capillary one. The collar setæ (fig. 2*c*) are remarkable in having a coarsely serrated fin-like process at the base of the blade instead of the ordinary two processes. I do not know whether this could be a stage in the development of such setæ. There are five or six in each fascicle and the same number of fine capillary ones.

5. *Hydroides bifurcatus*, n. sp. (Plate **8**, fig. 3).

Specific characteristics: the opercular funnel has 25 sharp pointed teeth round its edge and a central crown of seven curved spines; six of these are bifid at the distal end giving two sharp outwardly directed lateral teeth; each has also a median inner hook a short distance below these lateral ones. The seventh spine is much curved and has only the inner basal upwardly directed median tooth which is also present on all the others (fig. 3).

Locality. A single specimen from Minikoi, Prof. Stanley Gardiner's Collection, no tube. It measures 20 mm. without its branchial crown and its greatest width is 2 mm. The gills, of which there are 20 pairs, are 3 mm. long and have large terminal filiform processes. The opercular pedicle is a little longer than the branchiæ so that the operculum projects just above them. Owing to the condition of six of the spines this species might have been referred to the genus *Eucarphus* though it does not resemble any other species of this group so nearly as it does *H. heteroceros*.

The setæ are as usual in the genus—the uncini have seven teeth in the thorax and five in the abdomen, but are everywhere of the characteristic pattern.

6. *Hydroides monoceros*, Gravier (**21**) 1908.

Specific characteristics: opercular funnel asymmetrical and with about 16 serrations

having enlarged extremities; central crown has six small spines and a very large one with a lateral hook on either side of the strong curved terminal spine.

Localities. Three specimens about 15 mm. long from the bottom of SS. Juba off Zanzibar; one much larger specimen (54 mm. long and 3 mm. maximum width) from Suakin, Red Sea.

The tubes are thick and more or less curved, with longitudinal and transverse ridges and entire margins to apertures. The functional operculum with its pedicle is 4—8 mm. long. It is quite asymmetrical, the large spine arises from the dorsal side and often lies almost flat over the rest of it. This seems to be the chief point of difference from *H. minax*, Grube, which has a symmetrically placed central crown.

The large spine with its strong terminal and pair of lateral hooks varies much in length sometimes being as long as 3 mm. and thus able to extend some distance beyond the ventral boundary of the lower funnel when lying closely over it, a position in which it is often found. The edge of the lower funnel is produced into 16 or 17 processes with terminal enlargements, the funnel is asymmetrical the radii being much larger on the ventral than on the dorsal side.

The rudimentary operculum on the opposite side of the body is club-shaped.

The branchiæ (15—20 pairs) are of a brownish colour banded with white. There is a short interbranchial membrane, and the numerous rather small pinnæ extend nearly to the end leaving only a very short terminal filament.

The setæ and uncini agree with those figured by Gravier (**21**).

7. *Eupomatus exaltatus*, Marenz. (**33**) 1885; Willey (**50**) 1905 (Plate **8**, fig. 4).

Specific characteristics: the inner funnel of the operculum is raised on a short column and has eight or nine strong hook-like spines, without secondary processes except at base; the dorsal one is twice as large as the others and bends suddenly at a right angle over the top of them (fig. 4).

Localities. Two specimens from Wasin Channel, 7—10 fathoms; one from the bottom of SS. Juba, Zanzibar, and one (operculum only) from Dongonab Harbour, Red Sea.

Tubes round and almost smooth, being only slightly marked with growth lines and three low dorsal ridges. Large operculum on very long pedicle projecting some distance beyond gills when these are expanded.

Body of a dull green colour, branchiæ 13—15 on each side, greyish violet colour with two clear broken black lines on the outer side of each; terminal filament without pinnæ ·3 mm. only.

After preservation the slightly larger specimen from Wasin has a total length of 19 mm., the operculum with its pedicle being 4·3 mm. The abdomen consists of about 90 segments, the terminal ones provided with long fine setæ.

The smaller specimen from Wasin has nine central spines to its operculum which occurs on the right side; that is, it is exactly the same as the one described by Marenzeller (**33**); the larger specimen, however, has its functional operculum on the left side, and it only has eight central spines as in Willey's (**50**) specimen. The outer funnel of

the operculum has 24 teeth round its edge. The secondary operculum is in both cases quite small and rudimentary.

The specimen from the bottom of SS. Juba is smaller than the other two and has its functional operculum (with eight spines) on the right; the smaller one on the left is also almost fully developed and shows the same number of spines.

Another operculum with eight central spines was found with some material from Dongonab, but no trace of the rest of the animal could be found.

The uncini have six or seven teeth, in this being intermediate between Willey's and Marenzeller's specimens; otherwise the uncini and setæ agree very closely with those figured by the latter author.

This species is interesting in having a wide distribution considering its apparent rarity. The species was established by Marenzeller in 1884 on one specimen from the east coast of Eno-sima Island (S. Japan). Willey (**50**) records another single specimen without a tube from the Gulf of Manaar in 11 fathoms in 1905.

8. *Eupomatus spinosus*, n. sp. (Plate **8**, fig. 5).

Specific characteristics: opercular lower funnel with about 32 long pointed teeth, the upper or central one with 10 strong tall spines, each with distinct terminal hook pointing outwards and a nearly terminal inner one pointing downwards and inwards and also an inner median one near the base. The eleventh spine is much longer and curved over these and has only a basal hook (fig. 5).

Locality. Five specimens from Suez.

The tubes are thick with longitudinal ridges and somewhat irregular growth lines—one has sand grains adhering to it. The length of the thorax and abdomen combined varies from 10—23 mm. with a maximum width of 3 mm.

The branchiæ, of which there are about 11 pairs, have rather short terminal filaments and pinnæ. The pedicle, which is generally rather longer than the gills, is 3 mm. in one of the larger specimens. The spines of the operculum are almost black and are much less raised than in *E. exaltatus*. There are also dark brown bands anterior to the tori, these being especially marked in the thorax, giving a very distinctive appearance.

The collar is entire and not very high nor ample, the ventral lobe thus forming a straight band. The collar fascicle consists of large bayonet setæ together with some very fine capillary ones. The thoracic uncini have seven teeth, the abdominal six; both these and the setæ have the usual shape. The abdomen consists of about 100 segments in the large specimens.

Genus Pomatostegus (Schmarda).

Generic characteristics: 1. Several horny disc-like opercula united by a central vertical column. Pedicle with broad lateral wings. 2. Collar setæ bayonet-shaped and covered with fine hair-like processes, generally with simple bladed forms also. 3. Abdominal setæ sickle-shaped (setæ of *Salmacina*). Ehlers (**15**, p. 299) considers this point of special importance in distinguishing *Pomatostegus* from *Spirobranchus*.

4. Uncini with about nine teeth, the anterior one larger and hollowed out underneath like a gouge (cf. *Spirobranchus*). 5. Uncinigerous tori of right and left side almost meeting on the ventral side of thorax, leaving only a narrow straight depression along the median line (Ehlers, **15**, p. 297).

9. *Pomatostegus stellatus* (Abildgaard) (**1**) 1789.

Terebella stellata, Abildgaard (**1**) 1789.

Pomatostegus stellatus, Mörch (**37**) 1863; Benedict (**3**) 1886; Ehlers (**15**) 1887; Gravier (**21**) 1908.

The distinguishing characteristics of the several species of this genus that have been described do not seem to be at all clear. Bush (**8**, p. 499) states that *P. stellatus* has a smaller operculum and more elongated body than *P. brachysoma*, Schmarda, of which she gives a long description, mentioning 45 mm. as the length (but giving no width) of her one specimen. As a matter of fact, the one specimen of *P. stellatus* described in detail by Ehlers (**15**) is said to have a length of 35 mm. only, and to be composed of 140 segments. *P. macrosoma*, Schmarda (**48**), has been said to differ from both of these in having (1) a divided ventral lobe to its collar and (2) a greater number of turns to the branchial spirals; however, the latter is said by Ehlers to be an unsatisfactory specific characteristic as is also frequently the special form of collar or thoracic membrane. Therefore *P. macrosoma* is probably identical with *P. stellatus* and possibly *P. brachysoma* also.

Locality. Five specimens from "the side of a coral block," Suakin, Red Sea.

These specimens vary in total length from 21·5—52 mm. and have 70—96 abdominal segments. They agree as to colour with the description given by Gravier, but I have only been able to find very few bladed sickles (setæ of *Apomatus*) among the thoracic setae, the majority being rather short, stiff, simple and bladed forms. The abdominal setae have the rounded teeth described by this author, but have nearly lost their sickle-like curve, this is, no doubt, due to their lengthened immersion in preservatives (cf. Saint-Joseph, **44**, p. 334). The tubes are thick and irregular, overgrown with Polyzoa, *Spirorbis* tubes, &c. The cavity is, however, smooth and cylindrical, measuring 3—4 mm. in diameter. There is nothing else that need be added to Ehlers' excellent description (**15**, pp. 296—300) of one specimen without a tube from East Key.

Genus Spirobranchus, Blainville (**6**) 1817.

Generic characteristics: 1. Operculum with a calcareous plate generally bearing a group of branched spines. Pedicle with broad lateral wings. 2. Collar setæ as in Pomatostegus. 3. Abdominal setæ trumpet-shaped, the edges compressed and toothed and produced at one place into a long fine point. 4. Uncini the same shape as in Pomatostegus, but with rather more numerous teeth (9—25). 5. Uncinigerous tori of the two sides widely separated ventrally in front and gradually approaching one another towards the end of the thorax, thus leaving a triangular depression.

10. *Spirobranchus giganteus* (Pallas) (Plate **8**, fig. 6).

Serpula gigantea, Pallas (**39**) 1766.

Cymospira gigantea, Blainville (**6**) 1817; Schmarda (**48**) 1859; Quatrefages (**42**) 1865.

Spirobranchus giganteus, Mörch (**37**) 1863; Benedict (**3**) 1886; Ehlers (**15**) 1887; Gravier (**21**) 1908.

Specific characteristics: 1. Opercular plate with only two antler-like processes which sometimes however branch close to their bases. 2. Abdomen about 11 times as long as its greatest breadth and with numerous (200—300) segments.

After studying numerous specimens which vary a great deal among themselves in unimportant details, these seem to be the only constant characteristics not mentioned among the generic ones. Ehlers (**15**) gives these with two other characteristics as distinguishing *S. gigantea* from *S. incrassatus* and *S. tricornis*, both of which have three processes, differently branched on their opercula, and from the measurements given their abdominal regions are only 4—7 times as long as broad. Ehler's specimen of *S. incrassatus* seems however to have been a very small one. He gives the condition of the ventral lobe of the collar as another specific characteristic, pointing out that his specimens (? how many) of *S. gigantea* and *S. incrassatus* have this lobe divided into two triangular lappets, while in *S. tricornis* it is undivided and very elongated. At the same time he suggests that the condition with two lappets may be caused by damage.

In the specimens that I have examined there seems to be no constancy at all with regard to the collar. The ventral lobe is in several cases (fig. 6*a*) folded inwards in the middle and gives a striking resemblance to two triangular lappets, but in only the one large specimen from Hulule, Male, are there two distinct triangular lappets which show no sign of having been possibly caused by the original lobe being torn. In a great many the whole ventral lobe is much shrunken and folded back as mentioned by Ehlers, and when unrolled no appearance of triangular lobes could be distinguished, though the collar appeared notched in the centre.

The very numerous specimens of *Pomatoceros triqueter* from Plymouth that I have examined also show great variety as to their collars, and I am inclined to think that these are never of much use from a systematic point of view.

In spite of Ehlers' statement to the contrary, I have not found in any of the numerous specimens examined that *all* the collar setæ were the simple blades which are constantly present to some extent in the collar fascicle of Serpulids. In some specimens however (fig. 6*c*) the characteristic ones approach that condition more nearly than in others (fig. 6*b*) where the hairy projection is larger. The one figured by Benedict (**3**, fig. 43) is very similar to the former. Gravier (**21**) does not mention the collar setæ of his Red Sea specimens.

Localities. Numerous specimens were obtained from the Zanzibar region in 10 fathoms. One specimen came from Khor Dongonab, and several others also came from the Red Sea, having been obtained by divers in Suakin Harbour.

In Prof. Stanley Gardiner's collection there is a large and beautiful specimen from

Hulule, Male, and two (one incomplete) from Mamaduwari, S. Mahlos, Maldive Islands. These are about double the size of the Zanzibar and Red Sea specimens: one contracted specimen is nearly 100 mm. long with maximum abdominal width of 9 mm., another expanded specimen is 116 mm. long and only 6—7 mm. wide.

The tubes in most cases are completely covered with coral; there is the usual blue colour on the inside round the aperture, which is overhung by the characteristic pointed process.

The branchiæ, forming a spiral of four or five turns on each side, are generally "white or yellow at their bases, but of a brilliant crimson or other shade of red towards their distal ends." The massive pedicle of the operculum arises on the left side just dorsal to the branchiæ and has a "greenish colour." The collar, also "brightly coloured, wrapped over the edge of the tube when the worm was extended."

In every case the ventral lobe of the collar is produced at the side interior to the lateral lobe into a process which is sometimes more or less fimbriated, and suggests the languet of *Pomatoceros*. I have not seen this condition described before for the genus *Spirobranchus*, but it seems to be of constant occurrence. Considerable variation was found among the abdominal setæ; two of the commonest forms are shown in figs. 6, *d* and *e*. There is nothing else, I think, to add to the detailed description given by Ehlers. Most of the specimens agree rather with those of Gravier from the Red Sea in having the processes on the operculum shorter than in Ehlers' and Schmarda's figures. The opercular plate is in every case distinctly elongated dorso-ventrally and is broader ventrally.

11. *Spirobranchus giganteus*, var. *turbinatus* nov.

Locality. Hulule, Male Atoll.

This beautifully preserved specimen resembles the above as to setæ, operculum, &c., but has rather fewer branchiæ with longer free extremities and the ample collar enormously developed on the right dorsal side and rolled up like a scroll. In size it resembles the other specimens from the Maldive Archipelago.

12. *Spirobranchus gardineri*, n. sp. (Plate 8, fig. 7).

Specific characteristics: 1. Opercular plate nearly circular with one very long process arising from near its centre—the process being trifid near its distal extremity only (fig. 7 *a*). 2. Thoracic uncini very large and a somewhat different shape from the abdominal ones (figs. 7 *c*, *d*, *e*).

Three specimens from Providence Reef (N. of Madagascar) collected by Professor Stanley Gardiner.

The three specimens are almost exactly the same size, and in each the posterior part of the abdomen is cut off. In only one case is the latter region present; it belongs to a specimen which gives the following measurements: Pedicle of operculum, proximal region 4 mm. long and 2 mm. broad—this is attached almost exactly in the middle of the dorsal surface between the two sides of the branchial crown. The more flattened distal part of the pedicle is 13 mm. long, and with its narrow wings measures 5 mm. in width.

The opercular plate narrows slightly towards its point of attachment to the pedicle, *i.e.* towards the dorsal side. It has a bright orange-coloured edge in spirit specimens;

slightly nearer the dorsal than the ventral side, arises the process which is 10 mm. high and ends in the three branches which sometimes themselves give rise to short secondary branches. In one specimen the operculum is overgrown with a branching Bryozoon, but in the other two cases it is quite smooth.

The branchial crown is five-spiral and 15 mm. high.

The thorax to the front of the collar measures 9 mm. long and about 7 mm. wide, and is composed of the usual seven segments. The abdomen, with nearly 200 segments, is 36 mm. long and 6 mm. across its widest part. The ventral surface is very distinctly segmented and has a deep fæcal groove.

The collar is entire ventrally, but folded inwards in the centre so as to appear at first sight to have a median fissure (fig. 7 *a*). Two specimens thus appear to have somewhat rounded ventral lobes, while the other has two triangular lobes very much like those of *Spirobranchus giganteus* shown in fig. 6 *a*.

The collar setæ are as usual in the genus (fig. 7 *b*).

There were about 12 of these and 12 plain ones with a fringe on one side instead of a distinct blade.

The thoracic uncini are enormous (about 300 μ long) and have 26 teeth, the most anterior one being long and hollowed out underneath like a gouge (figs. 7 *c* and *d*). The abdominal ones are much smaller, with only 14 teeth (fig. 7 *e*), in front of the anterior gouged one is a small process. The abdominal setae are as usual (fig. 7 *f*) in the genus.

13. *Spirobranchus semperi*, Mörch (**37**) 1863; Willey (**50**) 1905.

Serpula quadricornis Grube (**24**) 1878.

Specific characteristics: 1. Operculum flat, with four distinct spiny horns. 2. Uncini with 9—13 teeth. 3. Branchial crown forms only one turn of a spiral.

Localities. Zanzibar and Red Sea.

14. *Spirobranchus semperi*, Mörch, var. *acroceros*, Willey (**50**).

Specific characteristics: this only differs from the above in having a conical opercular disc with the four horns, reduced in size, at the top.

Localities. Numerous specimens from Suakin Harbour and Agig Bay; also three from Dongonab in the Red Sea and several from Zanzibar in Mr Crossland's collections; one specimen without its operculum from Suvadiva, Maldive Group, in Prof. Stanley Gardiner's collection.

From the four first places both varieties are represented. The tubes are generally rough with longitudinal ridges and much overgrown with Bryozoa, &c. One which contained the var. *acroceros* and is not much overgrown is triangular, with a distinct notched median keel ending in a projection over the aperture. Collar very ample, entire and much folded ventrally and with small processes internal to the dorso-lateral lobes.

The opercular plate resembles Grube's figure (**24** Taf. xv. fig. 6) very closely. The two dorsal horns divide into two main tines quite close to their bases, whereas the two ventral generally only give rise to short processes. These horns are often hidden by Hydrozoa, debris, &c., and in one they are united and altogether hidden by a colony of

calcareous polyzoa. The pedicle of the operculum is very wide and has fringed lateral wings. Many of the specimens are larger than those described by Willey: one of the largest has the abdomen 17 mm. long, containing 84 segments of greatest width 4 mm. and the thorax 5 mm. long and nearly the same in width. The branchiæ (24 pairs) are 4 mm. high when extended, and the operculum very slightly higher.

15. *Spirobranchus semperi* Mörch, var. *aceros* nov.

This only seems to differ in having a flat opercular disc without horns, but very much overgrown with Hydrozoa—the yellow chitinous perisarcs forming branching processes 1 mm. or more high in some places. Amongst these were found some small crustacea. The one specimen present has about the same dimensions as the specimen of *Spirobranchus semperi* quoted above, but is slightly more elongated owing to its having been preserved in its tube.

Locality. Amirante Islands, F.I., 29 fathoms.

This has been placed as a variety only because it seems possible for opercular spines not to develop in some cases. In one specimen of *Spirobranchus contieri* described below three-branched spines were present on the dorsal half of the plate, while the ventral was quite free from them.

16. *Spirobranchus contieri* (Gravier) (Plate **9**, fig. 8).

Pomatoceropsis contieri, Gravier (**21**) 1908.

Specific characteristics: 1. Interbranchial membrane more or less fimbriated along its free edge. 2. Operculum with five (or six) much branched processes; pedicle winged. 3. Uncini with nine or ten teeth only.

This species seems to resemble closely Mörch's *S. dendropoma* (**37**), for which, however, Benedict (**3**) describes processes on the outer part of the radioles themselves at the level of the interbranchial membrane.

Localities. Numerous specimens "commensal with two species of coral from entrance to dock, Suez," others from sandbanks, Chaki-chaki Bay, Pemba; also from Zanzibar and from Suakin Harbour, Red Sea, from divers.

Tubes covered with layer of coral to near mouth.

"Branchiæ yellow, green and white with long filiform tips, interbranchial membrane extends about half-way up. Body dark chocolate red, velvety in appearance, the thoracic membrane being dark green and yellowish. After being in alcohol some time a pink colour dissolves out and the bodies then appear dark blue."

The process inside the lateral lobe of the collar that Gravier refers to as the languet is distinctly a small lateral projection of the ventral lobe of the collar. It varies a good deal in shape and is very similar to that generally met with in the genus *Spirobranchus*, being less definite in shape as a rule than the typical languet in *Pomatoceros triqueter*.

The variation in these specimens is very marked. In most the five or six branching processes on the operculum are hidden by a more or less cone-shaped or spherical mass of debris which seems to be held together partly by these processes and partly by the

presence of numerous colourless scalariform filaments. I have not seen any specimens, having an operculum with spines springing from the top of a truncated cone, as described by Gravier from Météore, but in more than one case specimens of *Spirobranchus semperi* and its variety *acroceros* have been collected and placed with this species.

The wings on the peduncle are fringed on their upper free ends or quite plain as pointed out by Gravier (**21**) or there may be only a single filamentous process or the whole wing may be so reduced as to appear at first sight to be absent. The operculum is always carried on the left side and there is no secondary one. The interbranchial membrane may have a single cirrus between two adjacent gills or a much divided process.

Length of specimens varies from 15 to 40 mm. and the width from 2—3 mm.

The setæ agree with those so beautifully figured by Gravier (**21**, text-figs. 482—487). The uncini, while much resembling Gravier's figure in some directions, show a distinctly gouge-shaped anterior tooth (figs. 8*a* and *b*); this is particularly clear in front view (fig. 8*c*), therefore I have ventured to include Gravier's species, which I cannot imagine can be different from this, in the genus *Spirobranchus*.

17. *Spirobranchus maldivensis*, n. sp. (Plate **9**, fig. 9).

Specific characteristics: 1. Operculum a thin calcareous plate, without processes, supported by a tall pedicle with thin lateral wings (fig. 9*a*). 2. Collar setæ with a short wide finely striated fin-like process at the base of the narrow anterior blade (fig. 9*b*). 3. Branchiæ about 32 pairs with numerous long pinnæ except at their distal ends, which are bare and filamentous. 4. Thoracic uncini have about 15 teeth in addition to the large gouge-shaped one (figs. 9*d* and *e*) and the abdominal 13. 5. Abdominal setæ narrow compressed trumpets with one side produced into a long process (fig. 9*f*).

Characteristics 1 and 2 separate this species widely from any other in the genus, in fact, it may at some later time be found advisable to establish a new genus for it. The collar setæ are somewhat similar to those of *Omphalopoma*, Lang, and some other genera and the operculum is unusual in having no spines.

Locality. Three specimens in their tubes from Mulaku, Maldive Archipelago, Prof. Stanley Gardiner's collection.

Three tubes are fused together longitudinally and a fourth is firmly fused with a Gastropod (*Turritella*?) shell. In the latter the small end of the shell at first sight appears to be a large pointed process overhanging the mouth of the Serpulid tube. Each tube has one coarsely serrated ridge. Two of the specimens are 20 mm. long and 2 or 3 mm. in their widest part; the other is 30 mm. long but not more than 2 mm. wide.

The branchiæ are 7—8 mm. high and not spirally arranged. The collar is high, folded inwards along the median ventral line and interior to the dorso-lateral lobes are small folded lateral processes of the ventral lobe as in *Spirobranchus*, &c.

The fascicles of collar setæ are rather long and slender containing about 10 of the characteristic setæ (9*b*) and about the same number of simple narrow blades (fig. 9*c*). All the other thoracic setæ are simple blades.

There are 6 uncinigerous tori on each side leaving between their ventral ends a triangular space with its apex towards the posterior.

The thoracic uncini are 86 μ long and have about 15 pointed teeth in addition to the large anterior gouge-shaped one (figs. 9*d* and *e*).

Pomatoleios, n. g.

Generic characteristics: 1. Collar setæ and eyespots absent. 2. Uncini with fairly numerous teeth, the most anterior being larger and gouged underneath (fig. 10*d*). 3. Abdominal setæ trumpet-shaped with one side produced into a long spine (fig. 10*c*). 4. Operculum flat with winged pedicle. 5. Tube with a flap over the entrance.

18. *Pomatoleios crosslandi*, n. sp. (Plate **9**, fig. 10).

Specific characteristics: 1. All thoracic setæ simple striated blades (fig. 10*b*). 2. Uncini with 10 or 11 teeth in both thorax and abdomen. 3. Branchiæ with very high inter-branchial membrane and long bare terminal filaments (fig. 10*a*).

Localities. Ras Shangani and Chwaka. Numerous specimens but no tube present. Mr Crossland, however, gives the following notes. "Rough coiled tube, blue coloured especially inside and having a flap over the entrance: occurring many together not far below high water mark, *e.g.* on old boiler at Ras Shangani and at Chwaka near high tide mark down to half tide, but easiest to collect at high neap tide."

Mr Crossland also draws attention to the remarkable vitality of these specimens which he had some difficulty in narcotising. The tube appears to be quite exceptional, but unfortunately there are none present in the collection: the total absence of collar setæ is also rare. Though numerous specimens, of total lengths varying from 4 to 14 mms., have been carefully searched no sign of these setæ has been found. Neither are there apparently any eyespots as in the genus *Placostegus*; the specimens also differ in other obvious ways from this genus. Should still younger specimens than those that I have been able to examine be found to have collar setæ, then this genus may be able to be included in the genus *Pomatoceros*. In *Pomatoceros triqueter* the collar setæ are sometimes much reduced in the adult (Soulier **49**), but according to Saint-Joseph (**44**) they are always present.

The six fascicles of thoracic setæ present are all alike, being composed of simple striated blades (fig. 10*b*).

The collar varies a great deal; the ventral lobes seem generally to be high and entire but folded as in fig. 10*a*, and they give rise to a small dorsal lobe or languet which lies just inside the dorso-lateral lobe of the collar.

The branchiæ, 13—16 pairs, are remarkable for the height of their interbranchial membrane (fig. 10*a*); this joins them together for about half their height and nearly half of the free part is bare of pinnæ forming a long tapering filament.

The opercular pedicle is short and has thick lateral wings which end distally in straight edges close under the operculum. It arises almost in the middle line of the dorsal surface slightly, if anything, to the left and is attached towards the dorsal side of

the flat opercular plate. The latter is circular, rather thick and quite soft; this condition may I think be due to the fixative though I am not sure whether the corrosive sublimate used contained any acid with it or not. At any rate, the appearance is much more that of a softened calcareous plate than of a chitinous one.

Genus VERMILIOPSIS, Saint-Joseph (**44**) 1894.

Generic characteristics: 1. Collar setæ simple blades. 2. Uncini with fairly numerous teeth, the most anterior are larger and blunter than the rest. 3. Abdominal setæ geniculate. 4. Some thoracic setæ are bladed sickles (setæ of Apomatus), thus differing from genus Vermilia with ordinary bladed setæ only. 5. Operculum with a horny somewhat cylindrical or conical cap.

19. *Vermiliopsis pygidialis* (Willey) (Plate **9**, fig. 11).

Vermilia pygidialis, Willey (**50**) 1905.

Specific characteristics: 1. Branchiæ with ocelli and elongated often much swollen ends free from pinnæ. 2. Operculum with a conical (sometimes truncated) chitinous cap (fig. 11*b*). 3. Uncini with 13 or 14 teeth. 4. Terminal dorsal gland generally present.

Localities. One large specimen from Ras Osowarmembe, Zanzibar, in 10—15 fathoms; others from Suez and Suakin in Mr Crossland's collections. One specimen from Suvadiva, Maldive Group and a portion from Funafuti in Prof. Stanley Gardiner's collection. Tubes ridged longitudinally and attached to the under sides of stones, &c.

Two specimens are about 25 mm. long but the others only 15 mm. or less without their gills, *i.e.* about the size of Willey's specimen—one small specimen is regenerating its collar, branchiæ and anterior thoracic segments. The general colour during life is "bright pink or red, the gills being banded with white." There are from 10—15 pairs of branchiæ; their swollen ends appear to be glandular, though they are not so much developed as in *Salmacina dysteri*. The pyriform ocelli are arranged in groups along the outer side of the rachises.

The thoracic membrane is short and between the ventral borders of the thoracic uncinigerous tori is a depressed shield-shaped space with its broad end forwards. The terminal dorsal gland in some preserved specimens appears brownish and chitinous, in others whitish.

The operculum is often covered with a reddish or white calcareous incrustation (fig. 11*a*). When this was removed the translucent, light brown, horny cap was revealed. This is in most somewhat truncated (fig. 11*b*) and has several deep brown rings round it. In the specimens collected in August at Suez there is no incrustation and the horny cap is quite conical and dark in colour. The incrustation is specially noticed in specimens collected in November and February. The specimen from Suvadiva Atoll is without any incrustation.

This species differs from *Vermiliopsis glandigerius*, Grav., in its branchiæ and operculum; its pedicle too is not ribbon-like, though it is certainly much wrinkled and swollen below the vertically placed horny cap.

The *Vermiliopsis infundibulum*, Lang (fully described by Saint-Joseph, **46**), has a terminal tooth to its operculum, a greater number (15—16) of teeth to its uncini and apparently no swollen ends to its branchiæ. Both Gravier and Saint-Joseph record that in these species the operculum occurs on the left—they seem to have plenty of specimens for examination, so presumably the position is constant in this genus. In all the specimens of *Vermiliopsis pygidialis* that I have been able to examine it occurs on the right, as also in Willey's specimen from South-West Cheval Paar, Ceylon.

Genus Filograna (Oken) (38) 1815.

Characteristics were originally given by Berkeley (**5**) to correspond with his previously described *Filograna implexa* (**4**).

Saint-Joseph (**44**, p. 335) takes the genus **Filograna** to include the sub-genus *Filograna* s. str. with two opercula as in *F. implexa*, and also the sub-genus *Salmacina* including *S. incrustans*, Claparède (**12**) and *S. ædificatrix*, also *S.* (*Filograna*) *huxleyi*, Ehlers (**51**), as well as *S. dysteri*, Huxley (**28**).

According to this arrangement the characteristics of the genus would be: 1. Tubes very slender, filiform, colonial. 2. Branchiæ 8. 3. Thorax with 7—9 segments. 4. Collar setæ with a large fin-like expansion at base of blade. 5. Other thoracic setæ sickle-shaped (setæ of Salmacina) or ordinary bladed forms. 6. Abdominal setæ more or less geniculate and serrated. 7. Hermaphrodite.

Sub-genus Salmacina, Claparède.

Generic characteristics: 1. No operculum. 2. The ends of the eight branchiæ may or may not have spathulate enlargements due to the presence of large granular cells.

Prof. McIntosh, in a paper communicated to the British Association in Sept. 1912, still upholds the view that *Filograna implexa* and *Salmacina dysteri* are identical, stating that both are to be found in the same colony in some places.

20. *Salmacina dysteri* (Huxley).

Protula dysteri, Huxley (**28**) 1855; Claparède (**11**) 1863.

Filopora filograna, Dalyell (**13**) 1853.

Salmacina dysteri, Giard (**19**) 1876; Saint-Joseph (**44**) 1894; Gravier (**21**) 1908; Pixell (**41***a*) 1913.

Specific characteristics: 1. Branchiæ 8 with spathulate enlargements containing granular masses at their ends. Similar granules occur at the end of the pinnæ and just in front of their bases along the gill rachises. 2. Spermatozoa developed in segments anterior to those producing ova.

Localities. Large quantities from the bottom of SS. Juba and from other places off Zanzibar; also from Wasin. Masses were also growing on a small buoy in the entrance to Suez Canal and on "SS. Fayoun, a pilgrim ship which had been stationary for about 8 months; one colony covered a square foot, was 8 or 9 inches high, and was apparently rapidly growing."

Some specimens from S. Vincent, Cape Verde Islands, are also present but in a poor state of preservation.

This species has already been fully described by Huxley (**28**) 1855 and Saint-Joseph (**44**) 1894.

It has been recorded from the Gulf of Aden by Gravier (**21**), who obtained a colony to the north of Ambouli in the Gulf of Tadjourah. He, however, failed to find any in process of budding, whereas all four stages recorded by Saint-Joseph (**44**, p. 343) are present in the material collected near Zanzibar in the spring and summer of 1901 and 1902.

The number of thoracic segments was very variable between 7 and 9.

Genus Protula, Risso (**43**) 1826.

Generic characteristics: 1. No operculum. 2. Collar setæ simple tapered blades. 3. Terminal dorsal gland present.

21. *Protula tubularia*, Montague (**36**) 1803.

For synonyms see Saint-Joseph (**44**) and Fauvel (**18**).

Specific characteristics after Fauvel (**18**, p. 693): 1. Ventral lobe of collar entire. 2. Abdominal setæ sickle-shaped.

Locality. Three specimens from Porto Praya, Cape Verde Islands.

The largest specimen is 30 mm. long without its branchial crown, which is missing.

I could only find simple bladed setæ in the thorax so that these specimens seem to resemble those from Courseulles described by Fauvel (**18**, p. 694) in this particular.

The bodies are long, narrow and almost cylindrical with the usual wide folded thoracic membrane. Saint-Joseph (**44**) has given a detailed account of this species.

22. *Protula intestinum*, Lam.

Specific characteristics after Fauvel (**18**, p. 694): 1. Ventral lobe of collar notched in median line. 2. Abdominal setæ geniculate.

Localities. One specimen dredged off Zanzibar, another in 10 fathoms off Wasin. A portion of a thin, smooth tube 5 mm. in diam. from same region.

The specimens are small forms less than 3 cm. with distinctly notched colourless collars. During life the numerous gills were also "colourless with bands of orange spots and the body was slightly tinged with scarlet." The abdomen was wide and somewhat fusiform.

Prof. Stanley Gardiner's collection contained one large orange specimen from Cargados Carajos, 30 fathoms; this, without its branchial crown, was 140 mm. long and the greatest width of the abdomen was 21 mm.

Genus Spirorbis, Daudin (**14**) 1800.

Characteristics of genera and sub-genera have already been given (**41**).

Sub-genus LÆOSPIRA, Caullery and Mesnil (**9**), emended Pixell (**41**).

23. *Spirorbis papillatus*, n. sp. (Plate **9**, fig. 12).

Specific characteristics: 1. Large collar setæ with coarsely serrated blades and fin-like expansions (fig. 12*c*). 2. Operculum with brood pouch, terminal cap flattened and surrounded with a wide phalange covered with papillæ (figs. 12*a* and *b*). 3. Some setæ of second fascicle ordinary sickles (fig. 12*d*). 4. Some setæ of third fascicle bladed sickles (fig. 12*e*).

Locality. Chuaka, Mr Crossland's Zanzibar collection. Numerous specimens "closely crowded together on the base of *Sertularia* colonies which are abundant in the sand not far below high tide level."

Tubes smooth, their bases overgrown with a red calcareous encrusting alga. Other specimens from a *Pinna* shell in Suakin Harbour, Red Sea, encrusted with a polyzoon.

In both the terminal part of the tube ascends, being in some nearly erect; the aperture is circular and entire, about 1·5 mm. in diameter.

Animals bright scarlet 2—3 mm. long; deep entire collar and wide thoracic membrane.

The operculum varies a good deal in appearance. Fig. 12*a* shows a form containing only a few ova. The edge of the phalange is provided with long papillæ. In fig. 12*b* these are much shorter and more irregular and the flexible side of the operculum is much distended with well advanced embryos which already have three or four setigerous segments. In other specimens the papillæ are much smaller and sometimes only appear to be scattered on the upper flattened side of the phalange.

Branchiæ generally 11, sometimes only 10. They have numerous long thin pinnæ starting some distance below the distal end, which tapers to a long thin filament. The operculum displacing the second gill on the left reaches about the same height as the functional ones.

In the long setigerous region of the abdomen, the stomach is very evident in nearly all specimens owing to its dark granular walls. This is followed by eight to twenty setigerous segments, the geniculate setæ having long deeply serrate blades.

24. *Spirorbis lævis*, Quatrefages (**42**) 1865; Claparède (**12***a*) 1868; Saint-Joseph (**44**) 1894.

Specific characteristics: 1. Collar setæ simple blades with coarse striations. 2. Other thoracic setæ simple blades. 3. Ova incubated in operculum.

Locality. A few specimens on a tube of a Sabellid from the North Harbour, Suez.

Tube with two or three regular coils and a circular aperture: the surface is generally marked with three longitudinal ridges and fine scalariform markings.

The specimens obtained complete from their tubes were young. Only two specimens with ova in their opercula were found.

25. *Spirorbis cornuariatis*, Phil. (**40**) 1844; Mörch (**37**) 1863; Marion and Bobretzki (**35**) 1875; Caullery and Mesnil (**9**) 1897.

Specific characteristics: 1. Large collar setæ with coarsely serrated blades and fin-like expansions. 2. Ova incubated in tube. 3. Talon of operculum with large, more or less hook-like projections.

Locality. Several specimens attached to the tubes of *Spirobranchus contieri* from entrance to dock, Suez.

Some of the setæ of the third thoracic segment are, as Caullery and Mesnil (9) point out, bladed sickles, not simple capillary ones as stated by Marion and Bobretzki (35). There are 9—12 segments in abdomen, each torus consisting of about 20 uncini.

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EXPLANATION OF PLATES 8 AND 9.

PLATE 8.

Fig. 1. *Hydroides homoceros*, n. sp. 1 *a*, Operculum, × 24; 1 *b*, collar seta, × 300; 1 *c*, abdominal seta, × 375.

Fig. 2. *Hydroides heteroceros*, Grube. 2 *a*, Operculum with spines open, × 17; 2 *b*, operculum with spines closed, × 17; 2 *c*, collar seta of a young specimen, ? same species, × 300.

Fig. 3. *Hydroides bifurcatus*, n. sp., operculum, × 24.

Fig. 4. *Eupomatus exaltatus*, Marenz., operculum, × 24.

Fig. 5. *Eupomatus spinosus*, n. sp., operculum, × 24.

Fig. 6. *Spirobranchus giganteus*, Pallas. 6 *a*, Ventral lobe of collar, × 19; 6 *b* and *c*, two extreme forms of collar setæ, × 300; 6 *d* and *e*, two forms of abdominal setæ, × 300.

Fig. 7. *Spirobranchus gardineri*, n. sp. 7 *a*, Anterior end photographed from ventral side, showing collar, operculum, &c., × $\frac{5}{2}$; 7 *b*, collar seta, × 300; 8 *c*, thoracic uncinus, × 300; 8 *d*, front view of anterior end of same to show the gouge-shaped tooth, × 400; 8 *e*, abdominal uncinus, × 300; 8 *f*, abdominal seta.

PLATE 9.

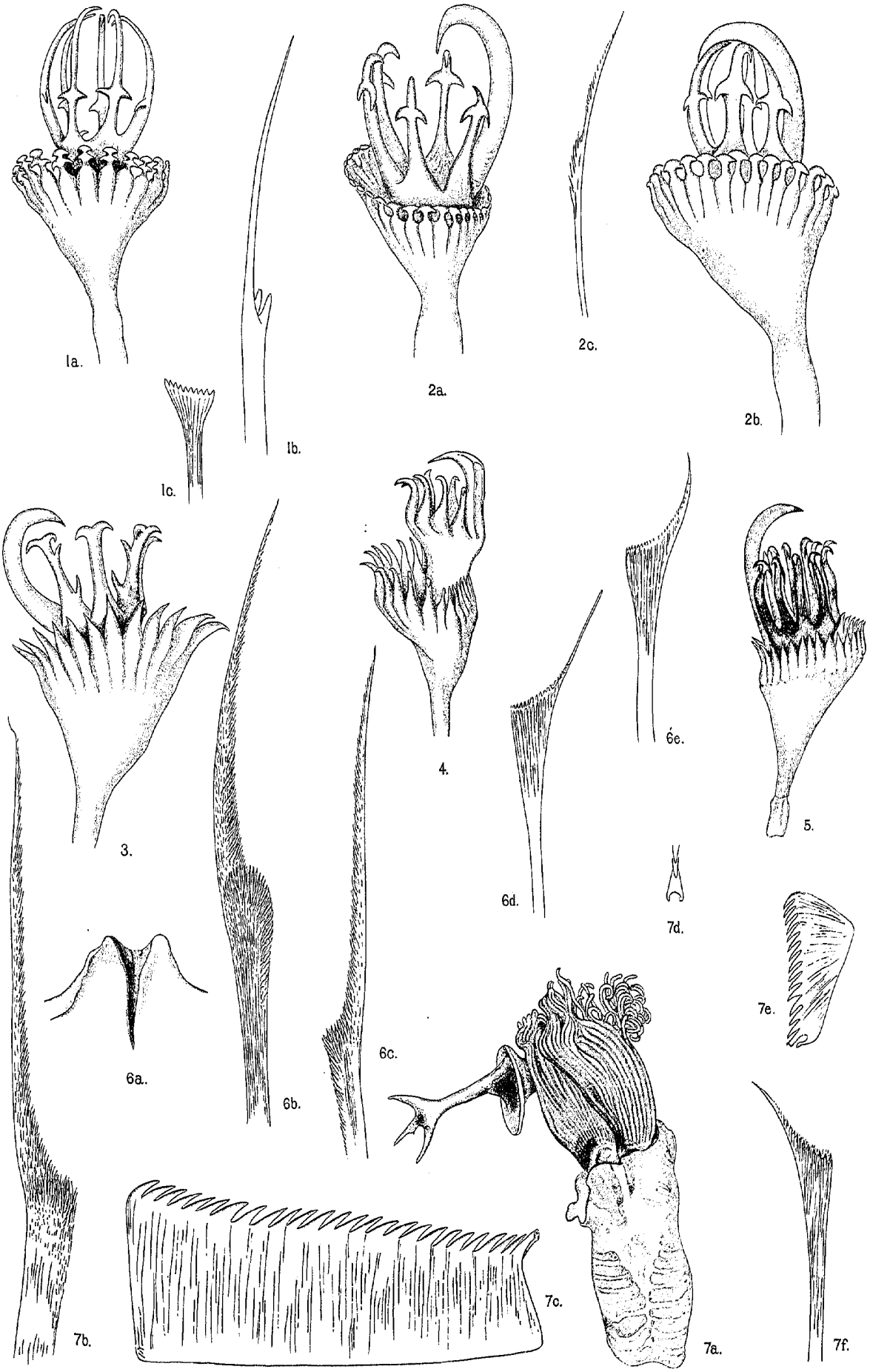
Fig. 8. *Spirobranchus contieri*, Gravier. 8 *a*, Thoracic uncinus, side view, × 220; 8 *b* and *c*, the same, × 400—*b*, side view, *c*, front view.

Fig. 9. *Spirobranchus maldivensis*, n. sp. 9 *a*, Operculum and pedicle, ventral view, × 8·5; 9 *b*, characteristic collar seta, × 300; 9 *c*, simple collar seta, × 300; 9 *d* and *e*, lateral and front views respectively of anterior end of thoracic uncinus, × 300; 9 *f*, abdominal seta, × 300.

Fig. 10. *Pomatoleios crosslandi*, n. sp. 10 *a*, Anterior half of animal, × 17; 10 *b*, thoracic seta, × 220; 10 *c*, abdominal seta, × 220; 10 *d*, anterior end of thoracic uncinus, front view of, × 220.

Fig. 11. *Vermiliopsis pygidialis* (Willey). Operculum, × 17; 11 *a*, with calcareous incrustation; 11 *b*, with incrustation removed.

Fig. 12. *Spirorbis papillatus*, n. sp. 12 *a*, Operculum with large ova, × 48; 12 *b*, operculum with embryos, side view, × 48; 12 *c*, collar seta, × 375; 12 *d* and *e*, setæ from second and third thoracic fascicles respectively, × 375.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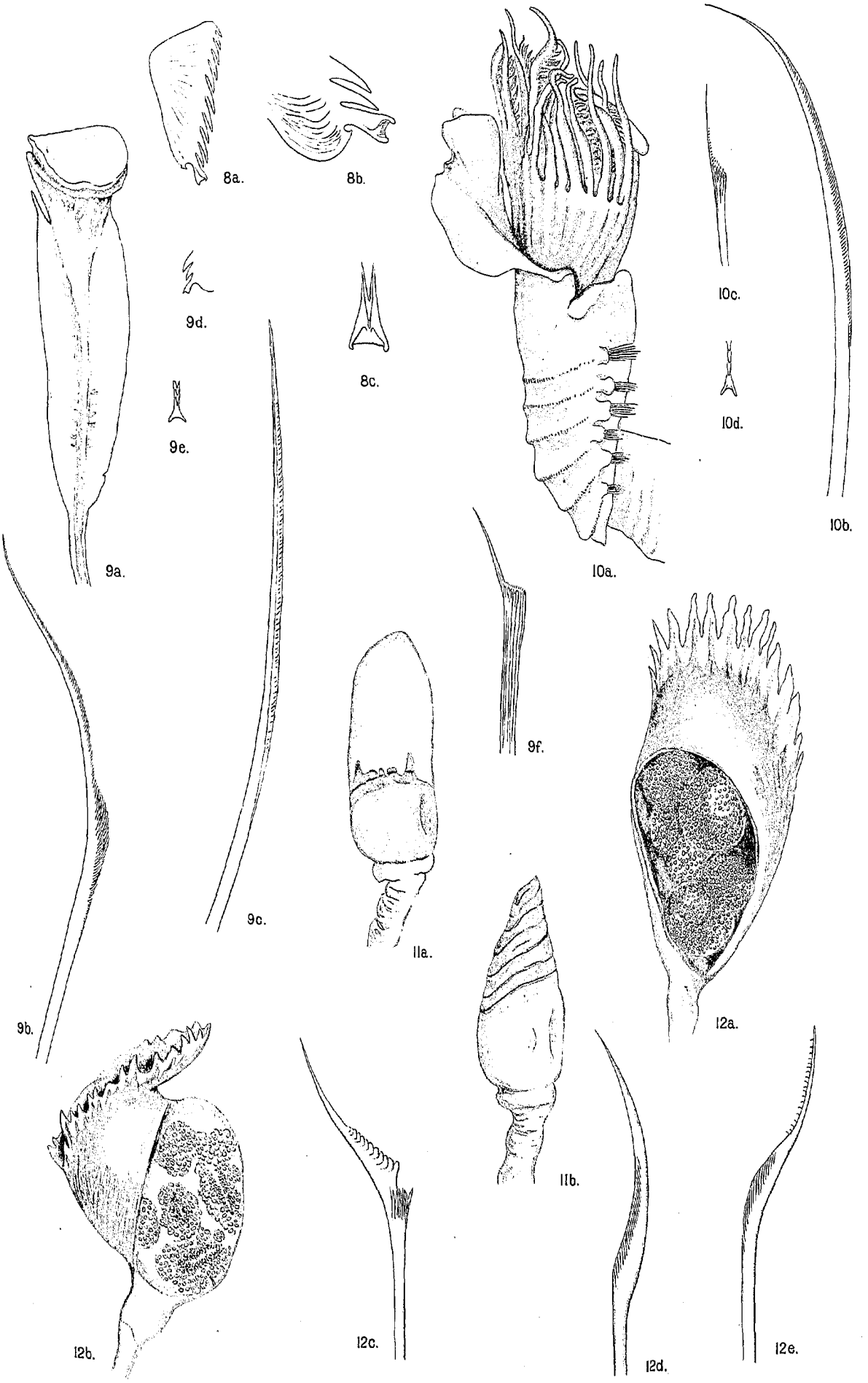
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