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DESCRIPTIONS OF NEW SOUTH AFRICAN FISHES.

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The following is a continuation of the description of new fishes procured on the South African Coast. It includes one new genus and seventeen new species, one of which may be a new genus, as follows:—

1. Serranus knysnaensis, n.sp. (*Serranidae*).
2. Pterois nigripinnis, n.sp. (*Triglidae*).
3. Histiopterus spinifer, n.sp. (*Squamipinnes*).
4. Lampris immaculata, n.sp. (*Lampridae*).
5. Cyttosoma boops, n.g. and sp. (*Cyttidae*).
6. Cottunculus macrocephalus, n.sp. (*Cottidae*).
7. Pseudorhombus natalensis, n.sp. (*Pleuronectidae*).
8. Pseudorhombus (?) andersoni, n.sp. (*Pleuronectidae*).
9. Platophrys dimorphus, n.sp. (*Pleuronectidae*).
10. Solea turbynei, n.sp. (*Pleuronectidae*).
11. Cynoglossus attenuatus, n.sp. (*Pleuronectidae*).
12. Cynoglossus brachycephalus, n.sp. (*Pleuronectidae*).
13. Arnoglossus macrolepis, n.sp. (*Pleuronectidae*).
14. Synaptura melanoptera, n.sp. (*Pleuronectidae*).
15. Solea fulvo-marginata, n.sp. (*Pleuronectidae*).
16. Synaptura ciliata, n.sp. (*Pleuronectidae*).
17. Chlorophthalmus punctatus, n.sp. (*Scopelidae*).
18. Scopelus argenteus, n.sp. (*Scopelidae*).

Fam. SERRANIDÆ.

Serranus kynsnaensis, n.sp.

(Plate XIX.)

D. X 14. A. III 7. Sc. 83 $\frac{8}{28}$. L. l. 72.

Depth of body $3\frac{1}{4}$ times in length; length of head equals depth of body. Snout slightly longer than diameter of eye, which is about $\frac{1}{4}$ the length of the head; interorbital width $5\frac{1}{4}$ in length of head; lower jaw projecting, with strong canines on the sides; maxillary extending to nearly below centre of eye; snout naked. Preoperculum and operculum scaly; preopercula finely serrated on both the posterior and lower border; opercular spines strong, the middle, which is equidistant from the upper and lower, is largest. Gill rakers long, 11 on the lower part of the anterior arch. Dorsal originating slightly behind extremity of longest opercular spine; first and second spine shortest, the rest not very unequal in length, and not separated from the soft rays by a notch; fifth spine equal to or slightly shorter than the longest soft ray, and a little over $2\frac{1}{3}$ in length of head. Caudal is somewhat imperfect.

The single specimen from which this description is taken was forwarded by Mr. Jackson, the Resident Magistrate at Knsyna, where it was found.

Fam. TRIGLIDÆ.

Pterois nigripinnis, n.sp.

Br. VII. D. XIII 9. P. 20. V. I 5. A. II 7. C. 12.

L. r. 35. L. tr. $\frac{5}{?}$.

Depth of body 3 times in length without caudal, $4\frac{1}{3}$ times with caudal. Length of head $2\frac{4}{5}$ in body. Diameter of eye a little less than length of snout, and contained 3 times in length of head. Interocular space $\frac{3}{5}$ diameter of eye, deeply concave. A long tentacle over orbit of eye, longer than breadth of interorbital space, with a black spot at its extremity. The wide posterior nostril is immediately in front of eye, the anterior about half way to end of snout, and provided with a long tentacle, almost as long as orbital tentacle, but without black spot. A long tentacle, about twice the diameter of the eye, hangs down from lower margin of preorbital bordering on the maxillary.

There are 35 rows of scales between temple and base of caudal; scales cover the head, including middle line of interorbital space, but not jaws, throat, and top of snout.

The pectorals reach nearly to the base of the caudal, the ventrals to about the 4th ray of the anal. None of the caudal rays are prolonged.

Colour (in formalin): Dorsal fin mottled with black, anal and caudal with scattered black dots, ventral and pectoral black, body brownish.

This new species seems nearest to *P. macrurus*, Alcock.

Locality: Three specimens were found $2\frac{1}{2}$ miles off the Umhlanga River mouth (Natal). Depth, 22 to 26 fathoms; bottom, fine sand The largest of these was 85 mm. in length (including caudal).

Fam. **SQUAMIPINNES.**

Histiopterus spinifer, n.sp.

(Plate XXI.)

D. IV 26. A. III 10. P. 17. L. l. 64. C. 4 + 17 + 2.

Height of body a little over $2\frac{2}{5}$ in length, the highest point being at the last spines of the dorsal. Head $1\frac{2}{3}$ in height of body; snout $2\frac{1}{2}$ in head. Diameter of eye $3\frac{3}{4}$ in length of head, nearly equal to the interorbital space, which is slightly concave. Small clusters of spines, which might rather be designated tubercles, occur (1) in the median frontal region just behind the head, (2) over the orbit, (3) above the upper angle of the opercular opening, (4) at the angle of the pre-operculum, and (5) above the maxillary. The scales of the body are small and ctenoid. On the head they are only present on the cheek and above the operculum, being absent on the frontal region, snout, operculum, and apparently the lower jaw.

The teeth are small, forming a broad band in both jaws. There are none on the vomer or palatines.

The dorsal fin is very high, its longest ray being longer than the height of the body in the proportion of 11 to 10. It is covered at its base by scales. The ventrals extend to beyond the root of the caudal, and are longer than the depth of body. The anal extends to about the posterior third of the caudal.

Colour: The body (in spirit) is an uniform dark brown, becoming almost black on the fins.

Only one specimen was procured by trawl.

Locality: Mossel Bay; depth, 30—36 fathoms; bottom, mud.

MEASUREMENTS OF SPECIMEN

Height of body	50 mm.
Length „ „ (without caudal)	72 „
„ „ head	30 „
„ „ snout	12 „
Diameter of eye	8 „
Length of ventral	45 „
„ „ pectoral	24 „
Longest ray of dorsal	55 „

Fam. LAMPRIDÆ.

Lampris immaculata, n.sp

(Plate XXII.)

Br. 6. D. 54. A. 36. V. 14.

Depth of body a little under $\frac{1}{2}$ the length (exluding caudal), length of head $3\frac{2}{5}$, diameter of eye about $5\frac{2}{5}$ in length of head and more than $\frac{1}{2}$ the interocular space.

Pectorals rounded, $1\frac{2}{5}$ in length of head. Anal has the first rays longer than those immediately succeeding them. Other fins as in *L. luna*.

The paired and unpaired fins are of a deep red colour. Snout, lips and region anterior to the eyes of the same colour, but less marked. Edge of pre-operculum, of operculum and posterior margin of gill opening, tongue and throat, including inner surface of rather long gill rankers and branchial arches, are similarly coloured. Body of a dark steel blue colour above, lighter and greenish below, the whole, including that part of the head posterior to the eye, with a suffused rose red colour. There are no white spots on any part of the body.

The lateral line is well marked, each scale, with a single unbranched tube, being of a bright red colour. These spots are continued forward from the anterior end of the lateral line in two directions, one arching upwards and forward to the top of the head, the other forward over the eye to the end of the snout. These, about half-a-dozen in each line, were of the same deep red as the pierced scales of the lateral line, and had a simple mucous pore in the centre.

The tongue is narrow, free and smooth as Lowe describes it in his specimen, and without the asperities noted by other observers. No large scale was found before the anal, but the pits above and below the caudal peduncle were present. The pyloric caecae were very numerous.

I have hesitated to describe this form as a new species as it agrees in many particulars with the Northern form which has been found to vary considerably. In general proportion of the body and fin formula it cannot be separated from *L. luna*, but the anterior elevation of the anal fin, the entire absence of spots on the body and the presence of marked lines of mucous pores over the head, which could hardly escape the notice of other observers, seems to indicate that it belongs to a different species. The pectorals are shorter and more rounded, but this may be an age characteristic.

The anterior elevation of the anal fin is of interest from a systematic point of view, as connecting the isolated family of the Lampridae with the Scombridae.

The specimen described was found on the 2nd August, 1902, cast up on the beach at Muizenberg, in False Bay, and was quite unknown to the fishermen at that place or at the adjacent Kalk Bay. Unfortunately, when procured, it was somewhat damaged, the right jaw being torn off, the left pectoral and both eyes gone. It was, however, in a perfectly fresh state. When placed in formalin the brilliant red of the fins rapidly faded.

There is a stuffed specimen in the South African Museum, found on the shores of Table Bay in the year 1887. There are well marked large white spots painted on this fish, but that this is an error of the taxidermist copied from a figure is very probable, as a note by Mr. Trimen in the records of the Museum undoubtedly refers to this fish, viz. :—"A Lampris (red and without spots) found stranded in Table Bay, 4th April, 1887. Length 3 ft. 7 in." The elevated anterior rays of the anal are even more marked than in the specimen described. The pectorals are not, however, so rounded.

The following measurements are those of the fresh specimen from Muizenberg :—

Length of body, excluding tail	805	mm.
„ „ to end of middle caudal ray...	880	„
Depth „	380	„
Greatest thickness	143	„
Longest ray of dorsal	185	„
„ „ ventral	170	„
„ „ pectoral along curve	200	„
„ „ „ from tip to base	174	„
Length of head	245	„
Diameter of eye	46	„ ?
Interocular space	85	„

Fam. CYTTIDÆ.

Cyttosoma, n.g.

Body compressed and elevate, head not so much compressed. Upper profile concave. Eyes very large, scales small, deciduous and replaced by spiny tubercles on head, nape of the neck (to 1st dorsal), thoracic and abdominal regions and by hard spiny scales along bases of dorsal and anal fins. Dorsals nearly separate, being joined by very low membrane, the first having seven spines and much shorter than the second. There are three anal spines. Rays of dorsal 29, anal 28, pectoral 22, and ventral 7; pectoral and ventral well separated. Minute teeth in lower jaw, none in upper jaw, vomer or palatine bones. Branchiostegals 7.

Cyttosoma boops, n.sp.

(Plate XXIII.)

Br. VII. D. VII 29. A. III 28. V. I 7. L. l. 100 (approx.).

The upper jaw is very protractible and can be drawn out $1\frac{1}{2}$ times its normal distance from the eye. The greatest depth of the body is $2\frac{1}{2}$ times the diameter of the eye, and is contained a little more than $1\frac{3}{4}$ in total length which is 158 mm. (mouth closed). The length of the head is contained $2\frac{1}{2}$ times in the body. Interorbital space $1\frac{3}{4}$ diameter of the eye. The lower ridges of the mandible serrate. Opercular bones are not serrate. The superior profile of the body rises abruptly behind the eye to the origin of the dorsal and continues backwards in the form of a thin ridge with straight border to within a distance from the root of the caudal equal to about $\frac{1}{4}$ of its length. The ventral profile is somewhat similar, though not so pronounced. The ridge here begins under the vertical from the commencement of the soft dorsal. It has the same straight outline. The soft rays of the anal are somewhat longer than those of the dorsal. The inter-maxillary can be received into a horse shoe shaped space which extends backwards to over the centre of the orbit. It is in length $1\frac{1}{2}$ times the interocular width. The maxillary is of the same length.

The nostrils are placed close together in front of an anterior protuberance of the supra orbital ridge. The pseudobranchiæ are well developed and the gill rakers are stout, short and lamelliform.

There are about 100 scales on the lateral line which extends on to the caudal. The greatest height of its anterior curve is below the commencement of the first dorsal; from this point

it gradually descends till under the 15th soft ray, when it continues backward in a straight horizontal line.

The scales of the body are thin and deciduous, circular and with concentric striæ only. On the middle region from the commencement of the dorsal to about the anterior margin of the orbits they assume the form of rough tubercles. The same occurs in the ventral region between the beginning of the anal and the isthmus. One or two enlarged scales occur on the body under the dorsal spine.

There are about 40 bony scales provided with low spines along the base of the dorsal and about the same number along the base of the anal. Two short bony ridges extend backwards from the posterior region of the eye.

Locality: The single specimen procured was obtained by trawl, Vasco de Gama Peak (near Cape Point) bearing N. 40° E., distance, $13\frac{1}{2}$ miles; depth, 120 fathoms; bottom, rough.

Fam. **COTTIDÆ.**

Cottunculus macrocephalus, n.sp.

(Plate XXIV.)

D. IV 11. A. 11? V. 3. P. 20.

Length of head one-half the length of the body. Depth of body $3\frac{4}{5}$ in length; diameter of eye $3\frac{3}{5}$ in head, or one-half depth of body. Snout nearly equal to diameter of eye.

Head and body covered by smooth loose scaleless skin. No bony tubercles on the head apparent. The posterior extremity of the maxillary is broad, $3\frac{1}{3}$ in diameter of eye, and falls in the vertical just in front of the centre of the eye.

The dorsal fin commences on a line between the posterior margins of the opercula. The anterior spines are short, and scarcely penetrate the skin. The soft rays extend backwards to near the tail. They fall nearly within the same verticals as the anal fin. The ventrals with 3 rays scarcely reach the vent, which is a little behind the vertical from the posterior edge of the operculum. The distance of ventral from end of snout about $\frac{1}{3}$ length of body.

Colour: Light brown dorsally, colourless ventrally.

Locality: Lion's Head, bearing S.E. $\frac{1}{4}$ S., distant 50 miles; depth, 230 fathoms; bottom, green mud; and South Head, bearing E. by S., $\frac{1}{2}$ S., distant 25 miles; depth, 190 fathoms; bottom, green sand and black specks.

Fam. PLEURONECTIDÆ.

Pseudorhombus natalensis, n.sp.

(Plate XXV.)

D. 67. A. 52. V. 6. L. l. 62.

Head $3\frac{1}{4}$ times, depth of body a little over two times in length of body, without caudal. Diameter of eye $\frac{1}{3}$ length of head. Eyes on left side, the lower slightly in advance of the upper, close together, divided only by a ridge. The distance of lower from the end of the snout is $1\frac{1}{2}$ in the diameter of the eye. The lower jaw projects slightly beyond upper. The posterior end of the maxillary falls in the vertical between the anterior margin and the centre of the eye. Teeth: about 20 in lower jaw, a few more in upper, slightly more developed on blind side.

The dorsal fin commences in front of the upper eye, just behind a small indentation on the snout. The first ray is partially free, being attached to an inter-radial membrane for about $\frac{1}{3}$ of its length, the second to the fifth approach gradually the form of the remaining rays, viz., with tips free only. All the rays are simple but the last two, which are small and bifurcate. The longest is in the posterior third, and is $2\frac{2}{5}$ in length of head. The anal has the last three rays branched. Left pectoral is $1\frac{2}{3}$ in length of head, the right pectoral a little more than one-half the left. The pre-anal spine is very slight. Caudal is wedge-shaped, with upper and lower border of posterior margin slightly concave.

Scales: Ctenoid on the left, cycloid on the right side. Lateral line with strong anterior curve for about $\frac{1}{4}$ of its length, the height of the curve being a little more than $\frac{1}{2}$ its length; the nucal branch ends about $\frac{2}{3}$ of the way towards the 8th ray of the dorsal fin; a branch starting from the same origin, proceeds to the interorbital region, giving off on its way another branch towards the pre-operculum.

Colour: Body covered with dark brown ring-shaped spots of fairly constant arrangement. Heads and fins with smaller spots.

Length of the largest specimen (including caudal), 132 mm.

Locality: Cape Natal bearing W. by N., distant $6\frac{1}{2}$ miles; depth, 54 fathoms; bottom, fine sand.

Pseudorhombus.

The apparent generic characters of this fish may be described as follows:—Eyes partly on left side, the upper occupying a crescentic gap between the dorsal fin and the head, and nearly in the vertical middle line of the head; mouth wide, the length

of the maxillary more than $\frac{1}{3}$ that of the head; teeth in a single series in both jaws, those in front slightly larger; interorbital space a mere ridge; dorsal commencing on a prominence which projects forward over the upper eye.

This definition approaches so nearly that of the genus *Pseudorhombus* in some respects (teeth, length of maxillary, etc.), that until more specimens are procured, its validity as a separate genus, and not merely an abnormality, must be received with some doubt. The peculiar feature which distinguishes it from *Pseudorhombus* is the near approach to the original bilateral symmetry of the head, and such variation, though very striking, is perhaps to be expected in a character of so recent an origin philogenetically. It apparently, however, does not belong to either of the three species of *Pseudorhombus* already recorded from this region (*P. russelli* from the Umbilo River, Port Natal, recorded by Günther, *vide* Catalogue, Vol. IV., p. 424; and the new species described above). It differs from these, and all the Indian species recorded by Day, in having the scales ctenoid on the blind side and it apparently belongs to an undescribed species.

Pseudorhombus andersoni, n.sp.

(Plate XXVI.)

D. 74. A. 54. L. l. 85.

Depth $\frac{1}{2}$, head $3\frac{5}{8}$ in length (excluding caudal). Eyes close together separated only by a ridge in diameter a little more than $\frac{1}{3}$ the length of the head, and equal to the distance between the lower and the end of the snout. The maxillary reaches to below the hind third of the eye. Teeth: about 12 in the lower jaw on the left side, 8 on the right. The dorsal fin commences at the tip of the projection which is about $1\frac{1}{2}$ times in the diameter of the eye. The pectorals are about equal, and one half the length of the head. The caudal was somewhat damaged, but appeared to have been wedge shaped, the middle ray (32 mm.) being apparently the longest.

The scales are ctenoid on both sides; the anterior curve of the lateral line is well marked, its depth being about a third of its length. The dorsal branch of the lateral line goes to the 9th ray of the dorsal. Scales occur on the rays of the dorsal and anal. Any colour that may have been present has been entirely removed by the spirit in which the specimen had been preserved for a long time.

Total length, including caudal, 176 mm.

Locality: The single specimen was found in Durban Harbour by Mr. A. Anderson to whom we are indebted for this and other valuable specimens.

Platophrys dimorphus. n.sp.

(Plate XXVII.)

D. 87. A. 72. V. 6. L. l. 50.

Depth of body $1\frac{4}{5}$ in length without caudal; length of head $4\frac{1}{8}$; longitudinal diameter of eye about $3\frac{1}{2}$ times in head, $1\frac{1}{2}$ in interorbital space (in the male, less than 1 in the female) and less than the distance of the lower from the end of snout. The posterior margin of the lower eye is near the vertical from the anterior margin of the upper. Lower jaw projects beyond upper; the maxillary scarcely reaches to the anterior border of the lower eye. In the male there is a strong spine in front of the lower eye projecting beyond the profile of the snout and a few tubercles on the (morphologically) upper margin of the orbit of either eye. These are absent in the female. A further sexual distinction is the presence of cutaneous flaps on the posterior margin of the eye in the male only. Teeth: a single row of fine setose teeth on the upper and under jaws.

Rays in anterior half of dorsal the longest, about $1\frac{3}{5}$ in head. The first two or three anterior and posterior rays are to the right of the median line. Left pectoral, excluding prolonged ray, a little less than the length of the head; with prolonged ray, which is usually though not invariably present in the male, it is $1\frac{3}{5}$ in the length of head. The right pectoral is smaller than the left about $1\frac{3}{4}$ in the length of the latter. The right ventral is in the middle line in advance of the left which is entirely on the side. The posterior extremity of the left reaches beyond that of the right. The left is coloured, the right being uncoloured.

Scales: Ctenoid on the left side, cycloid on the right, the lateral line has anteriorly a strong curve whose depth is about half its length.

Colour: Male, dark grey with minute black dots on anterior border of region between the eye and on ocular flaps, female of the same colour with the addition of dark spots or blotches often arranged in rows of 3 or 4 along the middle of the body and on either side above and below it.

Locality: $2\frac{1}{2}$ miles off Umhlanga River mouth (Natal); depth, 22-26 fathoms; bottom, fine sand.

Solea turbynei, n.sp.

(Plate XXVIII.)

D. 65. A. 52. L. l. 94 Vert. 8 + 25.

Depth slightly over $2\frac{1}{2}$, head 4 in length of body (without caudal). Diameter of eye $5\frac{1}{2}$ in head. Upper in advance of lower, by about a half diameter. Interorbital space $\frac{1}{2}$ the

diameter of the eye. Mouth extends nearly to below centre of lower eye. Lips not as a rule fringed—of 10 samples, one had one papilla on the upper lip, and another had a few on both. Papillæ on left side of head, close up to dilated left nostril, which is not fringed. The margin of the operculum has also papillæ, and there are a few at the base of the pectoral on the inner border of the opercular opening.

Dorsal commences on snout above the level of the upper margin of the upper eye, and extends to near caudal fin. Longest ray 3 times in head. Length of free portion of caudal is contained 3 times in its depth. Right pectoral, which is scaled at the base to about $\frac{2}{3}$ of its length, is contained $2\frac{1}{2}$ times in length of head, left pectoral slightly less.

Scales: Ctenoid on both sides. The lateral line contains about 94 pierced scales, crossed by about 108 rows of scales. The dorsal branch of the lateral line rises abruptly towards the 10th ray, and then bends forward in a sharp curve to run parallel with the dorsal to the snout.

Colour: Light slate colour, with numerous black dots on head, body and vertical fins. There is a black patch on the right pectoral and sometimes on the left.

Locality: Numerous specimens have been found in the work of the Government steamer, under the charge of Captain Turbyne, after whom the specimen is named. They were procured at Mossel Bay (18 fms. fine sand), and other localities.

Cynoglossus attenuatus, n.sp.

(Plate XXIX.)

D. 103. A. 90. C. 9. V. 4. L. l. 84—86.

Height $4\frac{1}{8}$ in length without caudal, $4\frac{1}{2}$ with caudal. Length of head $1\frac{1}{5}$ in height of body. Height of head $\frac{7}{8}$ of its length. Diameter of eye $\frac{1}{10}$ the length of the head, 4 times in its distance from the snout. The upper in advance of the lower, the lower one situated slightly in front of the middle of the head; interorbital space about $\frac{1}{2}$ of the diameter of the eye. The angle of the mouth is behind the posterior margin of the lower eye, and behind the centre of the head. One nostril between the eyes, and another in front of the lower, on a level with its lower margin. One ventral fin scarcely attached to anal.

Scales: Ctenoid on the coloured, cycloid on the blind side. Lateral lines, two on the coloured side separated by 12 rows of scales, two on the blind side.

Colour: Uniform brown.

Locality: Tugela River mouth bearing N. by W., distant $4\frac{1}{2}$ miles; depth, 24 fathoms; bottom, mud.

Cynoglossus brachycephalus, n.sp.

(Plate XXX.)

D. 107. A. 82. V. 4. C. 9. L. l. 76. L. tr. 14.

Depth of body 4 to $4\frac{1}{4}$, length of head $5\frac{2}{5}$ in length without caudal. Diameter of eye 6 to $6\frac{1}{2}$ in length of head. Eyes close together, orbits almost touching each other, upper slightly in advance of lower, posterior margin of lower in the middle of the length of the head. Greatest height of head more than its length. Angle of the mouth falls under the centre of the lower eye. Rostral hook in front of the anterior margin of the upper eye. Two nostrils, one on the anterior part of the interocular region, the other, with rather long tube, above the lip before the lower eye.

There is only one ventral fin (the left?). It is slightly attached to the anal.

The scales are ctenoid on both sides. There are two lateral lines on the left side separated by 14 rows of scales; no lateral line on the right side.

Colour: Body light brown with darker markings. The fins are strikingly coloured, being light brown with patches of very dark brown at short intervals. A patch of dark brown occurs on the caudal rays.

Locality: $2\frac{1}{2}$ miles off Umhlanga River mouth (Natal); depth, 22-26 fathoms; bottom, fine sand.

Arnoglossus macrolepis n.sp.

(Plate XXXI.)

D. 72. A. 50. L. l. 47.

Depth $2\frac{1}{2}$, head a little over $3\frac{1}{2}$ in length (without caudal). Longitudinal diameter of eye $4\frac{2}{5}$ in head. Eyes on left side, the upper slightly in advance of lower. Interocular space a mere ridge. Jaws with a single series of small teeth; lower jaw projecting beyond upper; maxillary extends to a point between centre and posterior of lower eye, and is nearly equal one half the length of the head. An open nostril in front of interorbital ridge with a tubular one anterior and superior to it. Of the corresponding nostrils of the right side the tubular one is on the snout in the middle line in front of the upper eye and the other is on the right side, is large and covered by a flap which is in a line with the dorsal fin. Gill openings are wide; a flap of skin (the continuation of the opercular membrane) is folded over from the left jaw to cover the right.

The dorsal commences on the snout a little to the right of the median line. The rays are divided and gradually increase in length to the third from the end, which is longest and $2\frac{3}{10}$ in

head. The anal is pretty similar to the dorsal, but the first and last rays are longer than the corresponding ones in the dorsal. The left pectoral is a little over $\frac{1}{2}$ the length of the head; the right pectoral slightly less than the left. The caudal is covered with scales to about half its length, which is about $\frac{1}{3}$ of that of the body.

Colour: Light brown with a few black patches on body and on vertical fins. Two black patches on the body at the extremities of dorsal and anal well marked and seemingly constant.

Locality: Tugela River mouth (Natal) bearing North; distant 22 miles; depth, 63-73 fathoms; bottom, mud.

Synaptura melanoptera, n.sp.

(Plate XXXII.)

D. 92. A. 70. L. l. 128.

Height 3·4, head 4·3 in body without caudal. Eye $5\frac{1}{5}$ in head, 8 times interocular width. Eyes close together, upper in advance of lower by $\frac{1}{2}$ a diameter. Angle of mouth under centre of lower eye. Gill cleft feebly fringed. Left nostril dilated, a space free from papillæ surrounding it, extending to mouth. Dorsal commences in front of centre of upper eye and extends to caudal, with which it is slightly confluent at lower half of last ray. Longest ray in centre 2.3 in head. Right pectoral 4 in head the same length as left pectoral. Ventrals symmetrical equal in length to pectorals. Scales ctenoid on right and left sides. Total length 83 mm.

Colour: All fins, except left pectoral which is colourless, are jet black, the extremity of the right pectoral tipped with white. The right side is light brown with large patches of darker.

Locality: Lat. 33° 6′ 45″ S., long. 27° 55′ 45″ E.; depth, 43 fathoms; bottom, sand, shells, and mud.

Solea fulvomarginata, n.sp.

(Plate XXXIII.)

D. 78-80. A. 61-65. L. l. 106-108.

Depth $2\frac{2}{3}$, head $5\frac{1}{3}$ in length of body (without caudal). Longitudinal diameter of eye a little less than $5\frac{1}{3}$ in head, upper in advance of lower by about half a diameter. Vertical diameter about 7 times in head and a little more than interorbital space. Mouth extends to below centre of lower eye.

Dorsal commences on snout at the level of the upper margin of the upper eye and extends to base of caudal. Longest ray $\frac{1}{2}$ the length of the head, the posterior extremities of the dorsal and anal are situated over the last vertebra and their posterior margins are almost vertical. The right pectoral, which is devoid of scales at its base, is $6\frac{1}{3}$ in head, the left pectoral being slightly longer.

Scales: Ctenoid on both sides. The lateral line is straight and difficult to make out.

Colour (in fresh state): Lemon yellow, most marked on the margins of all the fins, except the left pectoral, which is colourless. Cloudy patches of dark colour occur on the body, sometimes extending on to the bases of the vertical fins, and the whole is speckled with dark and white dots. The blind side is strikingly coloured, the dorsal, anal and caudal being of a bright lemon yellow, which at places extends slightly on to the body. The rest of the blind side is colourless, including left pectoral and papillæ of head region. (The yellow colour entirely disappears from the fish after being in alcohol a short time.)

Locality: Occasionally procured by seine net in False Bay.

Synaptura ciliata, n.sp.

(Plate XXXIV.)

D. 76. A. 63. V. 3. L. l. 100.

Height 2·7, head 5 in body (without caudal). Eye 8·5 in head, a little less than double interocular width, upper in advance of lower; angle of mouth below centre of lower eye. The lips and border of gill clefts are fringed, and the whole of the head and body of coloured side is covered with hair-like processes. A fringed dermal flap at nostril of blind side.

The dorsal commences on the snout at the level of the centre of the upper eye. The rays gradually increase in size to the last, which is confluent with caudal. The anterior are fringed on the left side. The longest ray 2·3 in head. The right pectoral is 4·25 in head. The left pectoral is slightly longer and broader. The ventrals are very small, the right $2\frac{2}{3}$ in pectoral, and a little less developed than left ventral.

Colour: Body dark brown, with darker specks, head almost black, vertical fins light brown, with dark spots, margin white. Right pectoral black, with brown tips. Pectoral and ventral of left side colourless, as is whole of left side.

Near *S. marginata*, Blgr., but has shorter paired fins, origin of dorsal further forward, body covered with short filaments.

Locality: Inner Harbour, Durban (Natal).

Fam. SCOPELIDÆ.

Chlorophthalmus punctatus, n.sp.

(Plate XXXV.)

Br. 8. D. 12. A. 9. P. 15. V. 9. L. l. 56. L. tr. $\frac{5}{10}$.

Length of head a little less than 4 times in that of body. Diameter of eye 2·6 times in length of head. Interorbital space a little more than $\frac{1}{2}$ the diameter of the eye.

The first rays of the dorsal fin are in front of the ventrals, and the distance between the adipose fin and the dorsal about equals the distance between the dorsal and anterior margin of the eye. The pectorals are also equal to this distance, and they do not reach the tip of the ventrals, which are nearly $\frac{8}{9}$ the length of the head.

Very fine teeth, or asperities, can be distinguished on the roof of the mouth. The margin of the scales have denticulations (2—3).

Colour (in spirit): Dark brown patches at nape of neck, anterior and posterior of dorsal fin, between this and adipose fin. Patches of the same colour occur on the side of the body. The head, body, and fins are covered with minute black spots, which cause the rows of scales to stand out very markedly, especially those in a direction descending obliquely backwards.

Locality: The three specimens procured were obtained by shrimp trawl, Lion's Head bearing N. 63° E., distant 34 miles; depth, 154 fathoms; bottom, black specks.

Scopelus argenteus, n.sp.

(Plate XXXVI.)

D. 14. A. 15. L. l. 38.

The depth of the body is contained 5 times in its length; the length of the head $3\frac{1}{5}$ times. The diameter of the eye is contained 4 times in the length of the head. Snout $1\frac{1}{2}$ the diameter of the eye. Mouth wide, premaxillary reaching nearly to the angle of the pre-operculum, the space between the posterior margin of the eye and the border of the pre-operculum is a little longer than half the diameter of the eye.

The origin of the dorsal fin is nearly midway between the tip of the snout and the posterior extremity of the adipose fin; it is slightly in front of the point of insertion of the ventral fin. The pectoral fin reaches to the insertion of the ventrals, not beyond.

Colour: Dark brown along the dorsal region of the body,

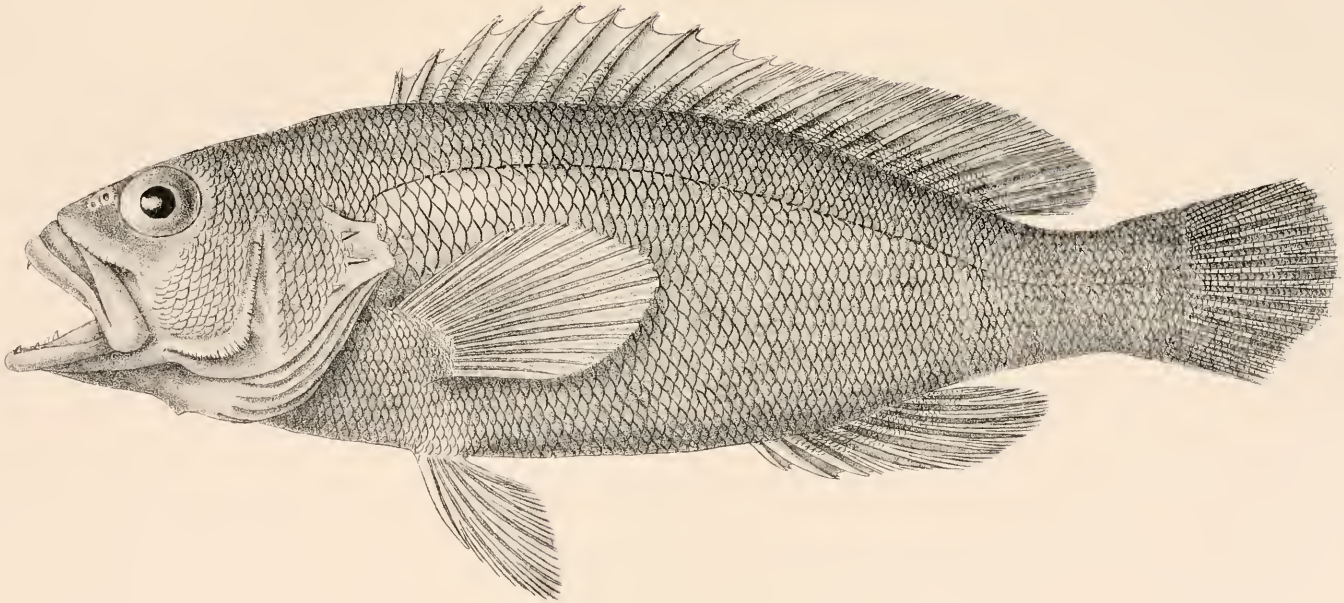
reaching about half way to the lateral line, and a less marked tinge of brown along the ventral region. In the middle of the body this colouring matter is nearly absent, and the scales have a bright silvery appearance.

The luminous spots are arranged as follows: Caudal 5 (in this respect differing from all other species of Scopelus and affording a ready diagnostic character); postero-lateral 1; anal 8 + 5 extending from origin of anal to midway between its posterior end and beginning of caudal fin, medio-lateral ("supra-anal" of Lütken) 3 in a line with the last of the ventrals and forming an oblique series; antero-lateral, 1 between ventral fin and lateral line; abdominal 5 in a curved line: thoracic 5, 3 in a line with mandibular and lower opercular, and 2 higher up in front of insertion of ventral; pectoral 3, 2 immediately below and 1 above insertion of pectoral fin; opercular 2, the lower situated behind the angle of the mouth in a line with mandibular; mandibular 3, antorbital 1, somewhat indistinct, on front margin of the eye a little below nostril.

Besides these luminous organs, there is a patch of luminous scales above and below the caudal region, and the snout is covered by soft glandular tissue, probably luminous in function.

Locality: Constable Hill (near Saldanha Bay) bearing E. ¾ S., distant 19½ miles, and Green Point bearing S.E. by E. ½ E., distant 36 miles; also South Head bearing E. by S. ½ S., distant 25 miles.

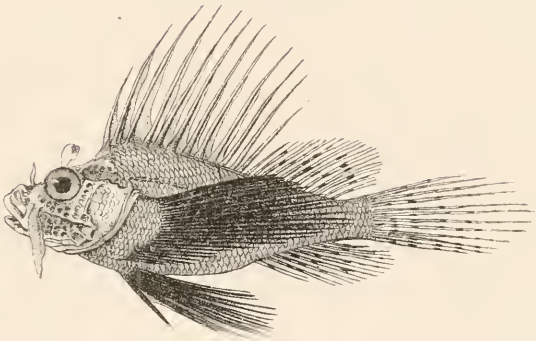
Published 1st March, 1904.



F. Newdigate del.

J. Green lith.

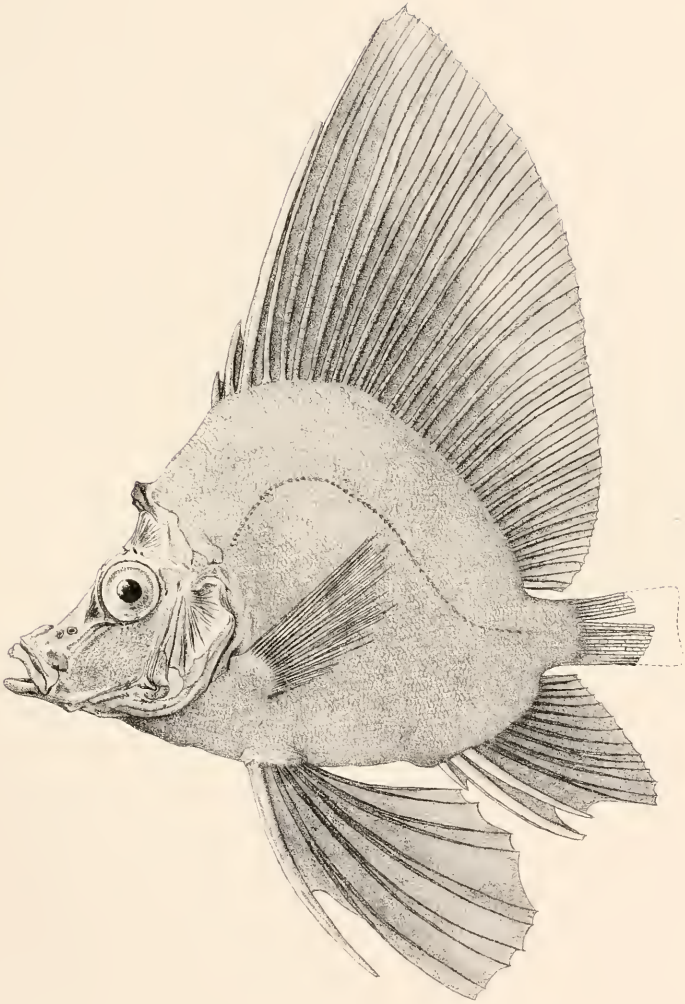
SERRANUS KNYSNAEUSIS n. sp.



P. Mc Manus del

d. Green lith

PTEROIS NIGRIPINNIS, n.sp



P. McManus del

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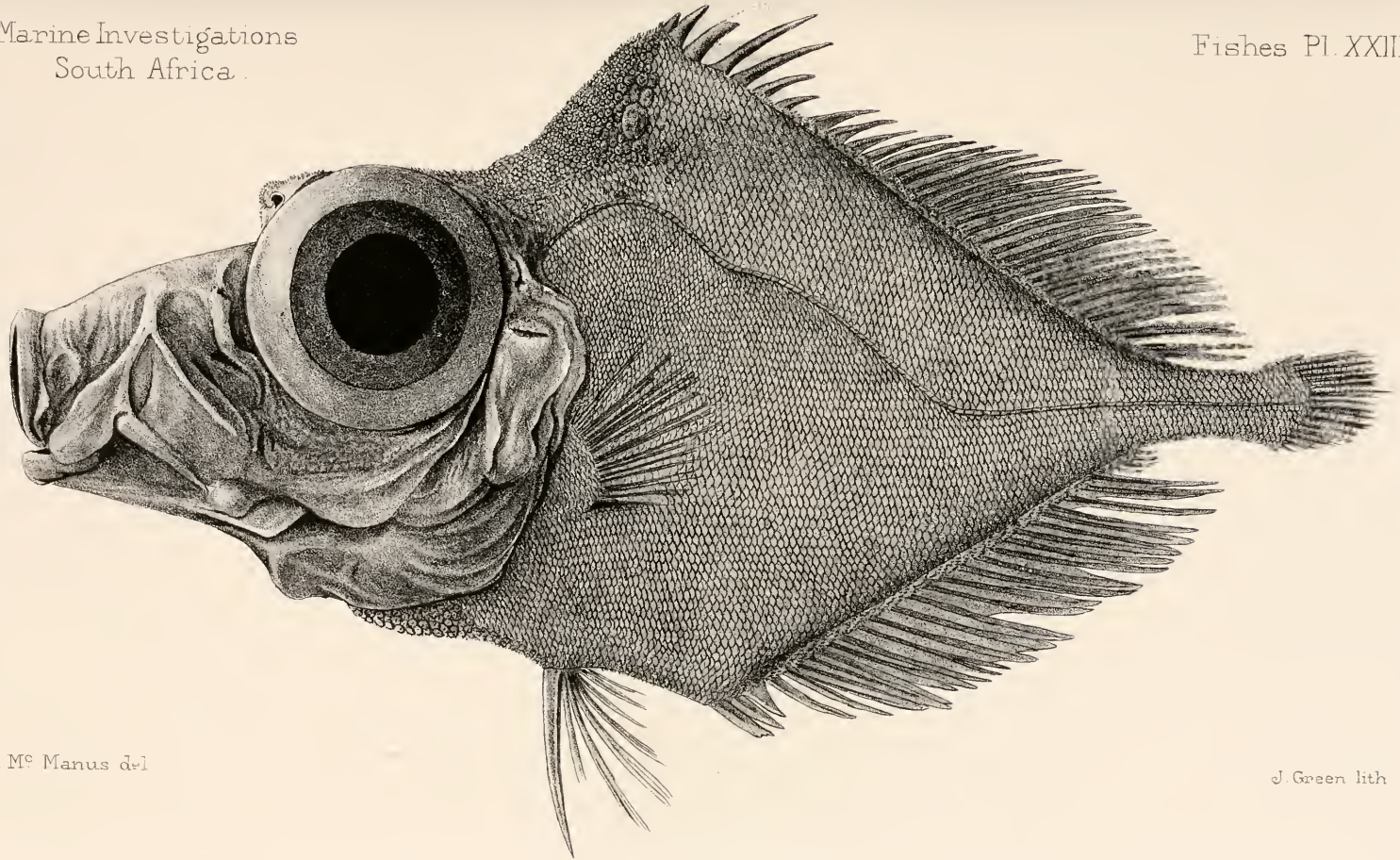
HISTIOPTERUS SPINIFER. n. sp

F. Newdigate del.

J. Green lith.

LAMPRIS IMMACULATA. n. sp.



P. Mc Manus del

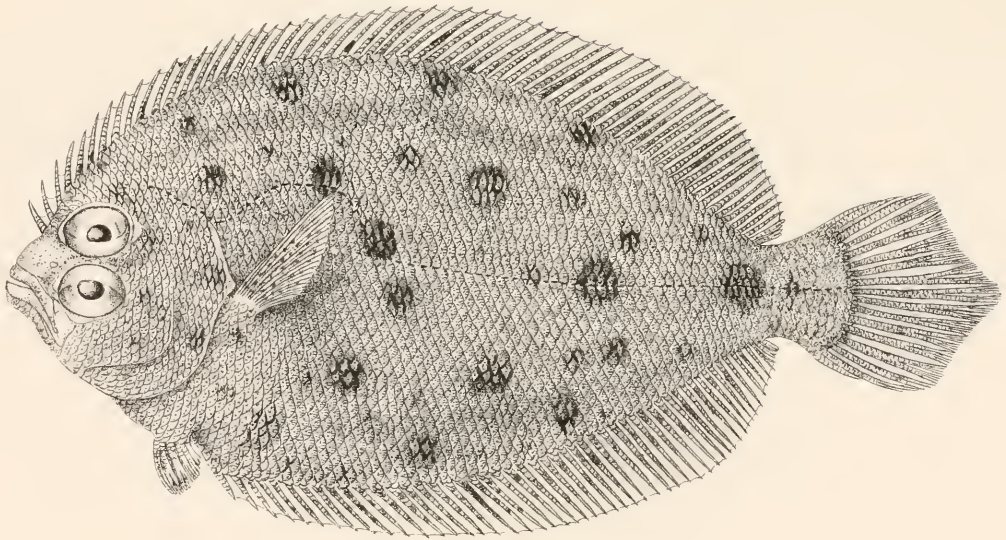
J. Green lith

CYTTOSOMA BOOPS, n.g, et sp.

P. Mc Manus del.

J. Green lith.

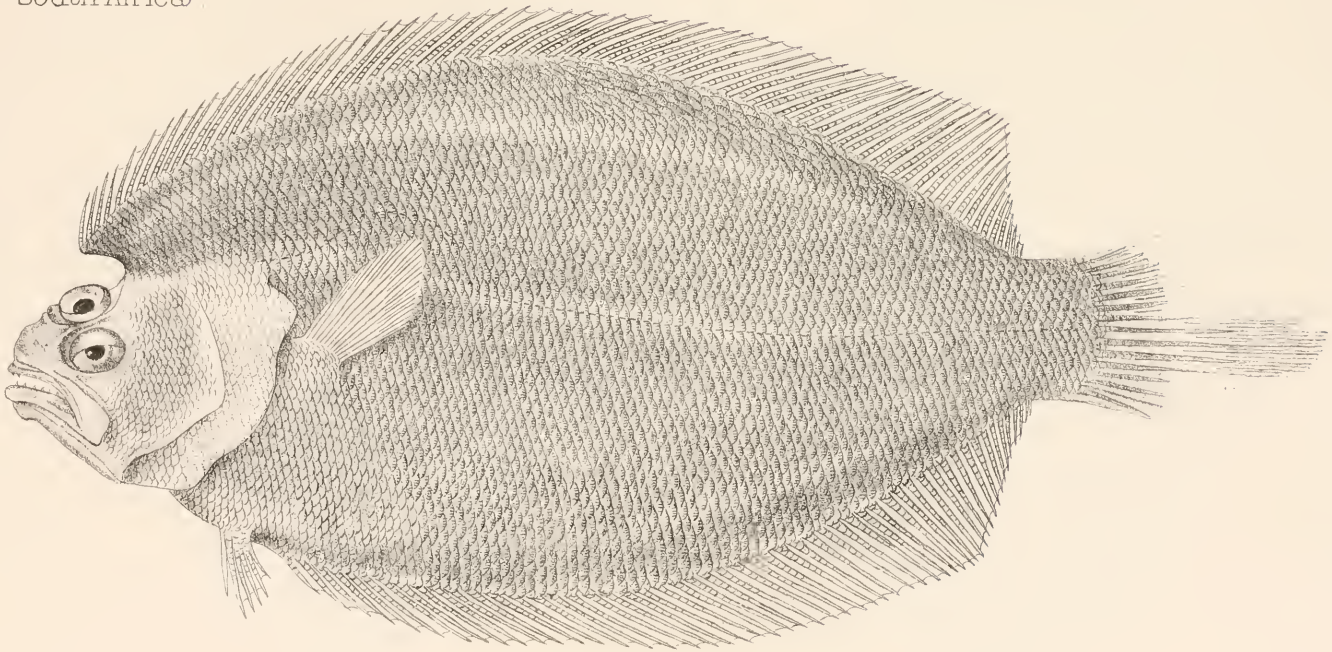
COTTUNCULUS MACROCEPHALUS. n. sp.



F. Newdigate del.

J. Green lith.

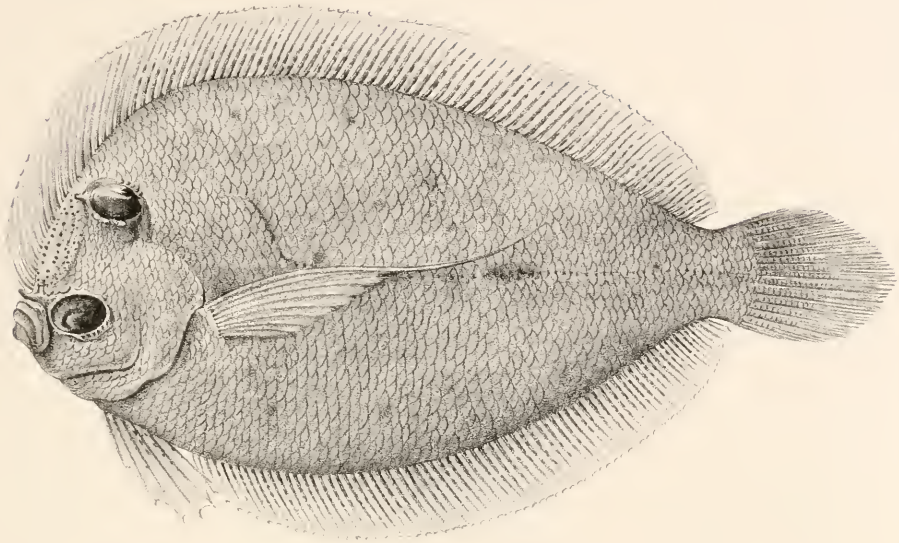
PSEUDORHOMBUS NATALENSIS. n. sp.



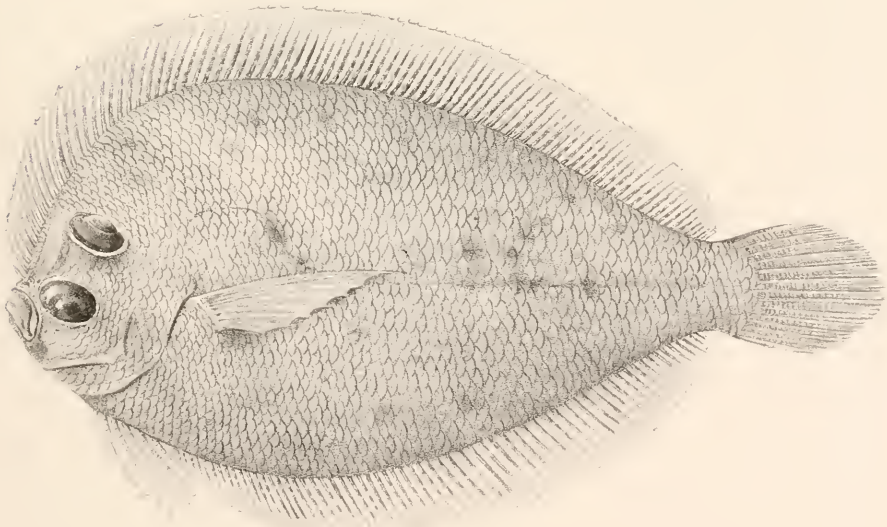
F. Newdigate del

J. Green lith

PSEUDORHOMBUS ANDERSONI, n.sp.



a

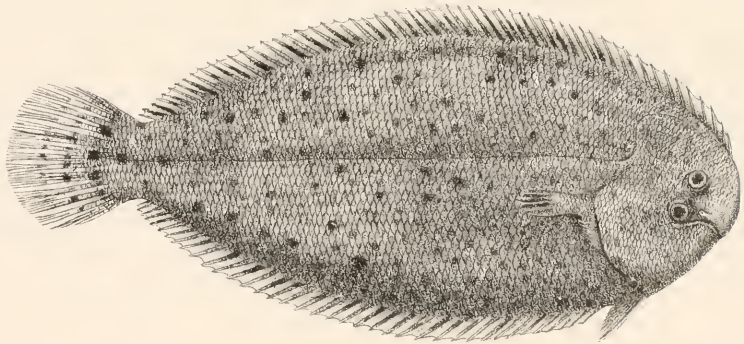


b

P. McManus del.

J. Green lith.

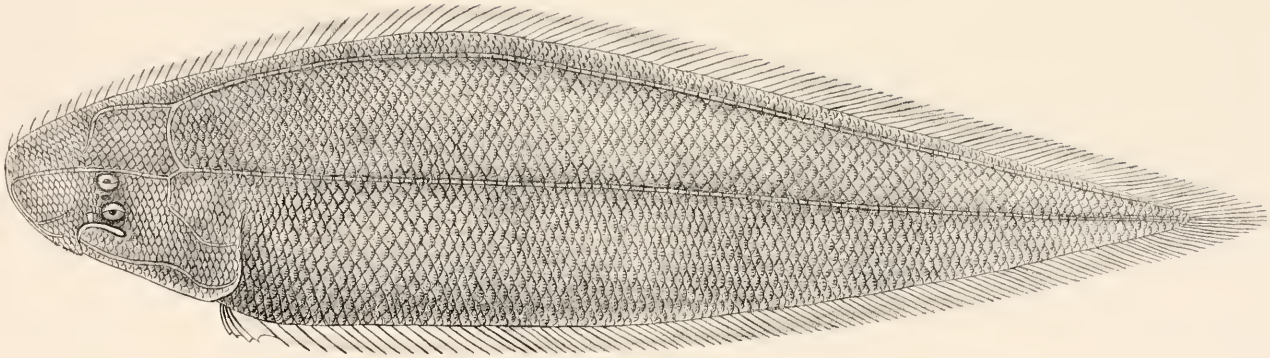
PLATOPHRYS DIMORPHUS. n. sp.
(a male b. female)



P. McManus del.

J. Green lith.

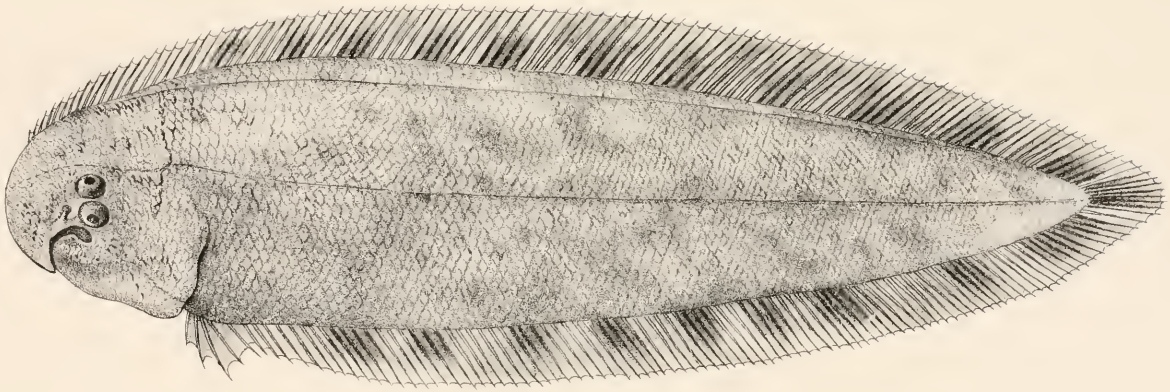
SOLEA TURBYNEI, n.sp.



F. Newdigate del.

CYNOGLOSSUS ATTENUATUS n. sp.

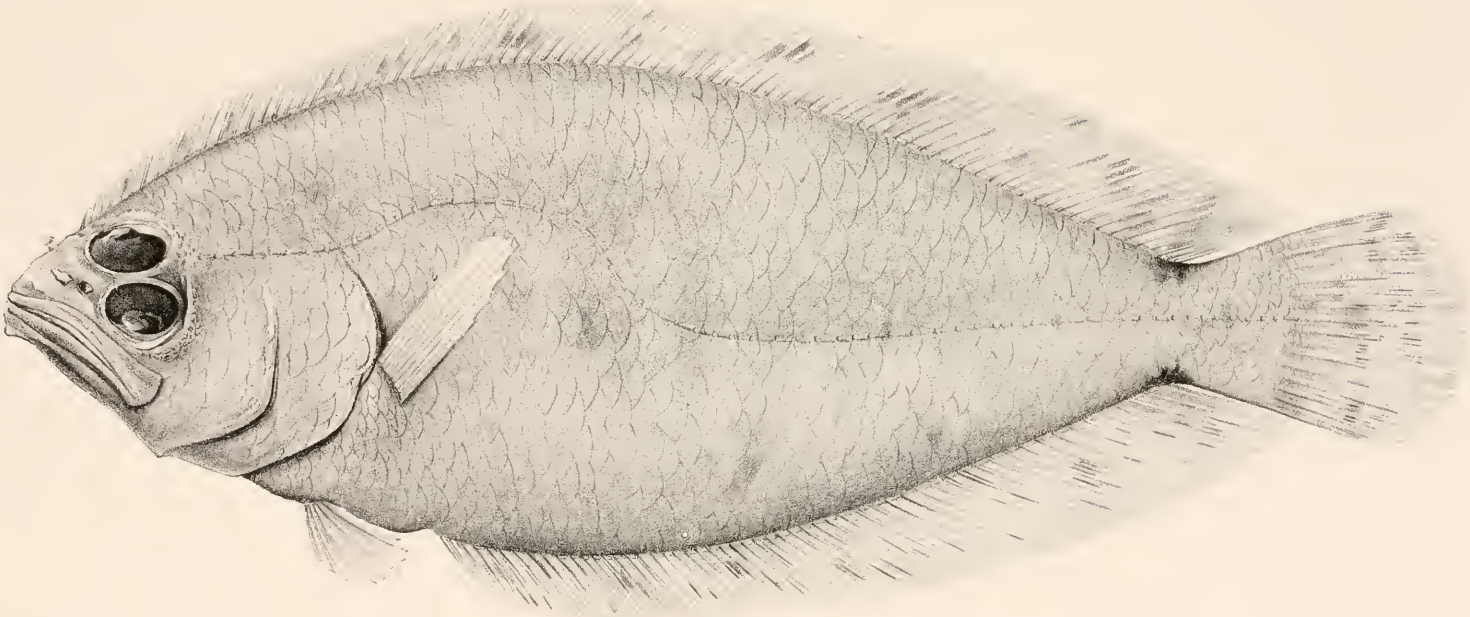
J. Green lith.



P. Mc. Manus del.

J. Green lith.

CYNOGLOSSUS BRACHYCEPHALUS n. sp.



P. McManus del.

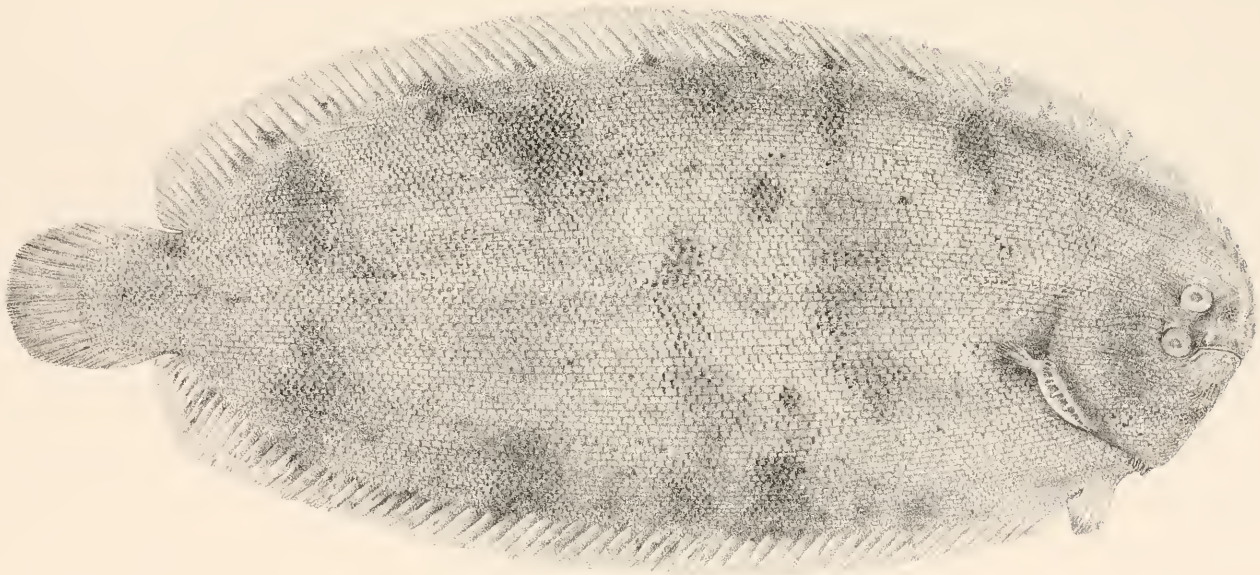
J. Green lith.

ARNOGLOSSUS MACROLEPIS n.sp

P. McManus del.

J. Green lith.

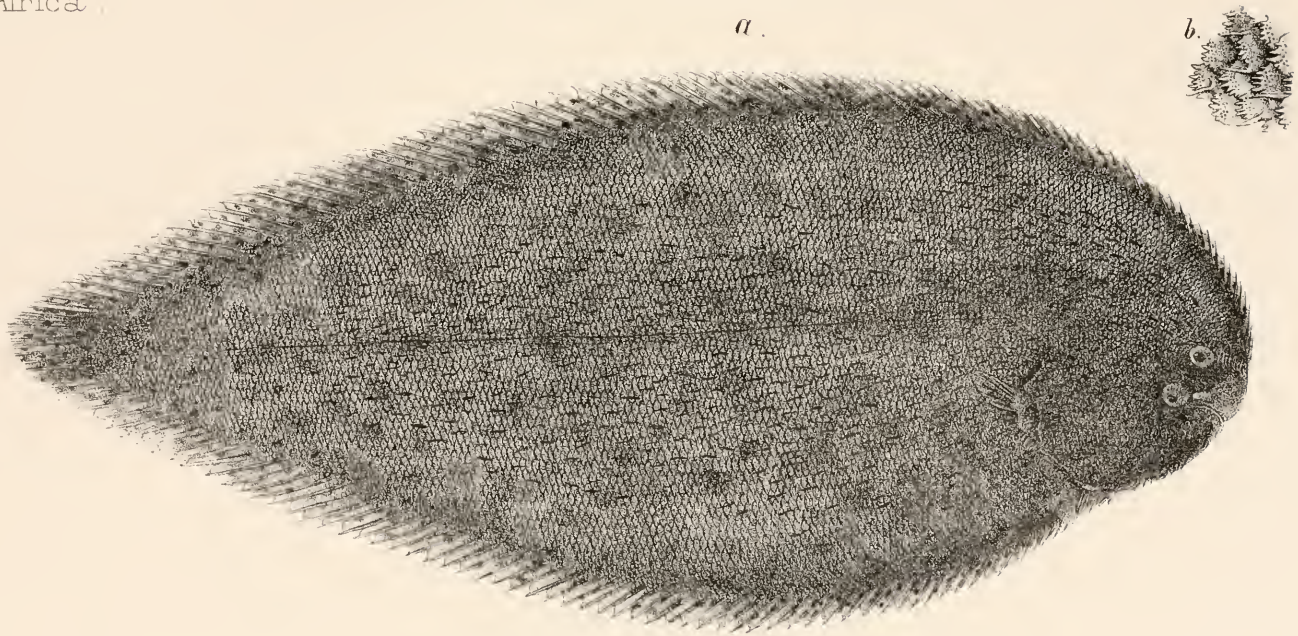
SYNAPTURA MELANOPTERA n. sp.



F. Newdigate del.

SOLEO FULVO-MARGINATA. n.sp.

J. Green lith.



P. Mc Manus del.

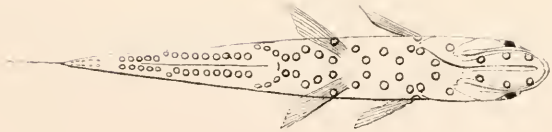
J. Green lith.

(a) SYNAPTURA CILIATA. n. sp.
(b) *scales enlarged.*

P. Mc Manus del.

J. Green lith.

CHLOROPTHALMUS PUNCTATUS. n. sp.



P. Mc Manus del.

J. Green, lith.

SCOPELUS ARGENTEUS. n. sp.

MARINE ANNELIDS (POLYCHÆTA)

OF

SOUTH AFRICA.

PART I.

BY

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CONTENTS.

INTRODUCTION.

PREVIOUS to 1861, little was known of South African Annelids. During the three centuries which had elapsed since the skilful Portuguese navigator, Bartholômew Diaz, made Europeans acquainted with the Cape of Good Hope, or, even during the somewhat shorter period since his countryman, Vasco de Gama, rounded the Cape, this group of marine invertebrates remained in obscurity. It is true that Pallas made known, by the aid of intelligent ship-captains and others, a few of its Annelids, such as *Pectinaria capensis* and *Lepidonotus Wahlbergi* (which he included under *Lepidonotus squamatus*—his *Aphrodita squamata*, and a form closely allied to *Lepidonotus clava*, Montagu). In 1854, an account of some Annelids, from the east coast at Mozambique, was published by W. C. H. Peters, but the descriptions are not sufficiently minute for accurate diagnosis. It was not, however, till the publication of Schmarda's work, in 1861, that the richness of the region in this group was disclosed. The Austrian naturalist described no less than about 50 Marine Annelids (Polychæta) from the Cape, and everyone of which he made a new species. About 18 families of Annelids were represented in this treatise, which marked an era in the literature of the subject. Unfortunately, the inferiority of his instruments, or the lack of artistic accuracy in delineating structure, makes it no easy task to diagnose some of the species, though the majority are recognizable — either by description or figures. Kinberg further added to the information concerning the Annelids of the region, including Port Natal, in his account of those collected during the voyage of the Swedish frigate "Eugenia." A few others were described by Grube from the Austrian "Novara" Expedition. The voyage of the German Exploring Ship "Gazelle," enabled Grube to extend his list of African Annelids —mostly from the region of the Congo and West Africa, but also from Table Bay at the Cape. Amongst these were several European forms, such as *Sigalion Edwardsi* (Madeira), *Glycera convoluta*, Kefertein, and *Pista cristata*, O. F. Müller. The "Challenger," again, considerably extended the information on the subject by obtaining 23 species, nine of which were dredged south of the Cape, in 98 to 150 fathoms, and the rest were collected between tide-marks at Sea Point, Cape Town, and at Simon's Bay.

Since the voyage of the "Challenger," Marenzeller has contributed a notice of the Annelids of Angra Pequena-Bucht, that is, a bay on the western coast of Africa, considerably to the north of the Cape (Great Namaqua Land). Ehlers, some

years later, still further enriched the subject by an account of Annelids from the East African region — chiefly south of Zanzibar. Lastly, an important collection has recently been made at Zanzibar, by a young and able observer, Mr. Cyril Crossland, and a report on certain groups has been published.* When the examination of these is completed, much information on the Annelids in general as well as of the Geographical distribution of the group will be available.

Dr. Gilchrist's collection was made between tide-marks, and probably indicates the most conspicuous forms of the region. In glancing at the series, it is found that the Polynoïdæ, Phyllodocidæ, Syllidæ, Nereidæ, and Sepulidæ have but few representatives, and the Hesionidæ are absent, yet all of them usually are found in numbers under stones, between tide-marks, in a prolonged search. Their number will probably receive considerable additions in future. The forms frequenting sand, or sandy mud, are for the most part absent, either because digging was not resorted to, or because the region was purely rocky. The Annelids generally found in the media mentioned are the Nephthydidæ, Glyceridæ, Opheliidæ, Scalibregmidæ, Telethusæ, Spionidæ (including *Magelona*), and Ammocharidæ, whilst in deep water the Ampharetidæ are frequent. Doubtless, the groups mentioned will be represented when the trawl and dredge are used. The trawl-net is especially productive—not only in regard to the debris of old bivalve and univalve shells in which Annelids lurk, or have their tubes coiled within them, but from the frequency with which soft Annelids, both errant and tubicolar (now devoid of a tube) cling to the meshes. By the flashes of phosphorescence, even small forms like the Syllidæ and *Polycirrus* may be secured at night, whilst the bright colours of others, such as the Nemeteans and Hesionidæ readily distinguish them by day. Many Annelids are minute, and require careful inspection of the apparatus for their detection. Special inquiry should also be directed to the forms which bore in calcareous rocks, in or under crusts of *Melobesia*, in shells, or softer media, which become pelagic, like Palolo, at the reproductive period, or which are useful as bait ; indeed, there are few which are not available for the latter purpose. The purely pelagic types such as *Alciopa*, *Halodora*, *Phalacrophorus*, *Pelagobia*, *Haliplanes*, and *Lopadorhynchus*, and the temporarily pelagic, such as *Autolytus*, may also occur in townets along with *Tomopteris*, and the larval and post-larval stages of the sedentary types.

Much may likewise be accomplished by splitting the rocks between tide-marks with hammer and chisel, or using a lever to overturn large stones and separate shelving rocks—in the

*Proceed. Zool. Soc., 1903, Part I., p. 169, Pls. xvi & xvii., and Part II., Aug., 1903.

fissures of which many Annelids lurk. Moreover, some frequent the tubes of other Annelids, like the British *Polynoë scolopendrina* in the tubes of *Terebella nebulosa*, or the South African *Polynoë attenuata*, occur in the ambulacral areas of certain starfishes, or on *Echini*, between mantle and shell of limpet-like mollusks, or in Balani, in the interior of the basket-like Hexactinellid sponges, in the tissues of these and of horny sponges, in the branchial chamber of Ascidians, and a few are parasitic in the bodies of other Annelids.

Particular care is necessary in the preservation of Annelids, which should, as a rule, be killed with corrosive sublimate, carefully washed, and then preserved in spirit, which should be changed after a few hours, and again within 24 hours. If the Annelids are large, the change should be repeated in a few days. Those intended for section may be treated with Flemming's, or with Bles's fluid. In any case, it is unsatisfactory to place many in a single bottle, or jar, of spirit.

When living, a special note should be made of their coloration, the presence of crustacean ectoparasites on their surface, or gills, the colour of their circulatory fluid (red or green), the presence of eggs, in sacs, or otherwise, the issue of sperms, and their habits and movements, both in nature and in confinement.

One of the most interesting features in Dr. Gilchrist's collection is the occurrence of so many European annelids at the Cape, and of others which can scarcely be distinguished from well-known European representatives. Moreover, some of these stretch far eastwards to the Indian and Pacific seas on the one hand, and on the other are found to the westward and the American shores, for instance, from Canada to Cape Horn. These Invertebrates seem to be independent of the laws which govern the distribution of such forms as the food-fishes, for instance, the common Gadoids, which prefer the colder waters of the north, yet there is a remarkable coincidence in the complete identity—even to their crustacean parasites—of annelids frequenting the widely distant littoral belts of Britain and South Africa. Nor is this community confined to one group of Invertebrates, for, amongst others, Mr. Stebbing* has noticed similar features in regard to the Crustacea. These and other facts lead to the belief that in the sandy bays of South Africa the hardy plaice of the North Sea might live and flourish in a noteworthy manner; nor would there be more difficulty in its transport than in the case of Australia. The Turbot, Conger, Whiting and Sole might also be useful additions. In any case, and as might be expected, it would appear that the laws which govern the distribution of land animals do not hold for all of the marine. The contrast, for instance, between the mammals and

* South African Crustacea, Part II., p. 1., 1902.

birds of South Africa and those of Britain is sufficiently pronounced, and even the fish-fauna of the two is divergent, yet in the group of the Annelids not a few are common to both regions, and as knowledge extends such may even be found more general than is supposed.

In the following report, a few collected by the "Challenger" are indicated in their proper places—occasionally with additional information. The references under the various species have been selected as those which, in all probability, may be most useful.

Euphrosyne Capensis, Kinberg, 1858.

1858. *Euphrosyne capensis*, Kinberg, Öfversigt K. Vet.-Akad. Förhaudl, d. 14 Januari, 1857. Stockh, 1858.
,, *Euphrosyne capensis*, Id., Fregatten Eugenies Resa. Taf. 12. fig. 14.
1861. *Euphrosyne polybranchia*, Schmarda, Neue wirb. Thiere, I. ij., p. 136, Taf. 32, figs. 264-287.
1885. *Euphrosyne capensis*, M'Intosh, Ann. "Challenger," p. 1., Pl. II. fig. 5., Pl. 1A. figs. 1-3.

This widely distributed species, which ranges from the Cape to St. Paul, is characterised, when contrasted with the British, by the proportionally longer, more finely spinose and more flattened body. The dorsal surface is convex, the ventral flattened. The head bears a caruncle, consisting of an elevated keel and a flat band, which reaches to the eighth segment. In front of it is a short and somewhat conical tentacle with an eye on each side of its base. A pair of more minute and in some almost confluent eyes occur on the ventral surface of the cephalic ridge. In front of the puckered opening of the mouth are two kidney-shaped pads, separated by a deep median fissure, and which may be homologous with the palpi of other families. These pads are probably of some importance as pivots during the action of the buccal apparatus. The arborescent branchiæ are purplish with the elliptical or sub-oval tips pale reddish, and each complete row generally consists of eleven trunks. The dorsal bristles are of two kinds—smooth and crenated in the fissure, whilst all the bifid ventral bristles are smooth. The size of the largest example agreed with those found by the "Challenger" under stones between tide marks at Sea Point, Cape Town,and the British *Euphrosyne foliosa* has the same habitat in the Channel Islands. The pigment in both probably subserves other functions than either ornament or protection.

A typical segment of the body consists of a convex dorsal and a flattened ventral arch. The former is bare in the middle line, but has laterally a superior division carrying a dense series of bristles and a posterior row of branchiæ—with a cirrus at the dorsal margin and another midway between the bristles and the branchiæ. The latter is the longer and has a slight median constriction. Neither tapers much. The inferior division has a tuft of bristles, and inferiorly and posteriorly a cirrus, which is generally more slender distally than either of the foregoing. All are shorter and thicker than in the British *Euphrosyne foliosa*. The dorsal row of bristles is comparatively short in contrast with the northern *E. borealis*, and are even less boldly marked than in *Euphrosyne foliosa*. The curve of the tip of the bristle is less pronounced than in the latter, and the disproportion between the processes more distinct. The notches on the limbs of the fork are due to transverse grooves. At the dorsal edge as well as in the centre of the row are many bristles with a smooth fork, the longer process being much attenuated—so that they project beyond the serrated kind. The ventral bristles are considerably larger than the dorsal, and are terminated by a slightly curved blunt tip, with a rounded spike at the base. The central canals from the processes coalesce after a short course downward, and a slight dilatation occurs opposite the enlargement at the upper end of the shaft.

In *Euphrosyne* and *Chloeia* the bristles are characterised by their extreme brittleness, their tubular condition, calcareous nature and the entrance of air into the interior.

The branchiæ, which are eleven in number in the typical segments, form a densely ramose series on the dorsal region of the segment. Each is dichotomously branched, and the tips end in elliptical or sub-oval bodies resembling those of *Euphrosyne foliosa*. So far as observed the branchiæ are devoid of a cavity, and the blood-vessels can be traced from the body-cavity up to, but not into, the tips of the organs. A complex series of muscular fibres appear at the base, and the cuticle and hypoderm are dense, except distally—where the former becomes very thin.

In the structure of the body-wall the species offers no peculiarities. The nerve-cords superiorly have a firm investment which is continuous from side to side. In the hollow between them superiorly is a fascicle of muscular fibres and below them is a central granular structure. Moreover, the cords are united by a striated isthmus inferiorly.

The anterior part of the buccal apparatus or proboscis is cylindrical, ensheathed in cuticle, and protrusible. The centre is occupied by a large muscular and vascular, but chiefly glandular mass, the inner lining of which is thrown into bold

longitudinal rugæ. The vast collection of glands would indicate important secreting functions. Behind is a remarkable lingual organ, which in longitudinal section resembles the tongue in mammals. It is attached at the base posteriorly to a dense glistening muscular mass, separated by a layer of horizontal fibres from the complex series of radiating muscles which diverge upward to the periphery of the organ. In vertical longitudinal sections in the middle line, these interwoven fibres posteriorly are separated, by septa passing downward from the thick chitinous coat, into spaces which enlarge anteriorly. The muscles at the tip of the tongue arch backward over the posterior part of the preceding glandular region (which forms a high vascular cushion), and pass downward to the front of the dense basal glistening mass formerly alluded to, the curve of the arch becoming less and less till the fibres are nearly vertical behind the cushion, or at the commencement of the smooth and dense cuticular region of the tongue. The chitinous coat of the organ is so largely developed at this part that it is as thick as the hypodermic layer. In this region also are three strong plates of transverse muscular fibres extending from summit to base. If the section deviates to the lateral regions, the decussation of the fibres is very complex. In transverse sections, again, near the tip, the thickness of the hypoderm on the rugæ of the prelingual mass as well as in the lingual papillæ is considerable. In the centre of the tongue is an inextricable mass of crossed and interwoven fibres, the base assuming a somewhat stratified appearance, since the blood-vessels lie at intervals in regular horizontal rows. The tip of the tongue is highly vascular, indeed, the organ throughout is richly supplied with blood-vessels. The dorsum of the free tip is covered by a series of elevated papillæ—truncated at the tip, and with one angle pointed. They are processes of the hypoderm sheathed in cuticle. Nothing can exceed the complexity of the muscular structure of this organ, which is eminently calculated to subserve important functions. Probably the animal erects its lingual process and applies it with a rasping action to the surface of a sponge, the successive pieces being crushed against the firm rugose wall behind, by the hard posterior surface of the tongue, and again subjected to the play of the deeply folded or lamellar region behind it, Before the food reaches the intestinal surface, it has been partially disintegrated and fitted for absorption, especially soft tissues like those of sponges. Minute shells of annelids, such as *Spirorbis*, are of course less affected, though many are broken into fragments, and all are in a condition to give up their contents.

Behind the tongue the alimentary canal presents on its ventral aspect a large and a small fold, the former in longitudi-

nal section often having a broad summit applied to the vault of the canal and a narrow base, so that it resembles a pedicled mass. This region has numerous transverse folds, so deep in some cases as to merit the name of lamellæ (like those in the ruminant's psalterium or "manyplies"). The canal then curves upward (from the posterior pit) and forms a kind of pylorus, with thick walls and deep furrows, and terminates in the intestine, into which the part freely projects. The thick rugose intestine, which agrees in structure with that in the ordinary Annelids, terminates in a dorsal anus, with two cirri at the sides inferiorly.

Some of the examples were laden with ova which in the preparations were of a pale orange hue and measured ·1524 mm. in diameter. They floated freely in the perivisceral cavity. No evidence existed as to their mode of escape. Other examples seemed to have spawned. Schmarda thought there were special oviducts which opened near the anus, but no trace of these was observed.

Like the British species at Herm, the South African form would seem to browse on the patches of *Halichondria* and other sponges which abound under stones between tide-marks; and there is no wonder therefore that there should be so many interesting homologies between its buccal apparatus and that of such Nudibranchs as *Doris tuberculata* and *Doris Johnstoni*, which follow precisely similar habits. In some examples, moreover, many fragments of crustaceans, numerous portions of cells and avicularia of Polyzoa showed that occasionally the dietary was varied.

The examples were procured between high and low water-mark at St. James', False Bay.

Lepidonotus wahlbergi, Kinberg, 1858.

1861. *Polynoë trochiscophora*, Schmarda, Neue wirb. Thiere I. II. p. 151, Taf. xxxvi., fig. 310.
1885. *Lepidonotus wahlbergi*, M'Intosh, "Challenger" p. 66, Pl. xi., fig. 1., Pl. xviii. fig. 8., Pl. xa., figs. 15, 16.
1898. *Lepidonotus wahlbergi*, De St. Joseph, Ann. Sc., Vol. 8c. sec. v. p. 225, Pl. xiii., figs. 2-8.
1898. *Lepidonotus wahlbergi*, M'Intosh, Ann., Nat. Hist. Sc. 7. Vol. II. p. 101, Pl. ii. figs. 11 and 12.

A further consideration of this form, afforded by Dr. Gilchrist's specimens, inclines me to the belief that Schmarda's species is identical, and it is possible that there is a closer relationship

between Stimpson's *Lepidonotus semitecta** than is hinted at in the Challenger volume,† so that this author's title may yet claim priority. Kinberg's examples came from the Cape as well as Port Natal, Schmarda's from Table Bay, while Stimpson procured his from Simon's Bay, and the present examples were got between tide marks at St. James', in False Bay.

The examples from the "Challenger" were larger than those of the present series, a male measuring 36 mm.

The head agrees generally with the type in *Lepidonotus*. The median tentacle is somewhat longer than the palpi, dilated at the tip, and with a filiform termination. The lateral tentacles, though small, correspond in structure. In the males, the ventral papillæ of the body are longer than in the females, in which they are tulip-shaped.

Schmarda's figures, presumably from life, though details are somewhat doubtful on this head, show the middle of the dorsum as quite bare from the head to the tail, yet he does not indicate the structure of the head thus exposed, the yellowish hue of the dorsum passing forward to the base of the tentacles, a condition at variance with nature. On the whole, the structure of the foot, the scales and the bristles, as shown by this author, do not offer any objection to the union of the species with Kinberg's. Schmarda observes that the proboscis is brown and yellow, and that the intestine (which he figures) has sixteen pairs of cæca.

The scales are generally covered with sand-grains, mud, thread-like algæ, Infusoria like *Salpingœca*, with, here and there, an example of *Loxosoma*.

The species seems to be widely distributed round South African shores, and takes the place, for example, of such a form as *Lepidonotus clava*, Montagu, in Britain. As Kinberg observes, the South African form is probably included in the *Aphrodita squamata* of Pallas, who conjoined with it the European species as figured by Baster.

Baron de St. Joseph, who has done such excellent work amongst the Annelids of the French coast, was of opinion that this species was only a variety of *Lepidonotus clava*, Montagu, but as shown in the Annals of Natural History in 1898,‡ a considerable margin for variation will be necessary before this can be established. De St. Joseph's main reasons for the union of the species are (1) that the figure of the scale in the "Challenger" volume exactly agrees with *Lepidonotus clava*, and (2) that in the same work it has been shown that the palpi are papillose, a feature, also, characteristic of *Lepidonotus clava*.

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* Prodr. Exped. Ocean. Pacif. Septen., &c. Proceed. Acad. Nat., &c. Philad., July, 1855.

† p. 67. ‡ Ser. 7, vol. II., p. 108, Pl. ii., figs. 11 and 12.

But in the latter species, only the first four scales have the large tubercles which are visible under a lens, whereas, in *Lepidonotus Wahlbergi*, every scale has them. Yet this is not an impassible barrier to their union—if in *Lepidonotus Wahlbergi* prominent and acute spines had not been present on several of the anterior scales. The tips of these spines are slightly bent, and are minutely nodular, so that the surface in some views presents a slightly areolar or scaled appearance. On the other hand, the truncated capstan-like tubercle, characteristic of the first scale of *Lepidonotus clava*, has the head minutely and somewhat regularly nodular, the tip of each process having a spine. When viewed from above, the rim of the head is thus minutely hispid. The arrangement and structure of the other papillæ, on the respective scales, also differ. Further, the dorsal bristles of *Lepidonotus Wahlbergi* have a stouter tip, with a definite curve, and is much less elongated and tapered than in *Lepidonotus clava*. The ventral bristles, again, have a more elongated tip, with a longer row of spinous ridges. From point to point, therefore, the European and the African forms differ, even the scales in the latter being distinctly smaller.

Yet it cannot be doubted that a close approach, in many respects, occurs between the two forms—separated by so many thousand miles, and in view of the conditions found in other South African Annelids, it may be that the differences pointed out in the foregoing paragraph, will suffice only to constitute a local variety. Chitinous structures of the nature of spines on scales, of bristles and the parts of the dental apparatus, are prone to vary, and intermediate forms of *Lepidonotus clara* may yet be obtained, which would warrant the union of this form with *Lepidonotus Wahlbergi*.

Euphione Elisabethæ, McIntosh, 1885.

1885. *Euphione Elisabethæ*, McIntosh, Ann. "Challenger," p. 62, Pl. ix., fig. 3, Pl. xvii., fig. 7, Pl. xviii., fig. 10, and Pl. viii. A., figs. 3—6.

This striking form was procured by the dredge south of the Cape of Good Hope, in 150 fathoms, on a bottom of green sand. It is about 35 mm. in length, and its breadth at the widest part (including the bristles) is 23 mm. The chief features are the correspondence of the head with that in *Lepidonotus*, only the eyes are almost connate on each side. The smooth tentacula and dorsal cirri have an enlargement at the tip, and a constriction beneath it. Scales—13 pairs, as in *Iphione*, flexible, leathery, the first being rounded, the rest somewhat rhomboidal, the anterior edge, however, being incurved, the posterior

convex. Their surface is studded on the inner region with rotate papillæ, some small and adpressed, others large, and elevated on a pedicle. Externally are softer elongated spinose papillæ, which, in shape, resemble a prickly pear; margin of the scale ciliated; dorsal bristles, pale, silky, with a very attenuate tip—hispid with opposite spines; ventral bristles, dull yellow, with simple, slightly hooked tips.

So far as known, this form has hitherto occurred only in the region mentioned, and is one of the most characteristic Annelids of the Cape.

Eunoa capensis, McIntosh, 1885.

1885. *Eunoa capensis*, McIntosh, Ann. "Challenger," p. 72, Pl. xv., f. 5; Pl. xi A., figs. 1—3.

A fragmentary form, procured between tide-marks at Sea Point, Cape Town, along with *Sabellaria*, *Terebella*, and *Sabella*. Unfortunately, the specimen had no scales, but it will be recognized by the following features:—The head is characterised by the large size of the base of the median tentacle; the lateral tentacles are short, with a filiform tip passing abruptly from the nearly cylindrical organ. Palpi of moderate length, and papillose. A pair of small eyes occur at the outer and posterior border of the head, whilst a pair lie behind the anterior border, and lateral in position. The tentacular cirri have a slight enlargement below the filiform tip, and the cylindrical column is papillose. The dorsal bristles end in a somewhat blunt rounded process, as in *Eunoa hispanica*,* and an allied bristle is seen in Kinberg's *Autinoë pulchella*,† from the mouth of the La Plata. The ventral bristles have comparatively short tips, with a simple terminal hook.

Polynoë capensis, M'Intosh, 1885.

1885. *Polynoë Capensis*, M'Intosh, Ann. "Challenger," p. 114, Pl. iv. fig. 4, Pl. xv. fig. 1, Pl. xix. fig. 4, Pl. ixa. figs. 4, 5.

Procured by the "Challenger" in the dredge south of the Cape in 98 fathoms.

Head elongated from before backwards. Two rather small eyes at the posterior border and two larger in front of the lateral prominences. The tentacular and dorsal cirri have a tendency to assume a fusiform condition, and all are smooth. The ven-

* Trans. Zool. Soc. Lond. ix., p. 396.
† Freg. Eugen. Resa., p. 20, Tab. vi., f. 29, Gs.

tral cirri are long and large. Body moderately elongated. Scales 15, ovoid, blackish grey, and smooth, with the exception of a triangular group of blunt tubercles near the anterior notch. Foot somewhat short with feebly developed pale dorsal bristles having many thecate infusoria parasitic on them. They have a short, peculiarly curved tip with fine rows of spikes. The ventral bristles have a well-marked hook at the tip and a secondary process beneath, besides a spinous edge. The bristles on the whole approach those of *Halosydna*, whilst the head somewhat resembles that of *Lepidonotus*.

Hemilepidia tuberculata, Schmarda, 1861.

1861. *Hemilepidia tuberculata*, Schmarda, Neue wirb. Thiere, I., II., p. 149, Taf. xxxvii., fig. 317, and woodcut.
1885 ? *Polynoë attenuata*, M'Intosh, Ann. "Challenger" p. 120, Pl. xv., fig. 2., Pl. xx., fig. 9. Pl. xia. figs. 8 and 9.

This species was first described by Schmarda as having been procured in Table Bay in shallow water under stones. The present example was obtained between tide marks at St James', in False Bay, 5th October, 1902.

It measures about 45 mm. in length, while its widest part anteriorly, inclusive of the bristles, is 7 mm. A considerable amount of coloration still remains along the centre of the dorsum, from the head to the tail, and it is somewhat symmetrically arranged throughout, especially in the posterior region which is devoid of scales. The sides of the body anteriorly covered by the scales, are pale as likewise are the feet, the bases of the tapering dorsal cirri, however, being set in a ring of dark pigment with a crescent attached in front, whilst the organ itself is coloured about half its length. The bare posterior region again is prettily marked with light and dark touches, making a surface almost like chain-work. Along the centre is a row of papillæ elongated from before backward and dark coloured, a bar of pigment tapering from each side and passing between the two nearest lateral papillæ, since they are alternately arranged with the median. Their tips are pale, whilst a triangle of dark pigment passes inward from each, the apex entering the pale region in front and rear of the central papilla, and thus behind the middle of each segment. Externally a dark patch intervenes between each papilla and surrounds the base of the dorsal cirrus, a little pigment also appearing on the basal part of the column of the organ. Pigment of an iridescent dark brownish hue tints the ventral surface for nearly two thirds of its posterior moiety, each segment having two long lozenges on each side, the posterior pair, which have their broad bases internally, being

specially distinct. The neural region is distinguished by its darker hue in front where no lateral pigment is, and by its pallor in the middle of the darker posterior region. A touch of pigment marks the base of each ventral cirrus at the anterior part of the coloured region, then various bars of dark pigment occur on the under surface of each foot, the whole having a characteristic arrangement.

The head is slightly leaden in hue, with a deep notch filled by the brown base (ceratophore) of the median tentacle in front. Two eyes of moderate size lie posteriorly near the nuchal border, whilst two less distinct occur towards the anterior angle, though they were so hidden by parasitic Loxosomæ that doubt remains as to their precise position. The median tentacle is comparatively short, little tapered, and ends in a slender filament. The lateral are typical in length and also have slender terminal processes. The palpi are marked by longitudinal cirri closely arranged, especially ventrally. The tentacular cirri have the same shape as the median tentacle.

The body is elongate, slightly narrowed in front, remains for some distance of nearly equal diameter and then gently diminishes throughout more than the posterior half towards the tail, which has two short cirri. Ventrally a median lozenge of pigment passes to the mouth. The anterior third of the body has numerous Loxosomæ between the feet and at the tentacular cirri. The bristles project on each side as pale yellow fasciculi.

The first pair of scales are paler than the succeeding, but have a similar pattern, viz., an ovoid pale patch at the scar, with a dark band traversing it. The broad crescent of pigment along the inner border, however, is less marked both in superficial extent and tone than in the succeeding scales. They adhere with considerable tenacity. In outline, the front pair are more or less circular with a projection opposite the pale region. The others are somewhat ovoid, the pale region being at one end, and the bar by-and-by becomes a spot. Though apparently smooth to the naked eye, minute and somewhat clavate papillæ are scattered over the surface, here and there appearing beyond the margin, as near the white spot (where they are specially numerous), and other parts.

The pale outer region has numerous small clavate papillæ, some of which extend beyond the border, and a few short papillæ also project at intervals from the inner border.

The typical foot resembles that in *Polynoë scolopendrina*, Savigny, yet Schmarda gives "pinna unica," as one of the specific characters, though he probably means apparently single. It really has two divisions. The foot forms a short cone with a bevelled tip (Plate I. fig. 1). The dorsal cirrus is comparatively short and slightly tapered, with a slender filiform tip. The surface has numerous short clavate papillæ which are

longest towards the tip of the organ. The dorsal division forms a separate elevation with the spine-papilla (pierced by the spine) at its outer and lower border. It carries a group of transparent slightly curved spinous bristles (Plate II., fig. 2, one of the shorter), which Schmarda figures as bifid terminally, and, which at first sight have this appearance, but the condition is only apparent, as more careful examination shows that the tips have been fractured, and, that in many, the split parts give a pseudo-bifid aspect. The shorter forms at the inner border of the fan, which have been shielded by the longer, have simple tips tapering to a point. The latter is often coated with a finely granular investment. These bristles are more slender and elongate posteriorly. They are evidently brittle, and, if the species, like *Polynoe scolopendrina*, inhabited a tube, and was commensal, the fracture of the tips would be explained.

The mass of the foot is formed by the ventral division, and the great yellow spine is more powerful than the superior, whilst its papilla is posterior. In front, another and longer conical papilla projects outward. The first or upper bristle is much stronger than the others, of a deep yellow colour, and hastate (Plate II., fig. 3, from the 40th foot), yet there are indications that it is only a modified form of the series which follows, for traces of rows of spines are present—especially in the anterior and posterior parts of the body, and even the tip occasionally shows a minute spike, or secondary process. At the 10th foot, for instance (Plate II., fig. 4), it is only a somewhat larger bristle, with a long spinous simple tip. At the 30th and 40th feet, on the other hand, it is truly hastate or javelin-shaped, and nearly symmetrical, yet a trace of the spinous rows occurs on the left. These are barely visible at the 50th foot, but, again re-appear in the bristles of the caudal region. All the bristles below the larger conform to the same type, having straight translucent and slightly yellowish shafts, the terminal region being enlarged at its commencement, diminishing distally till it reaches the bifid tip, where a slight dilatation again occurs (Plate II., fig. 5). Rows of spikes appear on the upper edge of the tip. These bristles have longer tips in the 10th foot, and they diminish in length and increase in strength for some distance backward, and remain short in the caudal region.

The ventral cirrus is short and subulate, the tip reaching only a little beyond the bases of the nearest bristles. Its surface, with the exception of the filiform tip, has clavate papillæ.

In all probability, the habit of this species is akin to that of such forms as *Polynoë scolopendrina*, being a commensal with another Annelid, mollusc or echinoderm. It is doubtful, if

Schmarda's *Hemilepidia erythrotœnia** is not a variety of the same species.

The example is a female with ova far advanced.

The relationship of this species to the *Polynoë attenuata* of the "Challenger" expedition,† is so close, that it may be necessary to unite them. The "Challenger" form was obtained between tide-marks at Sea Point, near Cape Town, along with *Sabellaria, Terebella,* and *Sabella,* and from its great length and general appearance, it resembles a commensalistic form, probably living in the tube of a *Terebella.* The two forms agree in general outline of the body, and in the number of the scales, those in the specimen from the "Challenger," however, being more distinctly papillose, especially at the margin, yet, it is only a question of degree. In the specimen from the "Challenger," no large bristles, such as are figured in this paper, were present, and the fact was commented on at the time. Such may be a variation, or an exceptional condition, for the other bristles closely correspond.

Sthenelais boa, Johnston, 1833.

1833. *Sigalion boa,* Johnston. Loud. Mag. Nat. Hist.vi., 332, f. 42.
1839. *Sigalion boa,* Id. Ann., Nat. Hist. ij., 439, Pl. xxiii. figs. 6-15.
1843. *Sigalion Idunæ,* H. Rathke. Nova Act, Acad. Cæsar. Nat. Cur. xx., p. 150, Tab. ix., f. 1—8.
1851. *Sigalion Idunæ,* Grube. Fam. Ann. p. 38.
1851. *Sigalion boa,* Williams. Rept. Brit. Assoc. 1851, p. 201.
1851. *Sigalion Idunæ,* Sars. Nyt. Mag. Natur. xi. 3, p. 264.
1861. *Sigalion Idunæ,* Id. Vid. Selsk. Förh., 1861 (sep. copy), p. 1.
1865. *Sigalion Idunæ,* Malmgren. Nord. Hafs.-Ann. p. 86.
1865. *Sthenelais Idunæ* and *S. boa,* De Quatrefages. Ann. i., p. 276.
1865. *Sigalion boa,* Johnston. Cat. Brit. Mus., p. 124, pl. 13, f. 6.
1873. *Sthenelais Idunæ,* Sars. Bid. Christ. Faun., p. 14.
1874. *Sthenelais boa,* McIntosh. Invert. and Fishes St. And., p. 118.
1875. *Sthenelais Idunæ,* Ehlers. Ann. "Porcupine," 1869, ibid., p. 18.
1876. *Sthenelais boa,* McIntosh. Trans. Zool. Soc. ix., p. 390.
1876. *Sigalion Idunæ,* Tauber. Ann. Danic. 83.
1880. *Sthenelais Idunæ,* Langerhans. Zeit. f.w. Zool. xxxiii., p. 276, Taf. xiv., f. 6.
1883. *Sigalion Idunæ,* Levinsen. Nord. Annul., p. 199.

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* Op. cit. p. 150, Taf. xxxvii., fig. 318.

† Op. cit. p. 120, Pl. xv., fig. 2; Pl. xx., fig. 9; Pl. xia., figs. 8 and 9.

1884. *Sigalion Idunæ*, V. Carus. Faun. Medit., p. 205.
1888. *Sthenelais Idunæ*, De St. Joseph. Ann. d. sc. nat. (7), v., p. 187, Pl. viii., f. 55.
1890. *Sigalion Idunæ*, Malaquin. Ann. Boulon., p. 23.
1900. *Sthenelais boa*, McIntosh. Brit. Ann. II. (Ray Soc.), p. 409, Pls. xxvi., f. 7 and 8; xxvi*a*. f. 21 and 22; xxix., f. 1; xxxi., f. 5; xxxiii., f. 16; xli., f. 19—23.

Procured between tide marks at St. James' and False Bay, 19th July, 1901, and 25th June, 1902, the former being the larger. A few about 60-90 mm. in length have a breadth, over the bristles at the widest part, of 5-7 mm.

The head is somewhat shield-shaped, broad in front and narrower behind, with two eyes in front, one on each side of the ceratophore of the median tentacle. Another pair lie in front on the anterior border, and thus are not readily seen from the dorsum. The median tentacle is comparatively short and subulate in outline. A ctenidium occurs at each side of its base. At the posterior border of the head is on each side a truncated papilla. The structure of the first feet, which occupy the usual position in front, and that of the palpi is typical, a large ctenoidal flap ensheathing the inner base of the latter—which are long tapering organs.

The body is a little diminished in front, remains for some distance of nearly equal breadth, and then diminishes gradually towards the tail which bears two slender cirri of moderate length. The dorsum is mottled with the touches of pigment on the numerous scales, which have, in those best marked anteriorly, a madder-brown crescent behind the scar, joined by a process which runs into another crescent just within the upper and posterior border of the scale. In passing backward, however, various additional pigment-touches appear, so that the pattern becomes more complex, some presenting three spurs from the anterior to the posterior crescent, besides a broader spur beneath.

In structure they appear to agree in the closest manner with *Sthenelais boa*, Johnston, in regard to outline, papillæ and cilia.

The typical foot likewise corresponds with the European form in every minute detail.

It is noteworthy to find a variety of the well-known British species frequenting the shores of South Africa, and which does not in any essential feature differ from it. The wide range of the species, however, makes this less remarkable, for it not only frequents the shores of Norway but stretches far southward along the western shores of Europe and into the African section of the Atlantic at Madeira.* A closely allied, if not identical form occurs at Bermuda.†

* Langerhans, Zeit. f.w. Zool., Bd. xxxiii., p. 276, fig. 6.
† Trans. Conn. Acad. x., p. 666, 1900.

EULALIA VIRIDIS, O. F. Müller, var. CAPENSIS, Schmarda.

1800. *Die grüne Nereide*, O. F. Müller. Naturges. ein wurm arten, p. 162, Tab. 11, fig. 1.
1820. *Nereis viridis*, Savigny, Syst. Ann. p. 45.
1834. *Phyllodoce clavigera*, And. and Ed. Annel. p. 226, Pl. va. figs. 9-13.
1840. *Phyllodoce viridis*, Johnston, Ann. Nat. Hist. iv., p. 228, Pl. vi., figs. 11-15.
1843. *Eulalia viridis*, Œrsted, Ann. Dan. Consp. p. 27, figs. 22, 30, 35, 86, and 88.
1849. *Phyllodoce viridis*, Leuckart, Arch, f. Naturges, 1849, p. 202.
1851. „ „ Grube, Fam. Ann. pp. 56 and 129.
1865. „ „ Johnston, Cat. B.M. p. 178, Pl. xvi., figs. 11-15.
1861. *Eulalia capensis*, Schmarda, Neue, wirb. Thiere, I. ij., p. 86, Pl. xxix., fig. 231.
1867. *Eulalia viridis*, Malmgren, Nord. Hafs- Ann. p. 98, Tab. xv., fig. 39.
1874. „ „ M'Intosh, Invert. and Fishes, St. And., p. 120.
1885. „ *capensis*, Id. Ann. "Challenger" p. 168, Pl. xxvii., fig. 7, Pl. xxxii., fig. 10, Pl. xiva., figs. 16 and 17.
1888. „ *viridis*, De St. Joseph, Ann. sc. nat. (7) v. p. 283, Pl. xii., fig. 154.

Obtained between tide marks at St. James', in False Bay, 5th August, 1902.

A specimen of average length—55 mm.—and of the usual proportions.

The chief features are the size and general signs of luxuriant growth, as shown in the larger dorsal and ventral lamellæ, and the larger bristles. Yet in all essential characters of proboscis, feet and bristles, though the proportions slightly vary, as indicated minutely in the account of the "Challenger" Annelids, the distinctions are so slight as to warrant its being placed as a variety of the European form.

This species abounds not only in European waters, but extends to Madeira (Langerhans*) and to Angra Pequena—Bucht (Marenzeller†).

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* Zeitsch. f. w. Zool. Bd. xxxiii. p. 309. † Zoologisch. Jahrb. Bd. III. p. 5 (sep. abdr.).

Eteone spetsbergensis, Malmgren, 1867.

1867. *Eteone spetsbergensis*, Malmgren, Nord. Hafs.- Ann. p. 102., Tab. xv. fig. 38.

Found between tide-marks at St. James, False Bay, 2nd September, 1902.

This form extends from Europe to the shores of America, and again to those of South Africa.

The specimen is larger than the finest example from St. Andrews, or Lochmaddy, representing the eastern and western shores of Britain. This free growth affected the size of the lamellæ and the foot generally—without altering the characters of the parts or the bristles. It is chiefly a dweller in sand.

Autolytus prolifer, O. F. Müller, 1788.

1788. *Nereis prolifera*, O. F. Müller. Zool. Danic II, p. 15, Tab. 52, f. 5—7.
1862. *Polybostrichus Mülleri*, Keferstein. Zeit. f. w. Zool. xii., p. 113, Tab. xi., f. 1—6. (male)
1855. *Saccoucreis helgolandica*, Max Müller. Arch. f. Anat, u. Physiol., 1855, p. 18, Tab. II. (female)

It occurred amongst the debris of other forms from St. James', False Bay, 8th July, 1902.

The example was minute, about 4 mm. in length, yet it had all the specific characteristics of head, eyes, and cirri. The compound bristles, also, were essentially the same as those from Britain and other European localities.

The range of this form is, therefore, very wide—stretching from the shores of Norway, where the distinguished author of the "Zoologia Danica" found it budding, to those of Madeira and South Africa on the one hand, and from the Channel to the American coast on the other.

Pionosyllis malmgreni, McIntosh, 1869.

1869. *Pionosyllis Malmgreni*, McIntosh. Trans. R. S. E. xxv., p. 414, Pl. xvi., f. 10.

A small Syllidean, measuring about half an inch, or a little more, in length, with rather long cirri, which are distinctly articulated.

Procured between tide-marks, St. James, in False Bay, 8th July, 1902.

The head is typical in regard to palpi, and the position of the eyes, the posterior pair of which are nearer each other than the anterior, and thus lie obliquely forward and outward from the posterior pair. The median tentacle is somewhat shorter than the longest cirri in the example. The body is proportionately stout, tapering posteriorly towards the tail, which ends in two long cirri. The sides are flanked by the curved cirri, which cling firmly to their bases, thus differing from the ordinary forms, in which these organs are readily detached. They are long, gently tapered, and distinctly articulated from base to apex, the number of segments ranging from below 20, to 29 or 30. The setigerous region is somewhat elongate, with a bifid tip, a small papilla at the end superiorly, and a group of stout bristles, which are pale, slightly curved, dilated, bevelled at the tip of the shaft, and furnished with a moderately elongated terminal piece, which has a minutely bifid tip, after the manner of *Pionosyllis*, and a spinous edge beneath. None of the swimming bristles were present.

The ventral cirrus extends fully as far as the tip of the setigerous region.

So far as observed, this form agrees with the British species, though, perhaps, the bristles are less numerous.

It is interesting that a form first found at Lochmaddy, North Uist, should stretch to the shores of South Africa. Langerhans, however, procured no less than four species of the genus at Madeira.

Schmarda found at least nine representatives of the Syllidae at the Cape, but it is not possible to identify any of them with this form. His *Syllis closterobranchia* has jointed bristles with an elongated bifid terminal piece, but the dorsal cirri are thick and short. No other form described by him approaches it, though several of his species had compound bristles with bidentate tips.

A single Syllidean (*Syllis capensis*) was obtained by the "Challenger," at Station 141, south of the Cape of Good Hope, in 98 fathoms, on a bottom of green sand. Though devoid of the long capillary bristles Malmgren associated with the genus, and having moniliform cirri, it would seem to approach *Pionosyllis* very closely, indeed, in the proofs it was so termed. In the structure of the compound bristles, it approaches the present form, as it also does in the general structure of the head, and in the absence of long simple bristles, but it diverges, in so far, as its dorsal cirri have only eight or nine segments, whereas, *Pionosyllis malmgreni* has as many as 20 or 30. How far age affects the number of these organs is, however, an open question ; certainly the forms are nearly allied.

Syllis cornuta, H. Rathke, 1843.

1843. *Syllis cornuta*, H. Rathke (Beitr. z. Fauna Norw.), Nova Act. Acad. C.L.C. Nat. cur. xx. I. p. 164, Tab. vii. fig. 12.
1867. *Syllis cornuta*, Malmgren, Ann. Polych. p. 43, Tab. vii. fig. 45.
1869. *Syllis cornuta*, M'Intosh, Trans. R.S.E., xxv. p. 415, Pl. xvi. fig. 14.
1869. *Syllis cornuta*, M'Intosh, Trans. R.S.E., xxv. p. 415, Pl. xvi. fig. 15.
1885. *Syllis cornuta*, J. V. Carus, Faun. Medit., I. p. 228.

Found in the debris of specimens of *Dasybranchus* from St. James'. False Bay, between tide-marks, 2nd September, 1902.

The head agrees with the typical Syllidean. and the body is rather narrow and elongated, though the softened specimen is not in a satisfactory condition.

A comparison with the European form indicates that in the small specimen (about 10 or 11 mm. in length) from South Africa, the dorsal cirri varied in a similar manner in length, being characteristically moniliform and with 18 to 28 segments in the longer forms. The setigerous region is similar, but, apparently from difference in size, bears fewer bristles than the European, though their structure corresponds. The ventral lobe has the same proportions.

No form described by Schmarda can be identified with this species. His *Syllis gracilis* approaches it in regard to the dorsal cirri, but the tips of the bristles are long and tapering. His *Gnathosyllis diplodonta* would seem to be near it in external characters, but its dental apparatus is peculiar.

Syllis cornuta ranges from Finmark to Norway and Spitsbergen, to the British shores, as well as occurs in the Mediterranean and at Madeira.

Nereis (Mastigonereis) variegata, Grube, 1858.

1858. *Nereis variegata*, Grube, Annulat, Œrsted., Vid. Meddel, Nat. Fören. p. 164.
1861. *Mastigonereis podocirra*, Schmarda, Neue wirb. Thiere, I., ii. p. 108, Taf. xxxi. fig. 247, and woodcuts.
1867. *Nereis (Nereilepas) Stimpsonis*, Grube, Ann. Novara. Exped. p. 18, Taf. 1, fig. 8.
1901. *Nereis variegata*, Ehlers, Polych. Mag. u. Chilen, p. 112, Taf. xiv. figs. 1-21.

Obtained between tide marks at various dates, at St. James', False Bay.

The examples ranged from $1\frac{1}{2}$ to 5 inches and in life the latter probably reached 7 or 8 inches.

The dull bluish iridescent head is shield-shaped, with the broad end posterior. Two eyes occur on each side posteriorly, the anterior being wider apart. A small cuticular lens is in the middle of each. The tentacles are stout and subulate. The palpi are massive organs with bulbous terminal processes. The dull brownish tentacular cirri are of moderate length, and the dorsal of the second pair is longest as in ordinary Nereids.

The body is slightly tapered in front, then dilates to its widest region and again diminishes gradually to the tail which ends in two cirri of moderate length below the anus. The dorsum in the preparations has a dull bluish iridescence, which Schmarda states (presumably in life) is greenish blue, and the ventral surface is yellowish brown. The sides are flanked by the feet with their amber-coloured bristles.

The proboscis (Plate I, figs. 6 and 7) in the majority of the examples is extruded, having distally a pair of powerful maxillæ which, in the old examples, have their teeth abraded, but in the younger forms show four or five distinct teeth in each. Dorsally (Plate I. fig. 6) a group of paragnathi lies a little behind each maxilla, and they are arranged in short lines, the longest being posterior. In the median line between these is a single larger tooth. On the ventral aspect of the maxillæ on each side is a group of paragnathi similar in size to the dorsal, but arranged in four oblique posterior rows, and an irregular anterior series (Plate I. fig. 7). A little posterior to these in the middle line is another group consisting of three curved rows and one or two points in front. A double belt of larger paragnathi occurs ventrally at the base of the proboscis (in extension), ending at each side in a single row, while dorsally the arrangement is continued by a transversely elongated and bluntly conical tooth on each side, and a single isolated tooth in the centre. The organ is symmetrically cut by lines into various areas so that it has a "quilted" aspect.

The first foot is typical of the Nereids, having a somewhat blunt and subulate dorsal cirrus, an ovate superior lobe, a truncated setigerous region with two black spines beneath, a smaller ovate ventral lobe extending beyond the former, and a lanceolate ventral cirrus. The setigerous region is supported by a single black spine which in lateral view separates the dark amber-coloured bristles into two groups. The upper consists of about three with long but stout tapering tips having spinous edges and two with the shorter falcate tip. The inferior group conforms to the latter type.

In its progress backward a tendency to a lamellar expansion of the base of the dorsal cirrus appears. Thus at the 20th foot

it forms a distinct ridge at the base of the cirrus dorsally, whilst the homologue of the dorsal lamella of the first foot has coalesced with the ventral base of the cirrus and is continuous with the dorsal ridge just mentioned (Plate I. fig. 8). Moreover, a new process, which first appears at the third foot in front of the spinigerous lobe, has at the 20th foot placed itself between the dorsal and ventral divisions of the foot, that is, has the dorsal tuft above it and the ventral beneath it. Two black spines are present, one to each division. The upper tuft consists of bristles with more slender shafts and longer spinous tips than any in the tuft beneath. At the 30th foot the upper division, viz., the flattened lamella with the dorsal cirrus at its tip, is now larger in proportion to the rest of the foot beneath, a condition still more evident at the 40th foot (Plate I. fig. 9), in which the vertical diameter of the lamella is equal to the rest of the foot beneath it. At the 60th foot the large somewhat rectangular lamella exceeds in vertical diameter the rest of the foot, and in some the dorsal cirrus springs from the upper angle and not from the middle of the upper edge, but this appears to be due to irregularly from injury or abnormality. The vascularity of the large flattened lamella is now very distinct, and it has a greenish hue. The various lobes of the feet are more distinctly separated from each other, as is also the ventral cirrus from the lobe adjoining. At the 70th foot the lamella stands nearly erect, the inner or dorsal edge being convex, the outer slightly concave (Plate I. fig. 10). There is little change till the tip of the tail is reached—when the flattened process diminishes.

The upper bristles (Plate II. fig. 12) have moderately elongated tips which are finely and closely serrated, the spikes coming off with a curve (the concavity being distal) at the base, but towards the tip they are straight and somewhat more prominent—if less regular.

The falcate bristles are generally devoid of terminal pieces and it is only by examining small examples of the developing bristle in the foot that a perfect one is obtained. This (Plate II. fig. 11) presents a short brownish tip slightly hooked, and as yet devoid of serrations, but these soon appear as in the figure. The bevelled tip of the shaft is also brownish, and from it the longitudinally and transversely striated central region passes backward. With the exception of the tip, the shaft is pale. In the older examples the entire bristle is deep brownish.

The largest example is a female with well developed ova flowing freely in the cœlomic space.

The food in the alimentary canal consisted—in one—of a peculiar alga with minute stalked globular processes.

Schmarda's woodcuts are recognizable, though he shows a papilla to the inner side of the ventral cirrus which is not visible

in these examples. He states that the maxillæ have only two teeth (fig. K.), but the specimen was probably adult, when considerable changes occur. He terms the dorsal cirri and their lamelliform base—gills. His examples were procured in Table Bay.

This species is very similar to the *Nereis heteropoda* of Chamisso and Eysenhardt,* procured on the shores of Unalaschca.

It also approaches *Nereis (Lipephile) macropos*, Claparède,† which again is closely allied to *N. Marionii* Aud and Ed., and the same may be said of De St. Joseph's *Neanthes Perrieri*‡ allowance being made for variations. The *Nereis vexillosa* of Grube § is another form the relationships of which require re-investigation: there is much in the description and figures which agree with *N. Marionii*. It is also clear that the *Nereis (Nereilepas) Stimpsoni* (an vor. *variegata* Grube-Kroyer ?) is the same form, procured at the Cape during the Austrian "*Novara*" Expedition.

Kinberg ‖ found another species of the genus, which he procured at San Francisco, California; whilst Michaelsen's ¶ descriptions and figures of the proboscis of Nereis (Mastigonereis) longicirra, Schmarda, from Ceylon, show a very close approach to the present species, indeed the main difference is in the basal belt of paragnathi in the extruded proboscis, which is distinctly double in the South African species. Ehlers, therefore, has good grounds for uniting them. This author,** indeed, has placed Schmarda's *Mastigonereis podocirra*, *M. longicirra*, Kinberg's *Paranereis elegans*, Grube's *Nereis Stimpsonis*, and four of Hansen's species under the *Nereis variegata* of Grube.

The distribution of this species, indicates what may yet be accomplished by a careful revision of specimens from various quarters of the globe.

Accompanying the foregoing was a young example (8th July, 1902), the feet of which approach those of such forms as *Nereis Dumerilii*, with glandular masses on the dorsum.

Lysidice capensis, Grube, 1867.

Not uncommon between tide-marks at St. James, in False Bay.

1867. *Lysidice capensis*, Grube. Ann. "Novara" Exped., p. 12, Taf. I., fig. 4.

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* De anim. quib. e Classe Vermium, &c. Fascic. II. p. 349, Tab. xxiv., f. 2. 1819.
† Ann. Chét, Nap. Suppl. p. 80, Pl. viii. fig. 1.
‡ Ann. Sc. Nat. (8) v. p. 288, Pl. xv. figs. 69-77.
§ Middendorf's Reise, Annulaten, p. 4, Taf. II. figs. 1, 5, and 6.
‖ Ann. Nova. Öfvers. af K. Vet. Akad. 1865, No. 2, p. 173.
¶ Jahrb. Hamburg, Wiss. Anat. ix., p. 9, figs. 8–10.
** Polychæt. d. Magellanisch, u. Chilenisch Strande, Berlin, 1901, p. 112, Taf. xiv. figs. 1-21.

A form reaching the length of 150 mm., or more, and having a breadth of 6—7 mm. at its widest part over the bristles.

The head is deeply bilobed, and carries three rather short stumpy tentacles, with a pale patch at the tip, the rest being of the brownish hue of the head. The median is the longer, and in the preparations its tip just touches the central fissure in front. External to the base of the outer tentacle, is an eye on each side, with a well-marked corneal thickening. The nuchal collar covers the back part of the head, concealing a median band, passing to the first segment, and a lateral junction at each outer tentacle, the margin of the central curving outward to the lateral.

The body is very little tapered in front, and the diminution towards the tail is also gentle. The latter terminates in two short subulate styles beneath the vent. It is pale brownish anteriorly, minutely dotted with pale specks, but in the preparations these disappear from more than the posterior half. Some of the anterior segments ventrally show the same specks on the brownish ground-colour, but the rest of the surface is of a uniform pale brown, variegated only by the reddish brown pad beneath the ventral cirrus.

The proboscis has maxillæ with rather short blunt blades in front, the posterior process narrowing to a notch, dilating, and again narrowing to form a lozenge-shaped appendage posteriorly. The maxillæ have three strong, blunt teeth in front. The notches on the azygos plate are indistinct, and there are few (about two) on the left anterior plate—beyond which is a small accessory plate. The right anterior curved plate has a bare edge internally, and four teeth externally, and at its outer edge is an accessory process.

The mandibles are boldly wedge-shaped, the anterior ventral plates being large and with curved lines. Internally, they are symmetrically striated, and are curved externally in front, a dense black longitudinal plate indicating the curvature. They taper posteriorly.

The apparatus is tinted blackish, and, on the whole, corresponds to the somewhat crude outline of the parts, in *Lysidice atra*, given by Schmarda. The posterior appendages are less elongated, and more definitely bevelled, than in *Lysidice Ninetta* of European waters, but it may yet be a question, how far such variations hold as specific distinctions, especially, as the size of the African examples is so much greater.

The tenth and 20th feet differ from the 30th and those following, by the absence of the long black ventral hook, otherwise, their structure is similar.

The 30th foot (Plate III., fig. 13) presents the single powerful black spine, which pierces the surface between the dorsal and

ventral bristles. Dorsally is the somewhat short subulate dorsal cirrus, the tip of which falls short of the setigerous region, which forms a thick truncated lobe, separated by a brief interval from the short and blunt ventral cirrus. The whole foot is richly vascular. The setigerous region bears above the spine a tuft of bristles with tapering tips, which have but faint indication of wings. A few brush-shaped forms are also present. Beneath the spine is a dense group of compound bristles with straight shafts, which are bent backwards and dilated at the tip, as well as bevelled for the terminal piece—which is somewhat short, bifid at the tip, and with wings.

The intestine contained sandy mud with fragments of sponge-spicules, echinoderms, and small calcareous fragments.

The specimen named by Grube *Lysidice capensis** seems to have been very small, only 21 mm. in length, but its general characters as well as the structure of the foot correspond.

Except in the coloration, Schmarda's *Lysidice atra* from the Cape agrees with this form. When the feet of the latter are contrasted with those of *Lysidice Ninetta* the African has black spines whilst the other has yellow spines, and the tips of the compound bristles appear to be slightly shorter in the African.

Some of the examples had free ova of a greyish colour in the perivisceral chamber, so that the breeding season would be at the time of capture.

As Langerhans found *Lysidice Ninetta* as far south as Madeira and the Canaries, it may yet be possible to reduce the number of species of this genus, and it may be that the form from the Cape will be placed as a variety of the European. The literature of this genus is much in need of critical revision.

It is curious that no example of the genus was procured during the voyage of H.M. Ship "Challenger."

Eunice aphroditois, Pallas, 1788.

1788. *Nereis aphroditois*, Pallas, Nova Acta Acad. Sc. Imper. Petropol. II. 4, p. 229, Tab. v. fig. 1.
1820. *Leodice gigantea*, Savigny, Syst. Ann. p. 49.
1861. *Eunice macrobranchia*, Schmarda, Neue wirb. Th. I. ij., p. 130, Pl, xxxii. fig. 258.
1864. *Eriphyle capensis*, Kinberg, Ofvers. af K. Vet. Akad. Förh, p. 385 (fide Marenzeller).
1865. *Eunice gigantea*, De Quatrefages, Ann. p. 311.
1878. ,, *aphroditois*, Grube, Ann. Semper, p. 147.
1885. ,, *aphroditois*, M'Intosh, Ann. "Challenger" p. 282, Pl. xxxviii. figs. 16, 17, Pl. xxa. figs. 8-10.
1889. *Eriphyle capensis*, Marenzeller, Zool. Jahrb. Bd. III. p. 7, Taf. I. fig. 3.

* Annel. Novara Exped. p. 12, Taf. I. fig. 4, 1867.

Obtained between tide marks, St. James', in False Bay.

A large Eunice, apparently common at the Cape, stretching to 180 mm. in spirit, and in life probably considerably beyond that measurement.

In dealing with spirit-specimens it is difficult to make out resemblances in colour, but in the examples from the Cape the tints of most are recognizable. The cupreous or brownish red and somewhat dappled hue, and the white bands anteriorly readily distinguish it.

The head, tentacles, bristles, branchiæ, and teeth all conform to the type. The simple bristles, which are modified winged bristles, are marked under a moderately high power by minute and slightly oblique lines (probably extending from the wings), and thus the surface is file-like, a condition figured by Schmarda in his *Eunice macrobranchia*, which is here considered to be the same species. The wing is very narrow, but the lines from the serrations on the edge pass inwards as described. These bristles have long tapering tips. The compound bristles with bifid tips were few in the examples procured by the "Challenger," and consequently an average example from the anterior region of the body is given in Plate II. fig. 14. The brush-shaped bristles have rather wide teeth with slender filaments distally, and a long filament at one end (Plate II. fig. 15). The posterior hooks correspond with those figured in the "Challenger."

The dental apparatus also coincides with the type, the great dental plates each having 5 teeth; the azygos 6; the left anterior lateral 4 teeth; and the right 7 teeth. Each of the two accessory pieces attached to the latter has a horny dental edge. The posterior appendages and the mandibles are typical.

The branchiæ commence in these examples on the sixth foot as a minute simple filament, and the organs become pectinate on the 11th foot. The pinnæ reach the number of 16 or 17, but they probably vary, and may increase with age. They are continued almost to the tip of the tail, which has two cirri beneath the vent.

The food in the alimentary tract consisted of portions of a Polyzoon with long vibracula, spicules of sponges, numerous diatoms, fragments of algæ and spores. In others, fragments of a larger sea-weed occurred, besides smaller branched forms encrusted with large diatoms and mingled with mud rich in Foraminifera, bristles of annelids, crustacean hairs, sponge-spicules and radiolarians.

Though Schmarda's description and figures of his *Eunice macrobranchia* leave much to be desired, yet, it is evident he refers to this species, and Ehlers is inclined to the same view. Thus he describes, under the specific characters, the semi-cylindrical body as cupreous, or reddish brown, and, further,

notes that it is 200 mm. long. His figures and description of the dental apparatus, however, are erroneous, and he has, apparently, joined the mandibles to the posterior appendages of the maxillæ. He observes that the first 12 segments are devoid of branchiæ, but he may have overlooked the simple branchial processes commencing on the 6th foot. He recognized the striated condition of the simple tapering bristles, and, though inaccurate, his figure of the compound form is recognizable. He gives the last segment of the body four cirri, but only two are present in those sent by Dr. Gilchrist.

The relationship of this form to the well-known *Eunice aphroditois*, Pallas, is interesting. In many respects they agree, and though the condition of the branchiæ on the anterior feet calls for notice, yet, it is easy for a simple branchial filament to become branched as age advances, or the environment alters. The wide distribution of *Eunice aphroditois* gives room for great variation, stretching, as it does, over the Indian and Pacific oceans to South Africa. Thus, specimens measuring fully two feet in spirit, from Viti Island, Samoa, show certain variations from others procured off Port Jackson, Australia, and between tide-marks at Samboangan. In the large examples, even the bristles are affected, for many of the compound forms have lost their tips, and, besides, are considerably abraded.

As Ehlers* has also pointed out, it is doubtful if Schmarda's *Eunice nigricans*, and his *Eunice schemacephala*, are other than varieties of the same form (*Eunice aphroditois*). Kinberg's† figures of *Eunice capensis* would also appear to refer to this species, as likewise Marenzeller's account of the same form from Angra Pequena-Bucht.‡

Marphysa sanguinea, Montagu, 1815.

1815. *Nereis sanguinea*, Montagu. Trans. Lin. Soc. xi., p. 20, Pl. iii., fig. 1.

1868. *Marphysa sanguinea*, Ehlers. Borstenw. ii., p. 360, Taf. xvi., fig. 8—11.

Procured between high and low water marks at St. James, in False Bay.

The head agrees with that of *Marphysa sanguinea*, from the Channel Islands.

The body in all is incomplete, the longest—with a short regenerated posterior region, measures 85 mm., but the perfect form is probably more than double the length. It is rounded

* Borstenw. ii., p. 306.
† Op. cit., Tab. xv. fig. 16.
‡ Zool. Jahrb. Bd. iii., p. 7 (sep. abdr.).

in front, flattened throughout the rest of its exterior, and proportionally broad. In life, it must have been finely coloured, for in spirit the anterior region is dappled with reddish brown, and iridescent.

The branchiæ commence on the 19th foot, or in others on 20th and 21st feet, as a simple filament, thus corresponding in origin with those of *Marphysa sanguinea* from the Channel Islands and southern Europe, and, as noted subsequently, their condition on corresponding feet is similar. No example was complete, but, as far as could be observed, their distribution posteriorly was similar.

At the 10th foot, the dorsal cirrus is proportionally shorter and stouter than in *Marphysa sanguinea*, and there are five black spines in the setigerous region, instead of three. The simple dorsal bristles are similar in both, and no appreciable distinction between the ventral bristles, except in size, in the respective forms is noticeable. The ventral cirrus is slightly more prominent in the British form. The foot remains the same till the appearance of the branchiæ—often posterior to the 20th foot. At the 30th foot, whilst *Marphysa sanguinea* has two long slender divisions of nearly equal length to the branchia, and the dorsal cirrus is slender, the African form has the gill much shorter—the longest not being more than twice the length of the dorsal cirrus, the shorter about the same length. Four divisions of the branchia occur in the 50th foot of the British form, and they are nearly of equal length—two arising distally, and two beneath (externally); the African has also four divisions—two terminal, and two external. The proportions of the other part of the foot are the same. In each, four divisions of the branchia occur in the 70th foot.

So far as can be observed, both from the external appearance and the minute structure of feet and bristles, as well as of the dental apparatus, the British and the South African forms are the same. The species stretches to the American shores of the Atlantic, having been found on the coast of Rhode Island and New Jersey by Leidy,* by Webster† further south on the Virginian shores, and he states that it is common, especially near high water-mark. He points out that De Quatrefages made a new species (*Marphysa Leidii*) of Leidy's examples, having, by mistake, changed the 16 of the American authors' description into 60. Marenzeller,‡ again, finds the same species at Angra Pequena, on the south-eastern coast of Africa.

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* Jour. Acad. Nat. Sc. Philad. ii., Vol. iii., p. 147.
† Trans. Albany Inst. ix., p. 36 (sep. copy).
‡ Zool. Jahrb. iii., p. 11 (sep. abdr.).

ARABELLA (ARACODA) IRICOLOR, Montagu, 1802, var CÆRULÆA, Schmarda.

1802. *Nereis iricolor*, Montagu, Linn. Trans. vii. p. 82.
1861. *Aracoda cærulæa*, Schmarda, Neue wirb. Thiere, I. ij. p. 115, Taf. xxxii. fig. 253.
1865. *Lumbriconereis tricolor*, Johnston, Cat. B.M. p. 141.
1885. *Notocirrus capensis*, M'Intosh, "Challenger" p. 236, Pl. xxxvii. figs. 3, 4; Pl. xviiia. fig. 15.
1888. *Maclovia gigantea*, De St. Joseph, Ann. sc. nat. &c., ser. p. 230, Pl. ix. figs. 92-95.
1901. *Aracoda cærulea*, Ehlers, Polych. Magellan. u. Chilen., p. 143, Taf. xix. figs. 1-6.

Between tide marks at St. James', False Bay, apparently in considerable numbers.

In general aspect this form closely resembles the *Arabella iricolor* of Montagu.

The head forms a blunt cone which varies in outline according to the specimen, in some having a tendency to an ovoid outline, whilst in others it is more elongate. In lateral view it is distinctly conical. At the base dorsally are four black eyes arranged in a transverse line. The central pair are usually most distinct, and young examples show the eyes best. The under surface of the snout is often marked by a central hollow. The first (peristomial) and the succeeding segments resemble those of *A. iricolor*, and the same may be said for the rest of the body, including the feet.

The dental apparatus (Plate iv. fig. 16,) presents the same arrangement, three toothed plates being in front of the great dental plate, but the size of the individual teeth in these plates is considerably larger in the British forms. This is very noticeable in the first—a single fang, and in the second. There is thus a tendency to diminution. The great dental plates have a more distinct, pointed process externally and anteriorly, and they are somewhat shorter than in the British type.

The maxillæ are also rather shorter, and their bases are truncated transversely. About 6 teeth are visible at the edge of the broad basal region. These teeth are more numerous in those from the Channel Islands, 7 or 8 at least being present. The posterior appendages articulate with the maxillæ by a broad triangular process which obliquely slopes to the long appendage on each side, whereas in the British this is longer and narrower. Moreover, three appendages instead of two occur posteriorly, the additional process being somewhat broader, shorter and median.

The mandibles (Plate iv., fig. 17) also show certain differences, being broader, stouter and shorter in the African, narrower and

more elongate in the British, but essentially they are the same. Unfortunately the injured condition of the teeth in examples procured by the "Challenger" led to ambiguity as to the relations of the species.

In the shape of the feet there is little to discriminate between the forms, both having the setigerous lobe with its group of pale spines anteriorly, whilst the slightly curved conical lobe passes backward beneath it. Nor are the differences of the bristles noteworthy. In both some of the bristles are longer, have a marked curve at the commencement of the tapering tip and well-marked wings, but do not show marked serrations, whereas others have shorter tips with broader wings and bold serrations, three of which at least have ridges running in from the edge. In the British form this expanded region with the serrations appears to be more differentiated, the wings being narrower beyond it, so that the tip is more slender, but such distinctions are variable.

The body terminates posteriorly as in the European forms, and regeneration of the tail occurs. In some, a slight tube of mucus with sand-grains surrounds the body. On the whole the forms approach each other very closely, and if even the variations of the European examples are considered, e.g., as shown by Ehlers and by the British specimens, then there is little ground for specific distinction. Thus Ehlers, for instance, figures* the same arrangement of the posterior appendages of the maxillæ as seen in the African forms.

Further, the genus *Aracoda* of Schmarda† is clearly founded on this species, which he procured not only at the Cape but on the coast of Chili, and therefore lapses, since Grube's title has priority.

There is little in Schmarda's description of the genus, except that there are no eyes or dorsal cirri, bristles simple, 8 or 10 maxillæ, of which the inferior alone are calcareous. He noticed the serrated edges of the bristles with wide tips. His specific characters are :—Body cylindrical, bluish ; Cephalic lobe longer than the first two segments ; ten superior maxillæ. Feet conical ; bristles winged, bent towards the tip. He gives a length of 240 mm. and 500 segments. His figures of the dental apparatus (woodcuts, p. 115) are fairly good, and so with that of the serrated bristle.

Schmarda's coloured figure shows the anterior end trilobed and tinted brown, but such a condition could only have been produced by the partial extrusion of the proboscis—a feature occasionally seen in the present examples. This author followed no strict law in grouping his Annelids, for his second

* Borstenwürmer, II. Plate xvii. fig. 19.
† Neue Wirb. Thiere, I. ii. p. 115, Taf. xxxii. fig. 253.

species of *Aracoda*** *(A. heterochæta)* is apparently a *Lumbriconereis* with a different dental apparatus.

It is probable that this species occurs at the Canaries (Langerhans§), so that the step to South Africa is broken. The *Arabella opalina*, of Verrill,‖ is a very closely allied, if not identical species, and this has also been found at Porto Rico, by Treadwell.†† The *Arabella macnlosa*, n.s., of Verrill,‡‡ from Flatts Inlet, Bermudas, presents no feature other than what might occur in a variety of this almost cosmopolitan form.

Further, the *Aracoda caerulea*, Schmarda, as described by Ehlers, would not seem to differ in any essential particular from the British representatives, for the presence of a third narrow appendage to the maxillæ is of comparatively little moment. This third appendage occurs in the same species from Japan (Kada Bay). The view here suggested is the more likely, from the fact of the very wide distribution of the species. A form which stretches from Britain to Japan on the one hand, and from South Africa to Juan Fernandez on the other, should not be too rigidly judged, according to artificial standards of distinction.

LUMBRICONEREIS TETRAURUS, Schmarda, 1861.

1861. *Notocirrus tetraurus*, Schmarda, Neue wirb. Th., I. ij., p. 117.

1885. *Lumbriconereis Pettigrewi*, McIntosh, Annel. "Challenger," p. 239, Pl. xxxvi., figs. 7, 8, 9, Pl. xvii*a*., figs. 11—14.

1901. *Lumbriconereis tetraura*, Ehlers. Polych. Magell. u. Chilen., p. 137, Taf. xvii., figs. 1—10.

Found between tide-marks at St. James, False Bay.

The head of this species forms a blunt cone with one or two longitudinal grooves dorsally, and a close series ventrally. Posteriorly is a median band, with a depression on each side, where it joins the first segment.

An elongated species of the usual shape, and the tail is terminated by four short caudal cirri, the inferior being the longer. The colour is brownish, with fine bluish iridescence—especially anteriorly.

** Grube† adopted Schmarda's genus Aracoda for those which had the bases of the maxillæ toothed, and Ehlers* followed. Considerable confusion, however, exists as to the toothed condition of the maxillæ, for the teeth are often hidden from the nature of the edge of the maxillæ.

Ann. Semper., p. 175.

Op. cit., p. 111.

§ Langerhans, Nova Acta. Bd. xlii., No. 3, p. 112, Taf. ii., fig. 18.

‖ Report Invert. Vineyard Sound, 1874, p. 594, figs. 69 and 70.

†† Bullet. U.S. Fish Com. for 1900, p. 199.

‡‡ Trans. Conn. Acad. Arts and Sc. x., 1900, p. 651.

The dental apparatus comes near that of Schmarda's species, the long pointed ends of the posterior appendages being diagnostic (Plate III., fig. 18), and resembling those of Kinberg's *Lumbriconereis Jacksoni.** The maxillæ are strongly curved, and articulate posteriorly with a dilated region, which is again constricted, and ends in two slender tapering points (one on each side). In lateral view, the maxillæ show a considerable curve. The great dental plates have four distinct teeth on each side, and the movement of these plates is such that the dental edge can be placed either horizontally or nearly vertically with the teeth pointing dorsally. A considerable portion of the edge of each posteriorly is smooth. In front of these is a small plate, which also appears on the ventral surface with one or two teeth, then a larger plate similarly placed in front, with a single tooth at its posterior (dorsal) edge ; whilst externally, is a flat horny plate, and after an interval, a thin curved horny process, which passes backward to a point opposite the middle of the maxillæ.

The whole apparatus is of a blackish-brown colour.

The mandibles are elongate, wedge-shaped as in *Lumbriconereis Pettigrewi*, only shorter.

The feet are normal in outline, a conical lobe, or process, slanting backward from the setigerous process. This is probably what Schmarda calls "*branchia (cirrus dorsalis) basi augustior*," a statement which has given rise to misapprehensions.

The bristles (Plate II., fig. 18*a*) anteriorly are winged with the usual curve at the base of the tip, and with finely serrated edges. Towards the 50th foot, winged hooks take the place of the inferior groups of winged bristles, and, by-and-by, winged hooks alone occupy the feet to the tip of the tail (Plate II., figs. 19 and 20). The wings of these hooks are somewhat broad, and the tip ends in a main fang, and several smaller points superiorly. In most of the larger forms these are abraded, being best seen in young specimens. The edges of the wings are serrated. The spines are yellowish.

The constricted condition of the posterior lamella of the foot (Schmarda's branchia) may have been connected with preservation, as this was not a feature observed in the present specimens.

Schmarda obtained it both at the Cape and on the coast of Chili, and Ehlers has recently described it both from Magellan and Chili. The distribution of this species is, therefore, very wide. The *Lumbriconereis Pettigrewi* of the "Challenger" would seem to be the same form.

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* Freg. Eugen. Resa, &c., Taf. xviii., fig 34.

Lumbriconereis ——— ?

Another form dredged by the "Challenger," at Station 141 (off the Cape of Good Hope), differs from any in the present collection. It is distinguished by the presence of a single long-winged hook ("Challenger" Annel., Pl. xvii*a*., fig. 15) in the anterior feet. An increase in the length of the tips of the second group of superior bristles anteriorly, and yellowish spines are other features. In the dental apparatus, the maxillæ had translucent hard tips, and the basal ridges did not correspond. The left great dental plate had four, and the right five teeth. The outer lateral plate in front is larger than in *Lumbriconereis tetraurus*, and bears two teeth. The inner has a short tooth.

As the only example was injured, it is well to draw attention to this species.

Lumbriconereis cavifrons, Grube, 1867.

1867. *Lumbriconereis cavifrons*, Grube. Ann. "Novara" Exped., p. 13, Taf. 1, fig. 5 ?

1868. *Lumbriconereis gracilis*, Ehlers. Borstenw. ii., p. 393, Taf. xvii., figs. 6—10.

Procured at St. James, False Bay, between tide-marks.

A small species about 1¾ ins. long.

The head forms a smoothly rounded blunt lobe in front, and is slightly constricted at the posterior border. A minute median band connects it dorsally with the first segment. In lateral view, the snout is nearly of equal depth throughout, so that the tip is characteristically blunt, but such is probably due to the degree of contraction, for in another example, with a deep median sulcus on the ventral surface of the snout, the latter was less blunt in profile. The dorsal groove mentioned by Grube in *Lumbriconereis cavifrons*, was not present in these.

The body is very little narrowed anteriorly, remains for some distance of nearly uniform diameter, and then tapers gently towards the tail—which, in the examples, had four short cirri (like papillæ), the two upper being the longer. The segments are very distinctly marked. The general colour of the body is pale brown, with only a little iridescence on the curves of the segments, and thus is in marked contrast with *Lumbriconereis tetraurus*. The cuticle is also somewhat delicate.

The dental apparatus (Plate iii. fig 21) presents a pair of strongly curved sharp maxillæ which pass backward to converge at a narrow pedicle connecting them with the posterior appendages. After a constricted region the latter again dilates, but the specimen is incomplete, though apparently they terminate in

the narrow plates. The great dental plates are pale translucent brown, and each has five prominent teeth of great strength. The plate in front has two teeth, and the anterior plate one tooth. Two prominent papillæ occur on the anterior edge of the lower lip, but no mandibles were present in either specimen.

The granular condition of the borders of the anterior horny plates, so well seen in British examples, is likewise present, though less distinct both in these and in the opaque areas exterior to the great dental plates.

The feet are not so prominent as in the preceding species, the posterior lobe being less conspicuous. The anterior feet have winged bristles dorsally and jointed hooks inferiorly. The former have the tip curved on the shaft—with broad wings and a short tapering tip. The hooks (Plate iv. fig. 22) have the long shaft slightly curved backward at its distal end and bevelled for the basal process of the terminal piece—which tapers to a crown with a main fang aud several minute teeth above it, and with guards or wings which come from the end of the shaft.

The first foot has a winged bristle or two, a long simple hook and two jointed hooks. At the fifth and sixth foot only one jointed hook occurs, but they evidently vary as in the 7th and 8th two winged bristles with tapering tips occur, then three jointed hooks, and ventrally a single smaller winged bristle. The latter disappears in the 12th, 13th and subsequent feet, the 14th having only a single simple hook.. The tapering tip of the bristle becomes shorter and the wings broader at the base.

The bristles by-and-by disappear, and the hooks remain simple (Plate IV. fig. 23) the shaft having a prominent curve at its stoutest or distal region, then narrowing to a crown which has a main fang and a series of small teeth above it. Moreover two small teeth occur on the distal edge of the great fang.

The description of *Lumbriconereis cavifrons* by Grube is somewhat imperfect, but it would seem to refer to the same form, though none of the present examples showed a dorsal groove on the head, which it may be remarked. also occurs in certain specimens of *Lumbriconereis gracilis*, Ehlers. The latter seems to be a closely allied if not identical form—first found by Ehlers at Fiume in the Gulf of Quarnero in the Adriatic, but which is now known to occur at Madeira and on British shores, so that its distribution is very wide and may yet embrace South Africa. Grube's examples came from Chalk Bay.

Young Examples.

Certain young forms procured on various dates, show the following differences from the foregoing (*Lumbriconereis gracilis*). They occurred in the tissue of a sponge inside a fragmentary *Trochus*.

The head has a similar shape, but it has two distinct eye-specks near the anterior border.

The body (Plate iv. fig. 24) has from 15 bristled segments in the smallest to 28 in the largest, and the tail terminates in four flat papillæ. The proportions of the first two body-segments are the same. In that with 28 bristled segments, the first twelve have bristles with tapering winged tips, these as well as all behind having also long simple (unjointed) winged hooks, which appear to agree in structure with *Lumbriconereis gracilis* beside which these were found.

So far as could be observed in transparent preparations the dental apparatus corresponded in general structure with that of *Lumbriconereis gracilis*, though the posterior appendages of the maxillæ were less developed. The great dental plates had 5 teeth, and the anterior plates respectively two teeth and one tooth. No mandibles were present. A horny structure in the gut posteriorly was either a portion of the dental apparatus which had been shed, or a structure which had been swallowed as food, the former being the more likely. These may be the young stages of the previous species, if it were possible that the jointed hooks anteriorly were only developed in the later stages.

Obtained between tide-marks at St. James, in False Bay.

Trophonia capensis, McIntosh, 1885.

1885. *Trophonia capensis*, McIntosh. Annel. "Challenger," p. 363, Pl. xliv., figs. 7, 8, Pl. xxxiii*a*, figs. 1—3.

The examples procured by Dr. Gilchrist are considerably longer than that obtained by the "Challenger" between tide-marks at Sea Point, Cape Town, in December, 1873, for they measured up to 90 mm., whereas, the "Challenger" example was only 60 mm.

The outline anteriorly is somewhat fusiform, and then the body gradually tapers to the tail which, however, is by no means slender. It terminates in the vent—with a slightly crenate margin. The segments were more numerous (about 90) than in that described. The skin had numerous sand-grains and siliceous and calcareous particles attached to it, the dorsal surface being coated with larger semi-translucent (pale) fragments—especially on the anterior region. The whole forms a tough investment of hardened mucus, fragments of sponge-spicules and light sand-grains, which can be peeled from the body—carrying many of the bristles with it. Thus exposed, the surface is definitely ringed and smooth—with papillæ arranged at regular intervals in each segment. Anteriorly, within the rows of bristles, are two rows of papillæ; between

the bristles and the hooks laterally are two rows; whilst, ventrally, there are four nearly equi-distant rows anteriorly; at the end of the anterior third are six rows, and these continue to the posterior region. These papillæ are readily recognized by their darker colour, the general surface of the body being pale brown. When the investment is removed, the body becomes flaccid—demonstrating that its comparative rigidity is due to this coat. The uniform arrangement of the small grains on the ventral surface and sides and their general effect, together with the addition of the larger translucent grains to the dorsal surface (to which, indeed, they were confined), showed discrimination and care on the part of the Annelid.

The snout bears two grooved tentacles, and a dense tuft of branchiæ superiorly on each side. The latter are more numerous and more slender than in the common European species (*Trophonia plumosa*), and they arise from the ventral aspect of a tongue-shaped triangular process, which projects upward and forward on each side from the upper lip. Each is marked, in extrusion, on the dorsal surface by a line of dark pigment just within a pale margin. The processes appear to fuse along the middle line, though a deep groove exists on the ventral surface. Ventrally, the branchiæ are closely arranged, and in somewhat regular rows. Each has an afferent and an efferent vessel. In the central line in front of the mouth is a longer papillæ, which may be bifid, each division being slender.

One example had the body-cavity filled with dark green ova, as in the case of the "Challenger" example, which was obtained in December. Another appeared to have masses of sperms in the same cavity.

The genus is probably identical with *Stylaroides*, Delle Chiaje.

Flabelligera luctator, Stimpson, 1856.

1856. *Tectnrella luctator*, Stimpson. Proc. Nat. Sc. Philad. vii., p. 391.

1861. *Phernsa tetragona*, Schmarda. Neue wirb. Thiere, i., ii., p. 20, Taf. xx., fig. 168.

1889. *Flabelligera luctator*, Marenzeller. Zool. Jahrb. iii., p. 15 (sep. abdr.).

Found between tide marks at St. James's, in False Bay.

A form somewhat fusiform in outline and ranging from 30 to over 50 mm. in length, and with a breadth at its widest part of 5-6 mm. It is of a firmer consistence than the ordinary *Flabelligera affinis*, and thus its habitat probably differs.

The tentacles are of considerable length and frilled in a characteristic manner. As a transparent object a series of club-

shaped granular papillæ occur in rows at the sides of the organ. The branchiæ form a dense group of thread-like structures on each side dorsally. Schmarda shows them of a bluish tint.

The foregoing organs are enclosed by a fringe of golden bristles, which with a dense series of elongated papillæ between them form a web continuous at the sides, but with a gap dorsally and ventrally. These bristles are comparatively short in contrast with *Trophonia*, but their structure is similar, and their curve is adapted to the contour of the wide fringe or palisade which they form around the central organs.

The long papillæ have slender stems with a fusiform dilatation near the tip—which ends in a bulbous enlargement.

The body is fusiform in outline, though by no means finely tapered, indeed the ends are blunt. The skin is dark brown and does not appear to have the abundant gelatinous tissue so characteristic of *Flabelligera affinis*. On each side of the dorsum is a series of bristle-tufts, the bristles having a similar structure to those in front, and at each tuft is a dense group of the long papillæ. The colour is dull greenish.

Ventrally, again, each segment has two long and strongly curved hooks (Plate iv. fig. 25) with slightly curved shafts which have a dilatation below the sharp hook at the tip, and another less marked at the commencement of the transverse lines at the end of the shaft. The number of the lateral bristle-tufts ranges from 41 to 54, Schmarda giving 37 body segments. His specimens, however, were smaller. The surface of the body has a considerable quantity of adherent sand-grains, which are found both dorsally and ventrally, but they do not form a continuous coat, much of the body being bare. The rows of ventral hooks have a narrower space between them than the dorsal bristles, the ventral surface of the tetrahedral body being thus much less than the convex dorsal region.

In regard to the sand-particles and their attachment it could not be said that each was fixed to the tip of a papilla. The grains seemed to adhere to mucus in which were sponge-spicules, diatoms, and here and there groups of papillæ, but the latter appeared to have no special connection with the particles though they may have with the mucus. The sand-grains contained many calcareous fragments amongst the siliceous.

The same sand with its coarser and finer particles occurred in the alimentary canal.

The general aspect of this form would seem to indicate that it leans to Flabelligera, though no example had the membrane between the hooks and bristles, and in this view it is satisfactory to have the support of so able an investigator as Dr. E. Marenzel-

ler, who found the species on the eastern coast of Africa, at Angra Pequena.* There are slight differences in the figure of the hook, to which the Austrian author gives transverse striæ in the distal region. Such, however, may be due to age or local variation.

Flabelligera marenzelleri, n.s. (an var. *affinis.*).

Collected between tide-marks at St. James, False Bay, South Africa.

Procured along with *Flabelligera luctator*, Stimpson, from which it is readily distinguished by its smooth body, the presence of a membrane between the hooks, and the flattening of the bristles to the sides of the body, apparently by a similar gelatinous membrane. On the whole, however, it has a less gelatinous aspect than such as *Flabelligera affinis.*

The frontal bristles, in general aspect, resemble those of *Flabelligera affinis*, though minute examination shows that the former are darker yellow, and that the segments are shorter. No appreciable distinction could be drawn between the elongated filaments, with their characteristic terminal enlargements. The tentacles and branchiæ are similar.

The fusiform body is more consistent than that of *Flabelligera affinis*, and retains its straight outline, the convex dorsum being covered by a glistening cuticle. The dorsal area is large, since the lateral rows of bristles and hooks are carried far downwards, thus encroaching on the ventral area.

The dorsal bristles are shorter, stouter, and duskier in hue than those of *Flabelligera affinis*, and the transverse bars seem to be rather closer. In the British form, these bristles taper to a more slender elongated tip—followed by the long papillæ. The latter appeared to agree.

The long golden hooks are arranged, for the most part, singly, along the sides of the ventral surface, and have, about the commencement of the distal third, a curve backward. Distally, the shaft joins the flattened sickle-shaped tip (Plate III., fig. 26), which dilates at its commencement, and ends in a sharp strongly curved brownish claw. The internal striations nearly correspond with those in the British species, indeed, it is hard to draw a distinction between the two. The South African has, apparently, a more brittle nature, since a separation often occurred at the transverse segments, is darker (as a trans-

* Op. cit.

parent object), and the terminal claw is usually more erect, a condition seen in certain varieties of the European form, such as those from the Clyde.

The body-wall of the South African form has thicker muscular layers, and the papillæ seem to be more elongated terminally than in the British, but preparation may be responsible for this.

The question, therefore, as to specific distinction is a delicate one, and separation rests on the shortness and strength of the bristles, with their slightly narrower transverse lines, the curves and colour of the hooks, and the more consistent body. Future investigation may show that the Mediterranean *Siphonostoma diplochaïtos* of Otto, has relations both to the northern forms and to those from the south.

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EXPLANATION OF PLATES.

Plate I.

Fig.

1. Anterior foot of *Hemitepidia tuberculata*, Schmarda. 13 diam.

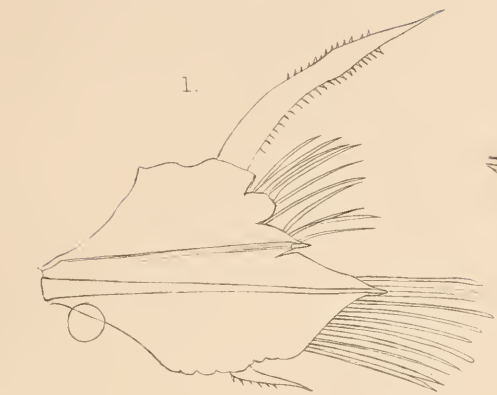
6. Dorsal view of the head and extruded proboscis of *Nereis* (*Mastigonereis*) *variegata*, Grube. Enlarged under a lens.

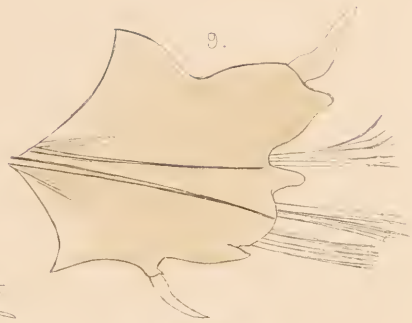
7. Ventral aspect of the proboscis of the same form. Enlarged under a lens.

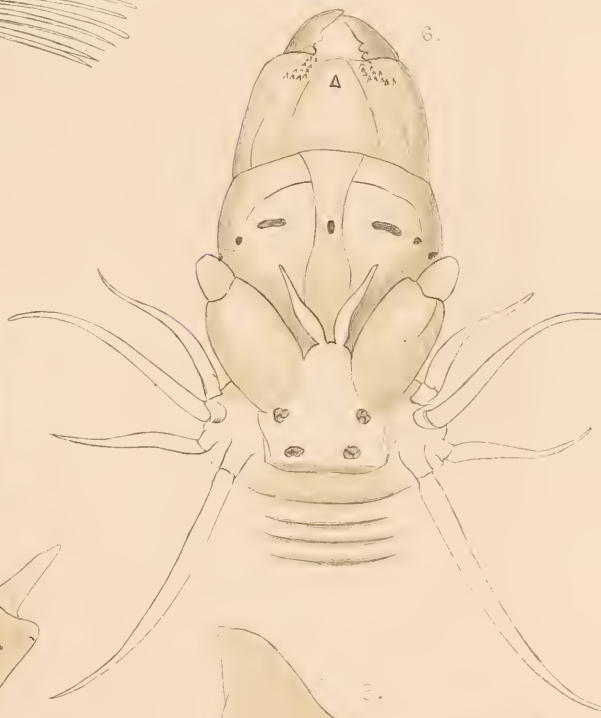
8. Twentieth foot of the same. 13 diam.

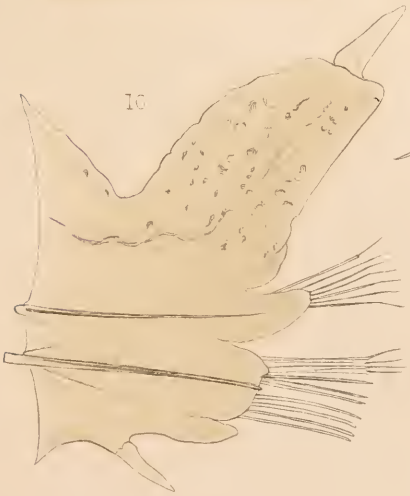
9. Fortieth foot of the foregoing. 12 diam.

10. Seventieth foot of the same. 17 diam.









W.C.M. del.

HEMILEPIDIA & NEREIS

Plate II.

Fig.

2. Dorsal bristle of *Hemilepidia tuberculata*, Schmarda. ×240 diam.

3. Large upper bristle of the ventral series of the fortieth foot. Similarly magnified.

4. Bristle from the upper series of the ventral of the tenth foot. Similarly magnified.

5. Bifid bristle from the ventral series of the same form. Similarly magnified.

11. Falcate bristle from the anterior region of *Nereis (Mastigonereis) variegata* Grube. ×240 diam.

12. Jointed dorsal bristle (with tapering tip) from the same region. Similarly magnified.

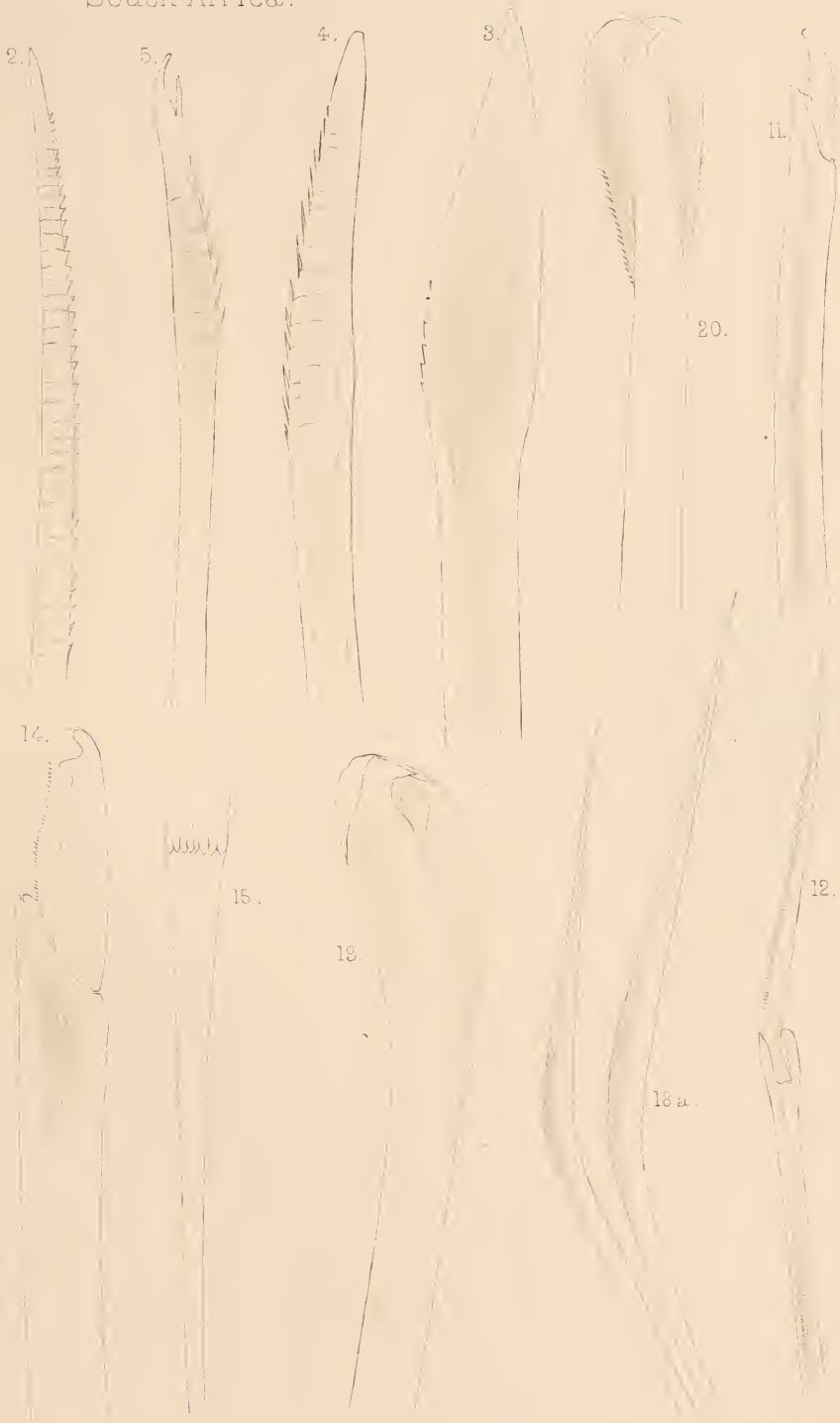
14. Falcate bristle from the ventral series of an anterior foot of *Eunice aphroditois*, Pallas. Magnified as before.

15. Brush-shaped bristle from the dorsal series of the same form. As before.

18a. Two winged bristles of *Lumbrinereis tetraurus*, Schmarda. 100 diam.

19. Winged hook of the same form in lateral view. ×240 diam.

20. Head of another winged bristle viewed from the face (front). Similarly magnified.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18 a.

Plate III.

Fig.

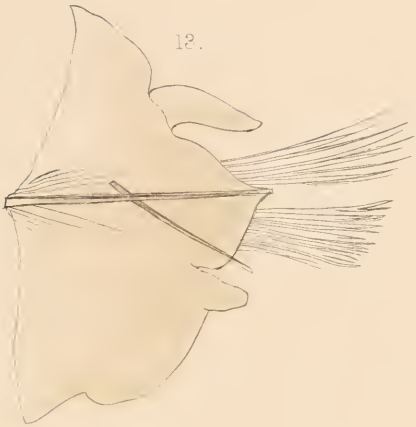
13. Anterior foot of *Lysidice capensis*, Grube. 24 diam.

18. Dental apparatus of *Lumbriconereis lebrauras*, Schmarda. The second tooth is somewhat imaginary as its bifid condition is not seen in this position. 15 diam.

21. Dental apparatus of *Lumbriconereis cavifrons*, Grube. The dotted line continued from the broken posterior appendages is imaginary. 15 diams.

22. Lateral view of winged tapering bristle of the same form. Zeiss oc. 2. obj. D.+3 in. draw-tube.

26. Hook of *Flabelligera Marenzelleri* (an. var. *affinis*, Sars). 140 diam.



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EONIDILÆ & CHLORÆMIDÆ.

Plate IV.

Fig.

16. Dental apparatus of *Arabella iricolor*, Montagu. 21 diam.

17. Mandibles of the foregoing. 15 diam.

22. Jointed anterior hook of *Lumbriconereis cavifrons*, Grube. Zeiss oc. 2. obj. D.+3 in. draw-tube.

23. Winged simple hook of the same species. Similarly magnified.

24. Young examples of the same form with eyes, and the dental apparatus *in situ*. 50 diam.

25. Hook of *Flabelligera Mercuzellen* (an var. *affinis* sars). 100 diam.

W. & M. del.

Mintern Bros lith.

EUNICIDÆ & CHLORÆMIDÆ.

MARINE ANNELIDS (POLYCHÆTA)

OF

SOUTH AFRICA.

PART II.

BY

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CONTENTS.

INTRODUCTION.

In this as in the previous part attention may again be drawn to the comparatively large number of European forms in South African waters, and to the very wide distribution of others which occur there. Thus the purple Polynoid, *Polynoë* (*Macellicephala*) *mirabilis*, ranges from the north-west of the North Island of New Zealand to the Cape on the one hand, and to the Kara Sea (Levinsen) on the other; whilst *Polyeunoa lævis* stretches from the Strait of Magellan to Prince Edward's Island and is now brought within 25 miles of the Cape. Indeed almost everyone of the species in this section is remarkable for its cosmopolitan tendencies, and, as critical examinations extend in future, it is probable that one or two still doubtful may be included in the same category. The range of such forms as *Chætopterus variopedatus*, *Cirratulus cirratus* and *tentaculatus*, *Dasybranchus caducus*, *Nicomache lumbricalis*, *Potamilla reniformis*, *Bispira volutacornis* and even the crustacean parasites of Annelids is remarkable, and show how much has yet to be done in the distribution of marine animals, and moreover illustrates the bold contrast they present to the distribution of land animals.

Fam. POLYNOIDÆ.

POLYNOË (MACELLICEPHALA) MIRABILIS, McIntosh, 1885.

1885. *Polynoë* (*Macellicephala*) *mirabilis*, McIntosh, Ann. "Challenger" p. 121, Pl. xvi. fig. 1, Pl. xii. figs. 9-11.
1886. *Oligolepis violacea*, Levinsen, Kara-Havets, Ledorme, p. 4, Pl. xxv. figs. 1-4.

This purple polynoid was procured in the trawl at 470 fathoms, 25 miles off Cape Point Lighthouse, bottom, green sand and hard ground. The specimens had been put in formalin and their colour was fairly preserved. The rich purple or deep mauve tinted the whole of the dorsum where it was most intense, the proboscis and the feet, the tips of which were less deep in colour. The ventral surface was also somewhat pale—marked along the ventral line by the nerve-cords; and a pale line passed from each segmental papilla to the middle line—nearly transversely in front, but obliquely forward and inward behind.

This form, a single example of which was first dredged during the cruise of H.M. Ship "Challenger" at Station 169 (off the north-west corner of the North Island of New Zealand) in 700 fathoms, is evidently an inhabitant of deep water. The South African examples, from their mode of preservation are

much more richly tinted than the original one. They agree, however, in all essential characters with the type-specimen. They are somewhat larger, the body of the most complete measuring 28 mm. in length (exclusive of the appendages) and of similar breadth to that procured by the "Challenger."

No scales existed on any of the examples (three), so that they would seem to be very slightly attached. Whether the delicate scale with a group of small papillæ—in the bottle beside the specimens—pertained to this form is unknown. The caudal cirri were likewise absent, the bristles of the last pair of feet being directed backward and greatly diminished in length.

In the description of the specimen from the "Challenger"* it is stated that the dorsal surface of the partially extended proboscis shows two papillæ, one beneath each flattened frontal lobe, but such probably refers to the two marked lateral fillets, which when the organ is fully extended occur opposite the gap between the dorsal and ventral series of terminal papillæ. The basal region is somewhat constricted and minutely corrugated and divided by a furrow into two fillets. Beyond the latter the organ dilates and forms a dorsal and a ventral crescent, whilst the lateral region passes forwards as a peak. The dorsal and ventral series of papillæ at the tip of the organ in extension are 9 in number, and they readily fall off in the preparations. The horny jaws follow the ordinary arrangement, the right of the dorsal pair passing between the ventral.

In the structure of the feet and of the bristles—both dorsal and ventral—they agree with the example from New Zealand. Opposite the base of each foot is a deep dimple causing the foot from the dorsal surface to have a bilobed base. Attached to the tip of one or two segmental papillæ—by a stalk from the lumen—were little whitish masses of sperms—all the specimens apparently being males. It comes to be a question as to whether such a type is not more or less pelagic at this period, a feature perhaps not unconnected with its wide distribution. The alimentary canal posteriorly formed a small empty tube, the body-cavity being filled with masses of sperms.

The *Oligolepis violacea* of Levinsen, from the Kara Sea, published the following year (1886) appears to be the same form.†

Polyeunoa lævis, McIntosh, 1885.

1885. *Polyeunoa Lævis*, McIntosh, Ann. "Challenger," p. 76, Pl. xii., fig. 2, and Pl. xx., fig. 8.

A single example devoid of scales was obtained in the trawl by Dr. Gilchrist in 470 fathoms, 25 miles off Cape Point Light-

* Op. cit. p. 122. † Kara-Havets Ledorme, Kjöbenhavn, 1886.

house; bottom—green sand and hard ground. Several loose scales, however, were in the bottle beside it and *Polynoë (Macellicephala) mirabilis*, the other form procured at the same time.

The occurrence of this species off the Cape is interesting—showing a nearer approach to shore than in those dredged by the "Challenger" off Prince Edward Island in 310 fathoms. The species likewise stretches fo the Strait of Magellan. Whilst two of the loose scales in the bottle agreed with those of the examples from the "Challenger," a third had a group of small papillæ, but its connection with the rest was uncertain. The example was a female with ripe eggs.

Fam. CHÆTOPTERIDÆ.

CHŒTOPTERUS VARIOPEDATUS, Renier, 1804.

1804. *Tricatia variopedata*, Renier, Osservazioni postume di Zool. Adriatica, p. 35.
" " Meneghini, ibid. p. 38.
1844. *Chætopterus pergamentaceus*, Will, Archiv. f. Naturg. t. x., p. 328.
" " Leuckart, ibid. t. xv. p. 340.
" *Leuckartii*, De Quatref. Annel. II., p. 216.
" *pergamentus*, Kowalewsky, Entwick. d. Rippenqualler, p. 6.
1855. " *Capensis*, Stimpson, U.S. Surveying Exped. Proceed. Acad. Nat. Sc., No. 33.
1861. " *hamatus*, Schmarda, Neue Wirb. Thiere. ii., p. 16, Taf. xix., f. 166.
1868. " *variopedatus*, Claparède, Ann. Nap., p. 338.
1885. " " *Carus*, Faun. Medit. i., p. 257.
1890. " *variopedatus*, Joyeux-Luffine, Arch. Zool. Expér. (2) viii., p. 245, Pls. xv.-xx.
1894. " " De St. Joseph, Ann. Sc. Nat. 8e Sér., xvii., p. 147, Pl. vii. f. 189-199.
1897. " " Ehlers, d. Hamburg. Magalhæn. Sammelreise, p. 109.

Between tide-marks, at St. James', in False Bay.

Ten bristled segments occur in the first region, the last joining the long wings, as in the example of the same species from the Channel Islands, England and Scotland. The head dorsally bears the long tentacles, at the bases of which externally are the eyes—a linear series of isolated pigment-spots which in the preparation are covered by the free flap of the collar. One or two

specks, however, are visible externally at the base of the collar on each side. The great setæ occur on the 4th segment and are modifications of ordinary bristles for special work (Plate V. fig. 51). They are of great size, widened at the tip and specially thickened by the chitinous secretion there, a feature well seen in forms which have not yet been worn. These, as in the figure, have the tip on one side acute, and, moreover, the edge is minutely serrated, as if to show its connection with the ordinary forms. These serrations disappear in those subjected to wear. Considerable variation in size occurs in representatives of the species from different quarters, thus in some Neapolitan examples these bristles are considerably smaller (Plate V, fig 52), but they retain their essential characters.

In the sickle-shaped anterior feet, again, the bristles present a characteristic gradation from the slender terminal forms with narrow wings (Plate V, fig. 53) to the spathulate kinds which succeed, and which in varying proportions occur throughout the greater part of the edge of the foot (Plate V., fig. 54) to the greatly developed series towards the base (Plate V., fig. 55) which not only have a much larger spathulate tip, but a thicker shaft, the figures being drawn to the same scale. The flattened and tapered tips of the spathulate bristles have probably special functions in progression, and in the various movements in the manufacture of the tube, just as the powerful bristles of the fourth segment have in these and other respects.

The hooks of the anterior region (Plate V. fig. 56) and those of the posterior agree with those from European waters, though the figures just quoted may not correspond in all cases. Thus in the able memoir of Joyeux-Laffine these hooks (Arch. Zool. Expér. 2d Sér. viii., Pl. XV., f. 4) are represented by an example which has the processes for the tendons at each end too large, as is also the tendon itself, and either an unusually long hook or one not fully on its flat has been selected for illustration. The French author has correctly indicated a double series of striations on these hooks. In the South African examples the most superficial striations slant downwards and forwards from the posterior border of the hook, whilst by deeper focussing a finer series pass from the teeth obliquely—with a slight inclination downwards and backwards.

A former comparison of examples from the various British areas in which it occurs with those from Naples led to the view expressed by M. Joyeux-Laffine,* viz., that so far as these go one species alone is concerned. The same conclusion is reached when the form from the Cape is included, for in all essential particulars it is identical with the European examples. This opinion is shared by Mr. Cyril Crossland, who is doing

* Arch. Zool. Expér. 2d. Sér. viii. pp. 346-50.

such good work amongst the annelids collected by himself at Zanzibar, and to whom the specimens had been shown before their final examination. The present examples are comparatively small—much less than those from Herm and Guernsey, or even from Shetland.

So far as can be gleaned from Stimpson's account, the same form is referred to, though he places the great bristles on the 3rd. foot. The general description and the number of teeth in the uncini agree. He found his examples at Simon's Bay, Cape of Good Hope. Schmarda procured his *Chætopterus hamatus* (op. cit.) from the same bay, and though his description is lax, there is little doubt, taking his figures also into consideration, that he refers to the present species. He mentions that the tube is constructed externally of fine sand-grains, whilst internally it is smooth. His figure of the animal in its tube gives a good idea of the relative proportions.

Chætopterus variopedatus is one of the most beautifully luminous annelids, bright flashes being emitted from the posterior feet, but the most vivid phosphorescence is at a point on the dorsum between the lateral wings of the tenth segment. Here the copious mucus exuded by the animal can be drawn out as bluish purple fire of great intensity, which besides, now and then gleams along the edges of the wing-like processes and illuminates the surrounding water. A very characteristic odour, somewhat resembling that of phosphorus in combustion, is given out by the animal during such experiments, and in this connection it may be observed that Quoy and Gaimard mention that an odour similar to that around an electric machine is produced by luminous marine annelids. An elaborate account of this phenomenon is given by Panceri,* who concludes that the luminosity arises in special epithelial cells.

The species of *Chætopterus* stand much in need of revision, and when this is carried out it will be found in all probability that the species here mentioned (*C. variopedatus*) has a very wide distribution and has been described under various names as new species ; nor is this surprising in an annelid which frequents the shores of at least three great continents, viz. :—Europe, Africa, and America.

Fam. ARICIIDÆ.

THEODISCA (ANTHOSTOMA) HEXAPHYLLUM, Schmarda, 1861.

1861. *Anthostoma hexaphyllum*, Schmarda, Neue wirb. Thiere, I., II., p. 61, Taf. xxvii., fig. 217.

Obtained between tide marks at St. James', False Bay.

* Atti d. Accad. d. Scienze. Napoli. 1875.

The head forms a small conical flattened process devoid of eyes or appendages.

Body of variable length, ranging from 135 to 200 m.m., somewhat tetrahedral in form, slightly tapered in front, and more gently posteriorly, but the tail is by no means slender, and it ends in an oblique funnel directed ventrally, with a somewhat frilled margin and a ventral process with three papillæ. So frequent is this organ in process of reproduction that it is difficult to say what its precise condition is. In many it is bordered externally by a fringe of the developing and rudimentary feet which resemble papillæ. The latter, indeed, seems to be the normal condition, the frilled lips of the anal funnel being sometimes separated by a smooth margin due to the papillose continuations of the feet. All that can be said of the adult specimens is that the tail ends in an anal funnel, the folds of mucous membrane internally forming six or seven symmetrical plaits on each side, whilst its rim is smooth. The dorsal surface is somewhat hollow, the ventral convex.

The first segment is achætous, and has the mouth on the ventral surface, out of which protrudes the foliaceous mass which gives origin to the name of the genus, and which is is the proboscis, as in allied forms. In partial protrusion three lobes are visible, whilst in full extension there are six or more. The organ forms a complex series of folded lobes the grooves of which converge to the central one. It can be entirely retracted.

The second segment has dorsally two processes, an inner flattened lamella with a blunt tip, and a tuft of long, slender and nearly straight bristles with closely arranged serrations, springing from its inner side. Externally is a shorter bluntly conical process arising behind a dense row of shorter and stouter bristles, the longer showing serrations, the shorter with blunt tips and only a trace of the serrations, the former lamella pertains to the dorsal region, the latter to the ventral division of the foot.

At the sixth bristled segment another conical process (branchiæ) appears on the inner side of the longer lanceolate leaf and is continued backwards. Whilst the former process remains more or less lanceolate, the outer lobe at this foot presents a broad lamellar base, which by and by extends downwards as a ridge behind the bristles.

The arrangement just noted reaches its maximum at the 25th bristled foot (Plate V., fig. 27), which has dorsally and ventrally a somewhat enlarged and tapering inner gill, then the lanceolate lobe and its tuft of long serrated bristles, and, after an interval, a short conical process and the long ridge behind the bristles. The latter consist of a long row of arcuate blunt forms, of others with slender serrated tips, and, ventrally, of elongated serrated intermediate forms. The condition resembles that in such forms as *Aricia Cuvieri*.

Behind the 25th foot the inner gill rapidly increases in size and inclines inwards over the dorsum, the tips turning forwards when they meet in the middle line. Coincident with the change in the inner gill, the dense row of ventral bristles diminishes in size and strength (the 28th foot terminating the larger anterior series) so that at the 45th foot (Plate V., fig. 29), the ventral division has assumed the shape of a short broad leaf with a few short blunt bristles in front of it—ventrally a short tuft of finely tapered serrated bristles, and dorsally a longer series having the same structure. Dorsally is the longer lanceolate process, which like the ventral has its convex base external, and the long tuft of tapering serrated bristles. Internally is the vascular and richly ciliated gill, the tip of which is tapered and devoid of cilia.

At the 70th bristled foot the change is small, viz., a slight diminution of the ventral lobe which also has lost its external convexity at the base.

Little alteration occurs towards the tip of the tail except the increase of the dorsal lanceolate lobe which is carried erect, and the slight diminution of the branchiæ on the more limited surface, for they are continued to the anal funnel. This region of the body is readily reproduced, but its precise condition in the adult as contrasted with the young is still in need of elucidation.

A whitish encapsulated body occurred on the ventral edge of an anterior foot. The capsule was filled with somewhat coarse granules.

A small Isopod was found on the surface of an example, but its presence may have been accidental. The head had two black eyes, and was followed by 7 segments and the telson.

This species is at once distinguished from *Aricia Cuvieri* by the condition of the dorsum anteriorly, and the absence of the pectinate rows of papillæ in the same region laterally. It is, however, in all respects an *Aricia*.

Schmarda's genus *Anthostoma*, which he constituted for the reception of the species from the Cape and one from Jamaica, had little that was definite in it, the characters being as follows:—Tentacles and tentacular cirri absent. Segments differing. A lobate proboscis. Branchiæ (cirri) with the exception of the anterior segments, three in number, and so with the bristle-tufts. Capillary and aciculate bristles. Fritz Müller appears to have included the same type in his genus *Theodisca*—afterwards more fully exemplified by Claparède, whose diagnosis is:—Ariciidæ with strap-like branchiæ; distichous feet—the inferior division bilabiate. Proboscis extensible as a digitate membrane. Head devoid of tentacles.

The relationship of the Mediterranean forms, viz., *Theodisca anserina*, and *Th. liriostoma* to the South African is uncertain, but the latter (*T. liriostoma*) comes very near it. Kinberg* records another species (*A. dendriticum*) from Vancouver.

The *Anthostoma robustum* of Verrill† seems to have a very similar structure, and the same may be said of the *Aricia lævigata* (Grube) of De St. Joseph,‡ from the Mediterranean. The species described by Treadwell‖ from the Antilles are very similar, as also is the *Aricia setosa* of Verrill,§ from Flatts Inlet beach, Bermuda—in shell-sand at low tide. In the latter form the branchiæ also begin on the sixth setigerous segment and continue nearly to the end of the body.

A small form about 5 or 6 mm. in length presents certain differences from the foregoing.

Head forming a small blunt cone—larger in proportion than in the adult.

Body very little tapered in front—more distinctly diminished towards the tail—where it ends in 4 short cirri (Plate V., fig. 28.)

Each segment has similar appendages to those of the adult, viz., an inner ciliated branchial process, a dorsal lamella with the tuft of tapering finely serrated longer bristles, a conical ventral lobe with a few spines, the tips of which have an f-shaped curve, and a group of shorter serrated bristles as in the adult. The f-shape of the tips of two of the spines is noteworthy at this stage.

The presence of 4 short subulate anal cirri—two dorsal and two ventral, if this be the same species (and it appears to be) is therefore a feature of moment, and shows that a change occurs during the development of the anal cup. At this stage, therefore, if the above interpretation is right, the posterior end agrees with that of *Theodisca* as described by Claparède¶ and Cunningham and Ramage,** but Claparède does not mention bifid bristles or hooks, whereas Cunningham and Ramage do, so that it is doubtful if the latter pertains to the same genus. At any rate the young form alluded to in the foregoing sentences agrees with the *Theodisca* of Claparéde; and in all probability the adults have the same appendages.

* Öfvers. K. Vetensk-Akad. Förk. 1866. No. 9, p. 337.
† Op. cit. p. 597, Pl. xiv., fig. 76.
‡ Ann. Sc. Nat. 8e., Sér. v., p. 360., Pl. xxi, f. 168-175.
‖ Bullet. U.S. Fish Com. 1900, p. 203.
§ Trans. Conn. Acad. x., p. 651. 1900.
¶ Glanures Zoolom. p. 44, Pl. iv., fig 6, and Ann. Chet. Nap. p. 310. Pl. xxiv., fig. 3.
** Trans. R.S.E., vol. xxxiii., p. 642, Pl. xl., fig. 8.

Fam. CIRRATULIDÆ.

CIRRATULUS CIRRATUS, O. F. Müller, 1776, (= capensis, Schmarda).

1776. *Lumbricus cirratus*, O. F. Müller, Zool. Dan. Prodr., p. 214.
1843. *Cirratulus borealis*, Œrsted, Ann. Dan. Consp., p. 67.
1843. „ „ Id. Grœnl. An. Dors., p. 54.
1856. „ *australis*, Stimpson, Proc. Acad. Nat. Sc., Philad., p. 392.
1861. *Cirratulus capensis*, Schmarda, Neue wirb. Th. I. ij., p. 56, Taf. xxvii., fig. 213.
1865. *Cirratulus australis*, Johnston, Cat. B. M. 210.
1867. „ „ Malmgren, Ann. Polych., p. 205.
1885. *Cirratulus capensis*, McIntosh, Ann. "Challenger," p. 383, Pl. xxivA., figs. 9 and 10.

The two Cape species form a parallel to the two common British forms, viz., *C. tentaculatus* and *C. cirratus*.

This form takes the place of the *Cirratulus cirratus* of the British area, and it is very closely allied to it, so closely that it has now been thought unnecessary to separate them.

The head is less horse-shoe shaped and more pointed, and it is devoid of eyes—so conspicuous in the British form. The buccal segment is of considerable breadth, and is followed by another segment free from bristles. The third segment bears hooks and bristles, as well as a branchiæ dorsally, close to the bristle tuft. The fourth has a similar arrangement. At the fifth is the dense group of branchiæ on each side, but the filaments spring from one or two of the succeeding segments. For forty of the following segments, the branchiæ arise close above the dorsal bristles, but they afterwards, and to the tip of the tail, have a considerable interval between them and the dorsal bristles, in this respect agreeing with the British examples. As in the British form, the size of these branchiæ is in contrast with that of the other species from the Cape.

The first ventral tufts are slender and bristle-like, but soon two or three dark brown hooks are found in each segment (Plate vi., fig. 30), the shape being f-like, with a forward bend at the point, and considerably stouter than in the next form. As a rule, only two are found in the posterior region of the body. Dorsally is a tuft composed of three long and finely tapered simple bristles—alternating with three slightly curved and somewhat longer spines than in the ventral series.

Posteriorly, the ventral hooks increase in size and strength, but the dorsal tuft has the same arrangement as in front.

In the intestinal canal is muddy debris, containing fragments of crustacea, sponge-spicules, diatoms, and other structures.

The branchiæ are, on the whole, more numerous than in the British examples.

Stimpson first found this form in the "circumlittoral zone," at False Bay, Cape of Good Hope, and he describes it as greenish or reddish brown, nine inches in length, and having a breadth of ·45 inch. He points out that the inferior bristles (except anteriorly) are short, stout, and arranged in groups of three. Schmarda gives the examples he procured at Table Bay a violet colour. The specimens obtained by the "Challenger" came from Sea Point, near Cape Town. Langerhans* met with this species, three c.m. long, in the Canaries, whilst Marenzeller† includes it in his account of the Annelids from Angra Pequena. He notes that Stimpson's form is the same, and, therefore, that his title should have priority to Schmarda's, but this is now of less consequence, since the form is identical with O. F. Müller's.

Cirratulus tentaculatus, Montagu, 1808.

1808. *Terebella tentaculata*, Montagu, Linn. Trans. ix., p. 110.
1834. *Cirratulus Lamarckii*, Audouin and Edwards, Annel. p. 271, Pl. VII., figs. 1-4.
1865. *Cirratulus tentaculatus*, Johnston, Cat. B.M., p. 209.
1868. *Audouinia filigera*, Claparède, Ann. Nap. p. 267, Pl. XXIII., fig. 3.
1889. *Cirratulus tentaculatus*, var. *meridionalis*, Marenzeller, Zool. Jahrb. iii., p. 16 (sep. abdr.) Taf. I., fig. 7A.

This form takes the place of the British *C. tentaculatus* and is larger than the preceding.

The head is bluntly conical and devoid of eyes. The peristomnial and the succeeding segments have similar proportional breadth.

The body is elongate, measuring from three to five inches in length, tapered at either extremity, and furnished with numerous long, slender cirri. The first cirrus is attached above the fourth bristles, and another is over the fifth and sixth respectively; then a dense group occurs in a transverse series to the inner side of the latter, a short gap in the middle line separating the two

* Nova Acta. Bd. xlii., No. 3, p. 115.
† Zool. Jahrb. iii., p. 19 (sep. adr.).

sides. This barrier indicates the division between the wider anterior and the narrower segments which follow. The cirri continue along the sides backward to the tail, on every segment and close to the dorsal bristles. They are on the whole longer and more slender than those of the preceding species, just as occurs in the British forms.

The anus is a longitudinal dorsal slit at the tip of the tail.

The bristles in this species are longer than in the former, both ventral and dorsal of the first bristled segment being slender, long, and finely tapered, and the tips are densely covered with a slender filamentous algoid. For a long distance backward both dorsal and ventral bristles remain capillary, and the middle of the body is passed before the ventral hooks are well developed (Plate VI., fig. 31). They are proportionally longer and more slender as well as more numerous than in the former species, with a slight bend of the shaft and a marked curve at the tip. A slender bristle or two occurs amongst them. The dorsal bristles retain the characters they have in front to the tail, so that in this respect alone there is a marked difference between the species.

The majority of the specimens were loaded with ripe ova.

This species resembles the British *Cirratulus tentaculatus* in several respects, but differs in the number and shape of the ventral hooks, which are shorter and fewer in the British form, in the segments of the anterior region and other particulars. In both the cirri spring close to the dorsal bristles.

The parallelism between the two species of *Cirratulus* at the Cape and the two common British forms is of great interest, and, allowing for the variations due to the divergent environment, it has been thought proper to unite the respective species. This opinion to some extent is that of Marenzeller, who makes the examples from Angra Pequena only varieties of the European species (*var. meridionalis*, Marenzeller). Moreover, if *Audonia filigera*, Delle Chiaje, is synonymous then this common form ranges to the Straits of Magellan.*

Fam. HALELMINTHIDÆ.

The *Halelminthidæ* or *Capitellidæ* were represented by several examples, one or two of which were devoid of branchiæ, whilst all the rest had these organs. As, however, both had the same number of capillary bristles (13 pairs) and segments ("thoracic") in front, and both agreed in the arrangement of

* Ehlers, Polychæt. Magalhaen, Hamburg, 1897, p. 110.

the rows of hooks (*toi*), in all probability all the specimens pertain to the genus *Dasybranchus*, those devoid of branchiæ having either retracted or lost them.

Dasybranchus caducus, Grube, 1846.

1846. *Dasymallus caducus*, Grube, Archiv f. Naturges, 1846, p. 166, Tab. V. figs. 3, 4.

1885. *Dasybranchus*, sp. (caducus), McIntosh, Ann. "Challenger," p. 290, Pl. XLV., figs. 13, 14, Pl. XXIVA, fig. 17.

1887. *Dasybranchus caducus*, Eisîg, Capitell, Nap., p. 823, et ubique, Taf. 16-23.

The examples vary from 90-170 mm. in length, and the largest has a diameter at its widest part of 7 mm., a size considerably exceeding that of the European specimens, though not much larger than the Japanese form found by the naturalists of the "Challenger."

The conical snout resembles that of *Notomastus*, and the number of distinctly bristled segments of the anterior region is 13. The bristles are long and slender, with a filmy margin indicating the presence of narrow wings.

The dense rows of minute hooks are similar in structure to those of *Notomastus*, having a main fang and several small points above it, but the shaft appears to have a more distinct dilatation, and the larger wings are united distally so as to form a kind of hood.

The branchiæ occur only on the posterior part of the body—as small tufts of simple or slightly branched filaments arising on each side of the ventral pads, and thus are comparatively near each other. The ease with which the branchiæ are retracted or lost accounts for their varied appearance. Those newly reproduced are short and simple, the older forms are more or less branched and larger.

There is little to distinguish this form from the European. In all essential respects it corresponds both generically, and so far as can be at present observed specifically also with *Dasybranchus caducus*, Grube, a form which has been found at Madeira and other parts of the Atlantic, in the Mediterranean, in the Indian and Chinese seas and in the Pacific.

The *Hyboscolex longiseta* of Schmarda* is probably the same form—procured at Table Bay.

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* Neue wirb. Thiere, I. ii., p. 54, Taf. XXVII. fig. 211.

Fam. MALDANIDÆ

NICOMACHE LUMBRICALIS, (O. Fabricius), var. CAPENSIS, (McIntosh).

1780. *Sabella lumbricalis*, O. Fabricius, Faun. Grœnl, p. 374,

1856. *Clymene lumbricalis*, Sars, Faun. lit. Norveg, II., p. 16. Tab. 2., figs. 23-26.

1885. *Nicomache capensis*, McIntosh, Ann. "Challenger," p. 399, Pl. XLVI., fig. 4., Pl. XXIVA., figs. 18, 19, and Pl. XXXVIIA., fig. 2.

A species of considerable size, probably reaching 130 mm. or more in length, and having a diameter of 5 mm.

The cephalic segment is enlarged, suddenly narrowed into a blunt ridge dorsally and running downward to the thickened oral border. On the ventral face the oral margin projects as a frilled ring, more or less dilated according to its condition.

Though on a comparatively gigantic scale in contrast with the British forms it is remarkable how closely the outline of the snout, its touches of reddish pigment, the form of the anterior segments, and the general conformation of bristles and hooks correspond.

The first four sets of bristles are stout, simple, tapering, slightly winged forms, the fourth having also a few very slender, almost capillary bristles. The fifth group has a few slender forms amongst the stronger with very minute spikes, and in the sixth and seventh these increase in distinctness till the condition shown in the figure of the "Challenger" is attained. Beneath each of the first three is a powerful spine, or occasionally two in the last. Under the fourth is a short row of the hooks characteristic of the species, and in the succeeding feet these increase considerably in number so that the rows are longer.

In comparing the 10th bristles and hooks of the British and South African forms little distinction is apparent except in size. The types are the same. It is true a larger number of spikes occur on the crowns of the hooks of the South African form, but this is due to their size.

The funnel (Plate VI., fig. 32) in the South African has from 14 to 30 papillæ round its border, whereas in the small British examples the number ranges from 14 to 20.

In a South African example there were 20 bristled segments, the entire animal being about 180 mm. in length. The smaller British examples appear to have the same number of segments hough none were complete.

The tube is composed of whitish or translucent grains of coarse sand with fragments of shells and coral bound together by the secretion. Though comparatively thick it is readily broken.

It is difficult to make out the species described from the Cape by Schmarda,* under the names of *Clymene microcephala*, and *Clymene lyrocephala*. The former may have lost its head, and the latter might be *Nicomache* viewed from the ventral surface with the proboscis partially protruded.

The wide distribution of this form and its varieties is noteworthy, for it frequents both shores of the Atlantic, that is Europe and Africa on the one hand, and America on the other.

NICOMACHE MCINTOSHII, Marenzeller, 1889.

1889. (?) *Nicomache McIntoshii*, Marenzeller, Zool. Jahrb. III., p. 19, Taf. i., fig. 8.

A fragment of the posterior end apparently of this form comes from St. James', False Bay, between tide-marks.

The body ends obliquely in a large ovoid expansion (Plate VI., fig. 33) which is fixed to the dorsal (?) surface, but extends elsewhere all round as a broad rim, with a slight notch in the mid-ventral line. The anus forms a prominent cone with 13 crenations on the margin and situated slightly nearer the ventral than the dorsal edge. A considerable area posterior to the vent is dotted with low flat papillæ like variolæ.

After the bristle-papilla and row of hooks on each side the last segment narrows to the segment-junction. The segment in front is short, with a peculiar dorsal flap or process which is somewhat shield-shaped—the median curve posteriorly being close to the segment-junction, though elevated above it, and a lateral curve on each side running forward to the bristle-papilla—which is nearly in the centre of the short segment.

The segment in front is also short, and has a similar modified dorsal shield with a central prominent edge just behind the bristle-papillæ; and a similar, though less distinct shield occurs on the third from the end.

The fourth bristle tuft from the posterior end shows rather stout but finely tapered winged bristles.

The hooks (which are probably posterior) have a broad and strong head with a powerful chief fang, and four prominent sharp processes with the points directed forward above it, but of course other hooks are present in the crown, these being apparent distally in lateral view (Plate VI., fig. 34). A filament passes

* Op. cit., p. 15, Taf. XIX., figs. 163 and 164.

from the neck of the hook and curves over the tip. The shaft diminishes from the crown to the shoulder near the anterior third, and then narrows with a curve to the base.

Marenzeller had complete examples of this Maldanid from Angra Pequena, somewhat further northward on the eastern coast of Africa, but they seem to have been much smaller, only from 40 to 45 mm. long and 2·5 mm. in breadth, whereas the fragment from the Cape measures 48 mm. and is about 3 mm. in diameter, so that in all probability the entire animal would not be less than 60 mm.

The head appears to be less developed than in *N. lumbricalis*, though having similar characters. The first six bristle-bearing segments are shorter than the three following. The first three segments have simple hooks after the plan of those in the common species, the rest have the characteristic hooks, and Marenzeller's figure (fig. 8 E) of the anterior hook differs only in comparative length, being slightly shorter than that from the posterior fragment from the Cape. He also describes the anal plate as granular, but apparently the small size of his examples did not exhibit the variolar condition so conspicuous in the larger specimen from the Cape. No tube is mentioned by this author.

The posterior end of Grube's *Maldane glebifex** is bevelled somewhat in the same manner, but it appears to be on a much smaller scale proportionately. The posterior end of *Maldane elongata*, Verrill,† has an obliquely truncated posterior border surrounding the base of the large anal process, which is obliquely placed, foliaceous, obovate, with the posterior edge broadly rounded, the upper surface concave, and the margin entire.

The posterior end of the *Maldane amphiglypta* of Ehlers,‡ from Magellan, has likewise a free flap, but of a different character from the South African form.

Unfortunately no figure is given, so that it is difficult to make a minute comparison. The American form was got at low water mark near New Haven in thick tubes of fine mud.

PRAXILLA PRÆTERMISSA, Malmgren var. CAPENSIS, McIntosh.

1885. *Praxilla Capensis*, McIntosh, "Challenger" Annel., p. 404, Pl. XXXV A., fig. 8.
1867. *Praxilla prætermissa*, Malmgren, Nord. Hafs-Ann. p. 191.
1867 „ „ Ibid., Ann. Polych., p. 100, Taf. xi., f. 62.

A form about 250 mm. in length and proportionately large. The head has a frontal shield like that in the European *Praxilla*

* Archiv. f. Naturges, 1860, p. 92, Taf. IV., f. 4.
† Op. cit., p. 609.
‡ Polychæt. Magalhaen, Sammelreise, Hamb. 1897, p. 119, Taf. VIII. f. 187-193.

prætermissa, though on a much larger scale than in British forms. The lateral folds of the cephalic region are very distinctly marked, though not long. On each side of the median in front is a well marked division, followed by three larger lobes which are notched in the centre. Behind are about six crenations before the median dorsal furrow, with indications of a tendency to form larger lobes. The median and two lateral ridges are similar to those of *P. prætermissa*. The buccal and the following segments, and to some extent the vent are marked by creases like hard grained morocco leather.

The body has 21 segments besides the buccal segment and the funnel. It is rare to find a complete example in Britain, and only one occurs in the South African collection. The funnel has from 22 to 26 teeth.

The bristles, spines and hooks appear to be very closely similar to those of the British forms though all are larger.

The tubes are formed of fine and coarse sand grains and fragments of shells—lined by secretion, and are friable whitish structures.

The preparations from the "Challenger" material were labelled *Praxilla prætermissa var. capensis* and it was the connate condition of the dorsal longitudinal muscles that led to separation. It is doubtful if this is sufficient to separate forms so closely resembling each other.

The distribution of the species would seem to be very wide.

Fam. HERMELLIDÆ.

SABELLARIA (PALLASIA) CAPENSIS, Schmarda, 1861.

1861. *Hermella capensis*, Schmarda, Neue wirb. Thiere I. ii., p. 23, Taf. xx., fig. 171.
1885. *Sabellaria (Pallasia) Capensis*, McIntosh, Ann. "Challenger," p. 418, Pl. xxv.A, figs. 24, 25, Pl. xxvi.A., figs. 11, 12.

The specimens were procured at St. James', False Bay, between tide-marks. Those obtained by the "Challenger" were collected between tide-marks at Sea Point, near Cape Town, where it was first found by Schmarda, and subsequently by Kinberg.

The largest example, including the tail, measures 105 mm. in length, and it is evidently a richly coloured form. Schmarda states that his were olivaceous, but in many parts were purplish brown.

The species is allied to the ordinary *Sabellariæ*, differing from the common southern form—*Sabellaria alveolata*—in

having only two rows of paleae, the shape of the inner being such that it compensates for the absence of the second inner row. Though Schmarda described and figured the paleæ as notched at the tip, the condition differs, since the thin chitinous spathulate tip has a fold on the under surface the end of which projects dorsally in the form of a spur. When viewed in certain positions, as obliquely from above, the appearance of a notch is simulated by the arrangement. On the other hand a lateral view gives a hatchet-shape to the blade, and the terminal spur is very prominent. The paleæ are crossed by curious transverse lines, which, especially along the convex edge, assume a wavy direction, and, moreover, a scaly aspect, apparently from friction, occurs along the same edge near the tip. Whilst it is possible to recognize these paleæ in Schmarda's description and figure, it is otherwise with the inner paleæ, for the contour of the latter, according to him, corresponds with a lateral view of the outer form—as a comparison of his figures with those of the "Challenger" will show.

The tip of the inner paleæ is bluntly pointed, then it gradually expands into a large thick heel which projects beyond the somewhat slender shaft, so that the latter nearly forms the apex of a triangle, and the serrated upper or anterior edge the base. These are evidently modifications of the same type. In this case the outline resembles an attenuated leg with a long tapering foot furnished with a huge heel, the latter having the dorsal surface crenated. In one of the examples (a large one) two blades of a broad Alga were attached by their stems to the inner paleæ, as in the case of that mentioned in the "Challenger" volume—and which had a single blade which overhung the crown like an operculum. A little below the bases of the outer paleæ of the crown a closely set series of lobate cirri with narrow stems occurs They are tinted of the deep purplish hue of the region, though in some specimens much of it is abraded. The cephalic branchiæ have about 16 stems on each side of the fork. The mouth has a long cirrus, or occasionally two, at the outer and posterior border of each palpus.

In the richly tinted thoracic region are the three typical sets of bristles. The oar-shaped forms of the dorsal row have a smooth blade. A high power shows only a few minute spines at the point of the most perfect examples, few of which are symmetrical distally. All have marked striæ at intervals. The ventral bristles are shaped somewhat like the hairs of *Ornithorhynchus*, the shaft dilating into a fusiform tip which is pointed. The hooks have a double row of teeth and an indistinct process.

The branchiæ are continued—from the first segment of the long posterior region of the body—throughout the greater part of its length, the posterior organs, however, being rudimentary. They cease at the seventh or eighth from the end—to which is attached the long anal tube.

No tube accompanies these examples, but in those brought home by the "Challenger," the structure was as follows :—The tube was dense, composed of entire small shells, coarse fragments of shells, sand-grains and other structures cemented by the tough secretion which also forms a lining to the interior. This lining is in many parts tinted of a dull purple, yet this does not prevent it from being semi-translucent. As in many other tubes in the collection the colour is pale, from the semi-translucent grains. It is thus in contrast with huge and heavy masses formed by a *Sabellaria* brought from St. Vincent by Dr. R. M. Gunn, composed of agglutinated tubes of coarse yet smoothly worn minute pebbles. The majority are white, but dotted here and there are many minute black pebbles which seem to be less rounded than the white. Such a mass illustrates well the power of *Sabellaria* to form structures capable of resisting the heaviest surf-waves.

As indicated in the "Challenger" volume,* an intricate central muscular region occurs in the anterior division of the body, *e.g.*, behind the mouth, and it is especially regular and beautiful in connection with the two median and two lateral channels in the dorsal region. The nerve-cords are internal and abut on the perivisceral chamber. Behind the foregoing the circular muscular coat is well-developed. The dorsal longitudinal muscles are much more massive than the ventral and are continuous over the vascular channel in the median line. The separate nerve-cords lie on each side of the median line. In the posterior region the dorsal and ventral muscles are proportionally small. The neural canal lies at the inner and inferior region of the nerve-cord. The great central area of the body is occupied by the distended alimentary canal, with the reproductive organs at the sides.

The contents of the alimentary canal consisted of sandy mud, numerous sponge-spicules, a few diatoms and organic fragments, besides many Gregarinæ.

The same species was found by Marenzeller † in the collection from Angra Pequena on the West Coast.

Fam. AMPHICTENIDÆ.

Pectinaria Capensis, Pallas, 1766.

1766. *Nereis cylindraria*, Pallas, Miscell. Zool. p. 117, Tab. IX, f. 1-2.

A large species measuring in spirit about 150 mm. in length, and having a diameter behind the paleæ of fully 12 mm.

* Op cit., p. 420.

† Zool. Jahrb. III., p. 21 (sep. abdr.).

Anteriorly the palulæ are fourteen on each side, set in a slightly oblique row, and with a dorsal curve. Each group forms a kind of stiff fan with the longest paleæ in the centre, the outer especially being shorter. A typical palea measures about 15 mm., is flattened and of a rich golden colour, iridescent under the microscope, and marked with longitudinal and transverse striæ. The tip is usually abraded—forming a transverse dark edge. A wrinkled area slopes obliquely downwards, and is bounded by a membrane which commences at the subulate tentacle a little in front of the outer edge of each fan, and has its free edge cut into processes, small at first and then triangular and larger. Below the paleæ is a broad membranous fold with long filaments at its free edge, which encircles the two dense groups of tentacular cirri.

The body is broad in front and tapers after a short distance gently to the tail, which ends in a sausage-like appendage, having a broad furrow with thick folded edges dorsally, and terminating in a tongue-like flap with a wide crenated margin. Beneath the process is marked by fine creases (like leather) and has a median groove and three lateral furrows which slope outwards and backwards.

Anteriorly the dorsum has an elevated glandular whitish thickening from which a tapering tentacle extends forward. A ridge cut into flaps passes from the elevated mass and joins the pre-oral fold. Another smaller whitish pad occurs behind the former to the inner side of the first branchia. The latter is the larger, and arises from the ventral ridge behind the mouth, is fixed for half its length, the other or outer part passing as a free fold dorsally. From the basal stem the branchial tissue splits into fine lamellæ, so that aeration is readily carried out. The second gill is similar to the first, but arises from the succeeding glandular ridge further out, and its free stem extends further on the dorsum. On the ventral surface in this region are four small central areas or cushions connected with conspicuous bands passing dorsally. The first lies in the ridge behind the mouth and has a frilled (glandular ?) band in front of it, connecting the inner (ventral) ends of the first branchiæ. The second has a stiff glandular ridge passing from its anterior border to the second branchiæ. The third is the least, and from its outer border a prominent fillet passes to and beyond the first bristle-bundle on each side. The fourth is shield-shaped, and from its anterior edge a flattened fillet extends to the side of the body, but does not reach the second bristle-bundle.

Sixteen pairs of bristle-bundles extend along each side, thus the number differs from that found in *Pectinaria*, where it is 17, the same number occurring in *Amphictene Cistenides* and *Pista*, whilst *Lagis* has only 15. This form therefore occupies an intermediate position in this respect, though most nearly approaching *Pectinaria* (Plate VII). The bristles (fig. 33 a and b)

are somewhat stout, with tapering, winged tips (*a*) which often show a split (*b*) in the wings from friction, thus giving the tips a peculiar appearance, especially as a change seems to take place thereafter. The last bristle-bundles are small, but show similar structure, except that the shaft dilates towards the tip, which is often split as in front.

The hooks (Plate VII fig. 36) approach those of *Pectinaria*, in so far as below the eight upper and boldly curved teeth is a short portion of the margin armed with minute teeth above the truncated inferior angle. As the tip of the last large tooth curves over these they are often indistinct.

The alimentary canal was distended with white sand—like coral sand, much of which disappeared on the addition of acid.

The beautiful, straight tube formed by the animal was almost entirely composed of spicules of sponges in short lengths placed transversely and fixed by secretions so as to form a perfectly round tube 115 mm. in length gently tapered from the wide to the narrow end, the former having a diameter of 15 mm., the latter of seven or eight mm. The spicules appeared to be of the same size throughout the tube, which presented no special lining, the inner surface being as smoothly and neatly formed as the outer, though under the microscope the minute reticulations or cells of the cement often stretched over the component spicules.

The labour involved in selecting and fitting with such marvellous skill the sponge-spicules composing a tube so large must have been both continuous and considerable. Moreover, the smaller end of the tube had a diameter of seven or eight mm., so that in view of P. Fauvel's statement that but one tube suffices for the life of the animal, we are left in doubt as to how it fared in its early condition. In the preparation about an inch of the tail projected beyond the small end of the tube.

As stated, the intestine showed that the annelid frequented calcareous sand, and, therefore, specially selected the sponge-spicules for the formation of its tube. As this example was procured between tide marks, the conditions are wholly different from similar tubes formed by the deep-sea representatives of the family.

The account of the genus Pectinaria by Malmgren differs from the condition in this example in so far as the marginal lamina of the area on the ventral aspect of the palulæ is not entire, but has at each side a series of acutely conical smaller fimbriæ, followed by larger and somewhat triangular processes of considerable breadth, which occupy the central region. There are 16 instead of 17 bundles of bristles, but only 13 rows of uncini, beginning at the fourth bristle-bundle. The minute structure of the hooks corresponds with that of examples of *Pectinaria belgica* from various regions, and it may be that variation

occasionally occurs. In certain examples of *Pectinaria belgica* also the ventral lamina near the paleæ is frilled and slightly scalloped.

This large and fine species was first described and figured as *Teredo chrysodon* by Bergius,* and subsequently noticed by the sagacious Pallas, who examined many specimens procured at the Cape of Good Hope by Vosmaer, and he mentions that Rumphius discriminated the same form as a third species—"Penicilli marini." Pallas noticed the structure of the tube, which he experimented with in various ways, but did not make out its nature. His familiarity with the European species (*Pectinaria belgica*, his *varietas Belgica*) makes his description of considerable value, and he would seem to have observed the difference between the smooth dorsal edge behind the paleæ in the European and the slightly scalloped one of the South African. The general description which he gives, indeed, does credit to his acuteness and accuracy, and his figures of the annelid and its tube are recognizable, the former being shown of its natural size.

Ehlers includes *Pectinaria belgica* in his series from Magellan, so that much has yet to be done in the distribution of this species.

Fam. TEREBELLIDÆ.

SCHMARDANELLA PTEROCHÆTA, Schmarda, 1861.

1861. *Terebella pterochæta*, Schmarda, Neue wirb. Thiere I., II., p. 43.
1885. *Schmardanella pterochæta*, McIntosh, Annel. "Challenger," p. 449, Pl. LIII. fig. 1, Pl. XXVII. A. figs. 24-26.
1889. *Leprea pterochæta*, Marenzeller, Zool. Jahrb. III., p. 21 (sep. abdr.)

Obtained between tide marks at St. James', False Bay. Schmarda simply states he found it at the Cape. It is probable that he procured it in the same way as the naturalists of the "Challenger," who collected it between tide-marks at Sea Point, Cape Town. The specimens were scarcely so fine as those procured by the "Challenger," but traces of the greyish or olive-green pigment occurred on the dorsum.

As shown in the "Challenger" Annelids this form agrees with *Nicolea* in having two branchiæ, but instead of 15 pairs of bristle-bundles it has 33. The bristles, moreover, are diagnostic,

* Abhand. d. schwed. Akad. deutsch v. Kästner XXVII. p. 235, Taf. IX. (fide Grube).

for whilst the lower part of the tip is winged as usual, a special terminal modification in the shape of a tapering pectinated region occurs (*vide* "Challenger" Plates XXVII.A., figs. 24 and 25). The tips diminish in length from above downwards, and the wings become broader, the pectinated region at the tip being longer and more evident. The pectinations, indeed, are visible in the developing bristle in the interior of the setigerous lobe. The hooks had three or four small teeth above the great fang, while the posterior margin forms an almost continuous and uniform curve with the ventral or basal margin, a small mucro only indicating the separation. The posterior hooks present very little difference in form.

The examples were females laden with apparently ripe ova.

Marenzeller* considers that this form should fall under the genus *Leprea*, Malmgren, as shown by him in his careful classification of the group, and there is no objection to this arrangement in the meantime. He procured various examples from Angra Pequena-Bucht.

Thelepus —— ?

The examples of this form are much softened so that an accurate description of the exterior is not possible. In general aspect, however, they agree with Scottish forms of *Thelepus cincinnatus*

The hooks (Plate VII., fig. 37) have a well-marked dorsal hollow, and the inferior margin terminates in a rounded process which projects almost as far as the mucro above it. Only a single hook occurs above the great fang. Posteriorly a pointed process projects from the angle as in *Grymæa*, but there is no tapering process beneath the mucro in front for the attachment of the ligament as in *Streblosoma* (*Grymæa*), which also has two teeth above the great fang. A further noteworthy feature is the tendency to the elongation of the stem of the mucro; and a slight tilting forward of the process as in *Enthelepus setubalensis*.† The hooks of *Thelepus setosus*, De Quatrefages, as figured by De St. Joseph‡ in his well-known "Annélides Polychètes des Cotes de Dinard," approach the South African form very closely. The chief differences are the presence of two hooks above the great fang, the less graceful curve of the base and the more erect mucro in the French form.

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* Sitzungsb. d. k. Akad. d. Wiss. 1 Abth. Jhng, 1884, p. 18, etc.
† Ann. "Challenger," p. 465, Pl. xxviii.A, fig. 13.
‡ Ann.Sc. Nat. 8e Sér., xvii., p. 230, Pl. 10, f. 260.

Fam. SABELLIDÆ.

Potamilla reniformis, O. F. Müller.

1800. *Die niereuförmigen Amphitrite*, O. F. Müller, Naturges. Wurmarten, p. 194, Tab. xvi., figs. 1, 2 and 3.
1849. *Sabella reniformis*, Leuckart, Arch. f. Naturg. xv. 1, p. 183, Tab. 3, f. 8.
1865. *Sabella saxicava*, De Quatrefages, Annéles, II., p. 437, Pl xv., f. 1-7.
1867. *Potamilla reniformis*, Malmgren, Ann. Polychæt., p. 114, Tab. xiii., f. 77.
1868. *Sabella saxicava*, McIntosh, Ann. Nat. Hist., 4th Ser. II., p. 286, Pl. xx., f. 5-8.
1894. *Potamilla reniformis*, De St. Joseph, Ann. Sc. Nat. 8e Sér. XVII., p. 292, Pl. xi., fig. 296-298.

A species which shows a considerable amount of purplish brown pigment on the anterior region of the body and on the bases of the branchiæ even in spirit.

The collar anteriorly has a median furrow on the dorsal surface, with a slightly frilled triangular lobe on each side. The rim slopes obliquely downward and outward, making a shallow notch on the dorsum before reaching the line of the bristle-tufts. It then curves to the ventral surface, the rim on each side being separated by a median fissure. Dorsally, a median furrow passes backwards a short distance, not beyond the third bristle-tuft. The anterior region of the body consists of eight segments, marked by the bristle-tufts and pads. The ventral median groove goes forward to the second segment behind the anterior region, then slopes to the right towards the furrow between the anterior and the following region of the body, but is not continued on the dorsum.

The length of the largest example was 80 mm. but the posterior region was imperfect.

The branchiæ are about fourteen in number, appear to be proportionally short, and the filaments proceed quite to the tip. On viewing the fans from the dorsum, the rachis in several has three distinct pigment-specks, in others one or two, so that the branchiæ have a characteristic appearance. The purplish brown specks project from the line of pigment on the anus as globular bodies. Their number is variable, but none had so many as those described by Langerhans,* (his var. *polyophthalmos* with six or seven eye-spots), from Madeira. The branchiæ in the British examples are often speckled green and white. The tentacles are somewhat lanceolate and pointed processes.

* Zeit. f.w. Zool. Bd. XL., p. 266.

The first bristle-tuft occurs immediately behind the collar and is unaccompanied by hooks. The bristles of the anterior region form vertical rows, the upper eight or ten bristles have tapered tips with wings (Plate VII., fig. 38). They are followed by two rows with spathulate tips (Plate VII., fig. 39) the upper row having longer tips often with a central filament, and in some indications of transverse rows of spikes, the lower having broader tips (fig. 40).

The anterior hooks (Plate VII., fig. 41) have a prominent fang and a crest or crown with fine serrations. The anterior curve is bold, and the posterior process long.

Posteriorly the tips of all the bristles are produced as long processes, the wings being rather abruptly widened above the slightly constricted end of the shaft (Plate VII., fig. 42). The posterior hooks are smaller, have a rounded anterior curve and a shorter posterior process.

The tubes inhabited by this form are often grouped together in longitudinal bundles, and are composed of tough hardened secretion coated with sand. They resemble those of the British "*Sabella saxicava*," though they are larger. In the same way the tips of the horny tubes are sometimes closed by being bent. In the larger tubes the grains of sand are coarser, and fragments of shells are added. In all cases the horny secretion is characteristically firm and more or less brittle. In one the tubes projected from a whitish mass of a compound ascidian, the sandy tube being in the centre and forming the axis on which the ascidian was supported. De St. Joseph finds that the tubes occur in a similar way between *Cynthia glomerata* and the granite rocks. In the Channel Islands as well as on the southern coast of England this species is very common. In the former it is abundant in oysters, *Pecten*, *Anomia* and other dead and living shells, in *Balani* covering the sides of the Gouliot caves at Sark, the tube is coiled beneath the *Balani* and pierces the latter to reach the surface. The species likewise perforates *Cellepora*, and even bores quite through the valve of a living *Pecten pusio*. It often occurs in the same oyster shell with *Gastrochæna*, *Polydora* and *Cliona*, and it sometimes places its tubes in groups in convenient fissures of the shell without boring, so that they can be dislodged *en masse*, as has been the case in a series from South Africa. Another site is under empty limpet-shells amongst muddy debris, part of each tube being inserted into a perforation in the shell; while again the cracks and fissures of the rocks near low-water mark afford a very favourite habitat, and the tubes often project through incrusting sponges and ascidians both simple and compound. As a rule the tough horny tube has grains of sand protecting the exposed portion, whilst the part immersed is hyaline and more delicate. The tunnels in shell, limestone and chalk are

circular, and are easily distinguished from those of *Dodecaceria* or *Polydora*. *Potamilla reniformis* not only frequents north European shores, but extends to Iceland, Greenland, America, Madeira, and the Canaries, so that its occurrence at the Cape is less remarkable.

Bispira volutacornis, Montagu, 1808.

1808. *Amphitrite volutacornis*, Montagu, Lin. Trans. VII., tab. vii., f. 10.
1865. *Distylia volutacornis*, De Quatrefages, Annelés, II., p. 421, Pl. 20, f. 5-7.
1894. *Bispira volutacornis*, De St. Joseph, Ann. Sc. Nat. 8e. Sér. XVII., p. 286, Pl. xi., f. 289-295.

A gigantic form (Plate viii., fig. 50) which in spirit measures fully 130 mm. with a breadth at its widest part of 17 mm.

Anteriorly a wide gap exists between the edges of the collar which are close to the first bristle-bundle. The collar expands in the middle line ventrally and is reflected, the left overlapping the right flap. Dorsally an elevated fold on each side of the middle line is sometimes formed between the edges of the collar—apparently by contraction. De St. Joseph describes the collar as of a deep violet with a border of white in the French examples.

The anterior region consists of eight segments. On the ventral surface of the third bristled segment on each side of the middle line are two elongated slit-like marks, and they are distinct as far back as the eleventh segment.

De St. Joseph found considerable variability in the thoracic segments, the number ranging from six to eleven, and, moreover, the sides are sometimes unequal, *e.g.*, seven on the left and eight on the right.

The dorsal tentacles (*palpes*, De St. Joseph) are long, flattened (with a thicker and a thinner edge) tapering processes, and from the outer edge of each the web at the base of the branchiæ begins. The branchiæ are rolled in a spiral of great complexity on each side. The outer whorls have longer filaments, the central have shorter, and in addition to the ordinary filaments a series of almost pectinate folds occurs in some at the dorsal edge of the whorl where the rim joins the tentacle. The central whorls are very short. In all there are not less than 260 filaments with their pinnæ which are rather short. The whole system is beautifully variegated. Thus a purplish belt marks the web, each filament having several touches of brownish purple alternating with pale regions, whilst the tips of many are

dark brownish purple. De St. Joseph mentions that some have entirely white branchiæ. The same author describes the basal branchial cartilages as forming only two spiral twists, whereas in spirit they appear to have three or four. Their vessels, he says, contain green blood. He observed an example with one of these organs in process of reproduction and represented by twelve white filaments. Both sides are spirally rolled, but the filaments are much shorter than in *Spirographis Spallanzani* from the Mediterranean.

Along the bases of the whorls an elevated collar or crest of mucous membrane winds, and probably has important functions in directing the streams of water and perhaps secreting mucus.

The arrangement of the spiral in *Bispira* as shown in this example is such that in a horizontal section only portions of three rows of branchiæ appear, for example near the base, the outer being the most complete, the next within (a continuation of the former) being less, and the third very short. The whole system really consists of a single lamina with its filaments spirally rolled on a firm axis which is thickest inferiorly and tapers superiorly. The upper central filaments are thus shortest, the outer and inferior, the web of which adjoins the collar of the annelid, are the longest. The spiral attachment thus winds round the axis from above downwards.

The outer whorl commences on each side at the tentacle, the web of attachment on the left having about two short tapering filaments as supports—before joining the first long branchial filament. On the right the branchial stems are disconnected, the membranous lamina attached to the base of the tentacle abutting inferiorly on a groove.

The body is massive, somewhat fusiform in outline—in so far as it is slightly tapered in front, and still more tapered to a blunt point posteriorly. The bristled segments are about 172 or more. It is rounded on the dorsal surface, flattened on the ventral, and terminates in the anus. A groove commences on the ventral surface at the anus, travels forwards in the middle line to the second post-thoracic segment, bends to the right towards the front of it, and passes obliquely through the segment in front to the space between the anterior and posterior regions, and is there lost, though in some old examples a shallow groove runs forward dorsally a little above the bristle-tufts and is lost at the collar. In front dorsally are the tentacles, and close to their bases ventrally is a frilled ridge on each side which amalgamates with the inner edge of the massive lips. In all probability the muddy water is conveyed along these to the mouth from the branchial spiral, so that both digestion and respiration are subserved. The lips form two prominent fleshy lobes projecting forward—darker in hue distally where slightly enlarged—paler below. Their inner edges are flattened, indeed, somewhat

hollowed below the vertical slit forming the mouth, and the ventral edge of which trends to the fissure between the lobes of the collar.

The species seems to be brightly coloured probably of a rich brownish purple, which in some uniformly tints the branchiæ. Each foot in the anterior region has a dark pigment-speck just in front of the papilla at its anterior and dorsal edge, and though the papilla is less distinct in the posterior region a similar speck of pigment continues to the tip of the body. Moreover, at the dorsal end of each hook-row in this region a dark speck is present.

The thoracic bristles are in eight bundles and differ from those in *Spirographis Spallanzani* by the greater length of the winged tips of the dorsal and the narrower wings of the ventral series (Plate VIII., figs. 43 and 44, the former form the upper series, the latter form the middle). In *S. Spallanzani*, the short broad spear-tips of the ventral are diagnostic, one being sketched by way of comparison in Plate VIII., fig. 45. The foregoing distinctions are still more pronounced in the posterior bristles, which have much more elongated tapering tips and narrower wings than in *Spirographis Spallanzani*—the respective forms being shown in Plate VIII., figs. 46 and 47 for the former and 48 for the latter. Moreover, the somewhat abrupt narrowing of the tip in *Spirographis Spallanzani* is diagnostic.

The anterior hooks have a similar arrangement to those in *Sabella*, and in minute structure (Plate VIII, fig 49) are closely allied to those of the Italian form, with which it has just been contrasted, except that the crown above the great fang is more distinctly serrated. The same features are shown in the posterior hooks.

The tube is composed of tough secretion having at the wider or lower end a few fragments of shells and coarse sand, the greater part, however, being bare. Above the middle this horny coat has a thick investment of muddy sand with here and there a shell-fragment. This leads to the upper region which is composed for the most part of muddy sand with only a thin lining of secretion. On the French shores De St. Joseph* has found tufts of *Amathia lendigera* growing on the posterior end, a feature observed in the tubes of other forms, such as *Chætopterus* and *Thelepus*, which are frequently feathered with graceful zoophytes.

This beautiful Sabellid, originally found on the beach at South Devon by the indefatigable Montagu, appears according to De St. Joseph, to live in colonies on the French shores, and probably also in South Africa, the young attaching their tubes

* Bollet, d. Soc. Adriat. d. Sc. Nat. viii., p. 296 (*fide* De St. Joseph) also List Zeit. f. w. Zool. xlix., p. 248–286, Taf. iv. and v.

to those of the adults (De St. Joseph). Even the crustacean parasites on the body in the regions thus widely separated have a parallelism as shown in the account of the South African form which follows. Both males and females occur on the branchiæ of large specimens as well as on the body.

De St. Joseph found the sexual elements developed at the end of September, the eggs being 0·10 mm. in diameter, and the sperms very minute. He states that these elements escape by the pores of the segmental organs at the ventral base of the setigerous lobe. A young specimen of seven mm. had nine thoracic and nineteen abdominal. Its branchiæ (few in number) formed spirals.*

Sabelliphilus (?) bispiræ.

Crustacean parasites of annelids have been known to zoologists since Kröyer† in 1837 described *Selius bilobus* as frequenting *Lepidonotus squamatus*, L. The same author next year found another on *Harmothoë imbricata*, L. which he provisionally termed *Silenium Polynoës*, but delay in publishing a description caused Steenstrup and Lütken, with Kröyer's consent, to substitute the title *Herpyllobius arcticus* for this crustacean. Sars‡ next contributed a description of four new species, viz., *Terebellicola reptans* on *Terebella debilis*, Malmgren, *Sabellacheres gracilis*, on *Myxicola Steenstrupi*, Kr., *Sabelliphilus elongatus* on *Sabella pavonina*, and *Choniephilus dispar* on *Euchone papillosa*, Sars. Keferstein in 1863§ gave an account of *Nereicola ovata* occurring on *Nereis cultrifera*, Grube, and the author and Grube likewise noticed the same form which is not uncommon in the Channel Islands. In 1864 Nordman‖ found a new copepod on *Nicomache lumbricalis*, and he termed it *Domusa clymenicola*. A few years later Hesse¶ in his account of new crustaceans from the shores of France described *Chelodiniformis typicus* from the lob-worm (*Arenicola marina*, L.). Claparède** the following year gave a resume of the literature of the subject up to date, as a preface to his description of a new species, *Sabelliphilus Sarsi* on *Spirographis Spallanzani*, Viviani. Three additional species were described by the veteran naturalist,†† Sars, the same year, viz., *Melinnacheres ergasiloïdes* on *Melinna cristata*, Sars; *Hepyllobius crassirostris* on *Evarne impar*, Johnston; and

* Op. cit., p. 291.
† Naturhist. Tidsskrift, 1ste R. I. Kjobenhavn.
‡ Forhandl. Vidensk. Selsk. I. Christiania, 1861, p. 46 (sep. copy).
§ Zeit. f. w. Zool. XII. Bd.
‖ Bullet. Acad. St. Petersb. 1864.
¶ Ann. Sc. Nat. 5th Sér. XI. p. 275. 1869.
** Ann. Sc. Nat. 5e Sér. xiii. Note p. 1, Pl. 7.
†† Nyt. Mag. Nat. Bd. xvii. 1870.

Eurysilenium truncatum on *Harmothoë imbricata*, L. In 1877 Kurz* published an account of *Eunicicola Clausii* as a parasite on *Eunice Claparedii*, De Quatrefages. The same year an important contribution by Levinsen† cleared up the ambiguity connected with *Herpyllobius arcticus*, Steenstrup and Lütken, and, besides, added four new genera and species to the list, viz., *Selloides Bolbroei* on *Harmothoë imbricata*, and a curious variety on *Gattyana cirrosa*, Pallas, *Rhodinicola elongata* on *Rhodine Lovéni*, Malmgren, *Bradophila pygmæa* on *Brada villosa*, H. Rathke, *Saccopsis Terebellidis* on *Terebellides Stroemi*, Sars, and *Crypsidomus Terebellæ* on *Amphitrite cirrata*, O. F Müller. In the Annelids of the "Challenger" is recorded a new form attached to the foot of *Leanira areolata*, McIntosh,‡ from 345 fathoms, south of Yedo, Japan, viz., *Leaniricola rotundata*. List§ in 1890 gave a minute account of two forms, one of which—*Gastrodelphys Clausii*—had apparently been first observed on the branchiæ of *Bispira volutacornis*, Montagu, by De St. Joseph,‖ the other, *Gastrodelphys Myxicolæ*, from the branchiæ of *Myxicola infundibulum*, Grube. The outline of *Gastrodelphys Clausii* differs considerably from the form subsequently described from South Africa, the latter having the appearance of an *Ergasilus*, and closely approaching the *Sabelliphilus Sarsii* of Claparède, the crustacean parasite of *Spirographis Spallanzani* in the Mediterranean. Various examples adhered to the largest, and probably oldest, specimen of the annelid both dorsally and ventrally, the anterior end being fixed in the fissure between two segments, and they also frequented the branchiæ, but they were not confined to the dorsal edge of the branchiæ, most, indeed, occurring on the pinnæ or close to their origin.

The crustacean, which may provisionally be termed *Sabelliphilus bispiræ*, parasitic on this annelid differs from the *Gastrodelphys Clausii* as described by List,¶ and which he found on the branchiæ of *Bispira volutacornis* of Montagu from the Adriatic. De St. Joseph had apparently obtained the same form on the French coast some years previously—fixed by the rostrum and ventral plate to the dorsal edge of the branchiæ, its long axis being parallel to that of the rachis. He had provisionally named it *Bispirophilus tenax*, but, as he himself observes, the name of List has precedence, and he appears to have satisfied himself that List was dealing with the same species.

In outline the South African ectoparasite leans more to the typical Ergasilidae than *Gastrodelphys*, which in the female is narrow in front and broad behind, whereas the present form is

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* Sitzungber. Akad. Wiss. Wien, 1877.
† Videnskab. Meddel, Nat. Foren. Kjöbenhavn.
‡ Ann. "Challenger," p. 133. Woodcut, Fig. 2.
§ Zeit. f. w. Zool. xlix. Bd. p. 71 Taf. iv.–viii.
‖ Ann. Sc. Nat. 8e Sér. xvii. p. 292, 1894.
¶ *Vide* Dr. Thos. Scott, 20th Rept. S. F. B., Part III., p. 288.

broad anteriorly and narrow posteriorly. In the male, moreover, the resemblance between the species is slight, the elongated body gently tapered from front to rear having little resemblance to the male of that from South Africa. It may be that two parasitic crustaceans occur in Europe, and that the present species agrees with one of them, but no evidence on the subject has been found. These crustacean parasites of Annelids approach in a close manner those of various fishes, *e.g.*, such as *Bomolochus*, are of the Ergasilidae, parasitic on the sole and the ling.

The female (Plate IX fig. 56) is about 1.2 mm. in length and in general outline resembles an *Ergasilus*, often seen on *Doris tuberculata*, having an ovate body (cephalothorax, Claparède) to which is appended the tapering tail. The anterior end is shaped like a hoof and the first segment is distinguished from the rest by a lateral peak on each side. The second segment is somewhat less in transverse diameter than the body at the peaks; in antero-posterior diameter it is wider than the two following, and the last segment is still less. A lozenge-shaped segment follows with a few hairs at each lateral peak; and this is succeeded by a larger ovigerous segment from which the bulky ovisacs extend. Four progressively diminishing caudal segments occur posteriorly, and to the last are attached the two caudal processes with long spines. The first of these segments in the male especially appears to be more or less fused with the genital segment. A lozenge-shaped greenish or brownish opacity occurs in the centre of the carapace in some and is probably due to the food.

The antennules (Plate IX fig. 53) are of average length and have seven segments, the second being the longest and the last minute. They have similar hairs to Claparède's *Sabellipilus Sarsii** from *Spirographis*. The antennæ are shorter than in the latter species, and have only two terminal hooks, and these do not seem to be so closely parallel as in Claparède's form. The buccal appendages appear to be similar to those of the latter. Dr. Thomas Scott, who, along with Prof. G. S. Brady has done so much good work in the group, kindly examined this form, "which has a general resemblance to *Bomolochus*, though it belongs to the closely allied family Lichomolgidæ. The appendages of the mouth in the latter are very well described and figured in the 3rd volume of Prof. G. S. Brady's Monograph, and if the drawings be compared with the corresponding appendages of *Bomolochus* given in my paper in last year's Report of the Fishery Board for Scotland, a marked difference between them will be noticed, especially in the structure and armature of the mandibles and maxillæ. On the other hand there is among the genera composing the Lichomolgidæ a certain similarity in

* Op. cit.

the structure of the mouth-organs. In Part III. of the 12th Report of the Fishery Board is a note setting forth the more prominent of these differences—*Sabelliphilus* included."

The first four pairs of thoracic feet are biramous, the stronger showing externally three joints, the distal segment being somewhat ovoid, and furnished with strong spines. The next segment also has a long spine—the other has an elongated terminal segment. The fifth pair appears to be rudimentary—probably represented by the lateral processes of the narrow segment in front of the genital segment (the first abdominal of some *e.g.* Claparède).* This segment has the enlarged vulvæ to which in the sketch the ovisacs adhere (Plate IX., fig. 56). These are distended with moderately large eggs. In some the ova were still in the ovaries, though ready for deposition, and in one filmy tissue adhered to the vulvæ—either for the purpose of receiving the ova on discharge, or which had been left after the escape of the eggs from the ovisacs. Moreover, in several a spermatophore was attached to the pigmented tissue of the vulva on one side, but was detached during examination (Plate IX., fig. 55).

The male is less than the female, measuring ·7239 mm., and is proportionately more elongated (Plate IX., figs. 51 and 52), all the segments of the body being narrower. The antennules (Plate IX., fig. 53) agree in regard to the proportions of their segments with those in the female and so with the antennæ (Fig. ibidem). The other appendages of the region also correspond. In lateral view (Plate IX., fig. 52) the four anterior thoracic feet are more distinctly observed, and the shape of the rostrum is more clearly defined. The genital and caudal segments, however, do not readily take this posture, so that they are generally seen in a horizontal position—not on edge—probably because the genital segment, which is flattened from side to side, maintains this position. The condition of the genital segment at once distinguishes this sex, for it is broadly ovate, convex in front, but somewhat concave posteriorly. It contains an ovoid spermatophore on each side, and the apertures appear to be posterior, each debouching from a papilla. On extension the spermatophore is spindle-shaped (Plate IX., fig. 54). It however assumes a different aspect after the sperms have been utilized (Plate IX., fig. 55) for then the elasticity of its capsule gives it an elongated slipper-shape. The chitinous investment of the genital segment seems to lend itself more readily to its varying contents than that of the other parts—a feature probably due to its delicacy. As in the female, four caudal segments succeed the genital—each being slightly narrower than the one in front, and the last being somewhat longer. It bears the two elongated processes from which the spines extend.

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* Ans. Sc. Nat. 5th Se. XIII p. 14.

The spermatophores would seem to be discharged by the male at the vulvæ of the female, one or more becoming attached thereto and fertilizing the ova as they pass, or otherwise. Whether the male secretes new spermatophores and repeats the process of fertilization could not be determined.

It is interesting that the South African form so closely agrees with the *Sabelliphilus Sansii* of Claparède from the Mediterranean *Spirographis Spallanzani*. The proportions of the antenules and of the antennae differ, as well as the number of the terminal hooks in the latter. Moreover, in his figure he shows only three caudal segments behind the genital (the first having apparently been joined to the genital).

The following note by Mr. Andrew Scott on the Family, and the remarks of Dr. Thomas Scott, after consideration of all the features of the case, are of special interest in connection with this ectoparasite.

The Family *Sapphirinidæ*, which includes the genera *Pseudanthessius*, *Lichomolgus*, *Hedmannella*, and *Sabelliphilus*, and the Family *Ergasilidæ*, containing such genera as *Ergasilus*, *Bomolochus*, etc., are founded chiefly on the structure of the cephalic appendages, especially the mandible.

In the *Sapphirinidæ* the mandible is in the form of a thin plate, with a more or less distinctly serrate edge. The mandible in the *Ergasilidæ* is jointed, and terminates in a strong *tooth*, with a serrate edge.

The genera *Pseudanthessius*, *Lichomolgus*, and *Hedmannella* are distinguished by the structure of the inner branch of the fourth pair of swimming feet. In *Pseudanthessius* the inner branch is one-jointed; in *Lichomolgus*, two-jointed; and in *Hedmannella*, three-jointed. The other appendages are very much alike in the three genera.

Sabelliphilus is separated on account of the structure of the second maxilliped of the female. In *Pseudanthessius*, *Lichomolgus*, and *Hedmannella* the female second maxilliped terminates in a short, almost obsolete claw. In *Sabelliphilus* the maxilliped is well developed, and terminates in a long, strong claw.

Dr. Scott observes that this crustacean certainly belongs to the *Sapphirinidæ* (= the *Lichomolgidæ* of Brady and others). It does not agree with *Sabelliphilus* in the structure of the antennule, and to some extent in the structure of the first and second maxillipedes, and especially in the structure of the endopodites of the fourth pair of the thoracic legs. In *Sabelliphilus* the first two joints of the antennules are considerably dilated, and the endopodite of the fourth pair of legs are three-not two-jointed. On the other hand the specimens from South Africa—in the structure of the antennules, and especially in the structure of the endopodite of the fourth pair of legs—agree

very closely with *Lichomologus*, but differ very much from that genus in the structure of the second maxillipedes. In *Lichomologus* this pair of maxillipedes in the female are stout, and terminate in an almost obsolete tooth-like claw. Indeed, he (Dr. Scott) does not remember any described genus to which these specimens can be satisfactorily ascribed. If the specimen dissected had been a male instead of a female it would have agreed fairly well with *Lichomologus*, as the male in that genus has the second maxillipedes usually furnished with a moderately long claw, but as it is a female it exhibits in its appendages a relationship to both *Lichomologus* and *Sabelliphilus*.

Fam. SERPULIDÆ.

PROTULA CAPENSIS, McIntosh, an var. *tubularia*, Montagu.

1803. *Protula tubularia*, Montagu, Test. Brit. p. 513, and Suppt. p. 171.

1885. *Protula capensis*, McIntosh. Ann. "Challenger," p. 509. Pl. LIV., fig. 2; Pl. XXXI.A, figs. 12-13.

The species is large, attaining (in spirit) a length of 100 mm., and a breadth between the bases of the anterior bristles of 14 mm. Of the total length, about 18 mm. pertain to the branchiae, 27 mm. to the anterior (thoracic) region, and 55 mm. to the posterior region.

The dorsal surface is grooved along the middle line anteriorly, but is convex posteriorly. The ventral surface, on the other hand, is deeply grooved throughout, the groove, however, being interrupted by the deep membranous apron at the posterior part of the thoracic region.

At the truncated anterior end the mouth opens dorsally as a deep pit with a smooth papilla projecting out of it. Similar grooves to those in *Bispira* lead from the spirals of the branchiæ to the mouth, and probably subserve the same purpose, viz., the conveyance of food and mucus.

The branchiae form two dense masses on each side, attached by a surface shaped somewhat like a trefoil to the body. Moreover, the left mass is composed of three spirals which are mounted on a basal region composed of a single spiral. Such may be an abnormality.

The right side has but a single complex spire considerably longer than the compound one on the left, the last whorl terminating dorsally and sending from its edge a lamina towards the mouth, apparently for directing currents thereto.

The filaments have a dense series of somewhat short pinnæ which proceed to the tip, the latter only being distinguished by

its larger bulbous end. As transparent objects the filaments (radioles) present an interrupted dark line in the centre, probably from a blood vessel, and the pinnæ are richly ciliated.

The question as to whether the complex spirals in this large form (double the size of that procured by the "Challenger") are the product of age is interesting, and the fact that each side differs from the other in the character of the spirals shows that considerable variation is possible.

The collar commences by a wide fan-like flap at each side dorsally, and extends round the ventral border to the other side The first or lateral flap is partially separated by a fissure from the rest of the collar, which otherwise is continuous. The lateral flap of the collar is continuous again dorsally with the loosely folded membrane which flanks the anterior or thoracic region, and which passes between each of the bristle-bundles to be attached as a folded or frilled band to the ventral surface, embracing on each side the soft pad for the rows of hooks. Dorsally, the whole forms a continuous membrane, for it is attached on the dorsal aspect of each bristle-bundle, and it is highly vascular, every part of it being permeated by the finely branched vessels with their dark blood. Posteriorly the ventral edges of the membrane are joined by a thicker fold (already alluded to), and which probably contains glandular elements like the area in front.

The anterior regions has seven pairs of golden bristle-bundles, each consisting of a dense group of fine bristles with delicately tapered tips and narrow wings. The great number of these slender bristles in a tuft is a feature of moment. No spine is present. The bristle-bundles are nearly of the same size from the first to the last. They appear to correspond in minute structure with those of *Protula capensis*.

In the same way the anterior hooks appear to differ only in size, for the curves are the same. These remarks also apply to the posterior hooks.

The species occupies a large white, calcareous tube (which was absent in the "Challenger" collections), sinuous in outline, and having an average diameter of 13-14 mm. It is smooth internally, but roughened externally by various growths such as tubes of *Filigrana*, patches of *Cellepora* (*Lepralia*), *Balani*, coarse sand and *Melobesia*.

The many close structural resemblances between this and the European species (*Protula tubularia*, Montagu) raises some doubt as to the specific distinction on grounds so slender as the slight modification of hooks and other parts. Its much larger size in South African waters will account for some of these variations. On the whole it may be considered as a variety of the European species.

[Published 25th June, 1904.]

EXPLANATION OF PLATES.

Plate V.

Fig.

27. Twenty-fifth foot of *Theodisea* (*Anthostonia*) *hexaphylla*, Schmarda. × 21 diam.

28. Posterior end of a young example of the foregoing (?) with four anal cirri. × 90 diam.

29. Foot of the foregoing (adult) from the middle region of the body. × 21 diam.

51. Tip of great bristle from the 4th segment of *Chætopterus variopedatus*. × 100 diam.

52. Smaller bristle of the same kind from an example from Naples. × 100 diam.

53. Terminal winged bristle at the tip of the sickle-shaped anterior feet. × Zeiss oc. 2. obj. D.

54. Spathulate bristle from the middle of the same foot. Similarly magnified.

55. Large spathulate bristle from the inner end of the series. Similarly magnified.

56. Anterior hook of the same species. × Zeiss oc. 2. obj. D. + 3 in. draw-tube.

W.C.M. del.

Maynard Brown lith.

ARICIDÆ & CHÆTOPTERIDÆ

Plate VI.

Fig.

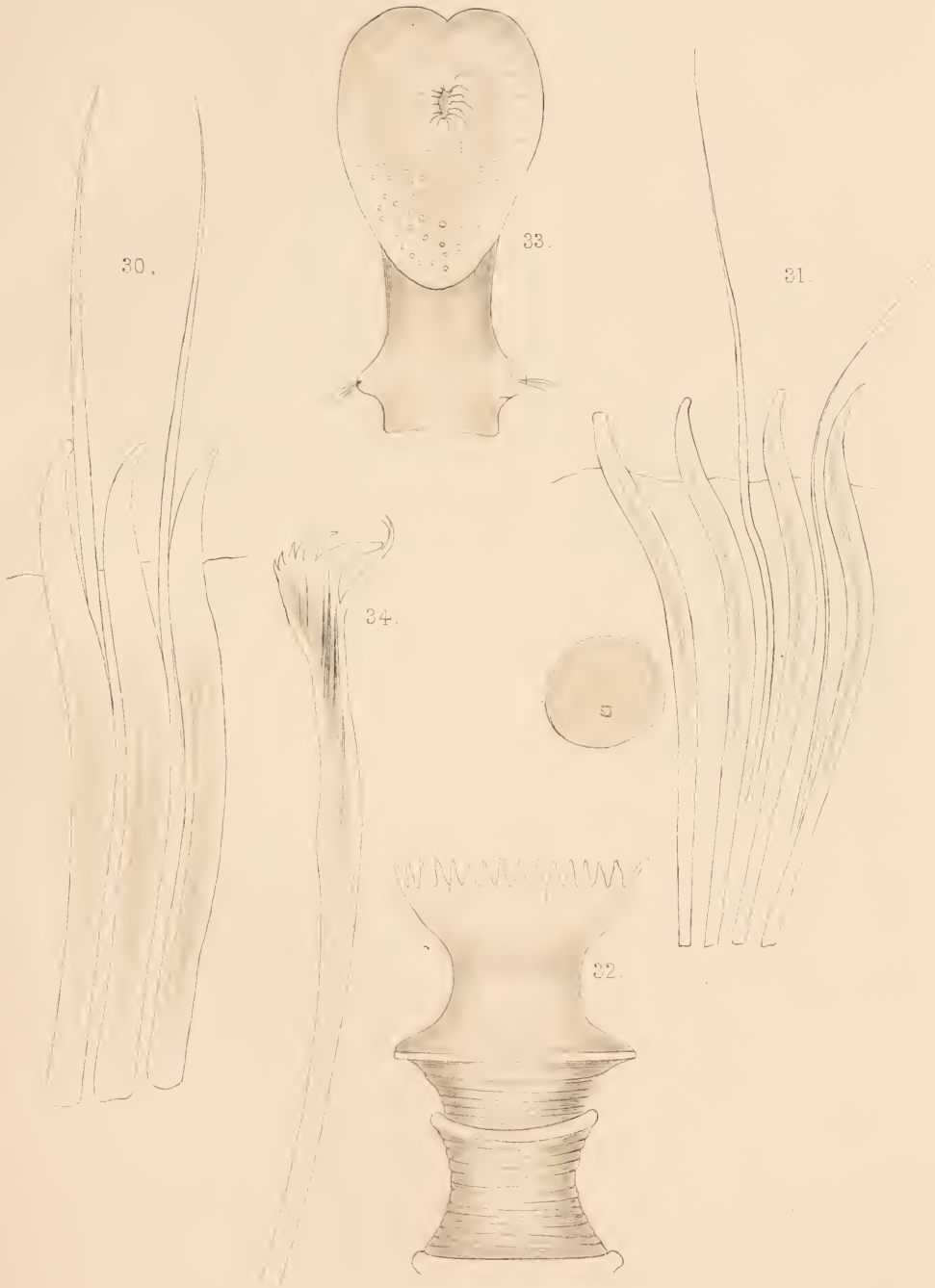
30. Anterior hooks and bristles of *Cirratulus cirratus*, var. *capensis*. × 100 diameters.

31. Anterior hooks and bristles (drawn to the same scale) of *Cirratulus cirratus* from Britain. An ovum is on the left. × 100 diam.

32. Anal funnel of *Nicomache lumbricalis* var. *capensis*. × 20 diam.

33. Foliate anal expansion of *Maldane McIntoshii*, Marenzeller. (Under a lens.)

34. A posterior hook of the foregoing. × 150 diam.



Mintern Bros. lith.

CIRRATULIDÆ & MALDANIDÆ.

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Plate VII.

Fig.

35a. Tip of bristle of *Pectinaria capensis*, Pallas. × 150 diam.

35b. Tip of an injured bristle from the same region. × 150 diam.

36. Hook of the same species in lateral view. × Zeiss oc. 2, obj. D. + 3 in draw-tube.

37. Hook of *Thelepus*—? × As in the foregoing.

38. Upper bristle of *Potamilla reniformis*, O. F. M. × As before.

39. Tip of upper spathulate bristle of the same species. × As in the foregoing.

40. Tip of a lower spathulate bristle of the same form. × As before.

41. Hook of the same form. × As in the previous example.

42. Tip of a bristle from the posterior region of the same species. Similarly magnified.

AMPHITENIDÆ, TEREBELLIDÆ, SABELLIDÆ

Plate VIII.

Fig.

43. Upper winged bristle from the region of *Bispira volutacornis*. × Zeiss oc. 2. Obj. D.

44. Winged bristle from the middle of the tuft (thoracic region). Similarly magnified.

45. Winged bristle from the same region in *Spirographis Spallanzani*. Similarly magnified.

46. Upper bristle with narrow wings from the posterior region of *Bispira volutacornis*. × As before.

47. Inferior bristle of the same tuft. Similarly magnified.

48. Winged bristle fron the same region in *Spirographis Spallanzani*. × As before.

49. Hook of *Bispira volutacornis*. × Zeiss oc. 2. Obj. D. + 3 in draw-tube.

50. Lateral view of *Bispira volutacornis*. About natural size.

W.C.M. del.

Hintern Bros lith

SABELLIDÆ.

Plate IX.

Fig.

51. Male of *Sabelliphilus (?) bispiræ*, from the dorsum. × 100 diam.

52. Another example partly in profile. The genital segment and the caudal region, however, are seen from the dorsum. × As before.

53. Anterior region of the carapace of a male with the antennules and antennæ, the two powerful hooks of the latter being conspicuous. × Zeiss oc. 2. Obj. D.

54. Spermatophore when first extruded. × 100 diam.

55. Spermatophore as detached from the region of the vulva with its elastic capsule more or less contracted. × 100 diam.

56. An ovigerous female *Sabelliphilus (?) bispiræ*. Magnified to the same scale as the males.


51.
53.

THE

TURBINOLID CORALS OF SOUTH AFRICA

WITH NOTES ON THEIR ANATOMY AND VARIATION,

BY

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CONTENTS.

I. INTRODUCTION.

The present paper, containing an account of the Turbinolid corals of the Cape, has entailed the careful examination of upwards of 2,000 specimens from the present collection, and in the British Museum I investigated also over 1,000 specimens of the genus *Flabellum*, the account of which it did not seem advisable to defer until the whole family should have been finished (see "*Marine Investigations in South Africa*," Vol. II., pp. 117-154, 1902). In addition, it was necessary to carefully study the genera not represented in the collection, a work which clearly showed Duncan's classification* to rest on no scientific basis. However, I have provisionally adopted that arrangement of genera, preferring to leave the revision until I shall have worked through all the different families.

I would like here to express my indebtedness to the Government Biologist of Cape Colony for entrusting me with the examination of the collection. All the specimens of the different corals that came up in the dredge appear to have been taken and carefully preserved. Their species may seem to be few, but the large numbers of several have allowed a proper examination to be made of their variability. The latter is shown to be very great in solitary corals. It may be divided into three classes:—(1) that due to environment, (2) continuous, and (3) discontinuous, or in other words, (1) vegetative, (2) normal, and (3) specific. The presence of all three is quite clear in *Heterocyathus aequicostatus*, as it was also in *Flabellum rubrum*,§ (1) the general characteristics and sizes from different depths and localities; (2) to some extent the variation within the types, but in particular the meristic variations; and (3) the existence of definite types. Indeed, the collection has enabled us to get an insight into the variability of corals, such as must be carefully considered in any future systematic work on the Madreporaria.

The anatomy of the polyps has also been studied, and as far as it goes, confirms the diagnosis of the species from their

* Jour. Linn. Soc., XVIII., pp. 1-204 (1884).

§ Vide also "Variation in F. rubrum," *Proc. Phil. Soc., Camb.*, Vol. XI., pp. 463-71.

coralla. After the full account given of *F. rubrum*, only a few notes are required on those subsequently examined, although several have been investigated almost as carefully as that species. The uniformity in the minute anatomy of the different forms is surprising, the only new point developed being in connection with the endodermal nematocysts of the tops and sides of the septa, which have been shown to be of wide distribution in the different species (pp. 122-127).

II. SYSTEMATIC LIST.

Genus DESMOPHYLLUM.

Desmophyllum, Ed. and H., Cor. II., p. 76 (1857).

1. DESMOPHYLLUM CAPENSE, n. sp.

There are five specimens, with eight separate corallites of a gigantic species, which is very closely related to *D. ingens*. Moseley (*Challenger Reports*, Vol. II., p. 161, 1881). It differs from that species in that (*a*) the tops of its corallites are always straight, never expanded, nor trumpet-shaped; (*b*) in the largest specimens there are six cyles of septa, instead of five, and (*c*) there is no columella, though the septal edges may be thickened and fused together for 1 cm. or so above the base of the axial fossa.

Beyond the above, the species requires no description, in its other characters generally agreeing with *D. ingens*, from which, nevertheless, it appears to be a distinct species. Three of the larger corallites are respectively 45 × 25 mm., 40 × 26 mm., and 41 × 19 mm. across their upper ends, and have 162, 144, and 152 septa, of which 24, themselves divided into two series, are considerably broader, thicker, and more exsert (5 mm.) than the rest. The corallites vary up to 12 cm. in length, and are throughout rather flattened. The edge-zone of the polyps extends down the outer sides of the corallites for a varying distance, in the specimens up to 5 cm.; and this part is ridged with rather irregular bluntly lobate, or ridge-like costae, decreasing in size from the calicular openings. Below the edge-zone there is no trace of any epitheca, the surface of the corallites being simply covered by incrusting organisms or bare. Two, three, or more

corallites frequently grow together, but, as in *D. ingens*, there is no trace of any connection, either former or present, between their polyps. It is in certain cases possible, however, that the lateral polyps may have arisen by budding at the edge-zone of the central polyp, but there is in some cases a little ridge, where presumably the edge-zones of the two neighbouring polyps met one another, while in other cases there may have been a fusion of the edge-zones, as commonly occurs in other corals.

The deposition of exotheca, shown by Moseley in *D. ingens* (erroneously termed epitheca, see Pl. IV., fig. 4a), has been carried to a much greater extent in the present form, at the base of one corallite where the edge-zone spreads out, a thickness of over 1 cm. being visible. It is to some extent due to this deposition that the corallites have not got that trumpet appearance found in *D. ingens*. At the base of one of the type specimens of *D. ingens* in the British Museum endothecal dissepiments are distinctly recognisable. This, too, is the case in *D. capense*, where they are rather irregular (2—5 mm. apart), straight or more or less curving, more closely set near the theca. They may be almost absent, and in no case are visible from the surface; they never cross the axial fossa, and only deep down (2 or 3 cm.) extend out for more than a millimetre or two from the theca.

The septa have entire edges, a little thickened at the base of the axial fossa, and are smooth-sided, with little or no trace of ridges.

Eight corallites, forming five specimens, from Cape Hangklip, S.E. $\frac{1}{2}$ E., $7\frac{1}{2}$ miles. Depth, 44 fms. Bottom, fine sand and mud. (Refer. No., 15549.)

Genus FLABELLUM (Lesson).

Flabellum, Gardiner, *Marine Investigations in South Africa*, Vol. II., p. 117 (1902).

I have already reported on the specimens of this genus, but two corallites which I at first referred to *Desmophyllum*, evidently belong to it as well. The essential difference between the two genera lies in the fact that the wall of the calicle is formed by epitheca in *Flabellum*, but by theca in *Desmophyllum*. Delicate wavy transverse growth-lines are characteristic of *Flabellum*, and belong to the epithecal corallum. A true columella is present in neither genus, but either may have the axial fossa filled in by the fusion of the septal edges or by trabeculae from the same.

2. FLABELLUM SIBOGAE.

Desmophyllum alabastrum, Alcock, Siboga Deep Sea Madreporaria, p. 28, pl. IV., figs. 5, 27, 27a (1902).

There are two specimens of this very delicate species, both freed from their bases of attachment and somewhat chipped. They correspond in every particular with the form described by Alcock from the East Indies as *Desmophyllum alabastrum*, which I have had to rename as the specific name, "*alabastrum*," was preoccupied by Moseley in the "Challenger Report." The specimens measure 24 and 22·5 mm. in height, and 9 × 7 and 8·5 × 8·5 mm. in diameter, across the mouths of the calicles.

The form is certainly quite distinct from the other Cape of Good Hope species, and so far as I can at present see, from all other described species of the genus. In Duncan's system of classification it would be referred to the genus *Rhizotrochus*.

Locality.—Buffalo River, north of, 15 mi. Depth, 310 fms. Nature of bottom, coral and mud. Date, April 24th, 1901. (Two specimens.)

3. FLABELLUM PAVONINUM (LESSON).

Flabellum pavoninum, Gardiner, *Marine Investigations in South Africa*, Vol. II., p. 123, pl. IV., figs. 18-21 (1902).

4. FLABELLUM RUBRUM (Q. et G.)

Flabellum rubrum, Gardiner, *Marine Investigations in South Africa*, Vol. II., p. 125, pls. I.-IV., figs. 1-17, 22-31 (1902).

Genus SPHENOTROCHUS Ed. and H.

Sphenotrochus, Ed. and H., Cor. II., p. 65 (1857).

The genus is one of the best defined and most isolated among the Turbinolidae. The polyp completely covers the whole of the corallum, so that there can be no epitheca present.

5. SPHENOTROCHUS GILCHRISTI, n. sp. (Pl. I., fig. 1, a—g).

Corallum free, greatly compressed, rounded at the base with no mark of any former attachment.

The septa are 24 in number, and form two series. Cycles I. and II. are equal in size, ·75—1·5 mm. exsert in accordance with the size of the whole corallum. The septa of cycle III. form the second series, and are only about half as exsert as those of

I. and II. The columella is a plate, one-third to one-half the length of the calicle, its upper edge intermediate in height between the upper edges of the septa of the two series; it is joined by processes from the 12 larger septa, about 1·5 mm. below its edge.

The theca has the appearance of having been formed by thickenings of the septal edges. It has no definite costae, but the whole of the exterior is covered by a series of minute, linearly extended granules, forming lines, which commonly converge a little round the base of the corallum. They start somewhat irregularly as elongated paired granules, each pair forming a V, on the exsert portions of the septa, but below, on the widest portion of the corallum, 8 or 9 lines correspond to two neighbouring septa.

Height of the specimens by the greatest and least diameters of their calicles in mms., 13 × 11 × 6, 11·5 × 9·5 × 5·5, 9·5 × 8·5 × 5, 11 × 8 × 3·5, 10 × 8·5 × 5, 10·5 × 8 × 4·5..

Locality.—Near Kowie, Lat. 33° 45′ 20″ S., Long. 26° 44′ 20″ E. Depth, 44—43 fms. Date, November 19th, 1898. (Seven specimens.)

The species most closely approaches to *S. granulosum*, Ed. and H., from the Eocene. It differs from the four recent species described by various authors, in the fact that it has no costae and no wings on either side. Two specimens have the columella slightly notched in the centre, and one has two pairs of thickenings on the sides of the same, opposite the tertiary septa on either side of the large central pair.

Genus TROCHOCYATHUS, Edw. and H., Duncan.

The genus appears to be fairly well defined, but I do not see any reason in the characters that Duncan gives for the retention of *Thecocyathus* as a subgenus, since they are due to purely environmental causes. The hollow root-like growths from the "interseptal chambers," described by Pourtalés in *Th. cylindraceus* and *laevigatus* (*Ill. Cat. Mus. Comp. Zool.*, No. IV., 1871, pp. 13, 14), may provide a character of value, but this description must be re-read in view of the now known ectodermic origin of the corallum. Similar roots are also found in *T. cincticulatus* below, a close ally. If they have really any connection with the interseptal chambers, they can only be formed in the youngest stage of growth of the polyp, unless it be assumed that the polyp redissolves its theca in places so as to push them out. I have, however, been quite unable to see any such connection, and if there be none, the innermost wall alone can be regarded as a thecal formation, and all the external walls must be epithecal.

6. TROCHOCYATHUS RAWSONII (Pourtalés) (Pl. 1, fig. 2, a, b, and Pl. II., figs. A-K).

rawsonii, Pourtalés, *Cat. Mus. Comp. Zool, Harvard*, Vol. IV., p. 35, pl. VI., figs. 7-10 (1871), and *Bull. Mus. Comp. Zool., Harvard*, Vol. V., p. 199 (1878).

I refer no less than 38 dried specimens to this species, though their general type differs from the description of the species in the fact that the shape is conical, with base varying in breadth up to one-third the diameter of the calicle. This, however, is probably purely a matter of environment, and Nos. 31 and 32 of the table are in this character typical members of *T. rawsonii.*

The species characteristically seems to have four cycles of septa complete, with a fifth incomplete, decreasing in breadth and height from the lower to the higher cycles, and varying up to 1.5 mm. in exsertness, edges smooth, sides covered with low, granular ridges radiating from the theca. The costae equal the septa in number, and are subequal in size, very low but distinct and granular. The intercostal valleys are generally filled in below with epitheca, almost to the level of the top of the costae, this deposition extending to within 2 or 3 mm. of the thecal edge. Pali are present in front of septa of cycles I. to III., before cycle I. round and before III. rough, flattened pillars 1 mm. or so broad; those before III. are more distant from the centre of the calicle, and with the pali of cycle II., typically form chevrons before the secondary septa. Columella about 1 mm. lower than the upper ends of the tertiary pali, formed by about 6 rods, which are with difficulty to be distinguished from the pali of cycle I.

No. of Dredging.		Septa in Cycles.	Pali in Cycles.	Rods of Columella.	Growth Lines.	Height in mm.	Greatest by Least Diameter in mm.	Remarks.
I	1	6, 6, 12, 22	6, 6	7	4	16	10 × 10	Broken base, 3·5 × 3·5 mm., with about 14 septa.
	2	6, 6, 12, 22	6. 6, 1	5	5	28	12 × 12	Bent through 90 degrees.
	3	6, 6, 12. 24	6, 6	6	2	13+	9 × 9·5	Broken base, 3 × 3 mm., with 12 septa.
	4	6, 6, 12, 24	5, 6, 12	15	6	33	16 × 10	
	5	6, 6, 12, 24	6, 6, 12	10	5	23+	13 × 13	Broken base, 4·5 × 4 mm., with 12 septa.
	6	6, 6, 12, 24	6, 6, 12	5	5	35	14 × 14	Broad encrusting base, 14 mm. across.
	7	6, 6, 12, 24, 2	6, 6, 12	7	5	32	15 × 14	Rods of pali and columella very thick.
	8	6, 6, 12, 24	5, 6, 12	8	4	26+	14 × 12·5	Broken base, 5·5 × 5 mm., 16 septa.
	9	6, 6, 12, 24	?	?	2	30	16 × 16	Dead when obtained.
	10	6, 6, 12. 24	?	?	3	22	13 × 12	,, ,, ,,
	11	6, 6, 12. 24	6, 6, 12	12	5	18+	13 × 13	,, ,, ,, Pali uncertain.
	12	6, 6, 12, 24	?	?	3	15+	10 × 10	Broken end, 4 mm., 12 septa.
	13	6, 6, 12, 24, 4	6, 5, 4	3	3	15	9 × 9	A very delicate specimen.
	14	6, 6, 12, 24, 6	6, 4. 12	11	4	26	17 × 16	Some of pali II. fused with III.
	15	6, 6, 12, 24	6, 6, 12	5	5	28	15 × 15	
	16	6, 6, 12, 24, 8	5, 4, 12	10	6	23	13 × 13	Some pali II. fused with III.
	17	6, 6, 12, 24	?	6	4	23+	14 × 13	Broken end, 6 mm., 14 septa.
	18	6, 6, 12. 24, 10	6, 6, 12	11 ?	4	17+	13 × 12	,, ,, 6 mm., 20 ,,
	19	6, 6, 12, 24	?	9	6	29	15 × 15	Dead.
	20	6, 6, 12, 24, 16	?	?	5	28	16 × 14	Dead. Rods much fused together.
	21	5, 5, 10, 20, 4	5, 5, 10	6	4	26	11 × 11	
	22	7, 7. 14. 28, 4	7, 7, 14	15	8	55	18 × 17	
II.	23	6, 6, 12, 24, 6	6, 6, ?	?	6	14	14 × 13	Constricted. 9 mm. below mouth.
	24	6, 6, 12, 24, 8	6, 6, 7	9	5	43	16 × 16	Rods very thick. Pali fused.
	25	6, 6, 12, 24	6, 6, 12	12	4	33	17 × 17	Pali I. and II. pushed into columella.
	26	6, 6, 12, 24, 10	6, 6, 12	8	6	37	17 × 17	
	27	6, 6, 12, 24, 12	6, 6, 12	9	4	35	16 × 15	Rods remarkably thin and deep down.
	28	6, 6, 12, 24, 14	6, 6, 12	10	5	35	19 × 17	Rods medium, very shallow
III.	29	6, 6, 12. 24, 14	6, 4, 10	2	4	41	17 × 16	2 pali II. fused with III.
IV.	30	6, 6, 12, 24	?	?	4	15	10·5 × 9·5	Calicle constricted, pali delicate and twisted.
V.	31	6, 6, 12, 24, 6	6, 6, 12	19	3	17	11 × 10·5	
	32	6, 6, 12, 18	?	?	?	14	10 × 9·5	Calicle much broken.
VI.	33	6, 6, 12, 24, 14	6, 6, 12	7	3	23	17 × 16	Remarkably shallow calicle.
	34	6, 6, 12, 24, 16	6, 6, 12	9	3	17+	15 × 14	Broken end, 6 mm., 24 septa.
VII.	35	6, 6, 12, 24	6, 6	4	3	14	9 × 8·5	Pali III. not formed.
	36	6, 6, 12, 24	6, 6 ?	5	2	15	9·5 × 9	,, ,, forming.
	37	6, 6, 12, 22	6, 6	2	5	14·5	7 × 7	Pali I. scarcely separate from columella.
	38	6, 6, 12, 16	?	?	4	11	6 × 5·5	Pali I. scarcely separate from columella.

Localities.—I., 22 specimens, Vasco da Gama, N., 71° E., 18½ miles, stones. II., 6, Vasco da Gama, S., 75° E., 13½ miles, black specks. III., 1, Cape Point Lighthouse, E., 26½ miles, sand, black specks, and coral. IV., 1, Buffalo River, N., 15 miles, coral and mud. V., 2, lat. 30° 3′ S., long 27° 57′ E., sand, shell, and rock. VI., 2, Cape St. Blaize, N.W. ½ N., 30 miles, rock. VII., 4, Cape Vidal, N.N.E. ¼ N., 9½ miles, rock.

The nature of the adult pali and columella cannot be clearly understood without a knowledge of their gradual development (Pl. II., figs. A-E). The earliest stage could be seen only in sections, where there were 12 septa, 6 pali, and one rod in the columella. The smallest corallum, No. 38, is in a slightly later stage; the pali are somewhat indefinite, and there are several rods in the columella. The other coralla of VII. and Nos. 1, 2, and 3 have 12 rather oval-shaped pali, situated before the septa of cycles I .and II. Those before cycle I. are nearer to the centre of the axial fossa, and in the largest specimens merge into the rods which form the columella, not being clearly distinguishable from them, though their separate origin is clearly shown in sections.

In the specimens from station I. every stage between the last could be followed to the fully adult, with well-formed, more-flattened tertiary pali. Although scarcely typical, in the largest specimens there seemed to be a tendency for the tertiary pali to push the secondary pali into the centre of the fossa, where they simply appeared as rather more flattened rods at the sides of the columella, opposite the points of the chevron then formed by the tertiary paii alone. Occasionally the secondary pali become fused with the tertiary.

The variation in the septa may best be seen by reference to the table. It appears to be mainly due to growth, only two specimens showing radial, *i.e.*, meristic variation, one having 5 and the other 7 systems.. The specimens, in addition, differed materially from one another in the number of the rods of the columella. In the 22 specimens of I. the number varied from 3 to 15, but the difference, while to some extent perhaps due to age and the size of the axial fossa, was mainly brought about by the variations in size of the separate rods of the pali and columella. Sections of the narrow base have a simple rod in the columella, and as fresh rods arise on the trabeculae which join the septa to this rod, there should be typically a gradual increase, with increase in size of the calicles. In No. 30 there was a tendency to twisting in the rods, but this was also visible in Nos. 12, 27, and 38. Again, the depth of the rods in the axial fossa varied from ·5 to 6 mm. below the edge of the theca.

The epitheca differed greatly, in some specimens giving their external surface a glazed appearance, and in others allowing the costae to be plainly visible almost to their bases of attachment.

Many specimens were broken off above the base. In perfect specimens the attached part was usually broadened by an epithecal deposit, varying up to 3 mm. in thickness. Some specimens were much eroded or dissolved away on the outside, and in these it was noticeable that the epitheca was attached before the septa, the costal edges of which were frequently brought into prominence by the epitheca—and sometimes theca—in between them being removed. Other dead specimens showed intermediate characters to one, in which nearly all the corallum had been dissolved, leaving a cast of the intersepted and other spaces in calcite.

It will be quite clear from a glance at the table and figures that the number of growth lines is not a character of any importance, nor probably due to seasonal changes. The lines consist of circular elevations around the corallites, and appear to represent pauses in their growths, which would seem to have restarted with slight constrictions of the calicles.

It is possible that the specimens 35 to 38 do not belong to this species They cannot be accurately compared with sections of the larger coralla at the same size, since the spaces in the latter are filled in by secondary deposits. They approach the smallest specimens of the other dredgings, but are evidently much younger.

7. TROCHOCYATHUS CINCTICULATUS (Alcock), (Pl. II., fig. 2).

T. cincticulatus, Alcock, *Investigator Deep-sea Madreporaria*, p. 17, pl. II., figs 5, 5a (1898).

I refer four specimens to this species, which is presumably founded on a single corallum, and that an extreme one, perhaps produced by unfavourable circumstances. The epitheca is a difficult character, though probably not a very important one. It is in my specimens a deposit formed as the coral grows by the retreating edge-zone of the polyp, *i.e.*, that part which lies external to the calicle. It covers over the costae, but shows their position as ridges, and fills in the intercostal valleys. It is somewhat obscured by boring organisms and the action of erosion, which seems to have attacked the epitheca first. Alcock's specimen in this respect doubtless shows the more typical growth of the corallum.

Three of my specimens closely resemble one another, and show what I consider to be the typical central form of the species, the description of which would be as follows:—

> Corallum broadly or narrowly attached, subcylindrical or conical, straight or curved. Epitheca covering the whole externally to within 1 mm. of the top of the theca, filling in the intercostal valleys, but showing ridges over the costae.

Calicle almost circular set round with four cycles of septa. Septa entire, all about ·5 mm. exsert, ending perpendicularly against the axial fossa. Primaries and secondaries rather thicker and broader, inner edges slightly thickened and twisted.

Pali two series, those in front of the primary septa blunt rods, intermediate in size between the rods of the columella and those of the second series in front of the secondary septa, which are so greatly broadened that they extend almost to the tertiaries on either side.

Columella forming a fifth to a quarter of the diameter of the calicle, situated about ·75 mm. below the ends of the pali, which again lie 1·5 to 2 mm. below the upper edge of the theca, essential, consisting of fine rods (fasciculate type), varying with growth up to about 30 in number.

Diameter of calicle, 6-9 mm.; height of corallite, 10-20 mm.

Locality.—Lat. 33° 3′ S., long. 27° 57′ E., 32 fms.; sand, shell, and rock.

The septa and pali do not vary from the above description in the three type specimens, but the fourth is constricted round the mouth of the calicle and in its pali, septa, columella, and epitheca closely approaches Alcock's specimen. The columella has five rods only, is equally deeply situated, as in the other specimens, but its rods are not so sharply marked off from the pali.

Genus HETEROCYATHUS, Ed. and H.

The genus is characterised by a low, broad, simple corallum, having an *Aspidosiphon* living in its base. The coral larva fixes itself on a small Gastropod shell, in the cavity of which the worm takes up its abode. The shell is generally of such a size that the coral in its growth is able to completely surround it, but the *Aspidosiphon* growing at the same time stimulates the coral to broaden its base, in which it retains a spiral cavity opening to the exterior, in which it lives. Where the coral does not so affix itself, its shape is conical, base pointed. Only a single species of the genus appears to be known. A number of so-called species have been described on single or few specimens. All are represented in the series from the Cape or in the collection of the British Museum, and it is obvious that they represent merely the descriptions of isolated specimens drawn by the dredge, etc., at random out of series of the same species.

8. HETEROCYATHUS AEQUICOSTATUS (Ed. and H.). (Pl. III., figs. 1-43.)

H. aequicostatus, Ed. and H., Cor. II., p. 51 (1857).

H. phillipinensis, Semper, *Zeit. f. wiss. Zool.*, XXII., p. 254 (1872).

H. parasiticus, Semper, *Zeit. f. wiss. Zool.*, XXII., p. 255 (1872). (1872).

H. pulchellus, Rehberg, *Abh. Ver. Hamb.*, XII., p. 8 (1892).

H. oblongatus, Rehberg, *Abh. Ver. Hamb.*, XII., p. 9 (1892).

The collection contains upwards of 900 specimens of this species, made up as follows:—

	Number of Specimens.	Depth in Fathoms.	Locality.	Character of Bottom.
I.	About 700	54	Cape Natal W. by N. 6½ miles	Fine sand and algae.
II.	14	47	Cape Natal W. by N. 4½ miles	Sand and shell.
III.	45	56	Umhloti R. Mouth N. by W. ¼ W. 15½ miles	Sand and shell.
IV.	4	39-40	Off Umhloti R. Mouth	Sand and shell; hard ground.
V.	14	36	Tongaati R. Mouth, N.W. by N. ¼ N., 5½ miles	Sand and shell; hard ground.
VI.	About 100	90	O'Neil Peak, N.W. ¼ W. 9½ miles	Broken shells.
VII.	1	45	Lat. 32° 53′ S., Long. 28° 12′ E.	Coralline stuff.

The collection contains so large a number of specimens that I have been enabled to make a study of its variation. Comparing the specimens from each locality together, and with the collections from different localities in the British Museum, it was clear that each locality had a size-mode of its own. This was apparently due partially to the particular species of shell on which the coral had affixed itself in each locality, but mainly to the environment, tropical forms, for instance, being usually larger and coarser than Cape forms. At the same time, the characters of the costae, septa, theca, pali, and columella were not affected, and plenty of intermediates existed, so that all clearly belonged to a single species.

	Flabellum rubrum.	Flabellum pavoninum.	Trochocyathus rawsoni.	Paracyathus parvalus.	Heterocyathus aequicostus.	Caryophyllia epithecata.	Caryophyllia, smithi.	Duncania capensis.
Edge Zone	0	0	5+mm.	3·5 mm.	Covers corallum.	1·2 mm.	5+mm.	0
Number of Tentacles ...	Half septa.	Equal septa (?)	24	Equal septa.	24	Equal septa.	24 (+ ?)	12
Mesenteries	Equal septa.	Twice septa.	Equal septa.	Equal septa.	Equal septa.	Equal septa.	Equal septa.	Twice septa.
" reaching the Stomodoeum.	48	48	24	24	12	12	24	12
Septa, Entocoelic	Half.	All.	Half.	Half.	Half.	Half.	Half.	All.
Septa, Exocoelic	Half.	0	Half.	Half.	Half.	Half.	Half.	0
Sphincter Muscle	0	0	0	0	0	×	0	×
Filamentar Nematocysts ...	0	0	×	0	×	^	×	×
Endodermal Nematocysts ...	Degenerate.	Very degenerate.	Very degenerate.	0	0	Slightly degenerate.	Very degenerate.	0
Acontia	×	×	0	?	×	0	?	×
Mesenteries having generative organs.	All.	All except last cycle	All.	All.	All.	All.	I., II. & III.	I., II. & III.

Comparison of the Polyps of the Turbinolidae.

The specimens from locality I. were particularly interesting, as three types were distinctly visible in them. The descriptions of each of these are given in the accompanying table. No. 3 were obviously young forms leading to Nos. 1 and 2, and showing plenty of intermediates. Nos. 1 and 2, however, represent two distinct modes, between which odd specimens existed, showing intermediate conditions in each of the characters which serve to separate them. Only two specimens were at all doubtful in their position, and in one of these, of which one side had apparently been broken down and regenerated, half the corallum belonged to type 1, and half to type 2. On each of 450 of these specimens, besides a number from other dredgings, I made 11 measurements, in an attempt to compare them together, and to find out with some precision the characters of the species. The results were exceedingly disappointing, partially no doubt owing to the peculiar conditions existing between the coral and its commensal *Aspidosiphon*, but mainly owing, I believe, to the variation of these forms being purely vegetative in their measurable characters, the direct result of environment, and hence of quite a different nature to that usually included under the term "variation."

My first attempts were to correlate (1) the length by (2) breadth of calicle, (3) breadth of base containing the *Aspidosiphon*, (4) height of whole corallum, and (5) weight of the dried corallum. Of these, 1 to 4 are dependent on the age, size, and rate of growth of the two organisms, as well as on the size and form of the original shell, on which the coral affixed itself, and also on the growth of the *Aspidosiphon*. No. (1) by No. (5) at first gave better results, but the weight of the corallum is largely influenced by the size of the gastropod shell and the weight of sand in the body, or in the tube of the individual *Aspidosiphons*, a variation ranging through 15 per cent. of the total weight. A real meristic variation was found in seven specimens, 1·2 per cent., in the number of cycles of septa. The number is so small that they can only be chronicled with the remark that in this, as in all its other specific characters, the form is extremely highly specialised, and more or less definitely fixed. Yet it is particularly interesting to note that four of these were in the much less numerous specimens of the 2nd type. In many of the specimens some septa of a fifth order were present. They formed $2\frac{1}{2}$ per cent. of type 1, and over 50 per cent. of type 2, while the per cent. in young forms was intermediate; it was noticeable that in only one case where 6 systems were present were there less than 48 septa.

Table showing the measurements, etc., of *H. aequicostatus* from dredging I. :—

Plates III.	(1) Type 1. Figs. 1-11.	(2) Type 2 Figs 12-21.	(3) Young Figs. 22-32
Number of Specimens	200	50	200
Average Length of Calicle	9·17 mm.	9·33 mm.	6·3 mm.
Average Breadth of Calicle	8·21 ,,	9·47 ,,	5·84 ,,
Average Height of Coral	7·03 ,,	9·7 ,,	4·28 ,,
Average Weight of Coral	·640 grms.	·588 grms.	·277 grms.
Spiral right to left	193	50	198
,, left to right	7	0	2
Spiral, 1 opening ...	4	6	11
,, 1+1 openings	136	29	104
,, 1+2 ,,	43	14	66
,, 1+3 ,,	17	1	19
Colour, All Septa ...	37	50	181
No Colour	54		
Cycles I & II·I > II	16	0	0
,, ,, I = II	77	0	0
,, ,, & III	16	0	19
Septa, 6, 6, 12, 24 ...	194	22	185
Irregular ...	1. (6, 6, 12, 14)	1. (6, 5, 11, 22)	2. (6, 6, 12, 24, 2)
,, ...	1. (6, 6, 12, 24, 2)	1. (6, 6, 11, 20)	7. (6, 6, 12, 24, 4)
,, ...	1. (6, 6, 12, 24, 4)	2. (6, 6, 12, 22)	1. (6, 6, 12, 24, 6)
,, ...	2. (6, 6, 12, 24, 6)	7. (6, 6, 12, 24, 2)	2. (6, 6, 12, 24, 8)
	...	1. (6, 6, 12, 22, 4)	1. (6, 6, 12, 24, 16)
	...	8. (6, 6, 12, 24, 4)	...
	...	3. (6, 6, 12, 24, 6)	...
	...	2. (6, 6, 12, 24, 10)	...
Meristic Variations ...	(7, 7, 14, 28)	1. (8, 8, 16, 32)	1. (5, 5, 10, 20)
		1. (5, 5, 10, 20)	1. (7, 7, 14, 23)
		1. (5, 5, 10, 20, 2)	...

The results are valuable, because they so definitely point to the existence of two perfectly distinct modes of growth, almost two varieties, in the species as well as the ordinary continuous and vegetative variations. Type 1 also shows the presence in a single habitat of small though perfectly discontinuous variations in the colouration of its septa, variations not found in type 2 nor in the young. Some are colourless, others have the septa of cycles I. and II. black, and yet others have all the septa black. In some the septa of cycle I. are blacker than those of cycle II., and in yet others cycle IV. septa have not as yet attained their colouration. When the calicle is looked at from the surface, the spiral chamber in which the *Aspidosiphon* lives runs from right to left in most cases, but in a certain number from left to right. In 50 specimens that I have ground down a shell is present in each. In one of a left to right spiral, the difference was due to the shell being sinistral, but in two others examined I could not determine with certainty their character, though both seemed to be dextral. The *Aspidosiphon* chamber commonly has, in addition to its large opening to the exterior, a second very minute opening on the under side of the corallum, close to the mouth of the shell it originally inhabited. This is, I believe, normal, but in 30 or 40 per cent. of the specimens there are 2 or more of the small openings, the additional ones lying along the spiral tube of the commensal.

In addition to the specimens already referred to, four specimens, all belonging to type 2, show fission of the calicle, or possibly in two cases budding from within the calicle (see Pl. III., figs. 35-38). A fifth specimen, belonging to type 1, had become killed over the greater part of its calicle, but the remainder budded out a fresh calicle, which now stands up on a broad base, situated on the parent cup. The dead specimens, of which over 100 were obtained in dredging 1, do not differ in size from types 1 and 2 as described, none belonging to the third or young series; they bear the same proportion, nearly 4 to 1, that these types have to one another.

Table showing the characters of types 1 and 2 and of the young specimens of *Heterocyathus aequicostatus* from dredging I.

	(1) Type 1. (Pl. III., Figs. 1-11.)	(2) Type 2. (Pl. III. Figs. 12-21.)	(3.) Young. (Pl. III. Figs. 22-32.)
Costae.	Same number as Septa, extending down to the base, almost equal in size, rounded and covered with low granules. Small intercostal spaces.	Same number as septa, extending down to the base, cycles I., II. and III. larger than IV. which consists of a row of separate granules, rougher and higher than in (1) with broader intercostal spaces.	Same number as septa, many absolutely resembling type I., others approaching II. in being much rougher and alternately larger and smaller with low spines rather than granules.
Base.	Smooth, low granules, only traces of costæ.	Roughly granular, costae sometimes extending on to it.	Generally smooth, a few glazed, exceptionally costae.
Theca.	Upper edge thin, never more than 1 mm. above top of columella.	Upper edge thin, generally 2 to 3 mm. above the top of the corallum in the axial fossa.	Often almost invisible owing to the whole calicle being greatly flattened and broadened on top of the *Aspidosiphon* tube.
Septa.	Generally 48, thick with narrow interseptal spaces, vary up to 2·5 mm. in exsertness average 1·5 mm., cycle I. broader and more exsert than II., II. than III., IV. more exsert than III., higher on either side of I. than II. Sides set with low ridges, edges not toothed. Commonly certain ones or all coloured black.	48 with tendency to have some of cycle V. represented, thin with relatively broad interseptal spaces, vary to 4·5 mm. in exsertness average about 3 mm., otherwise same as in type I. Ridges on sides conspicuous, spined, edges toothed towards centre of calicle. All same colour, white or some shade of grey.	Generally 48, a few approaching towards type II. in exsertness, but most much less exsert than in (1) cycle III much the least exsert, giving an appearance as if of 12 sets equal in prominence composed either of 1 of I. and 2 of IV. or 1 of II. and 2 of IV. Coloured or colourless, very few graded.

Table showing the characters of types 1 and 2 and of the young specimens of *Heterocyathus aequicostatus* from dredging I.—*(Continued.)*

	(1) Type I. (Pl. III. Figs. 1-11.)	(2) Type II. (Pl. III. Figs. 12-21.)	(3) Young (Pl. III. Figs. 22-32.)
Pali.	Before all the cycles large and conspicuous. I. rounded and single, II. slightly elongated sometimes double, III. typically elongated but often double or triple instead, IV. none generally, but exceptionally round ones in about two of the systems, commonly septa IV. fuse with III. so that pali III. probably each represent three pali.	None proper. Septa IV. fuse with III. and then these again with II. Septa I. are generally separate, but in the centre fuse with the rest, forming a mass of trabeculae, covered by fine points which run up along the septa of cycles I-III. for some distance, almost like fine teeth, occasionally extending to septa IV. in systems where cycle V. is present.	Very varied, either as type I. or II., or in accordance with intermediate conditions between these, resulting from the fusion of the septa together. Generally rather rounded and smooth, not as conspicuous as in type I., but more definitely connected with the septal cycles, sometimes rough and pointed.
Columella.	A mass of rods decreasing in size and height from the pali towards the centre of the axial fossa, densely packed together.		Sometimes a mass as in type I. sometimes a few and thick, but where pali type II. a few thin pointed spines. occasionally wavy trabeculae.

Of the other dredgings, the specimens of II., III., and VI. closely resemble those of I. No. II. has 7 specimens of type 1, 3 of type 2, and 4 young; while III. has 20 of 1, 2 of 2, and 22 young. No. VI. has only type 1 and young in the proportion to one another of 4 to 1, but the tendency of all its specimens is to be smaller than in I., II., and III. The calicle of the single specimen of VII. belongs to type 2, but the specimen is unique in that it is conical, and has no *Aspidosiphon* nor any trace of a gastropod or other shell (Pl. III., figs. 33 and 34).

The specimens from Nos. IV. and V. differ from the rest in that (*a*) their costae are very distinct ridges, rounded, but with deeper intercostal spaces than in type 1; (*b*) their septa tend to have a few of cycle V., and are intermediate in most characters between types 1 and 2; (*c*) their pali rather belong to type 2, the specimen shown in fig. 39 being one of the nearer to type 1; and (*d*) their columella is generally represented by a series of very fine rods. The average size of the specimens is larger than from other dredgings, 16 corals (4 of IV. and 12 of V.) giving average length of calicle 10·5 mm. by breadth 9·69 mm. Size almost precludes any except one of those shown in fig. 40 from being regarded as young, but some almost resemble young forms from I. greatly magnified, noticeably those shown in figs. 41 and 43.

At first sight, the specimens from Nos. IV. and V. almost appear to represent a different type to the rest, and in this connection it is noticeable that they come from similar depths and localities, considerably differing from the other localities. Some specimens, however, approximate towards each of the types—IV. are closer to type 1—and in each character there is a series between. In seven of the specimens from these dredgings the corals have settled on relatively large, conical shells, over which they are attempting to spread themselves (figs. 40, 41, and 43). In one where there is no trace of an *Aspidosiphon* the shell is flattened and still larger (fig. 42). One has its base, in which no shell can be seen, much distorted by the presence of two worms, having two external apertures and two spiral cavities.

Genus CARYOPHYLLIA (LAMARCK).

9. CARYOPHYLLIA BERTERIANA (Duchassaing).

C. berteriana, Ed. and H., Cor. II., p. 19, pl. D I., fig. 1.

C. berteriana et formosa, Pourtalés, *Cat. Mus. Comp. Zool.*, IV., p. 7 (1871); *Mem. Mus. Comp. Zool.*, IV., p. 34, pl. VI., figs. 1 and 2 (1874); *Bull. Mus. Comp. Zool.*, VI., p. 99 (1879).

There are two specimens in the collection of this typical West Indian coral, which was also obtained by the Challenger Expedi-

tion at the Canary Islands. Both were dead when obtained, but had preserved their structure, which approaches most closely to the form figured in the Hasslar Expedition Report. One is round, 22 mm. in diameter across the calicle, while the other is slightly compressed, 17 × 15·5 mm.

Localities.—Smaller, 90 fathoms, O'Niel Peak, N.W. ¼ W., 9½ miles, broken shells; and larger, 30 fathoms, Buffalo River, N., 15 miles, coral and mud.

10. CARYOPHYLLIA CAPENSIS, n. sp. (Pl. I., figs. 4 a-d).

Corallum conical, closely set on the outside with low, equal, finely-granular ridges, corresponding in number to the septa and formed by an epithecal deposit, covering over the costae and to some extent filling in the valleys between to within 2 mm. or less of the edge of the theca.

Calicle rather longer than broad, with theca slightly higher against its long axis. Septa five cycles, the last generally incomplete, none more than 1 mm. exsert, with very little difference between the orders. Primaries and secondaries sub-equal, considerably broader than the rest, tertiaries being intermediate these three orders alone connected to the columella and with entire (not toothed) edges. Quaternaries much thinner, but projecting again in front of the quinaries, and, where the latter are present, generally with from 2 to 4 blunt teeth.

Pali present in front of the tertiary septa alone, varying from rather thick, round pillars of rough appearance to flattened plates of upwards of 1·5 mm. in breadth. Columella rough pillars, varying in size with number present, about 4 mm. below the edge of the theca, almost level with the tops of the pali.

Locality.—32 fathoms, lat. 33° 3′ S., long. 27° 57′ E., sand, shell, and rock.

The size and variation may best be seen in the accompanying table of the specimens:—

No.	Septa in cycles.	Pali.	Rods to Columella.	Height in mm.	Diameter of Calicle in mm.
1	6, 6, 12, 24, 36	12	15	21	14·5×12
2	6, 6, 12, 24, 34	11	6	20	15×14
3	6, 6, 12, 24, 26	11	4	22	11·5×10·5
4	6, 6, 12, 24, 12	12		15·5	9×8·5
5	6, 6, 12, 24, 8	9		13·5	8×8
6	6, 6, 12, 16	8		6	5·5×5

In the smallest three specimens pali have not as yet been properly formed, and the tertiary septa, except in a few systems, have not become connected with the columella. No. 4 has distinct rods arising before five of the secondary septa, and forming part of the columella. No. 5 has three (? four) true pali before tertiary septa, but as also in No. 6, the other spines are less definitely connected with particular septa than in No. 4. Nos. 1, 4, and 5 are conical, with narrow bases of attachment; but No. 1 has secondarily deposited an epitheca, covering over the upper sides of two barnacles that have become attached to the outer side of its corallum. Nos. 2 and 4 have large and spreading bases, while No. 3 is intermediate in this character.

The most important characters of the species appear to be five cycles of almost equally exsert septa, low costae corresponding in number to the same and equal in size, and 12 relatively narrow pali, scarcely higher than the deep fasciculate columella.

The rule in the species, most typical of *Caryophyllia*, appears to be that the number of pali is equal to one quarter of the total number of septa present, whereas in the fully adult specimens of the species under consideration they would seem to be equal to one eighth. This character alone serves to separate it from most other described forms, but it allies it to those of which accounts have been given under the names *Bathycyathus indicus*, Ed. and H. (*Ann. des. Sc. nat.*, 3e ser., pl. IX., fig. 4) and *B. maculatus* (Pourtalés, *Mem. Mus. Comp. Zool.*, vol. IV., p. 34, pl. VI., figs. 5, 6), though it will be obvious that neither of these can be the form now described.*

11. CARYOPHYLLIA EPITHECATA, n. sp. (Pl. I., figs. 3 a-c).

(?) *C. clavus*, var. *epithecata*, Duncan, *Trans. Zoo. Soc.*, VIII., p. 312, pl. XLVIII., figs. 13-16 (1871).

I refer 30 specimens to a new species which I believe to be identical with a form that Duncan deemed to be a variety of *C. clavus*. While I cordially recognise the valuable work that Duncan did in showing the range of variation in this species of coral, I fail to see that the greater number of his varieties really represent *types of growth*—or modes of discontinuous series—to which the term "variety" should properly be restricted. Indeed, all the varieties of this coral seem to me to fall within continuous series with the exception of var. *epithecata*, the

* The genus *Bathycyathus* was rightly absorbed by Duncan into *Caryophyllia*.

meagre description and more particularly the figures of which lead me to doubt whether it belongs to the species at all.

Caryophyllia clavus, according to Duncan and all other authors, has five cycles of septa, whereas var. *epithecata* in the figures, supposed to be typical of it, is represented with a round calicle and only four cycles. It is not a matter of size, since five of Duncan's figures of *C. clavus* have their calicles of the same size or smaller than the type, and yet have pali and septa of the fifth cycle. Furthermore, I have examined a large number of specimens of Duncan's var. *smithi* of 5 to 12 mm. in diameter from English, Norwegian, and Mediterranean seas, and all without exception possess a considerable number of septa of the fifth cycle (quinary septa).

The description of *C. epithecata* would be as follows:—

"Corallum typically conical, often bent to one side and slightly compressed, sometimes attached by its small end, sometimes free owing to its peduncle having been dissolved away or broken. Epitheca present, extending over the outside of the corallum almost up to the edge of the calicle, and filling in the intercostal spaces. Sub-equal costae present, showing through the epitheca to the base of the corallite (if the corallum has not been dissolved away) as low, broad, sub-equal ridges separated by narrow valleys.

"Septa forming four cycles, those of I. and II. sub-equal, slightly broader and more exsert than those of III., which again are broader and more exsert than those of IV. Pali only before the tertiary septa, relatively thick, much-flattened rods, of about 1·5 mm. in breadth. Columella a quarter to a fifth of the diameter of the calicle in breadth, consisting of 2 to 9 twisted rods filling up the axial fossa."

I append a table of the specimens, from which it will be seen that 22 specimens have the typical number of septa, 4 specimens have the fourth cycle incomplete by two or four septa, while 4 others show meristic variation, two having five, one seven, and one eight systems. Eighteen of the specimens were, so far as I could see, free, some showing scars of former adhesion and 12 attached, all except two, by quite narrow peduncles. Some specimens show on their sides transverse ridges of growth, but these are much obscured in many by the deposited epitheca and in certain by both theca and epitheca having been dissolved away, leaving the edges of the septa exposed with the interseptal spaces filled in, apparently by deposited corallum (stereoplasma).

The size of the processes of the columella vary with the size of the axial fossa, but more particularly with their own number; in all cases they nearly fill in the fossa. The summit of the columella likewise varies in depth, in some specimens being

almost level with the top of the theca, and in others up to 3·5 mm. below. In all cases the summits of the pali are about intermediate between the height of the columella and the theca. The septa vary up to 1·5 mm. in exsertness, in all cases those of cycles I .and II. standing up about twice as high as those of III. and IV.; they show the usual ridges found in *Caryophyllia*, radiating out from the theca, passing at places into spines, which are characteristic of the pali.

The species approaches *C. arcuata*, Duncan (*non* Ed. and H.) and *C. antillarum*, Pourtalés, the descriptions of neither of which can, in my opinion, be at all exact.

Table of C. epithecata.

Locality and No.	No. of Septa in Cycles.	No. of Pali.	Rods of Columella.	Height in mm.	Diameter of Calicle in mm.
I. 1	6, 6, 12, 24	12	6	29	14·5 × 13
2	6, 6, 12, 24	12	2	22	12 × 11
3	6, 6, 12, 24	12	9	22	13 × 11·5
II. 4	6, 6, 12, 24	12	3	21	11 × 10
5	6, 6, 12, 24	12	4	21	11·5 × 10·5
6	6, 6, 12, 24	12	4	19	10·5 × 10
7	6, 6, 12, 24	12	6	16·5	10 × 9
8	6, 6, 12, 24	12	6	18	11 × 10
9	6, 6, 12, 20	11	4	12	9 × 8
10	6, 6, 12, 22	12	5	11	8 × 7
III. 11	6, 6, 12, 24	12	4	18	11 × 10
12	6, 6, 12, 24	12	4	26	12 × 10·5
IV. 13	6, 6, 12, 24	12	2	16	8·5 × 8
14	6, 6, 12, 24	12	4	27	11·5 × 10·5
15	6, 6, 12, 24	12	3	18	9 × 8·5
16	6, 6, 12, 24	12	4	17	8 × 8·5
17	6, 6, 12, 22	12	4	13·5	8 × 8·5
18	6, 6, 12, 24	12	3	17	8·5 × 7·5
19	6, 6, 12, 24	12	5	17	10·5 × 9
20	6, 6, 12, 24	12	3	15	8·5 × 8
21	6, 6, 12, 22	11	5	16	9·5 × 9
22	6, 6, 12, 24	12	5	17	10 × 9
23	6, 6, 12, 24	12	3	25	9 × ?
V. 24	6, 6, 12, 24	12	3	23	13·5 × 12
25	7, 7, 14, 28	14	3	24	13 × 11·5
VI. 26	6, 6, 12, 24	12	16	13	9·5 × 8·5
VII. 27	5, 5, 10, 20	10	4	14·5	9 × 8·5
28	5, 5, 10, 20	10	3	19	10 × 9
VIII. 29	6, 6, 12, 24	12	4	25	12 × 10
30	8, 8, 16, 30	16	6	17	16 × 13

Localities.—I., 124 fathoms, lat. 34′ 26″ S., long. 25° 42′ 45″ E., 3 specimens, rock. II., 85-90 fathoms, Cape St. Blaize, N. by E. ¼ E. 65 miles, 7 specimens, rough. III., 190 fathoms, Lion's Head, S. 72° E., 47 miles, 2 specimens, green sand and black specks. IV., 230 fathoms, Vasco da Gama, N. 71° E., 18½ miles, 11 specimens, stones. V., 210 fathoms, Cape Point

Lighthouse, E., 26½ miles, 2 specimens, sand and coral. VI., 80-100 fathoms, Cape Vidal, N.N.E. ¼ N., 9½ miles, 1 specimen, rock. VII., 185-200 fathoms, Cape Natal, W. by N. ¾ N., 11 miles, 2 specimens, sand and mud. VIII., 310 fathoms, Buffalo River, N., 15 miles, 2 specimens, coral and mud.

12. CARYOPHYLLIA EPHYALA (Alcock).

C. ephyala, Alcock, *Investigator, Deep-sea Madreporaria*, p. 13, pl. I., figs. 4, 4a (1898).

C. scyllaeomorpha, Alcock, *idem.*, pl. I., figs 3, 3a.

C. scobinosa, Alcock, *Siboga, Deep-sea Madreporaria*, p. 8, pl. I., figs. 2, 2a (1902).

I have referred five specimens to this species though they are to some extent divergent from it, approaching both to *C. scobinosa* and also to *C. scyllaeomorpha*. Their variation may best be seen in the accompanying table :—

No.	Locality.	Septa in Cycles.	Pali.	Processes of Columella.	Height.	Diameter of Calicle.
1	I.	11, 11, 22	11	4	12	9×8
2	I.	6, 6, 12, 22	12	5	11	8×7
3	I.	6, 6, 12	6	2	4	3·5×3·5
4	II.	6, 6, 12, 24	12	6	13	9·5×8·5
5	III.	8, 8, 16, 30	16	6	17	16×13

Nos. 2, 4, and 1—the latter an obvious variation from hexa-symmetry—approach closely to *C. ephyala* in shape, but are rather more constricted at the base than the type of that species. All further agree with that species in the general characters of costae, septa, pali, and columella, but all parts in the Cape specimens are more delicate and thinner.

Considering the whole question, if Duncan's account of variation in *C. clavus* (*Trans. Zoo. Soc.*, VIII., p. 310) and my account in *Flabellum rubrum* (*Marine Investigations in South Africa*, vol. II., p. 117 *et seq.*) be correct, I cannot consider that *C. scyllaeomorpha* and *C. scobinosa* are beyond the limits of variation of *C. ephyala*. The same remark applies to several other species of the same and other authors, but my specimens do not approach any of them closely enough for me to deal with them here.

Lastly, No. 3 is interesting, as showing the mode of growth of the species. Six pali are present before the secondary septa, while in the larger forms pali are only found before the tertiary septa. This change must be brought about by the first six pali fusing with their septa, and a fresh series forming opposite to the tertiary septa,* a modification of the same condition apparently producing the variation found in No. 1.

No. 1 approaches *C. scobinosa* and *scyllaeomorpha* in shape and in the character of its costae, which are overlaid and filled in by epitheca. They are distinct near the margin of the calicle, primaries more prominent, but below in some parts are not visible, as in *scyllaeomorpha*, and in others present characters described for *scobinosa*. In one system the quaternary septa may be more exsert than the tertiary as in *scobinosa*, but in another the reverse is the case. Granular striae on the septal sides, radiating from the theca and running perhaps into lines of spines, or small ridges, are common, so far as I have seen, to the septa of all *Caryophyllia*, and represent the centres of growth or deposition of the septa. The axial fossa in all my specimens is relatively shallow, but varies in every individual specimen.

The arrangement of septa in *Caryophyllia* is essentially hexaradiate. I have not enough specimens to see definitely whether the species has typically four or five cycles of septa. If, as I believe, four cycles is the adult number, No. 5 is a true variation, but if five cycles, *possibly* only a stage of growth; the same remark applies also to *scyllaeomorpha*.

Localities.—I., 85-90 fathoms, Cape St. Blaize, N. by E. $\frac{1}{4}$ N., 65 miles, rock. II., 80-100 fathoms, Cape Vidal, N.N.E. $\frac{1}{4}$ N., $9\frac{1}{2}$ miles, rock. III., 310 fathoms, Buffalo River, N., 15 miles, coral and mud.

Genus CERATOTROCHUS.

13. CERATOTROCHUS JOHNSONI (Duncan. Pl. I., figs. 5 a-c, and Pl. II., fig. M.)

C. johnsoni, Duncan, *Proc. Zool. Soc.*, 1882, p. 217, pl. VIII., figs. 5-8.

Locality.—I., six specimens, from 54 fathoms, Cape Natal, W. by N., $6\frac{1}{2}$ miles, fine sand and algae. II., one specimen, from 45 fathoms, lat. 32° 53′ S., long. 28° 18′ E., coralline stuff.

Seven specimens in the collection agree with Duncan's description in the absence of pali and any determinate epitheca, in

* The same method of growth is indicated in Duncan's account of *C. cyathus* (*Proc. Zoo. Soc.*, 1882, p. 214).

the character of the costae, in having wide interseptal loculi, in the character and ornamentation of the septa, and in the nature of the columella.

The specimens, however, are larger than the type, *i.e.*, have a wider calicle; the six from No. I. above, varying from 12 × 10·5 mm. to 9 × 8 mm., and averaging 10 × 9·2 mm., while the specimen from No. II. is obviously young. They are very slightly curved, and their growth appears to have been vigorous. All are relatively thin and delicate compared to the types. In the six apparently adult specimens, the full number of septa of four cycles are present, and in one specimen there are two septa of a fifth cycle. The septa of cycles I. and II. are subequal, varying up to 2 mm. in exsertness, rounded above, but ending almost perpendicularly against the axial fossa; deep down in the calicle—scarcely visible from above—they meet the columella. The tertiary septa are a little larger than the quaternary, but much more delicate, and only about half as broad and exsert as the first twelve. A little below the top of the columella they extend in almost horizontally to join it, commonly rising a little, this part generally ending above in a wavy edge. The columella consists of a series of slightly twisted, thin, anastomosing, plate-like lamellae, the whole in the largest specimens forming about a quarter of the diameter of the calicle, but in the smaller decreasing down to a sixth or seventh.

The series of arched thickenings on the septal sides, parallel to their upper inner edges, described by Duncan, are most noticeable and peculiar. I do not find any record of their occurrence in any other member of the Turbinolidae, though I have myself found them in a fragment of a coral apparently belonging to the genus *Duncania* from the Cape. Superimposed on them transversely, and continued into the valleys between, are the minute ridges, which, corresponding to the so-called "lines of growth," seem to be a constant feature in the family.

None of the specimens show any definite external growth lines, though one had evidently been partially killed at one edge of its calicle, but grew out again, the polyp subsequently enclosing the whole corallum as before. None likewise show any definite marks of attachment, but it is quite evident that all really were derived from fixed stocks. One specimen ends basally in three points. One of these appears properly to be the point, the other two having arisen in the regeneration which succeeded some injury.

The specimen from No. II. is a young form, with only 14 of the quaternary septa developed, though the rest are complete. The characteristic appearance of the axial fossa, so largely brought about by the continuations of the tertiary septa into the axial fossa, is not as yet developed, though clearly indicated.

Genus DUNCANIA, Pourtalés.*

There is only a single perfect specimen of this genus in the collection. It was broken off its narrow attached base by the trawl, but before this its cavity near the base had become quite solid, filled in by corallum.

In the British Museum Collection, I found a single specimen of *D. barbadensis*, Pourtalés, which evidently had been sent by Pourtalés himself to Duncan, or Moseley. It was not in good condition, but showed signs of the regular hexameral arrangement. Neither theca nor epitheca were distinguishable, *distinct* from one another. There was a simple wall to the calicle, outside which the tissues did not extend. The tissue, which forms a theca, arises by an uprising of that depositing the basal plate, while that building up an epitheca is the side wall of the polyp. The wall therefore of the calicle of *Duncania* is an epitheca. The interseptal chambers or the interior of a calicle may be filled in by solid corallum (stereoplasma), deposited by the tissues, but any deposition without the formation of tabulae or dissepiments is not a character of any importance in the Turbinolidae, nor, so far as I am at present aware, in Madreporaria.

One of the characters then on which Pourtalés founded the genus *Duncania*, and both the characters which Duncan gave for his alliance Haplophylloida, I can only regard as quite worthless in the genus under consideration. Whether it be really distinct from certain other genera in the Turbinoloida, with which it should be placed, I cannot at present express an opinion. It is almost certainly identical with *Haplophyllia*, which was also described by Pourtalés. The only difference lies in the columella, which in the latter genus is described as being "styliform, strong, very thick at the base," while the *Duncania* type has a "multipillared columella," and the present specimen is intermediate.

14. DUNCANIA CAPENSIS, n. sp. (Pl. I., figs. 6 a-c.)

Corallum cylindrical, with widely open, rounded calicle. Wall a thick epitheca, with a tendency to slightly constrict at the mouth, worn away below showing fine longitudinal lines, depressions opposite the attached edges of the septa.

Septa 48, in four cycles, I. to III. meeting in the centre of the calicle. Primaries and secondaries sub-equal, with their upper edges rising 1 to 2 mm. above the upper edge of the epitheca, rounded above, but with smooth edges, save for a single fine paliform tooth to each where it runs in to join the columella,

* *Zool. Results of Hasslar Exped.*, 1874, p. 44.

from surface view scarcely distinguishable from the pillars of the same. Tertiaries not so exsert and narrower, generally with three paliform lobes to each, decreasing in breadth but increasing in height and sharpness towards the centre of the calicle. Quaternaries very narrow, but quite distinct.

Columella shallow, three or four fine-pointed spines, quite similar to and possibly formed by the inner pali of the larger septa.

Height, 17 mm.; diameter of calicle, 15·5 mm.; of broken base, 3·5 mm.

Locality.—230 fathoms, Vasco da Gama, N. 71° E., 18½ miles, stones.

I have described the single specimen somewhat minutely, because I cannot be sure what are really its specific characters. It is just possible that it may be the same as *D. barbadensis*, Pourtalés, if one supposes that the specimens, on which that species was founded, were of slow growth, and so came from an unfavourable environment, while the Cape specimen came from a peculiarly suitable one.

Genus CYATHOCERAS Moseley.

The genus differs only from the last in the fact that the columella is formed by twisted processes, not straight rods, and that there are no paliform lobes.

15. CYATHOCERAS CORNU (Moseley).

C. cornu, Moseley, *Challenger Report*, p. 156, pl. IV., figs. 7, 7a (1881).

Three specimens (1-3), 310 fathoms, Buffalo River, N., 15 miles, coral and mud; and one (4), 330 fathoms, Vasco da Gama, N. 71° E., 12½ miles, stones.

	Septa.	Processes Columella.	Height in mm.	Diameter in mm.	Shape.
1	6+6+12+4	3	11	5	Bent conical attached to a piece of.
2	6+6+12+16	4	19	7	Bent conical, two lines of regrowth.
3	6+6+12+24	4	15·5	3·5	Straight conical.
4	6+6+12+24	3	14·5	10	Conical broken base, mouth a little overgrown.

The specimens are smaller, but otherwise closely correspond in every particular with the types in the British Museum. All have the inner edges of the septa against the columella sinuous as described, but there is rather more marked difference in size between the primary and secondary septa, which are subequal, and the tertiary. One specimen shows growth lines clearly. Nos. II. and IV. have an appearance as if formerly broken; it is, however, due to the epitheca overgrowing the edge of the calicle and the subsequent regrowth of the polyps.

III. THE ANATOMY OF THE TURBINOLIDAE.

1. GENERAL OBSERVATIONS.

I have below appended some remarks on the anatomy of such of the Turbinolidae as I have been able to examine. The results, so far as the classificatory characters of the different genera are concerned, may be seen by a glance at the accompanying table, in which I have included *Flabellum rubrum* and *pavoninum*, of which I previously gave an account, *Paracyathus parvulus*, a reef species with commensal algae from my own Maldive collection, and *Caryophyllia smithi* from Norway.

The investigation assists but little in any attempt to find out the relationship of the different genera to one another. I have, however, employed the examination of the polyps wherever possible to check the species, which, in the first place, I determined by their coralla alone. Having already seen that the polyp anatomy did not differ in *Flabellum rubrum*, in spite of its considerable variation in growth form, I examined polyps of the most widely-divergent growths, of *Heterocyathus aequicostatus* (10), *Paracyathus parvulus* (4), *Trochocyathus rawsonii* (4), and *Caryophyllia epithecata* (2). Differences due to age, the forms of the coralla, states of contraction of the polyps, conditions of feeding, etc., were common, but I found in no case any in the gross anatomies of the different specimens of the same species. A regular difference lay in the number of the mesenteries, which sometimes increase with age, entailing a corresponding increase in the number of the septa. The mesenteries reaching the stomodoeum and possibly the tentacles acquire their adult number at a very early age, and remain constant. Throughout the collection either half or all the septa were entocoelic, and, although it may have been due only to age, it was a rule that generative organs were present in the pairs of mesenteries on either sides of all the septa in each system, save those of the highest cycle, and in them alone.

When a polyp extends down the outside of its cup, the mesenteries and inter-mesenterial spaces continue into its edge-zone over the top of the corallum, dividing it up into a series of spaces lying over the costae. The tentacles first appear over the top edges of the primary septa, and continue to increase with the growth of the other septa, until they have attained their adult number. Thin-threaded nematocysts in batteries cover all except in *Paracyathus parvulus*, which has the whole epithelium of the tentacles evenly set with nematocysts.

The **stomodoeum** in all forms shows ridges over the attachments of the mesenteries, the filaments of which merge into them, and evidently belong likewise to the ectoderm. No definite groove is present, the whole epithelium being usually ciliated. The lower ends of the filaments commonly form coiled masses, the **acontia**; that they are ever capable of being ripped off the mesenteries and shot out is doubtful, but loops can and do frequently project into the stomodoeum. The mesenterial nematocysts, when present, are always of the thick-threaded type found in *Coenopsammia* (*Willey's Zoo. Results*, p. 357 *et seq.*). They perhaps kill or paralyse the prey when it is taken into the stomodoeum, but their size and enormous number suggest that they must have, or must have had, some other function.

The **body layers** in all parts of the polyps have so nearly the same structure as in *Flabellum rubrum* that their description in that form applies to all. They only vary in their minute anatomy in the presence or absence and distribution of the gland cells and nematocysts. Small thread-cells of the thin and thick-threaded tentacular and filamentar types are found anywhere in the ectoderms of the edge-zone, tentacles, peristome, stomodoeum, and filaments, though the large ones of each kind are restricted to their proper positions. But nematocysts also occur in the endoderm towards the tops of the septa. In *Caryophyllia epithecata* they are not so degenerate as in other forms, and clearly belong to the usual filamentar type. They are evidently not now functional in any way, though their arrangement and regularity is such that one is led to consider that they must have been so at one time. In this connection one may recall their abundance in the young post-larval stages of *Flabellum rubrum*. Indeed, it seems not unlikely that the method of development described in that form may be in reality the primitive one; the stomodoeum then would be of quite secondary formation (p. 151, *italics*).

Of course, I am well aware that the view set forth above is absolutely opposed to all preconceived ideas of the origin of the stomodoeum and the phylogeny of the Actiniaria. It, however, serves to explain their anatomy—endodermal nematocysts, ectodermal mesenterial filaments, massed filaments and true

acontia, filamentar nematocysts, ridged stomodoea, etc.—better than the view derived from the ontogeny of the few types that have been described. In effect, it seems to me that this is an excellent instance where natural selection may have acted on the developing polyp, in which the whole of the cavity of the body was open to the water, the nematocysts serving for its protection. With the formation of the stomodoeum in the adult the main function of the endodermal and filamentar nematocysts would be gone. It would then obviously be of no small advantage for the formation of the stomodoeum to be hurried on as early as possible, so that all trace of the original condition would only remain in the degenerate endodermal nematocysts and in the filamentar ones, which I cannot consider to have at the present time any adequate function to perform.

2. TROCHOCYATHUS RAWSONII.

The polyp extends down outside its cup for about a third of its height. It has 24 tentacles, the bases of which are confluent, and each crossed by a pair of mesenteries. The longitudinal muscles extend into them, and in contraction of the polyp completely introvert them from the base.

There are 48 **mesenteries,** septa IV. being exocoelic; 24 of these reach the stomodoeum, which is ridged over their attachments precisely as in *Flabellum.* Their filaments are of the usual form, but have no massed loops, corresponding to the acontia; their lower ends though are free, and may be capable of some degree of extension. Nematocysts much larger than in *Coenopsammia,* and with about 16 coils are present, particularly in the lower halves of the filaments, which are often almost choked with them.

The **endoderm** forms pads under the mesenterial filaments, but is not especially thickened over the generative organs. Scattered throughout it everywhere, but more numerous over the muscular bands, are a series of deeply staining bodies. A few of these, round in shape, deeply and evenly stained, are evidently fat globules. Others, more granular in appearance, and less regular in shape, appear to be simply food patches in the plasmodium, which forms the endoderm. Nematocysts are present in patches on the septal sides; they are of about the same size as the filamentar nematocysts, and almost in the same condition as in *Flabellum,* but with the thread less distinct. Testes occur in all the mesenteries. They are only one follicle thick, but in the larger mesenteries form great masses, deep down in the calicle, almost completely filling up the interseptal spaces.

In one of the specimens examined, two pelagic fish ova were found, one tightly clasped by the mesenterial filaments, the other in the lower half of the stomodoeum.

3. HETEROCYATHUS AEQUICOSTATUS.

The polyp completely covers the whole corallum, only stopping short around the aperture of the *Aspidosiphon* chamber. Canals from the intermesenterial chambers extend downwards over the costae, only becoming obliterated towards the centre of the base. The tentacles number 24, and are connected at their base, each with a pair of mesenteries, the muscles of which serve in contraction to introvert them. In the ectoderm mucous cells are very common, and there is also a deposit of brown pigment, showing that the polyps were probably coloured in the living state.

The **mesenteries** number 48, of which 12 reach the stomodoeum. Their lines of attachment are marked by ridges, which are similar to the filaments in structure, merging into them below. The latter end in coiled masses, the acontia, which, however, scarcely look as if they were capable of being extruded. Nematocysts of the usual type occur sparingly, except in the massed loops, where they are very numerous.

The **endoderm** forms large, rather granular pads at the base of the filaments, which in the contracted specimens almost sink into them. The gastro-vascular cavity of one specimen was crowded with small pieces of green weed, many pieces of which could be seen in these pads, apparently ingested whole. There was no trace of any endodermal nematocysts. Generative organs occur in all the mesenteries. In the larger ones, instead of forming a single layer of sperm masses or ova, they may be three or more follicles or ova thick between the two endoderm layers of the mesenteries. There are also in each ovary several ova from the free edge towards the attached base of the mesentery, not a single line, as is common in other genera. The specimens of dredging I. of type 1 (6 examined) were all female, and of type 2 (4 examined) all male. The young are either male or female, and specimens from other dredgings, independent of their type, are male or female.

4. CARYOPHYLLIA EPITHECATA.

The polyp only extends down the outside of the corallum for 1-3 mm. It has four cycles of tentacles over the septa, decreasing in size from I. to IV. Over septa IV. they are very

small, some mere little raised areas of the wall, packed with batteries of nematocysts of the usual type. When the polyp contracts, none of the tentacles seem to be capable of being introverted, though I., II., and III. are a little pushed in round their bases. Their protection is rather afforded by the folding inwards of the edge of the disc of the polyp, brought about by the contraction of a sphincter muscle. The anatomy, too, shows that there can scarcely be any introversion. Indeed, it would seem impossible, as the structureless lamella both of the tentacles and disc is remarkably thick and firm. The mesenteries, too, are attached between the tentacles, and do not seem to send up muscular fibres into them.

There are 48 **mesenteries**, septa IV. being exocoelic.* Twelve are attached to the base of the stomodoeum, into the wall of which their filaments pass, continuing up as ridges for about a half of its length; 12 also extend down from its mouth for about a third of its depth, but have no corresponding thickenings. Filaments are found on all the mesenteries, the edges of which are looped, but with no acontial portions. Nematocysts only occur sparingly, save in the lower halves of the filaments. In none is the black thread, which commonly occurs, distinct, and few have any eversible basal portion at all conspicuous. Their appearance may be due to the coral having recently been feeding, but is rather, I think, caused by a real degeneracy in them as stinging cells.

The **endoderm** is thin, but presents a smooth, even surface, as the inequalities of the corallum are filled in by thickenings in the structureless lamella. Food masses are found throughout it, but are more conspicuous in the pads at the bases of the filaments. The sides of the septa are in places packed with nematocysts, lying parallel to their surfaces, and pointing towards the mouth of the calicle. They are similar to those of the filaments, but have no trace of any eversible bases and are evidently degenerate. The testes are of the usual type, their follicles presenting all stages of development to be flaggellated spermatoza.

The corallum is much bored into, especially below the pali and columella, by the filaments of *Achyla*.

Note on CARYOPHYLLIA SMITHI.—I am indebted to Mr. R. C. Punnett for some well-preserved specimens of this form from 80-100 fathoms, off Bergen, Norway. As compared with *C. epithecata* the polyp extends much further down the outside of the corallum. The tentacles number 24, alternately larger and smaller, but where septa V. are present additional ones occur over IV. The structureless lamella is half to a

* In one specimen there were 50 mesenteries, only 23 septa of IV. being exocoelic.

quarter as thick as in the last species. There is no sphincter muscle and the tentacles are introversible from the bone.

There are such a number of mesenteries (62 in one specimen) that the highest septa in each system are exocoelic. There are 24 mesenteries reaching the stomodoeum, which has a similar number of ridges over their attachments, passing below into their filaments. The nematocysts are arranged in the latter as in the last species, but are quite well-developed.

The **endoderm** is similar to the last species. No definite nematocysts exist, but there are a number of granular, oval masses in patches on the septa sides, which appear to represent them in a still further reduced state. Boring algae are not present.

5. DUNCANIA CAPENSIS.

The polyp is seated on the cup, and does not extend in any way outside its wall. When expanded, it evidently stands up for some considerable distance above its wall, but in contraction this part is by means of a few sphincter muscular fibres drawn over the peristome and tentacles. These latter number 12, the bases of each of which are crossed by a pair of mesenteries. Underneath their epithelium the structureless lamella is relatively thick and rather vacuolated, and in correspondence the tentacles only appear to be introversible at their bases.

The single specimen examined has 68 mesenteries, 12 pairs on either side of septa I. and II., equal in size and alone joined to the stomodoeum, which is thickened over their attachments for the whole of its length, 12 pairs on either side of septa III. and 10 pairs enclosing the 10 septa of cycle IV.; the septa hence are all entocoelic. Filaments occur on all except one rather rudimentary pair of cycle IV. The lower ends of all are much convoluted, forming acontia, and crowded with nematocysts of the usual type.

The **endoderm** and **testès** are the same as in other species, but the former has no nematocysts. The testes are formed by a single thickness of follicles, and are situated behind and above the acontia. They occur in the mesenteries of cycles I., II. and III., but only on the largest of the latter. This distribution may be due to age—the coral was only 11·5 mm. across the calicle—but some of the mesenteries of cycle IV. are larger than those of III., which have testes, and it seems not improbable that the mesenteries of cycle IV. never have any generative organs.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. *Sphenotrochus gilchristi.*

(*a*) View of calicle × 3.

(*b*) Edge of the calicle, showing the exsert ends of the Septa.

(*c*) The ridges on the sides of the corallum.

(*d*) Side view of corallum in (*a*) × 1½.

(*e*—*g*) Side views of other coralla × 1.

Fig. 2. *Trochocyathus rawsonii.*

(*a*) View of calicle × 2.

(*b*) Side view of corallum of (*a*) × 1.

Fig. 3. *Caryophyllia epithecata.*

(*a*) View of calicle × 2.

(*b*) Side view of corallum of (*a*) × 1.

(*c* and *d*) Side views of other coralla × 1.

Fig. 4. *Caryophyllia capensis.*

(*a*) View of calicle × 2½.

(*b*) Side view of corallum of (*a*) × 1

(*c*) View of another calicle × 2.

(*d*) Side view of corallum of (*c*) × 1.

Fig. 5. *Ceratotrochus johnsoni.*

(*a*) View of calicle × 2.

(*b*) Side view of corallum of (*a*) × 1.

(*c*) Side view of another corallum × 1.

Fig. 6. *Duncania capensis.*

(*a*) View of calicle × 2.

(*b*) Side view of corallum of (*a*) × 1.

(*c*) Side view of upper edges of three septa of cycles I., III. and IV.

Plate II.

Figs. A—E. Diagrams to show the development of the septa, pali and columella in *Trochocyathus rawsonii.* The coralla are represented all of the same size, whereas they are very different, the figures showing the changes with increase in size. The rods of the columella are hollow throughout, the pali of cycles I. and II. shaded, and of III. black. The cycles of septa are marked with Arabic numerals.

Figs. F—K. Side views of various specimens of *Trochocyathus rawsonii* (XI.) to show the variation in growth and appearance of the coralla. The lines of growth show well in K.

Fig. L—Diagram of the calicle of *Trochocyathus cincticulatus.*

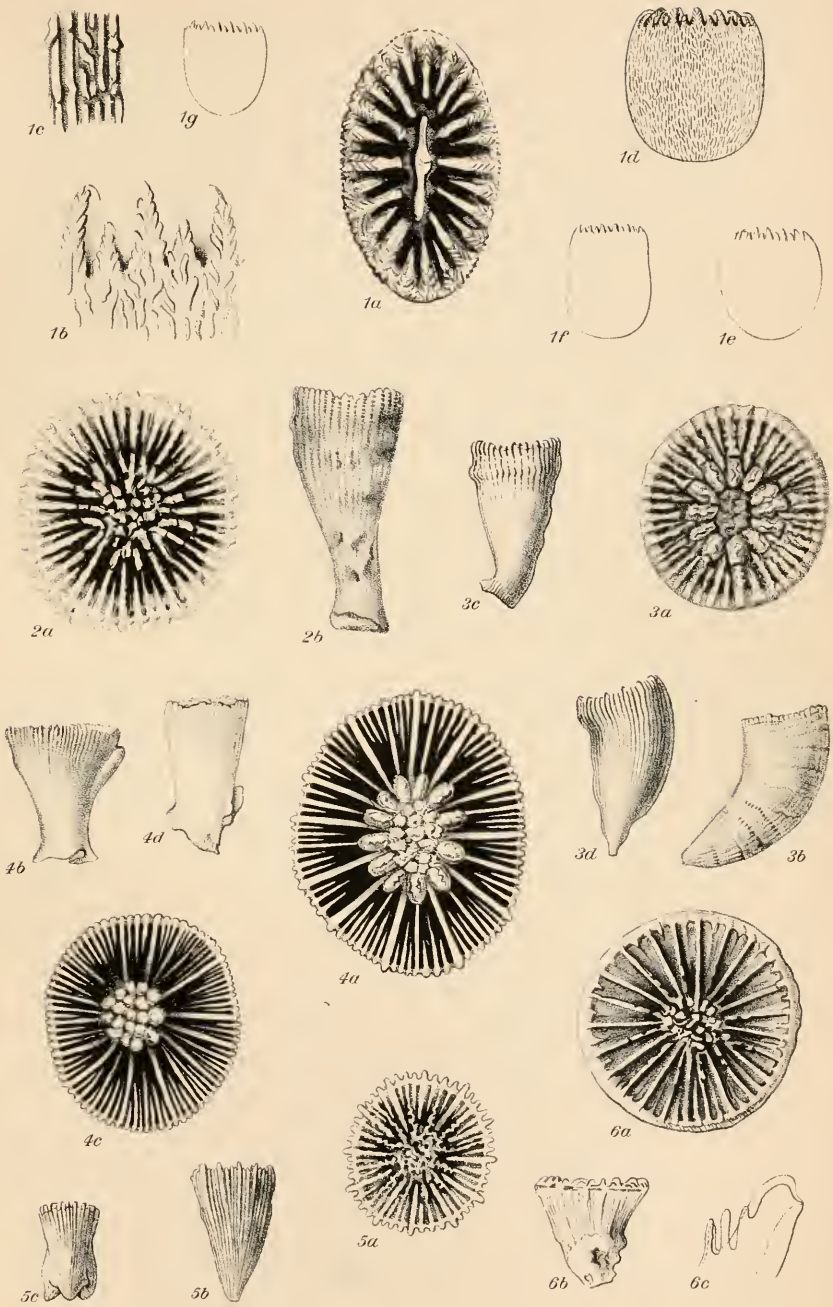
Fig. M—Diagram of the calicle of *Ceratrochus johnsoni.*

Plate III.

Coralla of *Heterocyathus aequicostatus.*

1—8. Type 1 from dredging I. × 1½.
9—11. Type 1 from dredging I. × 1.
12—19. Type 2 from dredging I. × 1½.
20—21. Type 2 from dredging I. × 1.
22—29. Young from dredging I. × 1¾.
30—32. Young from dredging I. × 1.
33—Specimen from dredging VII. × 1½.
34—The same × 1.
35—38. Specimen from dredging I. showing fission or possibly budding.
39—Specimen from dredging V. × 1½.
40—43. Other specimens from dredging V. seated on various shells × 1.

(Published 20th Sept., 1904.)



STANLEY GARDINER - TURBINOLIDAE.

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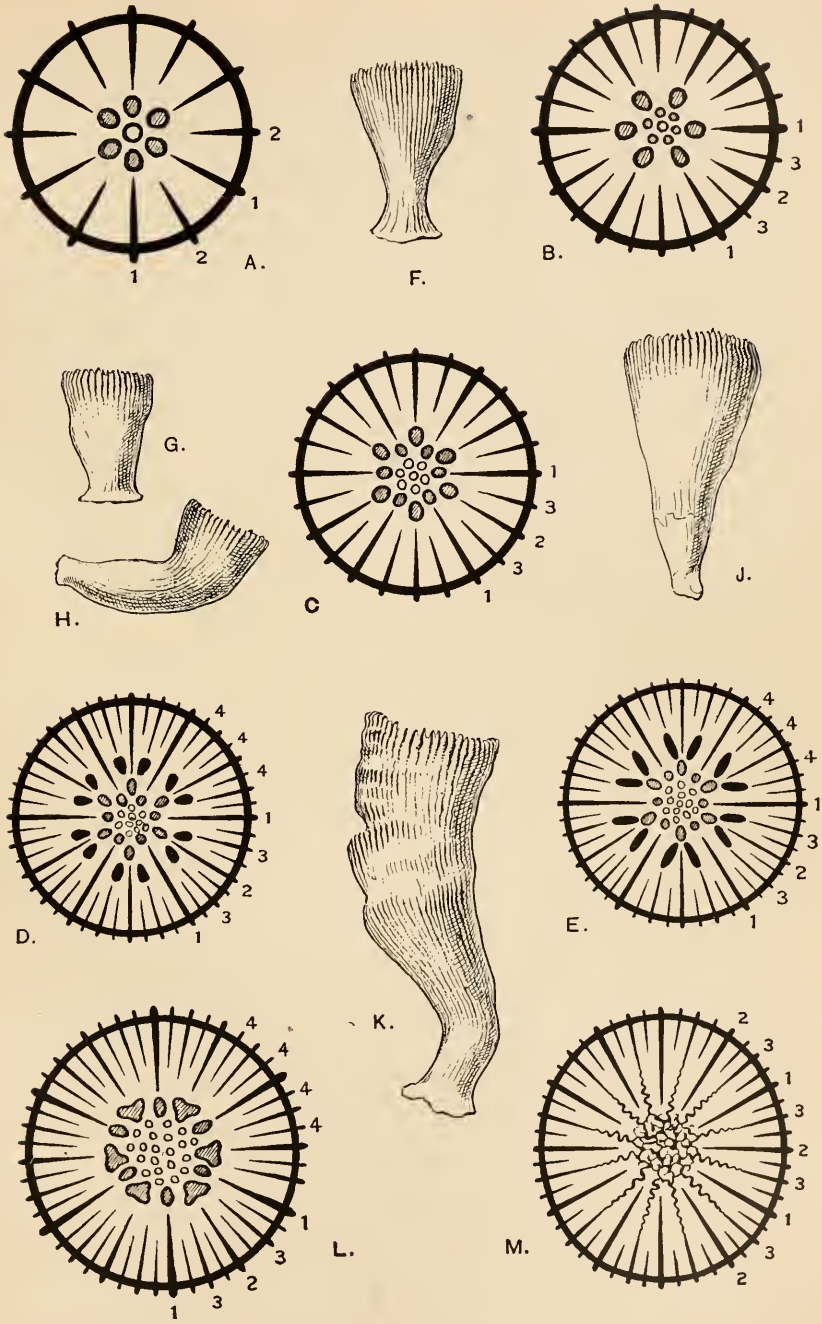

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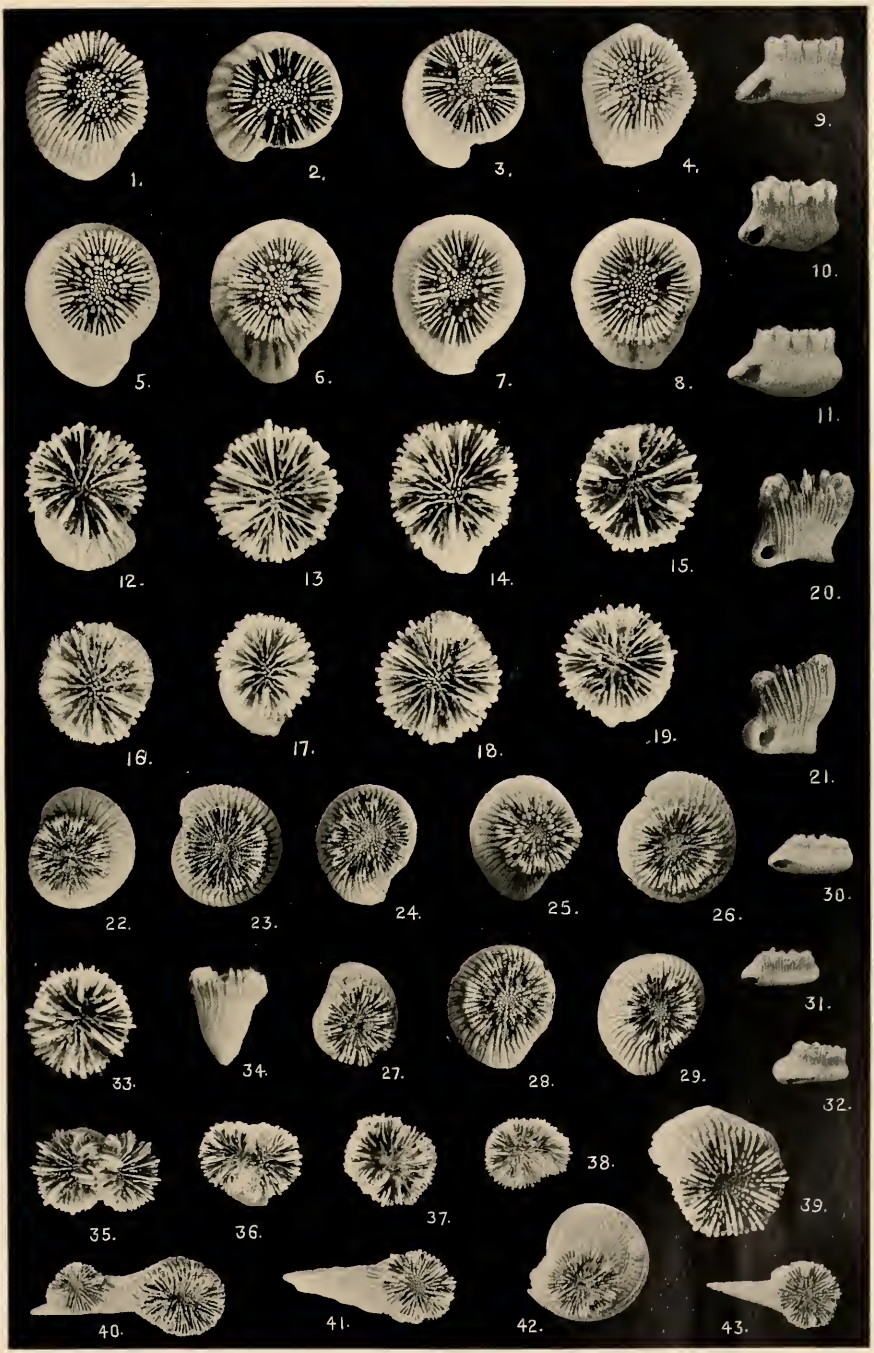

STANLEY GARDINER—TURBINOLIDAE.

THE DEVELOPMENT

OF

SOUTH AFRICAN FISHES.

PART II.

BY

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The following observations on the development of South African fishes are in continuation of those published at an earlier date (*Marine Investigations in South Africa*, Vol. II., page 181).

The material was procured by the Government steamer, chiefly while engaged in deep waters off Cape Point, and in occasional tow nettings in False Bay. Whenever possible the eggs were brought in alive, and their development observed. Many eggs and larvae were simply preserved in formalin, and an attempt was made to sort these out into what might be considered to belong to different species. In most cases, however, this turned out to be unsatisfactory, and to avoid confusion the observations made are held in reserve until living specimens can be procured. A few well-characterised eggs, however, are described from preserved specimens.

In Part I. of these observations the egg of a fish named provisionally "Species I." was described, along with the larva hatched from it. It is one of two kinds of eggs that were found attached to shells and stones. This now appears to be the egg of a species of fish known to fishermen as "Klip-zuiger," or "Sucker-fish," a name applied to fish having a well-developed sucker, by means of which they can adhere firmly to rocks, etc. They are small and of no commercial value, so that whatever injury may be done to the egg by nets or trawls is not likely to have any direct effect on the fishing industry. This identification was made possible by the finding of several young fish in

different stages of development in a tow-net attached to the beam trawl in about 20 fathoms in False Bay, off the Roman Rock, 13th October, 1898.

The smallest of these closely resembled the larvae of Species I., and the largest showed the widely separated ventrals with adhesive apparatus between them and the short dorsal fin situated on the tail, characteristic of the family Gobiesocidae. The others represented intermediate stages.

The only member of this family recorded from the Cape is *Chorisochismus dentex*, but as the posterior half of the ventral disc in these young forms has a free margin, they cannot be regarded as belonging to this fish, and they are not sufficiently far advanced to allow of more than a reference to the family with certainty. They have a gill cover free from the isthmus, and therefore do not belong to a species (apparently new) of *Lepadogaster* recently found in False Bay. In view of the characteristic oval eggs of this last-named genus,* a number of eggs were re-examined. In Part I. they were described as about one millimetre in diameter. A number of measurements show that none of them are perfectly circular, though some are very nearly so, one being 1·06 × ·98 mm., while others varied from about this to 1·37 × ·97. In most of these eggs there was also one oil globule from ·17 to ·3 mm., and the space between the eggs was less than in the case of those at first examined. In the fresh egg there was no evidence of a filamentous fringe round the basal part of the egg capsule, though some preserved in formalin showed radial striae on an irregular border.

The identification of the other demersal egg found (Species II.) has not yet been possible, but several specimens were again procured in dredging on rough ground in False Bay in the month of November. That they belong to a fish of small dimensions seems probable, as they have been on more than one occasion found inside an empty barnacle shell, the opening of which was small. Plate V, fig. 34, represents such a shell, (natural size) with one side cut away to show the blue eggs attached to its inner surface. Fig. 35 represents one of the eggs enlarged to show the numerous oil globules which occur towards one side of the egg.

In the following account, the various species dealt with are arranged according to the number of the oil globules and diameter of the eggs, as this artificial arrangement has proved very convenient. For this reason also a key (p. 150) to the eggs and larvae similar to that given in Part I., has been drawn up, including not only the species here dealt with, but those already mentioned in Part I. The items taken from the first table are printed in italics for convenient reference.

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* See Holt, Trans. R. Dublin Soc., S. II., IV., 1891.

The following species are dealt with here :—

(a) Species with one oil globule.

(b) Species with several oil globules.

(c) Species with many oil globules.

(d) Species with no oil globules.

(a) Species with One Oil Globule.

SPECIES XI.

Arnoglossus capensis, Blgr.

A single egg was procured by tow-net in Buffel's Bay, on the 14th November, 1903. It measured ·79 mm. in diameter, and had a single oil globule ·11 mm. in diameter. The embryo was fairly advanced, being about half the circumference of the egg. There was then no colouring matter on egg or embryo, but on the following day, when the embryo was about three-quarters the circumference of the egg, a faint reddish tinge could be seen, and this, when examined with a higher power, proved to be a number of small pigment cells scattered over the body from head to tail.

Hatching took place on the following day, and the larva showed several distinctive features (*vide* Plate V, fig. 36). The colouring matter, a bright brick red, was arranged in the following manner: Patches on snout, crown, orbit, otocyst, middle of the margin of dorsal fin, along the superior margin of body to near the tail, in the middle of the body, yolk (most marked behind oil globule), between yolk and rectum, and on inferior margin of the body. The most distinct were the patches above and below the body and extending on to dorsal and ventral fins. These were situated between the yolk and the extremity of the tail, but nearer the former.

Other characteristic features of the larva were the tuberculate appearance of the dorsal and ventral fins and their margins. Slight markings, apparently of the same nature, appeared on the posterior region of the yolk, the substance of which was homogeneous. The oil globule, which was situated posteriorly, had a purplish tinge on its periphery. The rectum was anterior. The notochord was mostly unicolumnar.

The relatively small size of the egg and the characteristics of the larva agree, on the whole, so well with the description and figure of *Arnoglossus** that I have little hesitation in provisionally identifying the parent as *Arnoglossus capensis*, Blgr., a flat fish recently described from False Bay.†

On 24th November, 1903, an egg was procured in False Bay ·7 mm. in diameter and having seven small oil globules in a group and about six branching cells on the yolk near embryo. On the 27th this produced a larva apparently identical with the above. The seven oil globules had fused into one, ·11 mm. in diameter. The larva was 2·8 mm. in length, had a few black spots on body and some black branching cells on yolk (not observed in the first specimen). The oil globule had a yellowish tinge, and the general colouring of the body and fins was the same as in the first specimen, with the same general arrangement. The fins were tuberculate in the same way.

SPECIES XII.

On several occasions fish eggs were procured in False Bay in the month of November, having a diameter of ·89 mm. with an oil globule of ·15 mm. This agrees so closely with the eggs of *Chrysophrys globiceps* (*vide Marine Investigations in South*

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* See Holt : Recherches sur la Reproduction des Poissons osseaux, Ann. Mus. d'Hist. Nat. de Marseille Zoologie, Tome V., 1899.

† The Flat Fishes of Cape Colony, by G. A. Boulenger, F.R.S., "Marine Investigations in South Africa," Vol. I.

Africa, Vol. II, p. 187) that they were at first supposed to belong to this fish. The larvae also were very similar in form, but were invariably devoid of all colouring matter. As the eggs were procured in abundance on several occasions, and in no case did the larvae show any trace of pigment, it seems advisable for the present to regard it as belonging to a different species.

Pagrus laniarius, C. and V. (Panga)

Although this fish occurs in abundance in the trawl, it is somewhat remarkable that only two ripe females and no ripe males have been as yet found among the many hundreds examined. These two specimens were procured on the 9th and 16th March, 1903, about 7 miles off Cape Infanta. The eggs (in formalin) measured ·93 to 1·02 mm. in diameter, and the old globule ·19 mm.

A number of ripe eggs of this fish were procured (6th June, 1904) by one of the Kalk Bay fishermen, who now show considerable interest in these investigations. They were larger than the above, being from 1·06 to 1·1 mm., with an oil globule of ·2 mm.

Macrurus fasciatus, Günth.

Many specimens of *Macrurus fasciatus* have on several occasions been procured in trawling in about 100 fathoms, but of these there was only one perfectly ripe female. This was on the 28th October, 14 miles off Cape Point, when 684 specimens were brought up in the trawl. None of these were ripe males, and the eggs could not therefore be fertilized.

The eggs (Pl. VI, fig. 37) when procured from the female were clear, homogeneous, and floated freely on the surface of the water in which they were placed. They were of a fairly uniform size, ranging from 1·15 to 1·06 mm. in diameter, the oil globule, which was yellow or red in colour, being from ·29 to ·27 mm. The vitelline membrane was thick (about ·02 mm.), and marked in a very distinctive manner. In some cases the markings appeared to be separate dots only, but these were seen in many to be connected by fine hyaline lines, so as to form polygonal markings on the surface of the egg. The dots themselves appeared on a side view to be small connecting pillars between the outer and inner surface of the vitelline membrane (fig. 38).

During the time the "Pieter Faure" was engaged in deep-water work off Cape Point none of the surface tow-nettings contained any eggs at all corresponding to these, but on four

occasions one or two eggs procured in the tow-net attached to the beam-trawl exhibited all the characteristics described above. The polygonal markings were very distinct, as well as the connecting columns. One egg contained an embryo fairly well advanced, and this, when dissected out, showed many black branching cells over the body from head to tail. The rectum was apparently anterior.

The eggs were procured at the following times and places:—

(1) August 20th, 1903. Cape Point, N. 81° E., 32 miles, 460 fathoms. One procured. Refer. No. 17385.
(2) August 27th, 1903. Cape Point, N.E. by E. $\frac{3}{4}$ E., 8 miles, 91 fathoms. One procured. Refer. No. 17555.
(3) September 27th, 1903. Cape Point, N.E. $\frac{1}{4}$ N., 46 miles, 760 fathoms. One procured. Refer. No. 18134.
(4) September 27th, 1903. Cape Point, N.E. $\frac{1}{2}$ N., 47 miles, 700-1,000 fathoms. Two procured. Refer. No. 18097.
*(5) July 8th, 1903. Cape Point, N.E. by E., 36 miles, 650-700 fathoms. One procured. Refer. No. 16799.

On these occasions a moderately fine net was used on the surface, while a coarse net and a moderately fine net were attached to the beam of the shrimp trawl, the eggs being found *only in the last.*

The measurements of these eggs were as follows:—

(1)	Diameter of egg,	1·15 mm.;	of oil globule,	·3 mm.			
(2)	"	"	"	"	"	"	" "
(3)	"	"	1·21	"	"	"	·25 " (contained embryo).
(4)	"	"	1·07	"	"	"	·3 mm. (contained embryo).

The manner in which they were procured seems, on the whole, to point to the fact that their natural place of occurrence is at or near the bottom of the sea. As against this supposition, however, we have to bear in mind that the eggs when procured from the ripe female floated, and that the bottom net was not a closing one. Neither of these considerations are conclusive however, as the fish from which the eggs were procured had been brought up from a depth at which there must have been great pressure, and the eggs under these new conditions of diminished pressure might float. Again, as against the second objection we have to consider that on none of the four occasions on which the eggs were procured were any found in the surface tow-net, which was in use at the same time. The question can only be satisfactorily settled by the use of a closing net.

* Contained 20-30 Small Oil Globules, but otherwise like the others.

Macrurus parallelus, Günth.

Of 145 samples of this fish procured on the 17th September, from 310-560 fathoms, 39 miles off Cape Point, one ripe female was found. On all other occasions when this fish was procured none proved to be ripe. The eggs were clear, not vesiculated, and floated freely at the surface of the water in which they were placed.

They vary from 1·32 to 1·3 mm. in diameter, the single oil globule measuring from ·31 to ·26 mm. The surface of the egg shows the same polygonal markings, with pillars at the angles, observed in the case of *M. fasciatus*, but it is readily distinguished by its larger size.

None of these eggs were found in tow-nettings.

SPECIES XIII.

On the 9th July, 1903, a few eggs were procured in a surface tow-net, Cape Point, N.E. by E., 36 miles. They measured 1·7 mm. in diameter, and had a single oil globule of ·33 mm. The yolk was vesiculated.

These produced transparent colourless larva, difficult to see even in a tube of clear water. They were about 4·67 mm. in length. The notochord was multicolumnar, the rectum posterior, and oil globule posterior. The yolk had well-marked vesiculations. The newly-hatched larva had a very marked downward curvature of the body anteriorly. The dorsal and anal fin were comparatively low, and the former commenced behind the middle of the yolk (Plate VII, fig. 43).

SPECIES XIV.

Seven eggs were found in a surface tow-netting taken on the 9th July, 1903, Cape Point, bearing N. by E., 36 miles. They were all 1·7 mm. in diameter, and had a single oil globule of ·38 mm. The yolk was vesiculated. The more advanced showed a well-developed embryo, with dark pigment cells. On the 12th, all the eggs had sunk to the bottom of the jar, and on the following day some had hatched out (temp. 60°·5 Fahr.).

The larva proved to be very elongate (6·7 mm.) and provided with characteristic black tufts, which did not disappear in formalin after being kept for some months. This characteristic

may be useful for identification purposes. There was no yellow pigment present, and the black pigment (Plate VII, fig. 41) was arranged as follows: Branching cells on snout, crown, behind eye, over part of yolk sac and the body adjacent to it; dense tufts, three above and two below the body posterior to the rectum. The oil globule was covered by a network of black cells. The notochord was multicolumnar and the anus anterior.

SPECIES XV.

Eight ova were procured in a surface tow-net on the 2nd July, 1903, Cape Point, bearing N.E. by E., 38 miles. They were 1·87 mm. in diameter, with an oil globule from ·38 to ·42 mm. They contained embryos fairly advanced, with tail slightly free, and were about half the circumference of the egg. The yolk was transparent and homogeneous, except for some clear dots over its surface, which may not however be constant. The embryo at this stage showed the following pigment patches of a greenish yellow colour: a patch behind each eye, a fainter tract along each side of the body, on the caudal region and oil globule. On the 26th, all the eggs had sunk to the bottom of the jar. They lived till the 31st, but were not in a healthy condition, and did not hatch out. Another lot, about 60 in number, was procured on the 17th September, Cape Point, bearing N.E. (approx.) 40 miles, and hatched out satisfactorily. The larva (Plate VII, fig. 42) is long (4·8 mm.), the rectum anterior, and the notochord multicolumnar. The pigment is arranged as follows: Yellow patches round eyes, on hinder part of yolk sac and oil globule, yellow tufts above and below body and extending on to fins. The arrangement of these tufts varied somewhat in the different larvae. The following were constant: One above the body a little behind the rectum, one below body about as far again behind it, another between the second and the end of the tail, and two at the end of the body. The variation occurred in the addition of another yellow tuft, sometimes above and sometimes below the body, near the third above mentioned. The eggs were procured in surface tow nettings as follows:—

Ref. No.	Locality.	No. Procured.	Date.
17161	Cape Point, N.E. by E. 38 miles.	8	July 23rd, 1903.
17230	Cape Point, E. ½ N. 25 miles.	5	July 30th, 1903.
18053	Cape Point, N.E. approx. 40 miles	60	Sept. 17th, 1903.
17414	Cape Point, E. ½ N. 34½ miles.	4	Aug. 20th, 1903.

SPECIES XVI.

This species is very distinctly characterised by having a thick envelope of a clear gelatinous substance, with polygonal facets on its surface. This substance is apparently homogeneous, and is transparent, so that the egg proper appears as a dark sphere surrounded by a sort of halo, having however occasionally a few dark spots outside its periphery. When viewed by transmitted light (Plate VI, fig. 39), the surface is seen to be divided up into polygonal markings, usually six-sided. When viewed from the side near the periphery of the egg, the sides of the polygonal facets were seen to be curved and raised into ridges having a smooth, sharp, and clearly-defined edge. This becomes very evident when the egg is removed from the water and viewed as an opaque object (fig. 40).

The total diameter, including envelope, varies from 1·91 to 1·7 mm., the egg proper from 1 to 1·06 mm. A single oil globule is present, varying from ·25 to ·21 mm. in diameter, and is usually greenish in colour, but sometimes clear and colourless.

Some of the eggs showed the early stages of embryos, but none far enough advanced to show any specific characteristic. All were examined and measured in 2 per cent. formalin.

The eggs were procured as follows:—

Ref. No.	No. Procured.	Locality.	Means of Capture.	Depth.	Date.
17555	18	Cape Point, N.E. by E. ¾ E. 8 miles.	Moderately fine net on beam.	380-2	Aug. 27th, 1903.
17863	4	Cape Point, N. 50° E. 34½ miles.	Coarse net on beam.	380-475	Sept. 11th, 1903.
17838	85	Cape Point, E. ½ N. 20 miles.	Moderately fine net on surface.	—	" "

NOTE.—Compare somewhat similar eggs described by Hensen and Raffaele.

(b) Species with Several Oil Globules.

Stromateus microchirus, Bonap.

A ripe male and female of this fish were procured in Mossel Bay, 19th February, 1903. Fertilized eggs were secured and kept till hatching took place, 34 hours later. No facilities for microscopic examination were available, and the following notes are from material preserved in formalin.

The eggs vary from ·81 to ·85 mm. in diameter. There are several oil globules, one to five of which are of a dark colour,

with indefinite outline, the others being smaller globules of the normal appearance. The former seem to be oil globules with dark pigment cells, as they could be dissolved, leaving branching pigment cells. The substance of other globules entirely disappeared in dissolving. The larger globule generally occupied a posterior or ventral position in the yolk.

The larva (Plate VII, fig. 44) at the time of hatching is short and stumpy, being about $1\frac{1}{2}$ millimetres from snout to tail and about one-half this in greatest depth. The posterior border of the yolk is near the middle of the total length.

(c) Species with Many Oil Globules.

Syngnathus acus, Linn.

A male of this fish was found in False Bay on the 7th August. In the pouch were rows of eggs of a yellowish red colour. They measured about 1·24 mm. in diameter, and contained many small oil globules, varying considerably in size.

SPECIES XVII.

A single egg (Plate VIII, fig. 45) was procured on 24th November, in False Bay, in a surface tow-netting, and measured 1·57 mm. in diameter. It contained many small oil globules, which occurred in groups and singly throughout its substance. On the following day the embryo was a little less than half the circumference of the egg and showed very characteristic pigment, quite visible to the naked eye as an orange red patch on the lower side of the floating egg. This was seen under the microscope to be a mass of pigment cells, dark red by transmitted light and light orange by reflected light. The whole embryo was covered by this pigment, which extended on to the yolk, gradually becoming fainter till only some scattered branching cells appeared on the surface of the yolk furthest from the embryo. These were of a dark and fainter colour.

Hatching took place on the 27th November.

In the larva the rectum is anterior and the notochord appeared to be multicolumnar, though this could not be made out with certainty owing to the presence of the colouring matter.

Cataetyx messieri, Günth.

On the 27th August, 1903, a large specimen of *Cataetyx messieri, Günth.*, was found, Cape Point, bearing N. 80° E., 32 miles. The depth was 460 fathoms with a bottom of green mud. It was relatively large for a deep sea fish, being about 2 feet in length, and much larger than the type and only specimen hitherto found. The latter, obtained by the "Challenger" in Messier Straits, was 8 inches in length. A conspicuous feature in this fish not seen in the smaller and probably immature "Challenger" specimen was an anal depression covered by a flap, on the inner side of which was situated a papilla, the whole being apparently a copulatory organ of some kind.

A little later, on the 17th September, Cape Point N.E., 40 mile (approx.), in 560-700 fathoms, bottom green mud, we were fortunate in procuring another specimen about the same size, but a female. The ovaries were distended with ova, which were readily discharged on applying a little pressure. They were of a warm reddish colour, which at once suggested the peculiar red characteristic of many deep sea animals, and which has been seen several times in the groups of the Alcyonaria, Nudibranchs and Crustacea in deep waters in this same region. The egg (Pl. VIII, fig. 46) contained many small oil globules, some of a bright red colour, others more of an amber tint, which was also the colour of a single relatively large oil globule which was present in each egg. In some of them when fresh a small patch of what appeared to be protoplasmic matter was observed alongside of this large globule, and this was more apparent when the colouring matter in course of time became quite bleached out by the light, but there was no indication of segmentation or embryos in any of the several hundred eggs examined. The two large ovaries were each about 115 mm. in length and 35 mm. in diameter. They were enclosed in a tough capsule fully distended with ova of the same bright colour as those which had been pressed out. The ova were produced from a series of transverse leaf-like expansions hanging from the roof of the cavity, their free margins extending nearly to its floor. They were closely packed in between these expansions and filled the remaining space under them where they were more loosely packed. From a rough calculation, there must have been over 30,000 in each ovary. It appeared at first that as the eggs were evidently so well developed and flowed so readily from the fish on pressure, they were the ordinary unfertilised eggs found in most fishes, only that they had the colouring and other characteristics of some demersal eggs. A more careful search, however, amongst the ova revealed eight larvae in a fairly advanced stage of development. They were not very difficult to see, though enveloped in a mass of eggs, as the black pigment

of the eyes formed a marked contrast. One was found in the right ovary and the others in the left, and they all occurred on the peripheral region of the mass of eggs on its ventral aspect. They were entirely removed from the ova-producing lamellæ, and had no connection with these or with the walls of the ovary. The eggs in their immediate neighbourhood were embedded in a sort of mucous substance, which coagulated in formalin, and which contained scattered throughout it isolated oil globules. In nearly every case the larvae were found coiled up in a peculiar manner, with a strong flexure near the middle of the body and another in the same direction towards the end of the tail. In one instance, in breaking up the mass of eggs surrounding an embryo, that is carefully detaching eggs and embryo from the surrounding mucous, there was an escape of numerous oil globules, which were also found in the open mouth and throat of the embryo, though none of the eggs or larvae seemed injured. In another case (Pl. xi., fig. 58) the embryo was coiled round a white substance, which at first seemed to be a mass of mucous and oil globules, except that it had numerous black pigment spots. Further examination showed that one end of this mass was enveloped in the mouth of the larva, and this on being withdrawn (Fig. 58a) appeared to be the tail of another and smaller larva. On some of the surrounding mucous being removed this proved to be the case. Fig. 58 represents the whole *in situ* after the tail had been withdrawn from the mouth. The rest of the body of the smaller embryo was coiled up in the form of a figure 8, the abdomenal and head region being somewhat broken up.

The largest larva was found lying on the floor of the ovarian wall, that is between the mass of eggs and the tough capsule, and quite free from ova and mucous. It was 10 mm. in length. The pectorals were well developed, and a few rudimentary rays appeared in them, and in the dorsal fin at its commencement over the head (see Pl. XI, fig. 57). The body and fins were covered with black branching cells. These were most marked in the head region, being somewhat more sparsely scattered on the body. They formed a border to the dorsal fin and a less marked one to the anal; a group of pigment cells occurred near the posterior extremity above and below the caudal portion of the body. The dorsal fin commenced well forward on the crown of the head (in the adult it is much further back), and continues backwards as a fairly wide border. The ventral fin behind the vent was also well developed, and there was a slight pre-anal fin. The vent was approximately medium, but somewhat nearer the head than the tail, much more so than in the adult. The rectum was well developed, and the intestine was continued forward, and after making one or two coils over a large liver could be traced to the œsophagus. The notochord appeared to be multicolumnar. There were four well-developed branchial arches and a clavicle.

I hope to make out more details by sectioning the material, which seems sufficiently well preserved for this purpose.

This is not the first time that evidence has been secured that some deep sea fishes are viviparous. Several species have been found with anal papillae, presumably male sexual organs, and Alcock has definitely established the fact in his important discovery of embryos in the eggs of *Saccogaster*. He has also suggested that the embryos may, when hatched out, procure in some way means of subsistence from the surrounding ova. The present case of comparatively large larvae, which from their size and development have apparently existed some considerable time in the ovarian sac after hatching, is a further step in the solution of the problem, and the fact that in those advanced larvae the yolk sac was completely absorbed, the intestinal tract was fairly well developed, and oil globules were found in their mouth and œsophagus, seems to indicate some confirmation of Alcock's hypothesis, and, further, that there is no special organ for absorption of these eggs, but that nourishment is taken in by the mouth. Before finding the small larva in the coils of another of much larger size, apparently in the act of devouring it, I was inclined to believe that the egg capsule, though tough, was in some way broken down, allowing the contents to escape. This case, however, seems to indicate that the larger larvae live on the smaller or those just hatched, the scattered oil globules found being those from the ruptured yolk sac of the younger larvæ. This is quite in keeping with the fact of there being so few larvae in proportion to the number of the eggs, and it would be easy to construct a probable life history of an embryo from the time of hatching to birth should it be one of the few that only can survive to that period.

(d) Species with No Oil Globules.

SPECIES XVIII.

On the 14th November, 1903, seven eggs, characterised by their small size (·76-·72 mm.) were procured in a surface tow-net in False Bay. No oil globules were present. There were embryos in each, fairly well developed, being a little over half the circumference of the egg. Distinct black dots occurred along the body, but no yellow pigment, either on embryo or yolk. Küppffer's vesicle was present at this stage. The embryos hatched out on the following day. There were a few black dots along the back of the body, and faint yellow pigment over the body, fins, and yolk. Clear dots occurred abundantly on fins, especially towards their margin. The notochord was unicolumnar, the rectum anterior, and the total length 1·74 mm. Fig. 47 is a drawing

representing this larva on the day following (the 16th), and fig 48 (from photograph) on the 18th, when the pigment appeared somewhat differently arranged, viz., a diffused yellow (in which the individual pigment cells were indistinct) occurring on head and body to a point half-way between the rectum and the end of the tail. Here the yellow pigment expanded into a band, traversing the dorsal and ventral fins. Yellow pigment also occurred on the anterior part of the yolk and on the rectum down to anus. Black branching cells appeared extending from the margin of the body above and below into the adjacent fins.

An egg, which seems to be the same, was found in a surface tow-net on the 17th September, 25 miles off Cape Point. It was about ·76 mm. in diameter, and had no oil globule.

Agriopus spinifer, Smith.

Some time ago the eggs of Agriopus were procured (*vide Marine Investigations*, Vol. II., p. 189), but fertilization was not effected. More recently a ripe male and female were found in the same haul, and fertilized eggs were secured (Buffel's Bay, 25th November, 1903). The eggs varied from 1·83 to 1·74 mm. in diameter.* Seven hours after fertilization the germinal disc showed about 30 to 40 cells, and on the following morning, or 24 hours after fertilization, the blastopore was about three-quarters over the egg (Plate IX, fig. 49). The corrugated appearance noted in the unfertilized eggs formerly preserved were readily seen at this and all subsequent stages, and seems to be a characteristic of the egg. Development seemed to be proceeding quite normally, and on the 27th the length of the embryo was about half the circumference of the egg, at which stage faint branching pigment cells of a dark colour began to appear all over the yolk. On the following day the embryo had increased in length, and the heart, otocyst, and rudiments of the pectoral fin were evident. On the 29th, however, all the embryos were found to be dead or dying. One was dissected out, and is represented in fig. 50. Dark branching pigment cells occurred over the yolk, along the head and body, and on the pectoral fin. The notochord was multicolumnar and the rectum anterior.

SPECIES XIX.

On one or two occasions a few opaque spheres were found in tow-nettings preserved in formalin. They were of a dull white colour, minutely vesiculated, but without any signs of oil globule or embryos, and there was therefore some doubt as to their being

* As there was some doubt as to the maturity of the eggs in the first case these dimensions are substituted in the key on page 152 for those first given.

fish-eggs. About half a dozen of these were found, however, in a fresh surface tow-netting, on the 11th September, 1903, from about 34½ miles off Cape Point (Cape Point bearing N. 50° E.). They measured from 1·87 to 1·72 mm. in diameter, and some contained an embryo a little less than half the circumference of the egg. Yellow pigment spots could be seen on the embryo from head to tail. Unfortunately, these did not hatch out, in spite of special care. Similar eggs were again procured on the 27th September, 46 miles off Cape Point, but they again did not survive till hatching.

Some time afterwards living larvae were procured in a surface tow-net 13 miles off Cape Point, on the 30th October, 1903, with the yolk opaque and vesiculated as in the above eggs, but without any trace of pigment on the embryo. The yolk was drawn out and somewhat rectangular in shape, and the rectum was anterior. The total length was 2·04 mm.

Scombresox saurus, Walb.

The diameter of 12 eggs varied from 2·76 to 2·1 mm. There was no oil globule, and the yolk was clear and not vesiculate. All showed a sprinkling of minute dark dots over the surface. The eggs seem to be of a particularly hardy nature, as, although some sank to the bottom of the jar owing probably to the collection of particles on them, and frequently became coated with a white substance apparently of fungoid growth, yet after clearing with a camel's hair brush they floated fairly well, and ultimately developed as the others. One procured on the 11th September, Cape Point bearing N. 50° E., distant 34½ miles, showed the embryo fairly well developed, but the tail not free. On the 16th, the embryo was further advanced, being about one-half the circumference of the egg and with the tail partially free. There was little colour in the embryo, there being only a few dark dots scattered sparsely over the body and a few stellate (mostly 3-rayed) pigment spots on the surface of the yolk, immediately adjacent to the body of the embryo, as shown in Plate X, fig. 53 (from an egg preserved in formalin). At this stage an active circulation, a characteristic feature of this pelagic egg, appeared. The heart beat 112 in a minute. A single afferent vessel could be perceived running along the ventral surface of the egg. The course of this vessel was in a straight line from the caudal region to the heart. By focussing deeper for the lower side of the egg till the dark spots on embryo and yolk become visible, the following efferent vessels become visible: One on each side, starting from the region of the rudiments of the pectoral fin and proceeding at right angles to the body over the yolk till about half-way to the periphery, when they each turn abruptly to the head region and return on either

side to the heart. Another efferent vessel may be seen, though less distinctly, proceeding along the body to the caudal region, where it apparently joins the afferent vessel first mentioned. On the day following, the pectoral fins were very distinctly visible behind the lateral efferent vessels, and the day after that the circulating system was much more developed, the whole surface of the yolk showing a network of vessels through which the blood corpuscles could be seen coursing rapidly.

The embryo remained without much further change for fourteen days. About two days before hatching a change was noted in the pigment. The orbits become of a dark blue and a group of cells of the same colour appears on the body near the pectoral fins, which at this stage are about half the length of the head. In addition to this, small blue specks appear along the whole length of the body. Very little movement is observed in the embryo before hatching, with the exception of the free pectoral fin (that not appressed against the egg capsule), which is in almost constant motion. In the only case in which the actual hatching was observed there was no rupture of the shell, but a sort of scaling-off of part of the capsule. At the time of hatching, the embryo was about one and a quarter the circumference of the egg.

The newly-hatched larva (Plate X, fig. 54) is as much characterised by the presence of distinctive colouring as it had been previously by its absence. With the exception of the yolk and fins, it is of a deep blue, which on examination with a low power may be resolved into dark blue stellate cells, closely packed on the dorsal aspect, but separated on the ventral region in front of the rectum and on a small part of the yolk adjacent to the body (that part which at an early stage was characterised by the presence of black stellate cells). The mouth is well developed and the lower jaw protrudes slightly beyond the upper. The embryonic ventral fins are well developed; that anterior to the anus slightly overlaps the posterior one. The dorsal is not so deep and begins further back, about half-way between the tip of the snout and the end of the caudal rays. The rectum is median, being about half-way between the posterior margin of the yolk and the end of the body.

The larva is long (one measured 8·5 mm.), and swims with a rather slow undulation of the whole body.

After hatching, the absorption of the yolk proceeds at a rapid rate, and three days later it has disappeared (Plate X, fig. 55). A marked change has meanwhile occurred in the pigment. It becomes differentiated into a dark blue band along the back, extending on the side for about a third of the depth of the body. The remainder of the body below this is of a silvery colour, tinged with blue. At this stage, the rays of the caudal which were present in the egg stage are more marked, but none have as yet appeared in the other vertical fins.

One larva survived for a few days longer, the chief change being the more definite demarcation of the blue band of pigment along the dorsal aspect, the appearance of rays in the dorsal and anal fins, and the more marked protrusion of the lower jaw (Plate X, fig. 56).

The behaviour of this larva, as observed on the animal when in the jar of water, differed considerably from that of other larvae reared. It appeared to seek its food entirely from the surface of the water, and kept up a ceaseless movement, the tail being well submerged, while the mouth-part skimmed along the surface. Small copepods were put into the water, but received no attention; whereas small pieces of bread put on the surface were again and again visited, the larva making repeated darts, perhaps at the minute forms which collected round the floating particles.

There is little doubt that this fish is *Scombresox saurus*, specimens of which in various stages of growth were found in the tow-nets about the same time and place. These varied from about 2 mm. longer than the form reared from the egg, but similar to it in every other respect, to forms about 70 mm. in length, and adults have frequently been found.* (I am aware that Haeckel, Kölliker, and Ryder have stated that the eggs of *Scombresox* are provided with long filaments, but not having access to all the literature at present I can only refer to them now.)

The eggs were procured at the following localities, and on the dates mentioned:—

Ref. No.	No. Procured.	Locality.	Date.
17,703	1	Cape Point, N. 81° E. 32 miles ...	Sept. 9th, 1903
17,835	2	Cape Point, N. 64° E. 37 miles ...	Sept. 10th, 1903
17,161	1	Cape Point, N.E. by E. 38 miles ...	July 23rd, 1903
18,021	12	Cape Point (approx.), N E. ¾ N. 39 miles	Sept. 17th, 1903
17,078	1	Cape Point, N.E. by E. 34 miles ...	July 21st, 1903
17,888	1	Cape Point, N. 49° E. 38 miles ...	Sept. 11th, 1903
16,798	1	Cape Point, N.E. by E. 36 miles ...	July 8th, 1903
17,861	1	Cape Point, N. 50° E. 34½ miles ...	Sept. 11th, 1903
17,838	1	Cape Point, E. ½ N. 20 miles ...	Sept. 11th, 1903
16,735	1	Cape Point Lighthouse, N.E. 28 miles	June 24th, 1903
16,732	2	Cape Point, N.E. by E. ¼ E. 38½ miles	June 23rd, 1903
16,734	5	Cape Point Lighthouse, N.E. 32 miles	June 24th, 1903
16,733	5	Cape Point Lighthouse, N.E. 32 miles	June 24th, 1903
17,928	2	Cape Point by D. R., N.E. ¾ E. 40 miles	Sept. 15th, 1903
16,860A	1	Cape Point, N.E. by E. 36 miles ...	July 9th, 1903
17,861	1	Cape Point, N. 50° E. 34½ miles ...	Sept. 11th, 1903
17,108	1	Cape Point, E.N.E. 36½ miles ...	July 22nd, 1903
17,969	5	Cape Point. N.E. (approx.) 39 miles ...	Sept. 16th, 1903
17,730	5	Cape Point, E. ¾ N. 38 miles ...	Sept. 9th, 1903
18,048	10	Cape Point (approx.) N.E. 40 miles ...	Sept. 17th, 1903

* Mr. G. A. Boulenger, F.R.S., has been good enough to confirm this identification.

SPECIES XX.

On several occasions an egg was procured of comparatively large size and with a large perivitelline space. It ranged from 2·97 to 2·64 mm., the perivitelline space being a little over one-fifth of this total diameter. Only the yolk of the egg is visible in the water to the naked eye, so that they may readily be mistaken for much smaller eggs. The yolk was characterised in nearly all cases by vesiculations, showing on its surface as polygonal honeycomb-like markings.

Development was comparatively slow. Some eggs which were procured on August 20th, with embryos about half the circumference of the yolk, hatched out on the 28th.

The embryo appears round the yolk as a series of globular-looking myotomes. Shortly afterwards, with the growth of the embryo, the yolk is drawn out into a lenticular-shaped mass, touching the outer envelope at its ends. The movements of the embryo were somewhat peculiar. After a long period of rest, it would suddenly make a spasmodic wriggle, which often completely reversed its position in the longitudinal direction.

The larva when hatched out proved to be well characterised. There was an entire absence of pigment; the yolk was drawn out so that it extended over more than half the total length of the animal. The anus was situated midway between the yolk and the extremity of the tail, and the notochord was multi-columnar (Plate IX, fig. 51).

The eggs were procured at some distance off Cape Point, as follows:—Cape Point, N. 50° E., 34½ miles—by townet at surface; and Cape Point, E. ½ N., 34½ miles—by townet at surface.

In specimens preserved in formalin, the perivitelline space sometimes becomes opaque and the yolk disintegrated, but the eggs are readily recognised.

SPECIES XXI.

This egg is readily recognised on account of its large size (4·2—4 mm.). It has a clear and glassy appearance in the water. Under a low power of the microscope it is translucent, and showed a number of polygonal markings. No oil globule is present.

Development was remarkably slow. One procured on the 20th August, and showing no trace of an embryo, showed the first traces of the embryo on the 24th. On the 28th, the embryo was less than quarter the circumference of the egg. The egg did not float; perhaps, however, on account of small particles of foreign matter adhering to it. On the 4th September the

embryo was about three-quarters the circumference of the egg, and showed occasional movements. On the 8th it was well developed. As a more advanced embryo had died at this stage and this one seemed to be feeble, it was removed from the egg, and the following characteristics observed (Plate IX, fig. 52): there was little colouring matter, only a few black branching cells being observed on head region and over yolk. The rectum was median (somewhat nearer the yolk than the end of the tail). The dorsal fin was low, and the tail came to a point without any caudal expansion. The ventral fin was deeper than the dorsal and the notochord was multicolumnar. The most characteristic feature was a low triangular prominence on the dorsal aspect over the centre of the yolk.

On three occasions the eggs were procured alive, but the larvae did not on any of these hatch out naturally.

The eggs were procured as follows :—

Ref. No.	No. Procured.	Locality.	Date.
17,724	1	Cape Point, E. ¾ N. 38 miles ...	Sept. 9th, 1903.
16,890	2	Cape Point, N.E. by E. ¼ E. 40 miles...	July 14th, 1903.
17,754	1	Cape Point, E. by N. 35 miles ...	Sept. 9th, 1903.
16,690	1	Cape Point Lighthouse, E.N.E. 30 miles	June 22nd, 1903.
17,761	3	Cape Point, N.E. by E. 38 miles ...	July 23rd, 1903.
17,078	1	Cape Point, N.E. by E. 34 miles ...	July 21st, 1903.
16,980	1	Cape Point, N.E. by E. 36 miles ...	July 15th, 1903.
16,826	1	Cape Point, N.E. by E. ¾ E. 38½ miles	July 8th, 1903.
16,798	1	Cape Point, N.E. by E. 36 miles ...	,, ,,
17,284	1	Cape Point, E. ¾ N. 46 miles (D. R.) ...	Aug. 18th, 1903.
18,048	1	Cape Point (approx.), N.E. 40 miles ...	Sept. 17th, 1903.

KEY TO EGGS AND LARVÆ OF SOME SOUTH AFRICAN FISHES.

Egg.					Larva.				
Oil Globule.	Diameter of Egg.	Diameter of Oil Globule.	Pelagic (P) or Demersal (D)	Remarks.	Position of Oil Globule.	Position of Rectum.	Notochord.	Pigment, &c.	Species.
	·79	·11	P	Smallest egg with 1 oil globule	Posterior	Anterior	Unicolumnar	Red pigment on body, fins and yolk	Species XI. (Arnoglossus capensis ?)
	·81 (?)	*·16 (?)*	*P*	...	*Anterior*	*Anterior*	*Multicolumnar*	*Slight*	*Species VI.*
	·88 - ·82	*·19*	*P*	...	*Posterior*	,,	,,	*Moderate, on body*	*Chrysophrys gibbiceps*
	·88	*·16*	*P*	...	*Ventral*	,,	,,	*Slight*	*Pagellus mormyrus*
	·80	·15	P	...	Posterior	Anterior	Multicolumnar	None	Species XII.
	·80 ·85	*·17*	*P*	...	*Posterior*	*Anterior*	*Multicolumnar*	*Moderate, on body*	*Chrysophrys globiceps*
	·91 ·82	*·2*	*P*	*About 10% have two oil globules*	,,	,,	,,	*(?)*	*Sciæna aquila*
	1·1 ·93	·19 ·2	P	...	...	...	...	...	Pagrus laniarius
One ...	1·15 1·06	·27 ·20	P ?	Polygonal markings	...	Anterior ?	...	Black branching cells from head to tail (in formalin)	Macrurus fasciatus
	1·21 1·07	*·23*	*P*	*Yolk early pigmented*	*Ventral*	*Anterior*	*Multicolumnar*	*On body and fins*	*Trigla Kumu*
	1·32 1·3	·31 - ·26	P ?	Polygonal markings	...	...	...	...	Macrurus parallelus
	1·44	*·20*	*P*	...	*Anterior*	*Median*	*(?)*	*Abundant on body and fins*	*Species IV.*
	1·7	*·2*	*P*	*Large perivitelline space*	*Postero-ventral*	*Posterior*	*Unicolumnar*	*Very little*	*Species III.*
	1·7	·33	P	Yolk vesiculate	Posterior	Posterior	Multicolumnar	No pigment, anterior curvature	Species XIII.
	1·7	·38	P	,, ,,	,,	Anterior	,,	Black tufts on fins	Species XIV.
	1·87	·42 ·38	P	Clear dots on surface (constant ?)	,,	,,	,,	Yellow tufts on fins	Species XV.
	1·91 - 1·7	·25 ·21	P	Gelatinous envelope	...	...	...	...	Species XVI.

KEY TO EGGS AND LARVÆ OF SOME SOUTH AFRICAN FISHES.—*Continued.*

Egg.					Larva.				
Oil Globule.	Diameter of Egg.	Diameter of Oil Globule.	Pelagic (P) or Demersal (D)	Remarks.	Position of Oil Globule.	Position of Rectum.	Notochord	Pigment, &c.	Species.
Several	·85 ·81	...	P	...	...	Anterior	...	...	Stromateus microchirus
	·81 ·72	*·15 ·04*	*P*	*From 1 (rare) to 12 oil globules*	...	,,	...	Yellow pigment abundant on all parts except extremity of tail	*Synaptura pectoralis*
Many ...	*1*	...	*D*	*Not pigmented.*	...	*Anterior*	Multicolumnar	*Abundant, on body*	*Species I.* (Gobiesocidæ)
	1	...	*D*	*Dark blue in colour*	...	,,	*Multicolumnar*	*Very little*	*Species II.*
	1·24	...	In pouch of male	Yellowish red	...	...	...	...	Syngnathus acus.
	1·32	...	*P*	...	...	Anterior	Multicolumnar	Embryo and yolk with branching yellow pigment cells protuberance over head	*Species VII.*
	1·57	...	P	Red pigment appears early on embryo	...	,,	,, (?)	Abundant red pigment	Species XVII.
	1·7	Largest ·72	Viviparous	Deep red	...	Median	,, ,,	Black (in formalin)	Cataetyx messieri.
	1·78	...	*P*	Embryo and yolk sac with branching yellow cells	...	Anterior	*Multicolumnar*	*On all parts*	*Species X.*

KEY TO EGGS AND LARVÆ OF SOME SOUTH AFRICAN FISHES.—*Continued.*

Egg.					Larva.				
Oil Globule.	Diameter of Egg.	Diameter of Oil Globule.	Pelagic (P) or Demersal (D)	Remarks.	Position of Oil Globule.	Position of Rectum.	Notochord.	Pigment, &c.	Species.
	·76 – ·72	...	P	Smallest egg	...	Anterior	Unicolumnar	Faint yellow on all parts	Species XVIII.
	·98	...	*P*	...	...	*Anterior*	*Multicolumnar*	*Dense on yolk and larva*	*Species V.*
	1·02 ·91	...	*P*	...	...	...	...	...	*Achirus capensis*
	1·06	...	*P*	Vesiculated	...	*Posterior*	*Unicolumnar*	*A few black spots on body*	*Species VIII.*
	1·83—1·74	...	P	Markings on vitelline membrane	...	Anterior	Multicolumnar	...	Agriopus spinifer
Absent	1·87—1·72	...	P	White, opaque	...	(?)	(?)	Yellow spots on embryo	Species XIX.
	2	...	*(?)*	*In a cluster*	...	...	...	...	*Species IX.*
	2·76—2·1	...	P	Minute dots over surface, vitelline circulation	...	Median	(?)	Blue on head & body	Scombresoxsaurus.
	2·97—2·64	...	P	Large perivitelline space, vesiculated yolk	...	,,	Multicolumnar	No pigment, elongate yolk	Species XX.
	4·2—4	...	P	...	...	,,	,,	Dorsal prominence	Species XXI.

(Published 30th September, 1904.)

PLATES AND EXPLANATIONS OF PLATES.

Plate V.

Fig. 34. Dead barnacle shell laid open to show blue eggs of Species II. (nat. size.)

" 35. Single egg of Species II. enlarged and showing numerous oil globules.

" 36. Larva (newly hatched) of Species XI. (*Arnoglossus capensis*, Blgr.) Nat. size 2·59 mm.

34

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P.M.C. Manes del.

Mintern Bros. lith.

Plate VI.

Fig. 37. Egg of *Macrurus fasciatus*. Nat. size, 1·1 mm.

" 38. Side view of part of egg capsule of *Macrurus fasciatus*, showing polygonal markings and pillars.

" 39. Egg of Species XVI. by transmitted light. Nat. size, 1·8 mm.

" 40. " " " by reflected light. " " "

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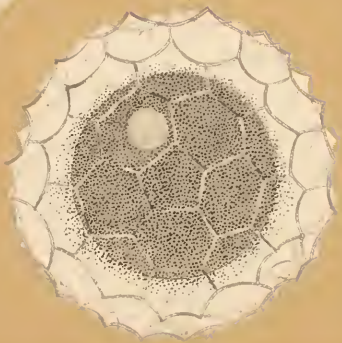

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F.M.S.Manie del.

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PLATE VII.

Fig. 41. Larva (newly hatched) of Species XIV. Nat. size, 0·7 mm.

" 42. " " " XV. " " 4·8 "

" 43. " XIII. " " 4·67 "

" 44. " " *Stromateus microchirus*, Bonap. Nat. size, 1·5 mm.

41.

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Lithograph del.

Mintern Bros. Lith.

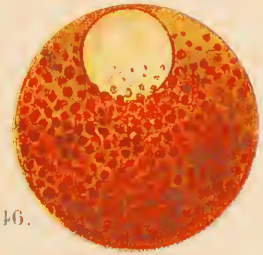
Plate VIII.

Fig. 45. Egg of Species XVII. Nat. size, 1·57 mm.

" 46. " " *Cataetyx messieri*, Gunth. Nat. size, 1·7 mm.

" 47. Larva (newly hatched) of Species XVIII. Nat. size, 1·74 mm.

" 48. " " " " One day older.



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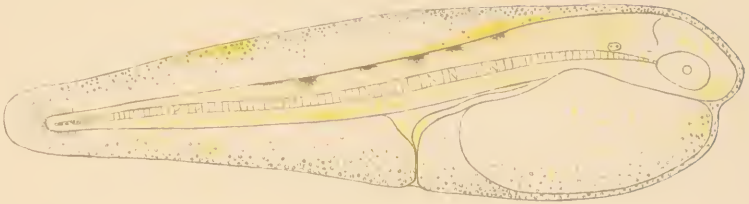

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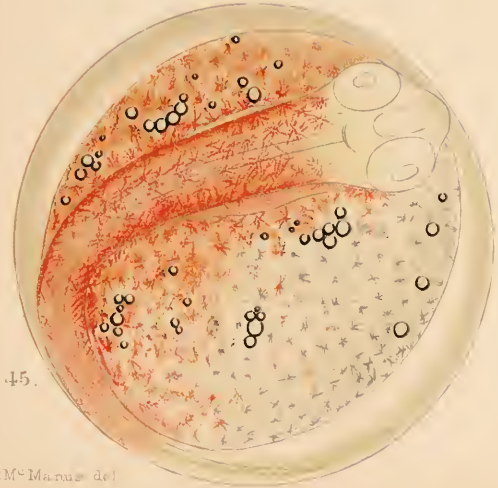

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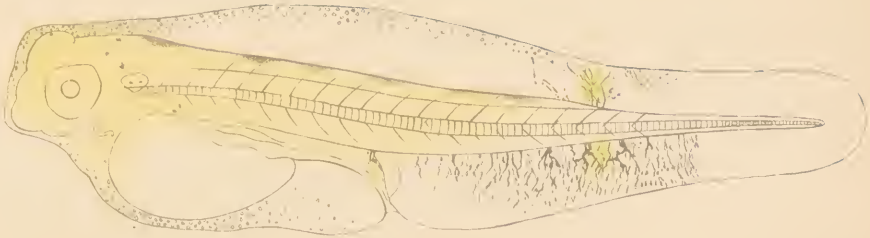

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P.McManus del.

Minter Bros. lith.

Plate IX.

Fig. 49. Egg of *Agriopus spinifer*, 24 hours after fertilization. Nat. size, 1·8 mm.

" 50. Larva of *Agriopus spinifer* taken from egg 4 days after fertilization.

" 51. " (newly hatched) of Species XX. Nat. size, 6·9 mm.

" 52. " of Species XXI. taken from an egg about 19 days after fertilization.

49

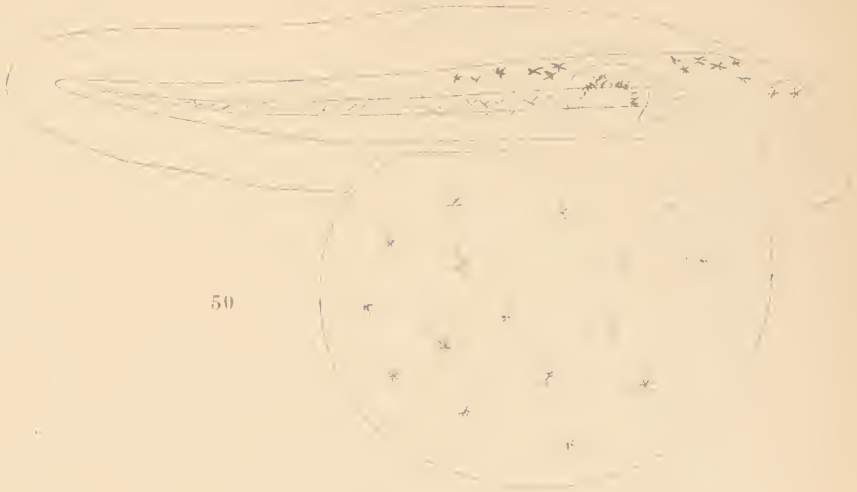

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Plate X.

Fig. 53. Egg of *Scombresox saurus*, Walb. Nat. size, 2·6 mm.

„ 54. Larva (newly hatched) of the same. Nat. size, 8·5 mm.

„ 55. „ (three days after hatching) of the same.

„ 56. „ (about six days after hatching) of the same.

53

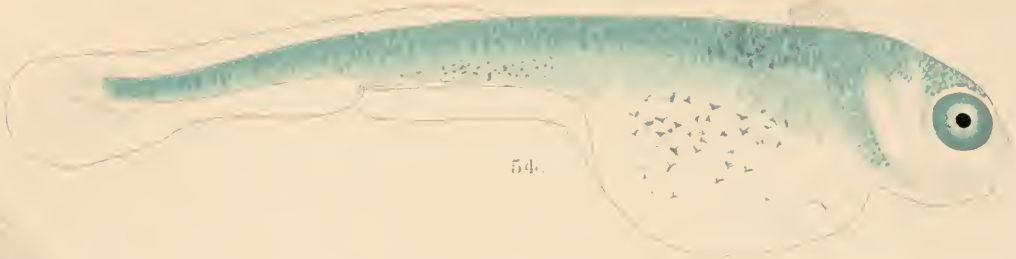

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Plate XI.

Fig. 57. Larvae of *Cataetyx messieri*. Nat. size, 10 mm.

" 58. Larva of *Cataetyx messieri* surrounded by ova (*b*) and mucous (*c*). The part (*a*) of the smaller larva was extracted from the mouth of the larger.

57.

58

J. McManus del.

Mintern Bros. Lith.

ON THE

ECHINODERMA

FOUND OFF THE COAST OF SOUTH AFRICA

PART I. ECHINOIDEA.

BY

PROFESSOR F. JEFFREY BELL, M.A.

Dr. Gilchrist has from time to time submitted to me his collections of Actinogonidiate Echinoderms; these are now quite numerous, and I cannot hope to have a report on them all ready in the present year.

As there is no confusion to be feared from reporting separately on the several classes, I purpose to publish first the observations which I have made on the Echinoidea.

The collection is not of interest as containing many new forms, but rather as widening (or confirming the widening found by the "Challenger") of the area of distribution of known forms. Here it is to be observed that the care of a really extensive collection of Echinoderms has imbued me with a strong, perhaps too strong, conviction that Echinoderms are very variable animals; I am not, in other words, prone to raise what may be individual, and are often slight, peculiarities into specific characters; still less do I think that any single character should be made the basis of a classification, or that a distance of even hundreds of miles of sea-bottom is sufficient evidence of specific distinctness. I own that I recognise that I do not belong to the most modern school of Echinologists, but I am not so old that I do not hope to see the pendulum incline again to my point of view. At least, I am still in good company.

The discovery of *Palaeolampas* in a living state is of great interest.

DESMOSTICHA.

CIDARIDAE.

Cidaris sp.

Single Examples of this family were collected as follows:—

Locality.	Date.	How Procured.	Depth.	Ref. No.
East London, N.W. ½ N., 11 miles.	April 15th, 1901	By Shrimp Trawl	250 to 303 fms.	81
Umhlangakulu River, N.W. by N., 7½ miles.	March 14th, 1901	By Dredge ...	50 ,,	92

I do not recognise them as belonging to any described species, and as the classification of this family has lately been thrown into the melting pot by Dr. Mortensen, whose rearrangement of the genera is, in his own words, "a provisional classification, which can scarcely be correct throughout," I propose to wait till something further* can be said about South African Cidarids. The only species as yet recorded from the Cape is *Cidaris metularia*.

DIADEMATIDAE.

Diadema saxatile.

Echinus saxatilis, Linn., Syst. Nat. x. (1758), p. 664.
Diadema setosum, Gray, Ann. Phil. x. (1825), p. 426.
Diadema saxatile, Loven, Bih. Sv. Vet. Ak. Hdlgr., xiii., 4, No. 5 (1882), p. 135, *ibique citata*.

A single young specimen of this widely distributed species was collected as follows:—

Locality.	Date.	How Procured.	Depth.	Ref. No.
Cape Morgan, N. ½ W., 10½ miles.	July 26th, 1901	By Dredge ...	77 fms....	111

Astropyga radiata.

Cidaris radiata, Leske apud Klein (1778), p. 52.
Astropyga radiata, Gray, Ann. Phil. x. (1825), p. 426; A. Ag., Rev. Echin. (1872), p. 94, *ibique citata*.

* Since writing the above I have received Dr. Meijere's report on the Echinoids of the "Siboga," where I see that the Danish Naturalist's refinements are not accepted.

Four young specimens procured as follows:—

Locality.	Date.	How Procured.	Depth.	Ref. No.
Tugela River Mouth, N. by W., 18 miles.	Feb. 6th, 1901...	By Shrimp Trawl	46 55 fms.	No. 57
Cape Natal, W. by N., 6½ miles.	Dec. 17th, 1900	By Large Trawl	48 fms....	,, 100
Cape Natal, W. by N., 6½ miles.	Dec. 14th, 1900	By Large Dredge	54 fms....	,, 108
Tugela River Mouth, N.W. by N. ¾ N., 15½ miles.	Feb. 6th, 1901...	By Shrimp Trawl	36 to 42 fms.	,, 173 (P.F. 11749)

This species was long since collected at the Cape by Dr. Krauss, although it does not seem to have been mentioned in any echinological list.

Echinothuriidae.

For, I think, the first time Echinothuriae have been found south of the Cape; the family is, in this collection represented by two specimens of *Phormosoma*, allied respectively to *P. tenue* A. Ag. and *P. bursarium* A. Ag.; it is useless to attempt to diagnose from isolated specimens, and the present condition of the family does not warrant any addition to it that need not be made; it is to be hoped that the large collection made by Professor Agassiz will allow us to gain a definite idea of the range and character of the variation exhibited by species, of which as yet too few examples are known. It is on the basis of such knowledge rather than on the distinction of minute differences that satisfactory systematics is based. [Dr. Gilchrist has lately been so good as to send me a large series, which I shall take an early opportunity of studying.]

The specimens were obtained as follows:—

Locality.	Date.	How Procured.	Depth.	Ref. No.
Cape Natal, N. by E. (Approximate) 24 miles.	April. 4th, 1901	By Shrimp Trawl	440 fms....	33
Cape Point, N. 81° E. 32 miles.	Aug. 20th, 1903	By Shrimp Trawl	460 fms....	139

Echinidae.

Echinus angulosus.

Cidaris angulosa, Leske, Addit. (1778), p. 92.
Echinus angulosus, A. Ag., Rev. Echin (1872), p. 122, *ibique citata.*

This species was obtained as follows:-

Locality.	Date.	How Procured.	Depth.	Ref. No.
Simon's Town	17th Sept., 1897	Collected at low tide		121
Three Anchor Bay ...	26th April, 1898	,, ,,		125
Somerset West	23rd Oct., 1897	,, ,,		128
,, ...	28th April, 1898	,, ,,		130
St. James'	22nd April, 1898	,, ,,	-	131
Lat. 34° 12′ 54″ Long. 18° 36′ 9″ ...	31st Aug., 1897	By Trawl	23-37 fms.	135
East London	17th Dec., 1898	Collected at low water	—	136
Between Mossel Bay Pier and St. Blaize Lighthouse	9th June, 1898	,, ,,	—	36 D
Knysna shore between jetty and village.	17th Aug., 1898	,, ,,	—	318 A
Between River and Sebastian Bluff, nearer the former.	15th July, 1900	,, ,,	—	9098

The spines of this species appear to be pretty constantly either red or purple; the difference is so marked and seems to be so equally divided among the specimens that it appears to me that it would be worth while to make observations on fresh specimens to see if it is due to differences of sex. I do not think this difference can be regarded as specific, notwithstanding Dr. Mortensen's statement that colour is an "excellent guide" for distinguishing the species of Echinus.*

Echinus gilchristi.

A number of specimens were obtained of an Echinus which appear to be undescribed.

Test tending to be conical, with rather small apical area; above the ambitus there is, ordinarily, but not always, a large primary tubercle on each alternate interambulacral plate; similarly below the ambitus there is one on each plate; the secondaries are of moderate size, and are rather closely packed. On the ambulacral plates above the ambitus there is more irregularity in the disposition of the primaries, but below it there is nearly always one on each plate; these and the secondaries are somewhat smaller in size than on the interambulacrals. The primary spines are white, moderately long, giving the uninjured creatures the general appearance of the northern *E. acutus*; the secondary spines are also white. The denuded test is of a stone-grey colour; young tests are flattened rather than conical.

This species may be named after its discoverer, the Government Biologist at the Cape.

* Danish Ingolf Exped. Echinoidea (1903) p. 37.

Measurements of three denuded specimens :—

Test. Diam.	Height.	Interambul-acra.	Ambulacra. Breadth at Ambitus.	Mouth Diam.	Vent.
55	38 5	23	12	19	6
45	36	20	10	17 5	5·5
38	21	14	8·5	11	4·5

This new species was obtained as follows :—

Locality.	Date.	How Procured.	Depth.	Ref. No.
Cape St. Blaize, N. by E. ¾ E., 6¼ miles.	Oct. 15th, 1899	By large trawl	35 fms.	34
Cape Pt. Light Ho., N. 16° E., 10 miles.	Sept. 5th, 1902	From shrimp trawl	85 fms.	70
Cape Pt. Light Ho., S.W. by W. ¼ W., 3 mi., trawl hauled up Cape Pt Light House S.W. by W., 4½ miles.	Dec. 5th, 1902	By shrimp trawl	33 fms.	83
False Bay ... ... Lat. 34° 19′ 28″ S. Long. 18° 33′ 50″ E.	Oct. 4th, 1898	By large trawl	—	85
Cape Seal, N. ¾ E., 38 miles	Feb. 20th, 1902	By dredge	80 fms.	138
Cape St. Blaize, N. by E. ¾ E., 6¼ miles.	Oct. 15th, 1899	By large trawl	35 fms.	145
Cape Point, N. 77° E. ...	July 29th, 1903	By shrimp trawl	660-700* fms.	200

Echinus juv.

The young of what I take to be an undescribed species of Echinus, and which I have reserved for future study, were taken as follows :—

Locality.	Date.	How Procured.	Depth.	Ref. No.
Cape Pt. Light Ho., S. ¼ W., 1½ miles.	June 8th, 1900	By large dredge	14 fms.	170
Zwartklip, N.E. ½ E., 1½ miles.	Nov. 26th, 1902	By dredge	11 fms.	180
Zwartklip, N.E. ¼ N., 1 miles	Nov. 17th, 1902	By dredge	10 fms.	182
Rocky Bank, False Bay ...	Oct 8th, 1902	By dredge	17 fms.	183

* All small flattened specimens.

PETALOSTICHA.

NUCLEOLIDAE.

Palaeolampas crassa.

Palaeolampas crassa, Bell, P. Z. S. (1880), p. 48.

Obtained at following place:—

Locality.	Date.	How Procured.	Depth.	Ref. No.
Kromhout, N. N. E., 2 miles	Dec. 12th, 1902	By dredge	14 fms.	16326
" "	" "	"	"	16326A

It was a great and unexpected pleasure to me to find that Dr. Gilchrist had dredged living specimens of this interesting form, to our knowledge of which there has been no addition since I described it in 1880. It appears to be fairly abundant, and examples of various sizes have been obtained. In the fresh state the test is uniformly covered with short yellowish green spines, longer below than above the ambitus.

The only criticism that has been passed on this genus that I know of is by M. de Loriol,* but, as he compares with *P. crassa*, "*Echinolampas rangi*," which has petaloid ambulacra, I can only suppose that I did not make my meaning clear to him.

SPATANGIDAE.

Pourtalesia carinata.

Pourtalesia carinata, A. Ag., Rep. Chall. Ech. (1881), p. 133.

A rather small specimen of what appears to be this species was obtained as follows:—Locality: Cape Point, N.E. by E. ¼ E. 46 mi. From shrimp trawl. Depth, 900 fms. Date, July 21st, 1903. Reference, No. 140.

It is a matter for congratulation that the resources of the Cape of Good Hope naturalist enable him to dredge in deep waters, for it was in the sea between Marion and Crozet Islands (at Stats. 146 and 147) that the "Challenger" made two of her most prolific hauls.

* Mem. Soc. Phys. Genève, xxvii., p. 88.

Urechinus naresianus.

Urechinus naresianus, A. Ag., Chall. Rep. Ech. (1881), p. 146.

This is, I believe, the first time that this interesting and very variable species has been dredged since the "Challenger" expedition. The student may be reminded that valuable observations supplementary to the original description were made by Lovèn in 1883 from duplicates obtained from the British Museum (see Kongl. Sv. Vet. Akad. Hand. xix., No. 7, pp. 90 et seq.).

Spatangus raschi.

Spatangus raschi, Lovén, Œfvers. Vet. Akad. Stockholm, 1869, p. 733; Bell, Cat. Brit. Ech. (1902), p. 167.

Locality.	Date.	How Procured.	Depth.	Ref. No.
Cape Seal, N. ¾ E., 38 miles	Feb. 20th, 1902.	By dredge	80 fms.	137

Lovenia elongata.

Spatangus elongatus, Gray in Eyre's Australia i. (1845) p. 436.

Lovenia elongata id. Ann. and Mag. vii. (1851), p. 181; A. Ag., Rev. Ech. (1872) p. 139.

Locality.	Date.	How Procured.	Depth.	Ref. No.
Cape Natal, W. ¼ N., 12½ miles.	Dec. 17th, 1900	By large dredge	85 fms.	10,785
Umhlot River Mouth, N. W. ½ W., 15½ miles.	Dec. 19th, 1900	,, ,,	100 fms.	10,016
Umhloti, River Mouth. N. W. ½ W., 15½ miles.	,, ,,	,, ,,	100 fms.	10916B

Echinocardium australe.

Echinocardium australe, Gray, Ann. and Mag. vii. (1851), p. 131; A. Ag., Rev. Echin. 1872), p. 109.

Locality.	Date.	How Procured.	Depth.	Ref. No.
False Bay, Roman Rock, N. by W, 1½ miles.	June 7th, 1900	By large dredge	22 fms.	3082
Cape Hang Klip, N. E. ¼ E. 27½ miles.	Feb. 26th, 1902	By shrimp trawl	105 fms.	14449
False Bay, Bakkoven Rock, W. ¼, N. ¾ miles.	June 7th, 1900	By large dredge	22 fms.	3098 C
Constable Hill, E.S.E. 15 miles.	March 13th, 1902	By shrimp trawl	100 fms.	75
Lion's Head East, 18 miles	March 22nd, 1900	By large dredge	104 fms.	93
Lat. 34° 43′ 15″ S. Long. 18° 30′ 00″ E. ...	Oct. 18th, 1898	By shrimp trawl	123 fms.	98
Algoa Bay, near Roman Rock. Lat. 34 00″ S. Long. 25° 45′ E.	Nov. 10th, 1898	By dredge	—	107
Mossel Bay	June 15th, 1898	By shrimp trawl	18 fms.	109
Paulsberg, W.N.W. 1 miles	June 8th, 1900	By large dredge	24 fms.	175
Paternoster Point, S.E. ¾, S. 9 miles	March 17th, 1902	By dredge	80 fms.	181

Echinocardium flavescens.

Spatagus flavescens, O. F. Müll, Prod. Zool. Dan. (1776), p. 236.

Echinocardium flavescens, A. Ag., Rev. Ech. (1872), p. 110; Bell, Cat. Brit. Ech. (1892), p. 171 *ibique citata.*

Locality.	Date.	How Procured.	Depth.	Ref. No.
Sebastian Bluff, N.W by W. ¼, W. 8½ miles.	July 5th, 1900	By shrimp trawl	34 fms.	7050
Cove Rock, N.W. ¾ W. 13½ miles.	July 30th, 1901	By dredge	80-130 fms	102
Algoa Bay, neighbourhood of Roman Rock, Lat. 34 2′ S. Long., 25° 45′ 30″ E.	Nov. 10th, 1898	By dredge	—	112
Lat. 33° 54′ 15″, Long. 25 53′ 30″	Nov. 7th, 1898	By dredge	31 fms.	185

LESKIIDAE.

Brissopsis lyrifera.

Brissus lyrifer, Forbes, Brit. Starfish (1841), p. 187.
Brissopsis lyrifera, Ag. & Des., Ann. Sci. Nat. viii. (1847), p. 15; Bell, Cat. Brit. Ech. (1902), p. 172.

Locality.	Date	How Procured.	Depth.	Ref. No.
Struys Point, N.W., 15 miles	July 9th, 1902	By shrimp trawl	48 fms.	15,307
Cape Hang Klip, N.E. ¼ E., 27½ miles.	Feb. 26th, 1902	,, ,,	105 fms.	14,449
Struys Point, N. by W. ½ W., 7½ miles.	Aug. 28th, 1902	,, ,,	42 fms.	15,346
Lion's Head, S. 72° E., 47 miles.	Mar. 16th, 1900	By large dredge	190 fms.	2,152
Cape Point Light House, N.E. by N., 7¾ miles.	Sept. 8th, 1902	By shrimp trawl	85 fms.	74
Lat. 34° 34′ S., Long. 18° 32′ 45″ E.	Oct. 18th, 1898	By dredge	100 fms.	103
Table Mountain, S.E. by S. ¾ S., 45½ miles.	April 4th, 1902	By shrimp trawl	120 fms.	197

Schizaster fragilis.

Brissus fragilis, Düb. and Kor., Vet. Ak., Hodg 1844 (1846), p. 280.
Schizaster fragilis, Ag. and Des.; see Bell, Cat. Brit. Ech. (1892), p. 164, *ibique citata.*

Locality:—In the neighbourhood of Bird Island, Lat. 33° 55′ S., Long. 26° 11′ 45″ E. Date:—16th March, 1899, by dredge. Depth, 29 fms. Reference, No. 29.

These two last species attain a much greater size than in Northern waters. The mean monthly temperature of the water in this locality for 1902 was 64·4 deg. Fahr., the maximum 74, the minimum 56.

[Published 5th October, 1904.]

THE PLANKTON

OF

THE SOUTH AFRICAN SEAS.

BY

P. T. CLEVE.

I.—COPEPODA.

INTRODUCTION.

Some time ago Dr. Gilchrist suggested that I should examine the samples of plankton collected in the South African Seas during the Government's survey of that region. I accepted the proposal with pleasure as this region has a certain bearing on some oceanographical questions in which I am particularly interested. The first set of samples had, with one exception, been obtained by means of a comparatively coarse tow-net fastened on the beam of the trawl. They contained almost exclusively animals, schizopoda, amphipoda, sagittæ, tomopteris and a large amount of copepoda. I intend to give in the following a report on the latter, and hope later on to be able to give an account of the halocyprida and the chætognatha.

The region of South Africa is of the greatest interest in its planktonological aspect, as it represents a battlefield of two mighty currents of different origin, the Agulhas Current and the Westwind Drift. The former carries the warm water of the Indian Equatorial Current towards the south, the latter the water of the Southern Pacific Ocean through the space between Fuegia and the Antarctic Continent.

The east coast of South Africa has a steep slope so that depths of 900 to 3000 metres (500 to 1800 fathoms) will be found at a short distance from the land. On the south side, from about Algoa Bay to the Cape of Good Hope, extends the triangular Agulhas Bank, its southern point being about 2 degrees of latitude south of Cape Infanta. The depths in this region are comparatively small, as a rule 70 to 100 metres (40 to 60 fathoms).

The warm Agulhas Current flows along the east coast of South Africa and east of the Agulhas Bank with a variable velocity, strongest in the summer months, especially in February. As a rule the average velocity amounts to about 2 knots; in the winter, especially in July, the velocity diminishes considerably, and the cold water from the Westwind Drift repels and permeates the current.

South-east of the Agulhas Bank the waters of the Agulhas Current become deflected and mixed with the water of the Westwind Drift, which moves eastwards, in the winter months and April with a velocity of about 1-1·25 knots.

The mixed water of the Agulhas Current and the Westwind Drift continues towards the east with a velocity of 1·5-2 knots. During the passage it sends a branch along the west coast of Australia, and a very mighty one, when it meets the south end of America, or the north going Humboldt Current. This may explain the fact that I found in the samples collected east of Natal a very considerable number of the copepoda discovered by Giesbrecht in the depths west of South America.

The currents over the Agulhas Bank are as a rule weak and variable. Between Cape Town and Cape Agulhas a current sets in in an E.S.E. direction with a velocity of one mile per hour. Along the south coast from Cape Agulhas to about 27° E. an eastward running current has been observed. Thus the water south of the Cape Colony is derived, at least to a great extent, from the west, that is from the origin of the northwards running Benguela Current. The latter is to be considered as a branch of the Westwind Drift, more or less mixed with waters from the Brazil Current, the continuation of which it touches during the passage from the South of America.

It might be expected that the waters on the Agulhas Bank would possess a kind of plankton different from that of the waters East of South Africa. This will be proved by the following account. It will be found that of the copepoda found south and west of the Cape Colony a considerable number also occur in the northern hemisphere, north of a line traced from the Newfoundland Banks to the Azores and the Cape Verde Islands, some so far to the north that they pass through the Faröe Channel and reach the coasts of Scandinavia. There is thus a strong probability that the hypothesis I have enunciated, that the waters of the temperate Atlantic in the northern hemisphere originate not from the Gulf Stream, but from the Benguela Current, which is supposed to pass as an under-current below the waters of the tropical Atlantic.

In order that the reader may judge of this question I have compiled from the literature an account of the geographical distribution of all copepoda found in the South African Seas.

I will in the following treat first of the copepoda of the west coast, then of the south coast and, finally, of the east coast.

Copepoda of the West Coast.

The samples examined were the following.*

1. (No. 23) Table Mountain, N. 79° E., 40 miles, 450 metres (250 fathoms) 18th April, 1900, coarse net. See Marine Investigations of South Africa, I., p. 193.
2. (No. 30) Lion's Head, N. 54° E., 38 miles, 350 metres (195-204 fathoms), 16th April, 1900, moderately fine net.
3. (No. 17) Lion's Head, N. 76° E., 28 miles, 250 metres (140 fathoms), 16th April, 1900, half-coarse net.
4. (No. 8) Lion's Head, N. 63° E., 34 miles, 277 metres (15 fathoms), 19th April, 1900, moderately coarse net.

The result of the examination of these four samples was 43 species, a considerable number, considering that all samples were collected in one and the same month, and chiefly along the bottom.

The following table indicates the species found in every sample ; the signs here, as in the following, indicate the apparent frequency, viz. : *cc* very common, *c* common, + not rare, *r* rare, *rr* very rare.

It is evident that the list cannot be a complete one of the forms occurring in the origin of the Benguela Current, but, nevertheless, it may be of interest to examine the distribution of the species in the Atlantic and Mediterranean.

I consider as tropical such forms as occur in the Equatorial and Florida Currents, as temperate such as occur in the space north of a line from the Newfoundland Banks to the Azores and Cape Verde. I count in this category also such forms as have been found in the Gulf of Guinea, but not in the Florida Current.

Of the species noted west of South Africa

32	per cent.	have	been	found in the	tropical Atlantic,
42	,,	,,	,,	,,	temperate Atlantic,
71	,,	,,	,,	,,	Mediterranean,
35	,,	reach the Faröe Channel,			
21	,,	have been found north of the Faröe Channel.			

Copepoda of the Agulhas Bank.

The samples examined were as follows :

1. (No. 26) False Bay, off Roman Rock, 37 metres (19·5-22 fath.) 13.x.1898, fine net.
2. (No. 18) Cape Infanta, N.N.W., 4 miles, 62 metres (35 fath.) 6.vii.1900, moderately fine net.

   (No. 4) Cape Infanta, N.N.W., 4 miles, 67 metres, (38 fath.) 6.vii.1900, coarse net.

   (No. 2) Cape Infanta, N.$\frac{3}{4}$W., 6 miles, 70 metres (40 fath.) 6.vii.1900, moderately fine net.

   (No. 5) Cape Infanta, N.$\frac{1}{2}$W., 13$\frac{1}{2}$ miles, 74 metres (42 fath.) 13.vii.1900, coarse net.

   (No. 20) Cape Infanta, N.$\frac{1}{2}$W., 13$\frac{1}{2}$ miles, 74 metres (42 fath.) 13.vii.1900, moderately fine net.

---

* The numbers in brackets are the Reference numbers.

3. (No. 16) Cape Infanta, N.E.$\frac{3}{4}$N., $4\frac{1}{2}$ miles, 65 metres (37 fath.) 29.vi.1900, moderately fine net.
4. (No. 1) Sebastian Bluff, N.W. by N.$\frac{3}{4}$N., 4 miles, 60 metres (34 fath.) 12.iv.1900, moderately fine net.
5. (No. 12) Sebastian Bluff, N.W. by N.$\frac{3}{4}$N., 4 miles, 60 metres (34 fath.) 22.vi.1900, coarse net.
6. (No. 21) Sebastian Bluff, N. by W.$\frac{3}{4}$W., $9\frac{3}{4}$ miles, 71 metres (40 fath.) 11.vii.1900, moderately fine net.
   (No. 29) Sebastian Bluff, N.N.W., $7\frac{1}{2}$ miles, 69 metres (39 fath.) 11.vii.1900, moderately fine net.
7. (No. 27) Mossel Bay, 37 metres (21 fath.) 24.vi.1898.
   (No. 28) Cape St. Blaize, N.W. by 3°, $5\frac{1}{2}$ miles, 58 metres (33 fath.) 29.vi.1898.
8. (No. 25) Cape St. Blaize, N.E.$\frac{1}{2}$N., $8\frac{1}{4}$ miles, 63 metres (36-37 fath.) 23.x.1900, coarse net.
9. (No. 19) Buffalo Bay, Walker's Point, N.W. by W.$\frac{1}{2}$W., $1\frac{1}{2}$ miles, 40 metres (23 fath.) 12.x.1900.
10. (No. 15) Buffalo Bay, 53 metres (30 fath.) 26.iv.1900.
11. (No. 9) S.E. Coast, 33°6′46′S., 27°56′45″E., 71 metres (40 fath.) 30.xii.1898, coarse net.

In spite of the comparatively large number of samples the number of species did not amount to more than 27, but on the other hand most species were represented by a very large number of individuals. Of these copepoda only 63 per cent were found off the west coast, which may be accounted for by the fact that the latter were collected along the bottom at a considerable depth.

Of the species noted above the Agulhas Bank

78 per cent. have been found in the Mediterranean.
41 ,, ,, ,, ,, tropical Atlantic.
63 ,, ,, ,, ,, temperate Atlantic.
48 ,, ,, ,, ,, north of the Faröe Channel, in the North Sea and along the coasts of Scandinavia.

TABLE I. Copepoda, collected in April, 1900, west of South Africa.

No. of the sample (page 179)	1	2	3	4
Depth in metres	450	350	250	277
Acartia danæ	...	rr	rr	rr
Aethidius giesbrechti Cæ.	...	...	...	rr
Calanus brevicornis	...	...	r	c
——— finmarchicus	...	...	r	r
——— minor	r	...	+	r
——— tenuicornis	...	...	r	...
Calocalanus pavo	...	rr	...	...
Candacia chirura Cæ. n.sp.	rr	...	rr	rr
——— pachydactyla	rr	rr	...	rr
Clausocalanus arcuicornis	...	+	+	r
——— furcatus	...	r	...	...
Corycæus danæ	...	...	rr	...
——— furcifer	...	...	rr	...
——— ovalis	...	r	...	...
——— robustus	...	...	...	rr

	1	2	3	4
Euchæta marina	...	...	r	...
Gaëtanus armiger	rr	...	...	...
Heterorhabdus abyssalis	rr	...	...	...
——— papilliger	...	...	rr	...
——— spinifrons	...	...	rr	rr
Lubbockia aculeata	...	...	rr	...
Lucicutia flavicornis	...	...	rr	...
Metridia lucens	+	+	c	+
Oithona plumifera	...	...	...	rr
Oncæa conifera	r	...	+	r
——— media	rr	...	...	r
——— mediterranea	...	...	r	...
——— venusta	r	r	...	...
Paracalanus parvus	...	r	...	...
Pleuromamma abdominalis	r	+	r	r
——— gracilis	+	c	+	c
——— robusta	...	r	...	...
——— xiphias	rr	...	...	...
Pseudodiaptomus serricaudatus	...	r	...	...
Rhinocalanus nasutus	r	+	...	+
Sapphirina angusta	...	...	rr	...
——— salpæ	rr	...	...	...
——— sinuicauda	rr	...	...	...
Scolecithricella minor	...	rr	rr	rr
——— neptuni Cæ n.sp.	...	rr	rr	rr
Scolecithrix danæ	...	r	rr	...
Xanthocalanus fragilis	...	rr	...	rr

Table II. Copepoda, collected south of the Cape Colony.

No.	1	2	3	4	5	6	7	8	9	10	11
Depth in metres ...	37	62-74	65	60	60	69-71	37-58	63	40	53	71
Date ...	13 X 1898	6-13 VII 1900	29 VI 1900	12 IV 1900	22 VI 1900	11 VII 1900	24-29 VI 1898	23 X 1900	12 X 1900	26 IV 1900	30 XII 1898
Acartia danæ	...	r	...	...	...	...	...	...	...	...	...
Aethidius armatus	...	+	...	r	...	r	...	...	...	...	...
Calanus brevicornis...	+	...	...	...	...	r	r	...	...	c	...
——— finmarchicus ...	+	+	r	...	r	r	c	cc	+	...
——— minor ...	+	cc	c	c	c	cc	...	+	c	c	+
Calocalanus pavo	...	...	...	...	...	...	...	...	...	rr	...
Candacia bipinnata...	r	+	r	+	c	r	c	c	r	r	...
Centropages chierchiæ	+	r	...	...	...	r	r	...	...	+	...
——— typicus ...	c	r	...	...	...	r	...	...	...	+	r
Clausocalanus arcuicornis... ...	+	c	r	...	...	+	r	...	...	...	...
Corycæus ovalis	...	r	...	...	...	...	...	...	...	...	...
Eucalanus crassus ...	r	...	...	...	...	...	...	...	...	...	...
Euchæta spinosa	...	...	...	...	...	...	...	...	...	...	rr
Metridia lucens ...	+	+	r	...	...	r	...	...	...	...	...
Oithona nana ...	r	...	...	...	...	...	+	...	...	...	...
——— plumifera ...	r	...	...	...	...	...	...	...	...	...	...
——— similis ...	r	r	...	...	...	...	...	...	...	...	...
Oncæa conifera	...	r	...	...	...	...	...	...	...	r	...
——— mediterranea ...	...	r	...	...	...	...	...	...	...	...	...
——— subtilis ...	+	...	...	...	...	...	+	...	...	...	...
——— venusta	...	...	...	...	r	...	...	...	...	...	...
Paracalanus aculeatus ...	...	r	+	...	...	r	...	...	...	...	...
——— parvus ...	cc	r	...	...	...	...	cc	...	...	...	...
Pleuromamma gracilis ...	...	...	...	...	...	...	...	...	...	r	...
Pseudodiaptomus serricaudatus	...	c	r	...	...	c	c	...	...	...	...
Rhinocalanus nasutus	+	c	r	c	c	r	r	r	r	r	+
Xanthocalanus fragilis ...	rr	...	...	...	...	...	...	...	...	...	...

Copepoda of the Agulhas Current.

The samples examined were the following :—

1. (No. 11) Cape Natal W. by N. 6½ miles, 97 m. (57 fath.) 14.xii.1900, moderately fine net.
2. (No. 13) Port Shepstone N.W. by W.¾W. 12 miles, 530 m. (300 fath.) 5.xi.1901, moderately fine net.
3. (No. 71) Cape Natal N. by E. appr. 27 miles, 780 m. (440 fath.) 4.iv.1901, coarse net.
4. (No. 22) Port Shepstone N.W. by W.¾N. 12 miles, 900 m. (500 fath.) 5.xi.1901, moderately fine net.
5. Morewood Cove (Natal) N.W. by N.¾N. 3 miles, surface 17.xii.1900 (contained abundantly *Noctiluca miliaris*).
6. (No. 24) Port St. John between Anchorage and Bluff Point 29 m. 8.iv.1901, moderately fine net.

TABLE III. Copepoda, collected east of South Africa.

No.	1	2	3	4	5	6
Depth in metre	97	530	780	900	0	29
Date	17 xii 1900	5 xi 1900	4 iv 1901	5 xi 1901	17 xii 1900	8 iv 1901
Acartia danæ	...	rr	...	rr	...	...
Acrocalanus gibber	...	rr	...	...	...	r
——— gracilis	r	rr	...	...	c	r
Aegisthus aculeatus	...	..	...	rr	...	...
——— mucronatus	...	...	...	rr	...	...
Aethidius giesbrechti	...	rr	...	rr	...	...
Augaptilus palumboi	...	rr	...	...	...	...
Calanus brevicornis	+	...	...	...	...	r
——— darwini	...	r	r	r	r	...
——— finmarchicus	...	...	...	r	...	...
——— minor	...	...	...	...	...	r
——— tenuicornis	...	r	rr	...	...	...
——— vulgaris	r	r	+	r	r	r
Calocalanus pavo	...	rr	...	rr	...	...
Candacia catula	...	rr	rr	rr	...	...
——— curta	rr	...	...	r	...	...
——— inermis C: e, n.sp.	...	rr	...	...	...	...
——— pachydactyla	...	rr	rr	r	...	...
——— tenuimana	...	...	...	rr	...	...
——— truncata	...	...	...	rr	...	...
——— varicans	...	...	rr	rr	...	...
Centropages chierchiæ	r	rr	...	r	...	r
——— furcatus	...	...	...	r	...	...
——— typicus	r	...	...	...	r	r
Chiridius poppei	...	rr	...	rr	...	...
Chirundina streetsii	...	...	rr	rr	...	...
Clausocalanus arcuicornis	...	r	...	r	...	...
——— furcatus	...	r	...	...	+	...

	1	2	3	4	5	6
Conæa rapax	...	...	...	rr	...	...
Corycæus danæ	...	...	...	r	...	...
——— furcifer	...	...	...	rr	...	...
——— robustus	...	...	...	rr	r	...
——— speciosus	...	r	...	r	...	...
Eucalanus attenuatus	...	r	+	+	...	r
——— crassus	r	...	r	r	...	...
——— elongatus	...	+	+	+	...	...
——— monachus	r	...	...	r	...	...
——— mucronatus	r	...	...	r	...	...
——— pileatus	...	rr	...	...	...	...
——— subcrassus	...	...	r	r	...	...
——— subtenuis	r	r	r	r	...	...
Euchæta acuta	...	r	...	rr	...	...
——— affinis C: e, n.sp.	...	...	...	rr	...	...
——— longicornis	...	rr	...	...	...	...
——— marina	r	...	r	r	...	r
——— media	...	...	...	rr	...	...
——— tonsa	...	rr	...	...	...	...
Euchirella messinensis	...	rr	r	rr	...	...
——— venusta	...	...	...	rr	...	...
Gaëtanus armiger...	...	rr	...	rr	...	...
——— miles	...	rr	...	r	...	...
Heterorhabdus abyssalis	...	rr	...	r	...	...
——— austrinus	...	rr	rr	...	...	...
——— papilliger	...	r	...	r	...	...
——— spinifrons	...	r	r	r	...	...
——— tanneri	...	...	...	rr	...	...
Lucicutia aurita C: e, n.sp.	...	...	...	rr	...	...
——— bradyana C: e, n.sp.	...	...	...	rr	...	...
——— clausii	...	rr	...	rr	...	...
——— flavicornis	...	rr	...	rr	...	...
Labidocera acuta	r	...	...	...	+	...
Metridia brevicauda	...	...	...	rr	...	...
——— princeps	...	...	rr	rr	...	...
——— venusta	...	rr	...	...	...	...
Oithona plumifera	...	...	..	rr	...	...
———rigida	rr	...	...	...	...	...
Oncæa conifera	...	r	...	r	...	...
——— media	...	...	...	r	...	...
——— mediterranea	..	r	...	r	...	...
——— venusta	r	r	...	r	...	r
Pachysoma tuberosum	...	...	...	rr	...	...
Phaënna spinifera	...	...	...	rr	...	...
Phyllopus bidentatus	...	...	...	rr	...	...
Pleuromamma abdominalis	...	c	+	+	...	...
——— gracilis	r	+	+	+	...	...
——— robusta	...	...	...	r	...	...
——— xiphias	...	r	r	r	...	...
Pontella securifer	...	...	...	rr	...	...
Pontellina plumifera	...	rr	rr	rr	...	...
Rhinocalanus cornutus	r	+	+	r	...	...
——— nasutus	r	rr	r	...	...	...
Sapphirina gemma	...	...	...	rr	...	...
——— nigromaculata	...	...	...	rr	...	...
——— opalina	...	r	...	rr	...	...
——— sinuicauda	...	...	...	...	rr	...
Scolecithrix danæ	...	+	+	+	...	r
——— persecans	...	...	...	rr	...	...
——— securifrons	...	r	...	rr	...	...
Temora discaudata	...	rr	...	...	...	...
——— stylifera	...	...	...	...	rr	...
Undechæta major	...	...	...	rr	...	...
——— minor	...	...	rr	rr	...	...

The number of species found east of South Africa amounts thus to 92. The geographical distribution will be found as follows :—

In the western Pacific, east of South America, have been found	...	80 per cent.
In the Indian Ocean ...	...	64 „ „
In the temperate Atlantic ...	...	55 „ „
In the Mediterranean ...	...	50 „ „
In the tropical Atlantic ...	...	19 „ „
North of the Faröe Channel	...	8 „ „

There is thus, as concerns the copepod-fauna, a very considerable resemblance between the region west of South America and the Agulhas Current.

List of Species of Copepoda Found Round South Africa and their Geographical Distribution.

In the following I have not indicated the literature, because the reader will find in most cases sufficient references in the works of Giesbrecht: "Copepoda, Gymnoplea" in "Das Thierreich," Berlin, 1898, and "Systematik und Faunistik der pelagischen Copepoden des Golfes von Neapel," Berlin, 1892.—In some few cases only references have been necessary.

Abbreviations for authorities are :—

B. Brady.
C:e. Cleve.
Cls. Claus.
D. Dana.
G. Giesbrecht.
L. Lubbock.
N. Norman.
A. S. A. Scott.
A. S. & T. A. Scott and I. C. Thompson.
G.O.S. Sars.
T. S. T. Scott.
T. I. C. Thompson.
a.o. and others.

Acartia danœ, Giesb.—Sparingly E., S. and W. of South Africa.

G.D.—Pacific 18°N.—3°S. 171°E.–80°W. (G.).—*Atlantic:* Benguela Current, 30°S. 11°E. (C:e). Cape Verde Region (G.), 34°—39°N.12°—66°W. (C:e). *West* Mediterranean (C:e).

Acrocalanus gibber, Giesb.—Agulhas Current.

G.D.—Hongkong (G.). S.E. of New Guinea (A.S.). Malay Archip. (C:e). Ceylon (A.S. & T.). Arabian Sea, Red Sea (C:e, G., a.o.). From 11°N.84°E. to 16°S.42°E. (T.). Along the east coast of Africa from the Gulf of Suez to 30°S. (T.).

Acrocalanus gracilis, Giesb.—Agulhas Current.

G.D.—Pacific 20°N—4°S. (G.). *Indian Oc.*, Malay Archip. (C : e). Ceylon to Socotra (A.S & T.), Arabian Sea and Red Sea (C:e), 2°S. 84°E. (C:e).

Aegisthus aculeatus, Giesb.—Agulhas Current.

G.D.—Pacific 3°S. 99°W. (G.). Atlantic, 52°N. 16°W., haul from 1410 m. (T.).

Aegisthus mucronatus, Giesb.—Agulhas Current.

G.D.—Pacific 3°S. 99°W. (G.) *Atlantic*, Gulf of Guinea (*A. longirostris* T.S. partim), 52°N. 12°—16°W., hauls from 2264 and 664 m. (T.).

Aethidius armatus, Boeck.—G. O. Sars: Crustacea of Norway, Calanoida, p. 25 P. XIII., XIV. *A. a.* Brady, partim, *vide* G.O. Sars.—Sparingly south of the Cape Colony.

G.D.—Shetland, Orkney (T.S.). Shagerak. (C : e). Off south and west Norway from Christiania to 71°N. (G.O.S.)—Other localities doubtful, because this species has been confounded with the following. The South African specimens agreed perfectly with the northern. They were only a little smaller or 1,6 millim. in length (1,8 millim. according to G.O.S.)

Aethidius giesbrechti, C:e—nomen nov. (A. *armatus* Giesb. F. Neap. p. 213).—Very rare east and west of South Africa.

G.D.—3°S-11°N. 99°-124°W. (G.) Gibraltar (G.)

Augaptilus palumboi, Giesb.—One specimen, Agulhas current.

G.D.—Pacific 3°S. 99°W., 1800 m. (G). *North Atlantic*, 52°N. 16°W., haul from 1905 m. (T.).

Calanus brevicornis, Lubbock.—Common south and west of the Cape Colony, sparingly east of Natal.

G.D.—41°S. 45°E., 35°S. 18°E. and 1°S. 1°W. (L.) 20°S. 38°W. (G.), 14°-18°N., 18°W. (C:e). Off Gibraltar (G.).

Calanus darwini (Lubbock).—Agulhas current.

G.D.—Pacific 0°-14°N. 91°—97°W., and the tropical part (G.). *Malay Archip.* (C:e). N.W. Indian Ocean, Arabian Sea and Red Sea (various authors). East of Africa 8°N. (T.). *Atlantic* 37°N. 46°W. (B.), 1°S. 1°W. (L.), 26°N. 34°W. (B.).

Calanus finmarchicus (Gunnerus).—Common south of the Cape Colony, rare east and west.

G.D.—Port Townsend (T.). Along the west coast of South America, from 8°N to "Jungfernkap" (G.), 37°S. 133°W. (B.), Hongkong (G.)—Arctic Sea and North Atlantic to 39°N. in the west and 29°N. in the east (C:e). Off Gibraltar, west Mediterranean (G., C:e). Adriatic (Grobben).

Calanus minor, Cls.—Very common south of the Cape Colony, rarer west thereof and extremely rare in the east.

G.D.—Pacific 34°-0°N. 91°-132° W. (G). West of South America, from Caldera to the Equator (G.). North and west of Australia (B.). S.E. of New Guinea (A.S.), Malay Archip. (C:e). *Indian Ocean*, 14°-13°-N. 60°-54°E. (G.). Ceylon and the north west Indian Ocean, Arabian Sea, Red Sea (T., A.S., C:e.). *Atlantic* : Benguela Current to Cape Verde (G., C:e). North Equatorial and Antilles currents, Florida current to 48°N. 29°W. (C:e). *Mediterranean* (G.)

Calanus tenuicornis, Dana.—Sparingly east and west of South Africa.

G.D.—Pacific : 40°N. 137°W. (D.), between 40°N. and 3°S. (G.). *Atlantic*, 22°-34°N. 53°-28°W. (C:e). Gibraltar (G.)—Mediterranean (G., C:e). 52°N. 15°W., haul from 1078 m. (T.).

Calanus vulgaris (Dana).—Agulhas Current.

G.D.—Pacific 20°N.-8°S. (G.). Sandwich Islands, Fiji Islands, N. and E. of Australia, New Guinea, Philippines (B.), Samoa, Banka Straits (D.), Hong Kong (G.), Malay Archip. (C:e).—N.W. *Indian Ocean* (C:e, A.S. and T.), Red Sea (various authors), East Africa from Socotra to 28°S. (T.).—*Atlantic*, Gulf of Guinea (T.S., C:e), Brazil Current (C:e), North Equatorial, Antilles and Florida Currents to 46°N. 38°W., the Azores and Cape Verde Islands (C:e).—*Mediterranean* (various authors).

Calocalanus pavo, Dana—Sparingly round South Africa.

G.D.—East *Pacific* 12°N.-3°S. (G.) S.E. of New Guinea (A.S.), Malay Archip. (C:e). N.W. *Indian Ocean* and Arabian Sea (A.S. & T., C:e), Red Sea (A.S., C:e), East of Africa 28°S. (T.).—*Atlantic*, Gulf of Guinea (T.S., C:e), Equatorial Antilles and Florida Currents to 56°N. 12°-26°W., Azores and the Canaries (C:e).—*Mediterranean* (various authors).

Candacia bipinnata, Giesb.—Common south of the Cape Colony.

G.D.—East *Pacific* 24°N.-3°S. (G.), West of Australia (G.).

Candacia chirura, C:e, n.sp.—West of South Africa, 250–350 m., sparingly.

Candacia catula, Giesb.—Agulhas Current.

G.D.—Pacific, Panama and 5°N. 115°W. (G.), Malay Archip. (C:e). *Indian Ocean* from Ceylon to Socotra (A.S. & T.), Arabian Sea (C:e), Red Sea (G., A.S., C:e).

Candacia curta, Dana.—Agulhas Current.

G.D.—Pacific Ocean, 0°N. 88°W. and Caldera. (G.)—*Indian Ocean*, Ceylon to Socotra (A.S. & T.), Arabian Sea (C:e), Red Sea (G., C:e), 50°S. 81°W. (D.), 30°S. 38°W. (G.), Gulf of Guinea (T.S.).

Candacia inermis, C:e n.sp.—Agulhas Current, 530 m.

Candacia pachydactyla, Dana.—East and west of the Cape Colony.

G.D.—Pacific 0°–12°N. 87°W.–110°E. (G.). East of Australia, Fiji Islands, Philippines (B.), South China Sea (D.) Malay Archip. (C:e).—*Indian Ocean*, from Ceylon to Socotra (A.S. & T.), Arabian Sea (C:e), 5°S. 83°E. (C:e).—*Atlantic*, South Equatorial Current (B.), North Equatorial and Florida Currents (C:e).

Candacia tenuimana, Giesb.—Agulhas Current.

G.D.—Pacific, 16°N. 166°E. (G.), Mediterranean (G.).

Candacia truncata, Dana.—Agulhas Current.

G.D.—Pacific, 9°–15°N. 119°–138°W. (G.), Samoa and Kingsmill Islands, Sulu Archip., Ellice Islands (D.).—*Indian Ocean*, Ceylon to Socotra (A.S. & T.), Red Sea (C:e); from 0°S. 64°E. to 20°S. 39°E. (T.), East of Africa 20°–28°S. (T. , 3°–5°S. 83°E. (C:e). *Mediterranean* (T.).

Candacia varicans, Giesb.—Agulhas Current, 900 m. *rr.*

G.D.—Western Mediterranean (G.).

Centropages chierchiæ, Giesb.—Round South Africa.

G.D.—Indian Ocean, Ceylon and Minikoi (A.S. & T.).—*Atlantic*, 38°–48°N. 10°–25°W. (C:e), 52°N. 11°W. (T.), Gibraltar (G., a.o.), West *Mediterranean* (C:e).

Centropages furcatus, Dana.—Agulhas Current.

G.D.—West of America 10°N.–10°S. (G.), east and north of Australia (B.), S.E of New Guinea (A.S.), Philippines (B.), Malay Archip. (C:e), Banka Straits (D.), from the Bay of Bengal to Mozambique (T.), Ceylon to Socotra (A.S. & T.), Arabian and Red Sea (C:e, A.S., T.).—*Atlantic*, Gulf of Guinea (T.S., C:e), Brazil Current (C:e), North Equatorial Current (C:e), Mediterranean (T.).

Centropages typicus, Kröyer.—Agulhas Current and Agulhas Bank.

G.D.—Atlantic : Gulf of Guinea, W. of Africa and Europe to 64°N. off the coast of Norway. Azores to the Newfoundland Banks and 38°N. 74°W. in the south ; north of Iceland (C:e). *Mediterranean* (various authors). Adriatic (Car.).

Chiridius poppei, Giesb.—Agulhas Current.

G.D.—West Mediterranean (G.).

Chirundina streetsi, Giesb.—Agulhas Current 780-900 m. *rr.*

G.D.—Pacific Ocean : 35°N.125°W. haul from 530 m. (G.).

Clausocalanus arcuicornis, Dana.—Round South Africa.

G.D.—Pacific : West of South America to 53°S., off California (G.), 20°N.-26°S. (G.).—*Indian Ocean* : 6°N.-36°S., 92°-89°E. (C:e). Malay Archip. (C:e). Bay of Bengal (T.). N.W. Indian Ocean, Arabian Sea, Red Sea (C:e, a.o.). 16°S. 43°E. (T.).—*Atlantic* : Benguela Current, Gulf of Guinea, Cape Verde, area between Madeira, Gibraltar, the English Channel, 56°N. 31°W., the east of New York and the Azores (C:e).—*Mediterranean* (various authors). Adriatic (Car.).

Clausocalanus furcatus, Brady.—Sparingly east and west of South Africa.

G.D.—Pacific : California Current 34°N. 131°W. (G.). 20°N.-26°S. until 175°W. (G.)—S.E. of New Guinea (A.S.). Malay Archip. (C:e)—*Indian Ocean* : 8°-6°N. 72°-95°E., Arabian Sea, Red Sea (C:e). Aden to 7°N. 77°E. (A.S.).—*Atlantic* : Brazil Current, Equatorial Currents, Antilles and Florida Currents, Sargasso Sea and Canary Current ; northern limit 40°-46°N. (C:e). West Mediterranean (G).

Conæa rapax, Giesb.—Agulhas Current, 900 m., *rr.*

G.D.—East *Pacific* 13°N.-3°S. 99°-132°W. (G.)—S.E. of New Guinea (A.S.)—*Atlantic :* 52°N. 15°–16°W., haul from 270 and 900m. (T.), Faröe Channel 1060m. (N.)

Corycæus danœ, Giesb.—Sparingly east and west.

G.D.—Pacific : 34°N. 131°W. and 19°N.–3°S. 88°–175°W. (G).—Malay Archip. (C:e).—*Indian Ocean :* Bay of Bengal (T.), Ceylon to Socotra (A.S. & T.), Arabian Sea (C:e), Red Sea (C:e., a.o). Mediterranean (T.).

Corycæus furcifer, Cls.—Agulhas Current and West of South Africa.

G.D.—Pacific : 11°N-3°S. 99°-124°W. (G.).—Malay Archip. (C:e).—*Indian Ocean :* Bay of Bengal (T.). Ceylon and N.W., Indian Ocean (A.S. & T.), east of Africa 16°-20°S (T.). Mediterranean (Cls., a.o.).

Corycæus ovalis, Cls.—Agulhas Bank *rr.*, W. of South Africa *rr.*

G.D.—Malay Archip. (C:e). Ceylon and N.W. Indian Ocean (A S. & T). Arabian Sea (C:e) Red Sea (C:e, a.o.). East of Africa 12°S. (T.)

Atlantic : Gulf of Guinea to Cape Verde, Brazil Current to 16°S 34°W., North Equatorial, Antilles, Florida Currents to 45°N. 16°W., Azores (C:e). Mediterranean (Cls., a.o.).

Corycæus robustus, Giesb.—Agulhas Current *rr.*

G.D. East Pacific Ocean : 20°N.-7°S. (G.). S.E. of New Guinea (A.S.), Malay Archip. (C:e). *Indian Ocean*, 6°N. 86-95°E., Arabian Sea, Red Sea (C:e, A.S. & T.).

Corycæus speciosus, Dana.—Agulhas Current.

G.D.—East *Pacific* 5°N.–25°S. until 137 E. (G.)—S.E. of New Guinea (A.S.).—*Indian Ocean:* Bay of Bengal (T.). From Ceylon to Socotra (A.S. & T.), Arabian Sea (C:e), Red Sea (A.S., C:e), East of Africa 8°N.–17°S. (T.).—*Atlantic:* from St. Helena to the Gulf of Guinea and Cape Verde, Equatorial, Antilles, and Florida Currents until 42°N. 62°–50°W., Azores and Canaries, exceptionally until 51°N. 20°W. (C:e), West of Ireland (T.), Brazil Current until 33°S. 15°–16°W. (C:e), Mediterranean (G.).

Eucalanus attenuatus (Dana.)—Agulhas Current.

G.D.—East *Pacific* 15°N.–15°S. (G.), California Current 25°N. 110 W. (G.), Kingsmill Island, China Sea. (D.) Malay Archip. (C:e).—*Indian Ocean* from 7°N. 82°E. to 20°S. 39°E. (T.), Ceylon and the N.W. Indian Ocean (A.S. & T.), Red Sea (C:e), 5°S. 83°E. (C:e), East of South Africa 12–17°S (T.). —*Atlantic:* Gulf of Guinea (T.S.), Mediterranean (various authors), Bay of Biscay (L.), 52°N. 12°–16°W., hauls from 900 and 1095 m. (T.), 56°N. 19°–12°W. (T.), N.N.W. of Ireland (N.), Faröe Channel (N.), 39°N. 66°–64°W. (C:e).

Eucalanus crassus, Giesb.—Agulhas Current. False Bay.

G.D.—*Pacific:* 19°–20°N. 138°E–175°W., west of South America 14°–26°S. (G.), Malay Archip. (C:e).—*Indian Ocean:* Ceylon (A.S. & T.), Red Sea (A.S. & T.). — *Atlantic:* Brazil Current (G.), Gulf of Guinea (T.S.), Mediterranean (G.), Faroë Channel (Wolfenden), N. and N.E. of Scotland (T.S.), Skagerak, exceptionally (C:e).

Eucalanus elongatus, Dana.—Agulhas Current.

G.D.—Along the west coast of South America from Valparaiso northwards 6°-35°N. 81°-125°W., east Pacific 14°N.-3°S. until 132°W. (G.), east of Kamtschatka (G.)–Sulu Archip., N. of Celebes (D.).—*Atlantic:* Gulf of Guinea (T.S.), 33°N. 32°W. (C:e), W. of Gibraltar, Mediterranean (G.), 52°N. 15°W. haul from 1006 m. (T.), 60°N. 7°W. (T.S.), N. and N.E. of Scotland, Moray Firth (T.S.), Skagerak 160 m. (Aurivillius).

Eucalanus monachus, Giesb.—Agulhas Current.

G.D.—Malay Archip. (C:e). Ceylon (A.S. & T.). Gulf of Aden (C:e). Off Gibraltar, Mediterranean (G.).

Eucalanus mucronatus, Giesb.—Agulhas Current.

G.D.—Pacific 16°-19°N. 175°W.-166°E. (G.). Malay Archip., Arabian Sea (C:e).

Eucalanus pileatus, Giesb.—Agulhas Current.

G.D.—West of South America 10°N.-3°S. (G.). Ceylon, Maldives and the Red Sea. (A.S. & T.).

Eucalanus subcrassus, Giesb.—Agulhas Current.

G.D.—West of South America 10°N.-3°S., Amoy, Hongkong (G.)—Malay Archip. (C:e).—Ceylon, Minikoi. (A.S. & T.) Red Sea (G., A. S. & T.)—Atlantic, Gulf of Guinea and off Cape Verde (C:e).

Eucalanus subtenuis, Giesb.—Agulhas Current.

G.D.—East *Pacific*, 15°N.-26°S., until 138°W. (G.)– Malay Archip. (C:e)—*Indian Ocean*, Ceylon (A.S. & T.). Arabian Sea (C:e). Red Sea (A.S.). 8°N.74°E. (A.S.) –*Atlantic*, 6°-5°S. 8°E-17°W. (C:e). Off Cape Verde (G., C:e).

Euchæta acuta, Giesb.—Agulhas Current.

G.D.—Mediterranean (G., A.S. & T.) Atlantic, 52°N.16°W., haul from 2264m. (T.).

Euchæta affinis, C:e, n.sp.—Agulhas Current.

Euchæta longicornis, Giesb.—Agulhas Current.

G.D.—West of South America 3°-6°N. (G.). Malay Archip. (C:e).

Euchæta marina, Prestand.—East and West of South Africa.

G.D.—West of South America 20°N.-26°S until 110°E.—South of Australia, Crozet Island (B.). Malay Archip (C:e). Ceylon to Socotra (A.S. & T.). 3°S. 83°E. (C:e). Arabian Sea, Red Sea (C:e). From Calcutta to Madagascar (T.). *Atlantic*, 32°N.-38°S. (B.). South Equatorial and Brazil Currents, North Equatorial, Antilles, and Florida Currents, Sargasso Sea, Azores and the Canaries, rarely until 51°N.-20°W. (C:e), 49°-56°N. 19°-68°W. (T.) Mediterranean (various authors).

Euchæta media, Giesb.—Agulhas Current.

G.D.—Pacific 16°N. 163-166°E., 1500m. (G.)

Euchæta spinosa, Giesb.—S.E. coast 33°S. 28°E. 71 m.

G.D.– Mediterranean (G.)

Euchæta tonsa, Giesb.—Agulhas Current, 530 m. *rr.*

G.D.—Pacific, 35°N. 125°W., haul from 530 m. (G.).

Euchirella messinensis, (Cls.)—Agulhas Current.

G.D.—Indian Ocean, Minikoi (A.S. & T.). 23°S. 61°E. (C:e).

? Gulf of Guinea (T.S.)—Mediterranean. (Cls., G.).

Euchirella venusta, Giesb.—Agulhas Current, 900 m. (length of the anterior part of the body 4 millim., of the posterior part 1 millim.).

G.D.—West of South America at the Equator (G.).

Gaëtanus armiger, Giesb.—Agulhas Current and off Table Mountain.

G.D.—Pacific : 5°N.-3°S. 99°-115°W. (G.).—*Atlantic* : Gulf of Guinea (T.S.). 52°N. 16°W., haul from 1420 m. (T.). Faröe Channel 1060 m. (N.)

Gaëtanus miles, Giesb.—Agulhas Current 530 and 900 m.

G.D.—Pacific : 35°N. 125°W., 3°S. 99°W. (G.).—*Atlantic* : 52°N. 12°-16°W. hauls from 900 and 1095 m. (T.). Faröe Channel 1060 m. (N.).

Heterorhabdus abyssalis, Giesb.—Agulhas Current, 530-900 m., *rr.* Off Table Mountain, 450 m., *rr.*

G.D.—Pacific, 14°N. 132°W. (G.)—N.W. Indian Ocean (A.S. & T.). Atlantic, 52°N. 16°W. haul from 1655 m. (T.).

Heterorhabdus austrinus, Giesb.—(Expedition Antarctique Belge, Copepoden, p. 28, P. VI., 1902).—Agulhas Current, 530 to 780 m., *rr.*

G.D.—Antarctic Ocean, 70°S. 84°W. haul from 250 m. (G.).

Heterorhabdus papilliger (Cls.)—Agulhas Current and off the West Coast, *rr.*

G.D.—Pacific, 19°N.-3°S. 175-99°W. (G.).—N.W. Indian Ocean (A.S. & T.)—Gulf of Aden (C:e).—Mediterranean (Cls., G.).—Atlantic, 52°N. 16°W., haul from 2580 m. (T.).

Heterorhabdus spinifrons (Cls.).—East and west of the Cape Colony, *rr.*

G.D.—Pacific, 30°S. 90°W. and 14°N. 160°E. (G.).—Minikoi and N.W. Indian Ocean (A.S. & T.)—Atlantic, 52°N. 15°-16° W., hauls from 664 and 1710 m. 55°-56°N. 32°-44°W. (T.).—Mediterranean (Cls., G.).

Heterorhabdus tanneri, Giesb.—Agulhas Current, *rr.*

G.D.—Pacific, 35°N. 125°W., haul from 530 m. (G.).

Labidocera acuta (Dana).—Agulhas Current.

G.D.—Pacific, 26°N. 110°W. and between 10°N. and 10°S. (G.). Hongkong (G.). Port Jackson (B.).—Malay Archip. (C:e). Indian Ocean, 8°-13°N. 54°-75°E. (G.)—Bay of Bengal (T.). From Ceylon to Socotra (A.S. & T.). Arabian Sea (C:e). Red Sea (various authors). East of Africa, 9°S. (T.), 27°S. 49°E. (C:e).—Gulf of Guinea (T.S.).—Isle of Man (T.).

Lubbockia aculeata, Giesb.—West side of the Cape Colony, 277 m., *rr.*

G.D.—Pacific, 0°N, 108°W. (G.). Red Sea (C:e). Mediterranean (G.).

Lucicutia aurita, C:e, n.sp.—Agulhas Current, 900 m. *rr.* (C:e).

Lucicutia bradyana, C:e, n.sp. (? *L. grandis*, Giesb.)—Agulhas Current, 900m., *rr.*

G.D.—*L. grandis* has been found by Giesb. in the Pacific, 1°N. 83°W.

Lucicutia clausii, Giesb.—Agulhas Current, 530 and 900 m.

G.D.—Pacific, 3°S. 99°W., 1800 m. (G.). Malay Archip. (C:e). Mediterranean (G.)—Atlantic, 52°N. 15°W., haul from 918m. (T.).

Lucicutia flavicornis (Cls.).—Agulhas Current, 530 and 900 m., *rr.* West of the Cape Colony, 250 m. *rr.*

G.D.—Pacific, 12°N.-3°S. 87°-128°W. (G.)—Indian Ocean, from Ceylon to Socotra (A.S. & T.). Red Sea (A.S., C:e)—Atlantic: Antilles and Florida Currents until 40°N. 56°W., Sargasso Sea, Azores and 34°N. 10°W., (C:e)—Mediterranean (various authors).

Metridia brevicauda, Giesb.—Agulhas Current, 900 m. *rr.*

G.D.—Pacific, 16°N.-3°S. 99°W.-166°E. 1000 to 4000 m. (G.).

Metridia lucens, Boeck.—Abundant south and west of the Cape Colony.

G.D.—Mediterranean (A.S. & T.). Atlantic, from Nova Scotia to Ireland and the Faröe Channel, North Sea, Skagerak and along the coast of Norway to 71°N. (C:e). Iceland (T.).

Metridia princeps, Giesb.—Agulhas Current, 780 and 900 m. *rr.*

G.D.—Pacific, 3°S. 99°W. 1800 m. (G.)—Atlantic, Gulf of Gascogne (*vide* Giesbrecht), 52°N. 16°W., haul from 2580 m. (T.). 62°N. 56°W., (N.).

Metridia venusta, Giesb.—Agulhas Current, 530 m.

G.D.—Pacific, 16°-5°N. 115°-166°E. 450-1000 m. (G). Atlantic, 52°N. 16°W., haul from 2825m. (T.).

Oithona nana, Giesb.—(Van Beemen: Publications de circonstance du Conseil intern. pour l'exploration de la mer Nr. 7, 1903).—South of the Cape Colony.

G.D.—S.E., of New Guinea (A.S.)—Malay Archip. (C:e). Ceylon (A.S. & T.). Arabian Sea (C:e). Red Sea. (G.)—Mediterranean (G.). Atlantic, 36°N. 6°W., (C:e), S.W. of Ireland (T.), English Channel, coasts of Holland, North of Jutland, West of Sweden (C:e).

Oithona plumifera, Baird.—E. and W., of the Cape Colony. False Bay.

G.D.—Pacific : 20°N.-3°S. 99°W.-166°E., 0°N. 91°W. (G.). New Guinea. (A.S.). Malay Archip. (C:e). Bay of Bengal to 20°S. 39°E. (T.). Ceylon to Socotra (A.S. & T.). Arabian Sea (C:e). Red Sea (C:e., a.o.). Atlantic : 33°S-40°N., North thereof sparingly, North Sea, Skagerak, off the coast of Norway into the Murman Sea (C:e).

Oithona rigida, Giesb. - C:e Kongl. Siv. Vet. Akad. Handl. XXXV., n. 5 p. 45. P. V., f.7-18, 1901—Agulhas Current 97 m. *rr.*

G.D.—Malay Archip. (C:e). Ceylon and Minikoi (A.S. & T.). Gulf of Aden (C:e). Red Sea (G.).

Oithona similis, Cls.—South of the Cape Colony, sparingly (probably because the nets used were too coarse).

G.D.—Cosmopolitan, also in the Antarctic Seas, 70°-71°S. 81°-92°W. (G.), and in the Polar Basin, off the New Siberian Islands (G.O.S). Off Franz Josef Land (C:e).

Oncæa conifera, Giesb.—Sparingly round the Cape Colony.

G.D.—Pacific, 12°N.-3°S. 87°-132°W. down to 4000 m. (G.), S.E. of New Guinea (A.S.), Malay Archip. (C:e), N.W. Indian Ocean (A.S. & T.), Arabian Sea (C:e), Red Sea (A.S., C:e), East of Africa, 12°-17°S. (T.)—Antarctic Ocean 70°-71°S. 83°-90°W. (G.).

North Siberian Sea, 78°N. 136°E. (G.O.S.), West of Greenland (Vanhœffen), St. Lawrence Gulf (T.), North Atlantic, 71°N. 21°W. to 62°N. 1°E. in 50 and more metres (C:e), Faröe Channel, 900 m. (N.), south coast of Norway (G.O.S.), Skagerak exceptionally (C:e), Azores rarely (C:e), Mediterranean (G.).

Oncæa media, Giesb.—Agulhas Current and off Table Mountain.

G.D.—Pacific, 5°N.-3°S. 99°-115°W. (G.), Malay Archip. (C:e), from Ceylon to Socotra (A.S. & T.), Arabian Sea (C:e). Red Sea (A.S., C:e).

From the east coast of the Cape Colony to the Cape Verde Islands, east of Rio Janeiro, Antilles and Florida Currents to 47°N. 41°W., the Azores and the Canaries (C:e), Mediterranean (G., a.o.).

Oncæa mediterranea (Cls). — Round the Cape Colony, sparingly.

G.D.—Pacific, 12°N.-3°S. 99°-132°W., 34°N. 131°-132°W. (G.), Malay Archip. (C:e), Bay of Bengal (T.), from Ceylon to Socotra (A.S. & T.), Arabian Sea (C:e), Red Sea (C:e, A.S.), East of Africa 8°N. (T.).—Atlantic : South Equatorial and Florida Currents to 40°N. 22°W., Sargasso Sea (C:e), Mediterranean (Cls, a. o.), 52°N. 16°W., haul from 900 m. (T.).

Oncæa subtilis, Giesb.—South of the Cape Colony.

G.D.—Benguela Current 32°S. 13°E.; 39°-49°N. 6°-24°W. (C:e), Mediterranean (G. C:e), Faröe Channel (Wolfenden, *vide* G.), Skagerak, once sparingly (C:e).

Oncæa venusta, Phil.—Round the Cape Colony.

G.D.—Pacific, 20°N.-4°S. 87°W.-137°E. (G.). S.E. of New Guinea (A.S.), Malay Archip. (C:e). From 19°N. 87°E. to 20°S. 39°E. (T.), from Ceylon to Aden (A.S.). Arabian Sea (C:e). Red Sea (C:e., A.S.). East of Africa 12°-28°S. (T.).

West of the Cape Colony (C:e). Brazil Current (G.), until 37°S. 36°W. (C:e). North Equatorial and Florida Currents to 41°N. 57°-58°W., Azores and the Sargasso Sea. (C:e). Mediterranean (various authors). 56°N. 18°-24°W. (T.).

Pachysoma tuberosum, Giesb.—Agulhas Current, 900 m. *rr.*

G.D.—Gulf of Panama (G.)—3°30°S. 83°30°E., surface (C:e).

Paracalanus aculeatus, Giesb.—South of the Cape Colony, sparingly.

G.D.—E. Pacific 10°N.-10°S., until 119°W. (G.). Hongkong (G).—S.E., of New Guinea (A.S.). Indian Ocean, 6°N. 92°E. (C:e). Arabian Sea (C:e). Red Sea (various authors)—Atlantic: from Ascension to Cape Verde, North Equatorial, Antilles, and Florida Currents to 41°N. 56°W. (C:e). West Mediterranean (C:e.).

Paracalanus parvus, Cls.—South of the Cape Colony.

G.D.—West of South America, 55°-10°S. (G.)—East of Australia (G.)—0°N. 108°W. (G.)—Hongkong (G.)—S.E., of New Guinea (A.S.). From 9°N. 71°E. to Aden (A.S.). Red Sea (A.S.).

Atlantic: West of the Cape of Good Hope, Gulf of Guinea, Cape Verde, Azores, Mediterranean, English Channel, Faröe Channel, North Sea to 61°N., Skagerak, south of Norway, Kattegatt (C:e). West Baltic (Mœbius.).

Brazil Current (C:e). North Equatorial and Florida Currents to the Newfoundland Banks (C:e).

Phaënna spinifera, Cls.—Agulhas Current, 900 m. *rr.*

G.D.—Pacific, 3°S. 99°W. and 14°N. 160°E., in 500 m. (G.). N.W. Indian Ocean (A.S. & T.). Gulf of Aden (C:e). Red Sea (A.S. & T.). From 3°S. 54°E., to 20°S. 39°E. (T.)—Mediterranean (G.).

Phyllopus bidentatus, Brady.—Agulhas Current, 900 m. *rr.*

G.D.—Pacific, 3°S. 99°W., 1800 m. (G.)—South Atlantic, 37°S. 46°W. (B.), Gulf of Guinea (T.S.), 52°N. 15°W., haul from 1060 m. (T.), Faröe Channel, 1060 m. (N).

Pleuromamma abdominalis, Lubbock.—East and West of the Cape Colony.

G.D.—Pacific : 36°N. 125°W., 16°N.-26°S. (G). Malay Archip. (C:e). From Calcutta to Mozambique (T.). 23°S. 61°E. (C:e). Along the east coast of Africa 12°-20°S. (T.) Ceylon and the N.W. Indian Ocean (A.S. & T.). Red Sea (various authors).

Atlantic : Gulf of Guinea (T.S., L.), Cape Verde Islands (C:e). Mediterranean (Cls., G.). 40°-50°N. 56°-31°W. (C:e). 52°N. 12°-16°W. (T.). From the north of Ireland to St. Lawrence Gulf (T.). Faröe Channel (T.).

Pleuromamma gracilis, Cls.—Round the Cape Colony.

G.D.—Pacific, 16°N.-26°S. (G.)—Malay Archip. (C:e). Indian Ocean, 13°-14°N. 54°-60°E. (G), from Ceylon to Socotra (A.S. & T.).—Gulf of Aden (C:e).—Atlantic : South of the Azores to 40°-50°N. 16°-64°W., (C:e). 52°N. 16°W., haul from 2825 m. (T.).—Mediterranean (G.).

Pleuromamma robusta, Dahl.—G. O. Sars. Crust. of Norway, Calanoida, p. 115 Pl. LXXVIII., LXXIX, 1903.—East and west of the Cape Colony.

G.D.—Arabian Sea, Gulf of Aden, Red Sea (C:e).—Atlantic : North of Ireland (N.), Faröe Channel (Wolfenden), North of the Faröe Channel, 200 to 400 m. (G.O.S.), West Norway, off Aalesund (G.O.S.).

Pleuromamma xiphias, Giesb.—Agulhas Current, 530 to 900 m. off Table Mountain, 450 m.

G.D.—East Pacific, 20°N.-3°S. 99°W.-160°E. (G.)—? Off Gibraltar (A.S. & T.).

Pontella securifer, Brady. — Agulhas Current, one single specimen.

G.D.—Port Townsend (T.)—Pacific, 33°-25°N. 138°-110°W., 16°N.-20°S. 109°W.-165°E. (G.). Indian Ocean, 8°N. 72°E. (G.). Ceylon and Minikoi (A.S. & T.), 2°-3°S. 83°-84°E. (C:e). Atlantic : Gulf of Guinea (T.S.), 5°-18°S. 24°-40°W. (G.).

Pontellina plumata, Dana.—Agulhas Current.

G.D.—Pacific, 34°-13°N. 97°-131°W., 15°N.-9°S. 80°W.-137° E. (G.). Kingsmill Islands and 1°-3°N. 173°E. (D.). Between Port Jackson, Fiji Islands and the Philippines (B.). Malay Archip. (C:e). From Ceylon to Socotra (A.S. & T.). Arabian Sea (C:e). Red Sea (A.S., C:e), 2°S. 84°E. (C:e). East of Africa, 25°S. (T.).—Atlantic : off the Cape of Good Hope (D.), Gulf of Guinea (T.S., a.o.), along the west coast of Africa to Cape Verde, the Azores (C:e, a.o.). Mediterranean (various authors). Brazil Current, 5°N.-25°S. 24°-44°W. (G.).

Pseudodiaptomus serricaudatus, T. Scott.—South of the Cape Colony, as a rule common.

G.D.—Ceylon and the N.W. Indian Ocean (A.S. & T.). Arabian Sea (C:e). Aden (A.S.). Tropical western Africa (T.S.).

Rhinocalanus cornutus, Dana.—Agulhas Current, not rare.

G.D.—East Pacific, 15°N.-7°S., 138W. (G.). Sulu Sea (D.), Philippines (B.), Malay Archip. (C:e). Bay of Bengal (T.). Ceylon and the N.W. Indian Ocean (A.S. & T.). Arabian Sea (C:e). Red Sea (A.S.), East of Africa, 3°N.-20°S. (T.).—Gulf of Guinea (T.S.). West Africa, 1°-27°N., Canaries (D., L., T.), Mediterranean (G., a.o.). Antilles, and Florida Currents to 42°-43°N. 42°-45°W. (C:e), 52°N. 15°-16°W., hauls from 1006 and 1438m. (T.). Faröe Channel (T.).

Rhinocalanus nasutus, Giesb.—East of Natal rare, south of the Cape Colony abundant in 37-74 m.

G.D.—West of South America from Magellan Straits to 6°N.; 20°N. 173°E. (G.). Ceylon to Socotra (A.S. & T.). Arabian Sea, rare (C:e), 20°S. 39°E. (T.). *Atlantic*, from 6°N. 22°W. to the Azores (C:e), Gibraltar, Mediterranean (G.); from 46°N. 34°W. to 40°N. 56°W. (C:e); 52°N. 16°W., haul from 1438 m. (T.); N.N.W. of Ireland, 389 m. (N.); 65°N. 10°W. 250-400 m. (G.O.S.); North of Scotland (Mœbius); Moray Firth (T.S.); North Sea, between Scotland and Norway (G.O.S.); Skagerak in 120 and more m. (C:e).

Sapphirina angusta, Dana.—Off the west coast in 277 m. *rr.*

G.D.—30°N. 134°W., 18°N. 145°W., Coquimbo (G.). Arabian Sea (C:e), 43°-35°S. 78°-23°E. (B., D.). 27°N. 20°W. (L.). West Mediterranean (G.).

Sapphirina gemma, Dana.—Agulhas Current, *rr.*

G.D.—East Pacific, 8°N.-33°S. 35°-27°N. 131°-111°W. (G.). Arabian Sea (C:e). N.E. of New Zealand and south of the Cape of Good Hope (D.). 7°-11°N., 17°-20°W. (C:e). Mediterranean (G., a.o.).

Sapphirina nigromaculata, Cls.—Agulhas Current, *rr.*

G.D.—Pacific, 20°N.-4°S. (G.), Malay Archip. (C:e), Bay of Bengal (T.). Ceylon, Minikoi, Socotra (A.S. & T.), Arabian Sea (C:e), Red Sea (G., a.o.), 0°-6°S., 64°-51°E. (T.).—Gulf of Guinea, Florida Current to 49°N. 23°W., Azores (C:e).

Sapphirina opalina, Dana.—Agulhas Current, *rr.*

G.D.—20°N. 173°E., Gulf of Panama (G.), Philippines (B.), Red Sea (Steuer). Gulf of Guinea (T.S.). 1°S. 1°W. (L.), 1°-4°N. 17°-25°W. (D.), Mediterranean (G., a.o.), Caribbean Sea (C:e).

Sapphirina salpæ, Cls.—Off Table Mountain 450 m. *rr.*

G.D.—38°S. 18°W. (G.), Bay of Bengal (T.), Ceylon and the N.W. Indian Ocean (A.S. & T.), 5°S. 83°E. (C:e), Mediterranean (G., a.o.), 52°N. 16°W., haul from 1438m. (T.).

Sapphirina scarlata, Giesb.—Off the west coast, 350 m. *rr.*

G.D.—0°-6°N., 80°-88°W. (G.), 3°S. 83°E., (C:e), Red Sea (C:e.).

Sapphirina sinuicauda, Brady.—Off Natal, surface ; off Table Mountain 450 m. *rr.*

G.D.—6°N.-4°S. 80°-89°W. (G.), 2°S. 84°E. (C:e), 10°N. 137°E. (G.), Philippines (B.), Ceylon (A.S. & T.), Red Sea (Steuer), Gulf of Guinea (T.S.), Azores (C:e).

Scolecithricella minor (Brady)—G.O. Sars, Crust. of Norway, Calan. p. 55, P. XXXVII, XXXVIII, 1902.—Off the west coast, 250–277 m. very rare. The South African specimens were only 1,2 millim. in length ; those from the Northern Atlantic 1,4 millim.

G.D.—Indian Ocean—47°N. 50°E. (G.), Gulf of Guinea (T.S.), 56°N. 28°-23°W. (T.), 67°N. 3°W. haul from 400 m. (C:e), south and west of Norway to 68°N. (G.O.S.), Skagerak (C:e).

Scolecithricella neptuni, C:e n.sp.—Off the west coast, very sparingly in 250–350 m. (C:e).

Scolecithrix danæ, Lubbock.—Off the east and west coasts.

G.D.—Pacific 20°N.-26°S. (G.), East of Japan (G.), North and East of Australia (B.), Malay Archip. (C:e), Bay of Bengal to 0°S. 64°E. (T.), Ceylon to Socotra (A.S. & T.), Arabian Sea (C:e).

32°S.-26°N. 13°–34° (B.), Gulf of Guinea (T.S., C:e) to Cape Verde Islands (C:e), 12°–37°N. 14°–25°W. (L.), 34°N. 38°W. (C:e), Canaries (T.), Mediterranean (G.), 52°N. 16°W., haul from 2825 m. (T.), 52°–56°N. 22°–44°W. (T.).

Scolecithrix persecans, Giesb.—Agulhas Current in 900 m. *rr.*

G.D.—35°N. 125°W., haul from 530 m. (G.), 52°N. 16°W., haul from 2580 m. (T.).

Solecithrix securifrons, T Scott.—Agulhas Current, 530–900 m., *rr.*

G.D.—Gulf of Guinea (T.S.), 52°N. 15°–16°W., haul from 918 and 1710 m. (T.), N.W. of Ireland (N.), Faröe Channel down to 1060 m. (N.).

Temora discaudata, Giesb.—Agulhas Current, *rr.*

G.D.—Entire Pacific between 20°N. and 9°S. and 26°-35°N. 110°-131°W. (G.). S.E. of New Guinea (A.S.). Malay Archip. (C:e). Ceylon and the N.W. Indian Ocean (A.S. & T.). Arabian Sea (C:e). Red Sea (G., a.o.). Mediterranean (A.S. & T.).

Temora stylifera, Dana.—Off Natal in the surface, *rr.*

G.D.—Malay Archip. (C:e). From 19°N. 87°E. to 20°S. 39°E. (T.). Ceylon, N.W. Indian Ocean (A.S. & T.). Arabian Sea (C:e). Red Sea (A.S., C:e). From Ascension to the Azores, off Morocco. Mediterranean. Antilles and Florida Currents to 42°N. 42°W. Brazil Current (C:e).

Undechæta major, Giesb.—Agulhas Current, 900 m., *rr.*

G.D.—Pacific, 36°N. 125°W. and 20°N. 173°E. (G.). Indian Ocean, 19°N. 87°E. Gulf of Suez (T.).

Undechæta minor, Giesb.—Agulhas Current, *r.*

G.D.—Pacific, 35°N. 125°W. and 16°-20°N. 166°-173°E. (G.). Minikoi and the N.W. Indian Ocean (A.S. & T.). Off Gibraltar (A.S. & T.).

Xanthocalanus fragilis, Aurivillius (Kongl. Sv. Vetensk. Akadem. Handlingar XXX nr. 3 p. 32, 1898.—*X. borealis* G. O. Sars in "The Norwegian North Polar Expedition, 1893-1896" V Crustacea, p. 49, P. xi, 1900; Crustac. of Norway, Calan. p. 45, P. XXXI, XXXII, 1902.—T. Scott: 20th Report of the Fishery Board for Scotland, III., p. 452, P. xxii, f. 8, 9, 1902. Compare the systematic notes in the following.)—The west and south Coast, *rr.*

G.D.—The north Siberian Sea, 78°N. 136°E. 50 m.; off the west coast of Norway, 59°N., 710 m. (G.O.S.). West Sweden, 50-120 m. (Aurivillius). Shetland (T.S.).

SYSTEMATIC NOTES.

Candacia cheirura, n.sp.

Diagn. of the female.—Terminal setæ of the third leg with outwards turned apex and as long as the distal part of the Re 3. The proximal part of the anterior antennæ 7-jointed. Genital segment with large projecting opening. Second joint of the abdomen with a protuberance on the under side. Proximal part of the setæ of the furca broad. First pair of legs with Si on B1. Fifth pair of legs with tricuspidate apex and with two spines on the exterior side. Length 2,7 mm.

Male.—Terminal seta of the Re of the third leg as in the female. Proximal part of the anterior antennæ 7-jointed. On the prehensile antenna the 15th joint has distally on the upper side a small spine, the 19th joint carries on its entire margin close small ridges, the 17th and 18th joints not uniting, the 18th carries strong transverse ridges, joints 15+16 $\frac{5}{6}$ of the joints 17+18. Fifth pair of legs: the left with forceps and shorter than the right. Length 2, 3 mm.

Description of the female.—*Colour.*—The following parts are brown: Re 2 and 3 of the first pair of legs, interior side of Re 2 and the entire Re 3 of the second pair, Re 3 of the third and fourth pairs, the terminal spines of the last thoracic segment.

Length of the anterior part, 2 millim.; of the posterior, 0, 7 millim. Greatest breadth 1 millim., in the middle of the anterior part. First thoracic segment as long as the four others together. Last segment symmetrical, ends in two spines, and has on the sides one or two small bristles. Abdomen 3-jointed; genital segment as long as the two following segments together, ventrally with a prominent large genital opening. The second segment, nearly twice as long as the anal segment, ventrally with a prominent rounded protuberance. Furcal branches slightly longer than broad, with a short spine on the exterior corner; Se broad, slightly shorter than the four St, which are broad and of nearly equal length. All very sparingly hairy. Si thin, arises from the interior distal end.

Anterior antennæ reach to the furca. Proximal part 7-jointed; distal part 17-jointed. Length of the joints in 0, 01 m.m.:

Aa ...	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0, 01 m.m.	12	7	7	8	8	5	2	5	5	5	8	8	9	9	13
	17	18	19	20	21	22	23	24-5							
	17	13	16	17	10	6	7	11							

Posterior antennæ.—Re $\frac{3}{5}$ as long as Ri; Ri 1 & B2 $2\frac{1}{2}$ times longer than broad. Re cylindrical, carries at its end 1 small and 6 longer S. Ri carries on the exterior lobe 6 long plumose Sa and one small Si, the interior lobe 5 long plumose setæ, and three very thin bristles.

Mandible, as in *C. varicans* (see Giesb., F. Neap., P. XXI, f. 24).

Maxilla, similar to the maxilla of *C. longimana* (see Giesb. P. XXII, f. 7). Re 2 & 3, with 1+2+2 S.

Anterior maxilliped.—L1 with one long and one very small S; L2 with 2 small S, L3 and L4 each with one spine and a small thin S. B2 with 2 almost equal strong spines inserted at some distance from each other and slightly shorter than the 3 falciform terminal spines.

Posterior Maxilliped.—B1 as long as B2 and Ri together; B2 as long as Ri. S as in the other species. S2 of B2 a little shorter than S1 and S3.

Natatory legs, 1-4 pair.—B1 of the first pair with Si. Distal part of Re 3 of the 1st pair longer than the proximal,—St of the 3rd pair as long as the distal part of the joint. Serration of the edge of Re fine.

Fifth pair of legs.—B2 with small Se, Ri without interior setæ ends in three apices, of which the median is the largest; besides two spines on the exterior margin.

Description of the male.—*Colour.*—The ends of the last thoracic segment, the comb on the prehensile antennæ and the Si, St and, partly, the third joint of Re of the natatory legs have brown chitin.

Length :—anterior part 1,8, posterior part 0, 6 millim.; $2\frac{1}{3}$ times as long as the greatest breadth, in front of the middle.

Anterior part 5-jointed. Last thoracic segment asymmetrical, the left corner being prolonged. It carries on the side some small bristles. Of the five abdominal segments the three first are of about the same length and twice as long as the fourth and the anal segments. The first joint carries on the right side a hornlike apophysis (as in *C. curta* and *C. pectinata).* Furca short and broad. Se and the four Si of about the same length, all of ordinary form and plumose. Si half as long and thin. On the distal exterior corner is a small spine.

Prehensile antenna very similar to that of *E. armata* and *C. varicans;* its proximal part 7-jointed. Joints 15 + 16 $\frac{5}{6}$ as long as 17 + 18. The joint 15 has distally on the upper side a small spine. The joints 17 and 18 do not unite. The joint 18 carries a comb of large and coarse ridges, the joint 19 along its entire length very fine and close ridges.

The 5th pair of legs closely resembling that of *C. varicans.*

Candacia inermis, n.sp.

Diagn. of the female.—Terminal setæ of the third pair of legs much shorter than the distal part of Re 3. Proximal part of the antennæ 7-jointed. Last thoracic segment rounded. Fifth pair of legs ends in three teeth of which the distal is the longest; there is, besides, somewhat proximal from the middle, another tooth. Length 3,3 millim.

Male unknown.

Description of the female.—*Body, anterior part* 2,5 millim. in length, 1 millim. in breadth, *posterior part* 0,75. The last thoracic segment with rounded ends. Abdomen symmetrical. Genital segment symmetrical as long as broad and longer than the second and third together. Furcal branches somewhat longer than broad. Se and the four terminal setæ of equal length, three times longer than the Si.

Anterior antennæ do not reach to the end of the furca, 24-jointed, its proximal part 7-jointed. Length of the joints in 0,01 millim.

Aa ...	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0, 01 m.m.	27	9	9	9	9	9	6	8	7	8	11	12	17	19	18
	17	18	19	20	21	22	23	24-5							
	17	17	14	14	10	7	11	18							

Posterior antennæ. Ri $1\frac{1}{2}$ times longer than Re + B1, three times longer than broad.

Mandible as in the other species, the masticatory apparatus with one strong exterior tooth, by a gap separate from two smaller ones.

Maxilla. Li2 reaches only slightly beyond the Ri, which carries 1 + 2 + 2 S. Re with 6 longer plumose setæ.

Anterior maxilliped. B1 $1\frac{1}{2}$ times longer than B2. L1 with 3S. L3 and 4 each with 2S, one strong and one small. B2 with 2 falciform strong spines of about equal length and breadth inserted at some distance from each other. The falciform spine of Ri only slightly longer than those of B2.

Natatory legs. B1 of the 1st pair with a short Si, B2 with a Si as long as the Ri; distal part of Re 3 twice as long as the proximal. Re 3 of the third pair $1\frac{1}{2}$ times longer than Re 1 + 2, its distal part half as long as the joint, its edge coarsely denticulated proximally, but finely serrate distally. Terminal seta falciform, not half as long as the distal part of the joint. Fourth pair, as usually, without Si.

Fifth pair of legs. B1 + B2 as long as Ri. The latter with a tooth in the middle of the exterior edge and 3 teeth at the end, the distal one the longest. There are no Si.

Euchæta affinis, Cre, n.sp.

The only female of this species, which belongs to the group of *E. norvegica*, measured in length 6,3 millim. (anterior part 4,5, posterior part 1,8 millim.). The frontal organs occurred on a moderate elevation not protracted into a conical projection. The corners of the last thoracic segment carried a tuft of hairs, but were not provided with an apiculus. The abdomen was naked, and its first segment carried in the middle the strongly projecting genital opening, enclosed

between dissimilar plates. There was no elevated ridge in front of the genital opening. The 1st pair of natatory legs had a two-jointed Re, Re 1 and 2 uniting into one single joint with concave exterior margin, which carried in its distal end a Se as long as Re 3. The sinus between the Se 2 and Se 3 of the Re 3 of the 2nd pair of legs was larger and deeper than that between Se 1 and Se 2 of the same joint. The Se of Re 2 of the 2nd pair reached to the basis of Se 1 of Re 3, was much larger than Se 1 of Re 3, and as long as Se 3 of that joint.

Lucicutia aurita, C:e, n.sp.

Diagn. of the Female. Length of the body 8 millim. The head broad, on each side with a short triangular spine. Anterior antennæ reach to the end of the furca. St of the 1st pair of legs as long as Re 3. St of the 5th pair of legs much shorter than Re 3. Si 2 of the same pair of ordinary form, not thicker than the other.

Description of the Female.—*Body.* Anterior part 4,5, posterior part 3,5 millim. in length. Its form is oblong, only slightly broader in the middle than at the ends, $3\frac{1}{3}$ as long as broad. Head broad in the front, on each side with a short but broad spine. Abdomen 4-jointed, its genital segment as long as the two following together, which are of equal length. Anal segment as long as the preceding. Furca as long as the three first abdominal segments together. Se nearly in the middle.

Anterior antennæ reach to the end of the furca, 25-jointed. Length of the joints in 0, 005 millim.

Aa	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	6	6	10	6	6	6	7	7	11	12,5	12,5	20	25	27,5	27,5

17	18	19	20	21	22	23	24	25
26	27	30	25	21	21	20	21	9

Posterior antennæ. B 1 with one Si as long as B 2. B 2 twice as long as broad, with one Si. Re as long as Ri, 8-jointed. Re 8 with one plumose Si, inserted at the basis of the 3 terminal ones and much shorter than them. Ri 1 nearly 4 times longer than broad; its two Si inserted nearer to the distal than the proximal end; the exterior margin of the joint hairy of stiff, small bristles. Ri 2 + 3, half as long as Ri 1; Le with 5 long plumose S and 1 Si. Li with 5 long and 3 short S. The Le carries some small bristles.

Mandible elongate; B with 3 plumose Si, reaching to Ri. Re somewhat longer than Ri, 3 times longer than broad. Ri, 3-jointed; joints of equal length. Ri 1 and 3 outside with some small stiff bristles. Re carries 6 plumose S and Ri 1 four, Ri 3 2 + 8 long plumose S. The masticatory apparatus was not examined.

Maxilla. Similar to that of *L. flavicornis* (Giesb. F. Neap. P. XIX., f. 9); Le 1 with 5 long plumose Si; Re twice as long as broad and with 5 thinner and 6 coarser, plumose S.—Ri with 5 + 4, plumose S. B2 with 3 S.—Li 3 cylindrical with a small spine on its exterior end and 3 plumose long S. Li 2 also cylindrical and with 3 plumose S. Li 1 twice as long as broad, with strong, almost straight, sparingly hairy spines.

First maxilliped similar to that of *L. flavicornis* (Giesb. F. Neap. P. XIX., f. 11).

Posterior maxilliped. B2, 1½ times longer than B1 and as long as Ri, with 5 plumose S, of which S4 is somewhat shorter than S1—3 and S5, which latter is the longest, but shorter than the joint. Of the 5 joints of the Ri the 2nd is the longest, all joints naked on the inside.

Natator, legs of the 1st–4th pairs. Re and Ri of all pairs 3-jointed. B1 with straight margins, of the 2nd-4th pairs with a short plumose Si. B2 with convex interior margins; it carries on the 1st pair a short cylindrical processus, from which issues a Si, and at its basis some stiff hairs. Ri of the 1st pair at a higher level than Re; but on the other pairs at the same level. Ri of all pairs reach to the distal margin of Re 2.

Proportional length of the 3 joints of Re and St.

	1p.	2p.	3p.	4p.
Re 1	10	10	10	10
Re 2	7	9	10	9
Re 3	12	25	25	25
St.	15	15	15	12,5

Se of Re 1,1,2 on the first pair, 1,1,3 on the other, longer on the 1st pair than on the other. St of all pairs with finely serrate edges (about 18 teeth in 0,01millim.), Si 1,1,4 on the first 1,1,5 on the other pairs. Re 1 and Re 2 hairy on the inside. The Se of the 2nd-4th pairs are enclosed between a pair of spinules.

The three joints of Ri of equal length. Ri 2 ends on all pairs in a small spinule. Se 0,0,1, Si 1,2,4 on the first 1,2,5 on the other pairs. Exterior margin of Ri 1 and Ri 2 of the 2nd-4th pairs hairy.

Fifth pair of legs.—B1 without Si. Re and Ri 3 jointed. Re more than twice as long as Ri; Se 1,1,2; Si shorter than Re 3; Si 0,1,3, of equal thickness. The 3 joints of Ri of equal length; Se 0,0,1; Si 1,1,4. Interior margin of Re 1 and Re 2 and the exterior margin of Ri 1 and Ri 2 hairy.

Lucicutia bradyana, C:e, n.sp.

Diagn. of the female.—Anterior antennæ reach to the end of the furca. Ri of the 1st pair of legs 3-jointed. St of the 1st pair of legs nearly as long as Re 3, St of Re of the fifth pair of legs shorter than Re 3. Si of the Re 2 of the 5th pair of legs a stout spine as long as Re 3. Length 5,7 millim.

Diagn. of the male.—St of Re 3 of the 1st pair of legs nearly as long as Re 3. Ri 2 & 3 of the right leg of the fifth pair loaf-like, with 6S. B2 of the left leg on the interior margin produced into a short spine. Length 5,5 millim.

Brady (Rep. Challenger VIII. 1. p. 50 P. XV., f. 1-9, 16 1883) has identified a copepod, found by the Challenger Expedition, with Leuchartia flavicornis of Claus. This, however, cannot be correct as the differences, especially as concerns the size, are too considerable. One female which I found in the gathering off Port Shepstone, 900m., seems to me to agree sufficiently with Brady's species. I found in the same sample one specimen of a male of about the same size as the female, and believe they belong to the same species. There are between the male of my form and of Brady's serious differences, which make the identification somewhat doubtful. The right leg of the fifth pair carries on the Ri 4 setæ in Brady's form, but 6 in my specimen. This may perhaps be accounted for by the supposition that Brady's specimen had lost two setæ. The other difference is in the B2 of the left legs of the fifth pair. It was on my specimen produced into a spine, but in Brady's specimen into a denticulated processus. The difference depends perhaps on the age.

The *Lucicutia grandis*, Giesbrecht, is doubtless very closely allied to both Brady's and my form. The male only is known and differs principally in the B2 of the fifth pair of legs.

The variation in the forms of the group of *L. clausii* is, according to Giesbrecht, considerable, and it therefore seems very probable that *Leuckartia flavicornis*, Brady (von Claus), *Lucicutia grandis*, Giesb., and *Lucicutia bradyana* C:e represent only variations in one and the same species.

Description of the female. *Body* in length 5,7 millim (anterior part 3,5, posterior part 2,2 millim), $3\frac{1}{2}$ times longer than broad (greatest breadth in the middle of the anterior part). Head broad, on each side with a slight angular prominence.—Abdomen 4-jointed, genital segment as long as the two following together, and as long as the inflated abdominal segment. Furca at least 5 times longer than broad, and as long as the two last segments together. The furca has two Se, one very small near the anal segment and another in the middle, reaching to the end of the furca.

Anterior antennæ reach to the end of the furca, 25-jointed. Length of the joints in 0,005 millim.

Aa	2	3	4	5	6	7	8	9	10	11	12	13
	6	7	6	6,5	6,5	6	8	7	7	9	9	15
14		15	16	17	18	19	20	21	22	23	24	25
18		18	20,5	20,5	23,5	23,5	18	18	15	18	18	9

Posterior antennæ. B1 with 1 Si; B2 twice as long as broad with 1Si. Re as long as Ri and 8-jointed; Ri 1 three times longer than broad, naked on the outside. Re 2 + 3 $\frac{2}{3}$ as long as Re 1. The outside of Le carries some small bristles. Else as in *L. aurita.*

Mandible. Re $1\frac{1}{4}$ times longer than Ri. Ri 3 carries in its top a row of small stiff hairs. Else as in *L. aurita.* The masticatory apparatus carries four strong, almost straight teeth and towards the interior side five smaller ones.

Maxilla similar to the maxilla of *L. aurita.*

Anterior maxilliped as in *L. aurita.*

Posterior maxilliped. B2 with 4 Si, of which Si 1 and 3 are slightly shorter than the other. Interior margin of B2 with a row of small stiff hairs. Ri 1,2 och 3 with a row of stiff hairs at the basis of the setæ. Else as in *L. aurita.*

Natatory legs of the 1-4th pairs. Ri on a slightly higher level than Re. B 1 and 2 of the first pair hairy on the interior margin. Proportional length of the joints of Re and St.

	1 p.	2 p.	3 p.	4 p.
Re 1 ..	10	10	10	10
Re 2 ...	7	7,5	9	7,5
Re 3 ...	17	20	25	20
St ...	15	10	—	10

Else as in *L. aurita.*

Fifth pair of legs.—Re and Ri 3-jointed. Re more than twice as long as Ri. St shorter than Re 3. Se 1,1,2. Si 0,1,3; Si 2 a strong thick spine, as long as Re 3. Of the three joints of Ri the Ri 3 is the shortest. Ri 2 ends in a small spine. Se 0,0,1. Si 1,1,4. Outside margin of Ri 1 and Ri 2 hairy.

Description of the male.—Body in length 5,2 millim. (anterior part 3, posterior part 2,2 millim.), nearly 4 times longer than broad. Abdomen 5-jointed; anal segment $1\frac{1}{2}$ times longer than the preceding. Furca about six times longer than broad and as long as the three last segments together, with a small Se near the anal segment and a longer one in the middle.

Anterior antennæ reach to the end of the furca (the distal part of the prehensile antennæ was lost in my specimen). The right antenna 25-jointed. Length of the joints in 0,005 millim.

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
3,5	4,5	7,5	7,5	6	6	6	6	6	9	9	14	14	18	18	18	18	20	16	
21	22	23	24	25															
16	15	15	15	9															

Posterior antennæ as in the female.

Mandible. Ri 2 and 3 uniting, else as in the female.

Maxilla as in the female.

First maxilliped as in the female.

Second maxilliped.—B1 somewhat shorter than B2. Ri as long as B2. Else as in the female.

Natatory legs of the 1–4th pairs.—Proportional length of the three joints of Re and Si :—

		1 p.	2 p.	3 p.	4 p.
Re 1	...	10	10	10	10
Re 2	...	7	7	10	10
Re 3	...	15	18	20	20
St	...	13	8	10	8

Else as in the female.

Fifth pair of legs similar to that of *L. grandis* and *L. clausii.* Ri of the right leg loaf-like, with 6 setæ. The margin and the flat side with patches of small stiff hairs. B2 of the left leg protracted inside into a spine-like processus.

Scolecithricella neptuni, C:e, n.sp.

Diagn. of the female. Head without crista, anterior antennæ 22-jointed. Teeth of the masticatory apparatus of the mandible with close long and stiff hairs. Spinules on the natatory legs few and delicate. Fifth pair of legs 3-jointed, the third joint ending in three triangular spines, two articulating and with some few spinules, one hairy. Length 1,4 millim.

Diagn. of the male. Head without crista. Anterior antennæ 23-jointed. Masticatory apparatus and natatory legs as in the female. Fifth pair of legs : left and right leg of equal length, so also the B1 ; B2 of both legs of about the same thickness throughout. The right leg with rudimentary Ri and a falciform Re $\frac{3}{4}$ as long as B2. The left leg with a long curved Ri and a short 3-jointed Re. Length 1,2 millim.

Description of the female.—Body in length 1,4 millim. (anterior part 1,1, posterior part 0,3 millim.), clumsy, its anterior part being highly vaulted, 5-jointed (length of the joints 0,5 ; 0,18 ; 0,15 ; 0,12 ; 0,13 millim.). Abdomen short, the genital segment as long as the three following together. Furca slightly longer than broad.

Anterior antennæ reach to the last thoracic segment, 22-jointed, Aa 8-10 and 24-25 uniting. Length of the joints in 0,005 millim.

Aa.	2	3	4	5	6	7	8-10	11	12	13	14	15	16	17	18	19	20	21
	3	1	1	1	1	1	4,5	1	1	1,5	1,5	1,5	1,5	1,5	1,5	1	1	1

22	23	24-25
1,5	2	4,5

Posterior antennæ. B 2 with 1 S; Re twice as long as Ri and thicker than it. Re 2 twice as long as Re 1 and Re 1+2 as long as the last joint. Ri 1 twice as long as Ri 2+3 and three times longer than broad. The Si reaches to the end of Ri 2+3. The Ri 2+3 twice as long as broad. Le with 5+1 setæ, Li with 5+3 setæ. Exterior margin of the joint hairy.

Mandible elongate; Re inserted in the middle of B2, which carries 1 Si reaching to the end of Ri, Re longer and broader than Ri. Teeth of the masticatory apparatus, especially the interior ones, covered with dense long and stiff hairs, giving it the appearance of a brush.

First maxilliped stout with the lobes crowded distally. L1 with 3 long spiniferous and 1 somewhat shorter hairy seta. L2 and 3 with 2 longer and 1 shorter seta. L4 with 1 stout falciform and 1 thinner seta. B2 carries 1 very strong falciform seta, 1 thinner but of nearly the same length, and a third somewhat shorter and much thinner seta. The setæ of Ri are all soft and flexible.

Second maxilliped. B1 and B2 of about equal length; Ri $\frac{3}{4}$ as long as B2. B1 with 1+2+1+2+3 setæ, B2 with 3+2 setæ; of the first group the distal is the longest and the median the shortest. Ri 5-jointed, Ri 2 the longest and Ri 5 the shortest. Ri 1 carries 4 setæ.

Natatory legs. In my specimen the 3rd and 4th pair were lost. B2 of the 1st pair with 1 plumose Si. Re 1,2 and 3 of about equal length, Se 1,1,1 longer than the joints, narrow and with stiff hairs. St similar to the Si. Si 0,1,3, jointed in the middle. Ri reaching to the middle of Re 2, with a lobus on the exterior side and 2+3 Si, the 3 latter being jointed in the middle. B1 of the 2nd pair with 1 plumose Si. Ri reaches to the distal margin of Re 2. Proportional length of the three joints of Re and St 10:12:18:18. Se 1,1,3. Se 1 comparatively short, the other as long as the joints are broad. Si 1,1,4. Ri 2 nearly three times as long as Ri 1; Se 0,1; Si 1,4. The flat side of Ri carries near the Si a group of some few very delicate spinules.

Fifth pair of legs symmetrical, 3-jointed; the third joint, three times longer than the other together, carries in its top 3 strong triangular teeth, the two exterior not articulating and with some few spinules, the third articulating and hairy.

Description of the male. Body in length 1,2 millim. (anterior part 0,8, posterior part 0,35 millim.). Anterior part 7-jointed. Abdomen 5-jointed ; the anal segment very short, the other of about equal length and breadth. Furca scarcely longer than broad. The longest furcal setæ as long as the abdomen.

Anterior antennæ reach slightly beyond the last thoracic segment, 23-jointed or 21-jointed, the Aa 8–10 uniting in younger specimens.

Posterior antennæ and the mandible as in the female.

Maxilla. Le 1 with 1 shorter and 6 longer plumose setæ. Li as prominent as Ri, with about 7 nearly straight hairy coarser setæ and several finer ones. Li 2 with 2 strong and longer setæ, 1 shorter seta. Li 3 with 1 + 4 setæ. Re is a slight protuberance with 4 comparatively short setæ. Ri 3-jointed, with 2,2, 4 + 1 setæ.

First and second maxilliped as in the female.

Natatory legs of the 1–4th pair. Re 3-jointed; Ri of the 1st p. 1-jointed, of the 2nd 2-jointed, of the 3rd and 4th 3-jointed. B 1 of the 1st pair without Si, of the 2nd–4th with a short Si. B 2 of the 1st pair with 1 Si. Ri of the 1st and 2nd pair reach to the distal margin of Re 2, beyond it in the 3rd and 4th pairs. Se of Re of the 1st pair 1,1,1, more than twice as long as the joints, on the other pairs 1,1,3, short and triangular. St of the 1st pair bristle-like, of the other pairs straight and knife-like, in the 2nd and 3rd pairs longer, in the 4th pair shorter than Re 3 ; their edge rather coarsely serrate (teeth about 4 in 0,01 millim.). Si of the 1st pair 0,1,3 ; of the others 1,1,4. Ri of the 1st pair with 5 setæ. Se of the 2nd pair 0,1, of the 3rd and 4th 0,0,1, but their Ri 2 ends in a small apiculus. Si of the 2nd pair 1,4, of the 3rd and 4th pairs 1,1,4. Small, delicate spinules on the flat side of the legs occur in the 2nd pair on Ri 2 (a set of 3–4 near the distal and proximal part) and on the distal part of Re 3, in the 3rd pair in the distal part of Ri 3 (a row of 6 small bristles) and on the distal part of Re 3, on the 4th pair in Ri 3 and at the distal margin of Re 2.

Fifth pair of legs nearly as long as the anterior part of the body, the right and left leg of equal length. B1 of both legs of equal length. B2 of the left leg slightly shorter than of the right one, both of about equal breadth throughout. The B2 of the right leg carries near its distal end a small tubercle (rudimentary Ri) and in the end a falciform Re, $\frac{3}{4}$ as long as B2. The B2 of the left leg carries a curved Ri, longer than B2, and a 3-jointed Re, half as long as B2.

The species in question differs in so many important characteristics, especially in the 5th pairs of legs and the masticatory apparatus, from the type-species that I am inclined to form for it a new genus, for which I should like to propose the name *Pseudoscolecithrix*.

Xanthocalanus fragilis, Aurivillius.

Giesbrecht has described from the Mediterranean two species of this genus, viz., *X. agilis* and *X. minor*, which, according to *G. O. Sars*, however do not represent more than one species, *X. minor* being founded on young specimens. *Aurivillius* added in 1898 two other species, *X. fragilis* and *X. simplex*. In 1900 *G. O. Sars* described from the Polar Basin a form found by *Nansen* and named *X. borealis*. So far I can see there is no essential difference between *X. fragilis* and *X. borealis*. The same form was found by *T. Scott* at Shetland, and the specimens I found in the South African Seas are evidently of the same kind, their fifth pair of legs being 2-jointed. Later Professor *G. O. Sars* describes more fully in the Crustacea of Norway Calanoida, *X. borealis*, which, in full-grown specimens, has 3-jointed 5th pair of legs with 4, not 3 terminal spines. Besides, the right leg of the 5th pairs of the male is rudimentary or wanting. In the species of Aurivillius the right leg is nearly as long as the left one. It seems to me possible that two nearly allied species have been confounded. In all cases the specimens from South Africa did not differ essentially from the description of Aurivillius. All my specimens were females, in length 2,9 millim. (Norwegian specimens 3,50 millim, from the Polar Basin 4 millim, according to G. O. Sars ; Aurivillius gives no measures for the female, but for the male 2,5 millim).

I. C. Thompson has described under the name of *X. giesbrechti* (Ann. Mag. Nat. Hist. [7] XII. p. 22, P. IV., f. 1-9, 1903) another apparently very nearly allied form, found west of Ireland in a haul from 2580 m. In case the illustration be correct one cannot identify it with *X. fragilis* as the anterior antennæ reach beyond the furca, but in *X. fragilis* scarcely beyond the genital segment.

There were in the collections I have received still some few new species, in parts belonging to new genera, but the rare specimens I have hitherto found were too incomplete for a full description.

EXPLANATION OF PLATES.

Plate I.

Fig. 1. *Candacia chirura*, Cleve, ♀ abdomen lateral (× 40).
" 2. " " " ♀ furca (two of the exterior setæ broken. In all other specimens the three remaining setæ were also broken, which gave the furca the appearance of a hand. Therefore the name), (× 85).
" 3. *Candacia chirura*, Cleve, ♂ abdomen dorsal (× 70).
" 4. " " " ♂ furca (× 170).
" 5. " " " ♂ prehensile antenna (distal part) (× 170).
" 6. " " " ♂ 5th pair of legs (× 170).

Plate II.

" 7. *Candacia chirura*, Cleve, ♀ leg of the 5th pair (× 170).
" 8. " " " ♀ leg of the 3rd pair (× 85).
" 9. " " " ♀ mandible (× 85).
" 10. " " " ♀ maxilliped of the 1st pair (× 85).
" 11. *Candacia inermis*, Cleve, ♀ abdomen ventral (× 40).
" 12. " " " maxilliped of the 1st pair (× 40).
" 13. " " " masticatory apparatus (× 170).

Plate III.

" 14. *Candacia inermis*, Cleve, proximal part of the 1st antenna (× 85).
" 15. " " " leg of the 5th pair (× 85).
" 16. " " " leg of the 3rd pair (× 85).
" 17. *Euchæta affinis*, Cleve, ♀ genital segment (× 40).
" 18. " " " *Re* 3 of the 2nd pair of natatory legs (× 85).
" 19. " " " leg of the 1st pair (× 85).

Plate IV.

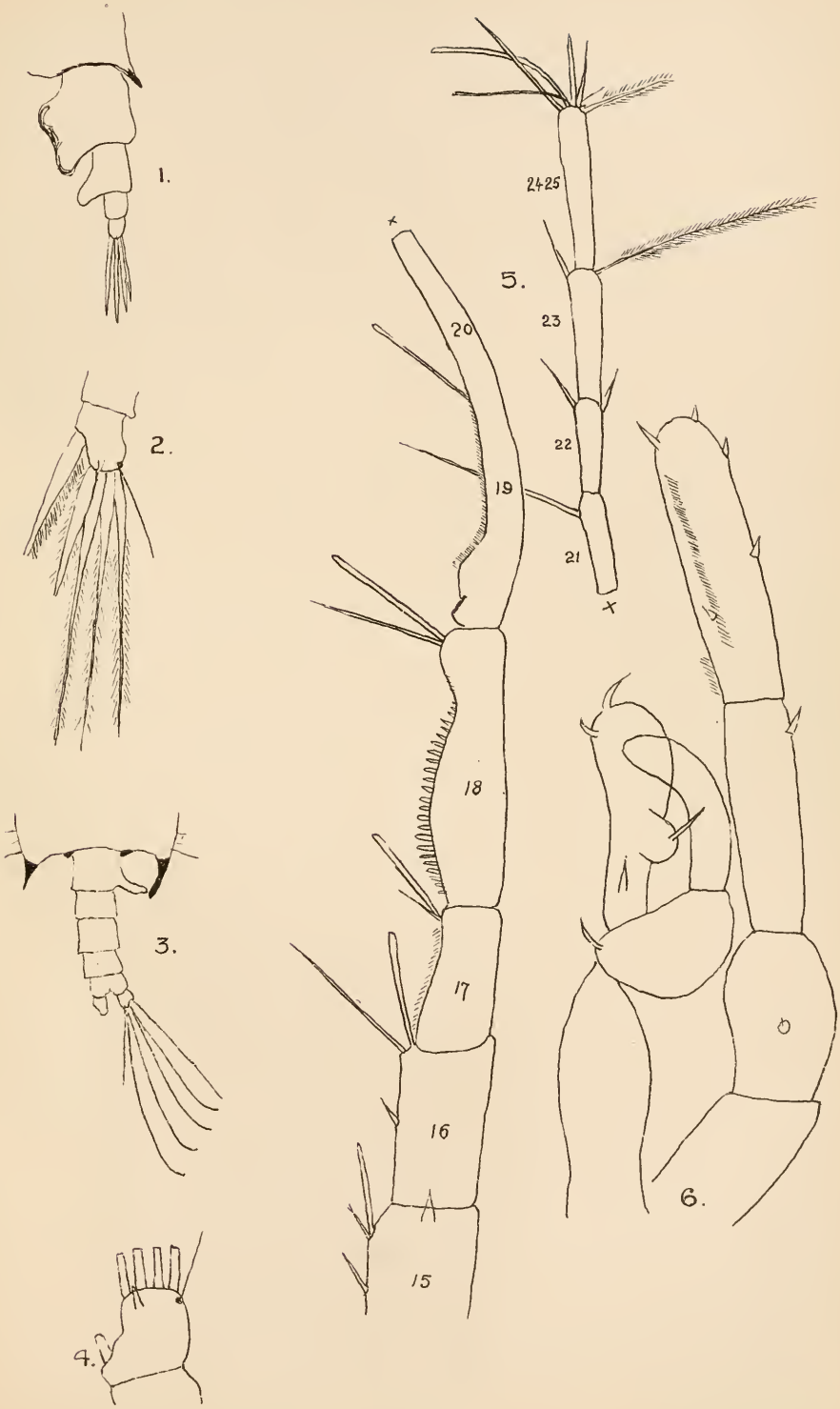
" 20. *Scolecithricella neptuni*, Cleve, ♂ lateral (× 40).
" 21. " " " ♀ antenna of the 1st pair (× 170).
" 22. " " " ♀ antenna of the 2nd pair (× 170).
" 23. " " " ♀ mandible (× 170).
" 24. " " " ♂ maxilla (× 300).
(Two setæ of *Li* 3 broken.)

Plate V.

" 25. *Scolecithricella neptuni*, Cleve, ♀ 1st maxilliped (× 300).
" 26. " " " ♀ 2nd maxilliped (× 300).
" 27. " " " ♀ leg of the 1st pair (× 170).
" 28. " " " ♀ leg of the 2nd pair (× 170).
" 29. " " " ♂ leg of the 3rd pair (× 170).

Plate VI.

" 30. *Scolecithricella neptuni*, Cleve, ♀ leg of the 5th pair (× 500).
" 31. " " " ♂ 5th pair of legs (× 500).
" 32. *Xanthocalanus fragilis*, Auriv, ♀ leg of the 5th pair (× 170).
" 33. *Lucicutia bradyana*, Cleve, ♀ *Re* 2 of the 5th pair of legs (× 85).
" 34. " " " ♂ 5th pair of legs (× 40).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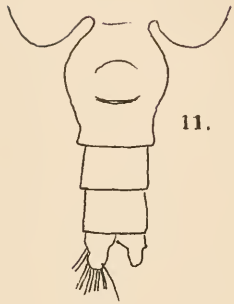
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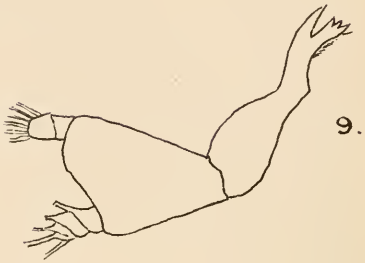
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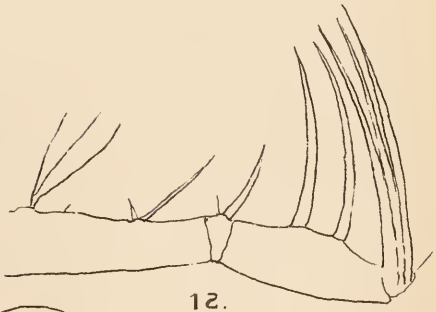
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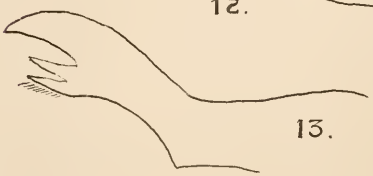
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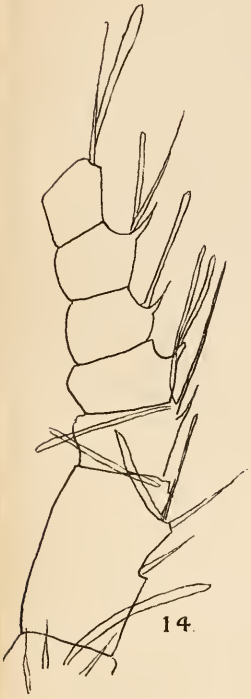

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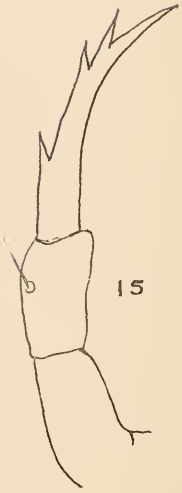

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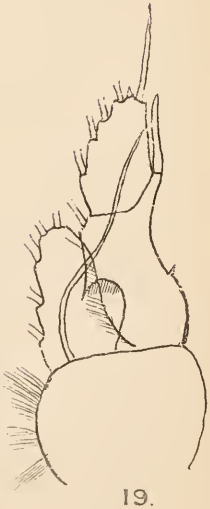

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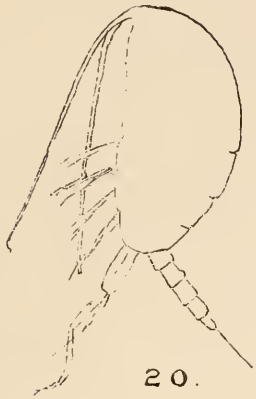

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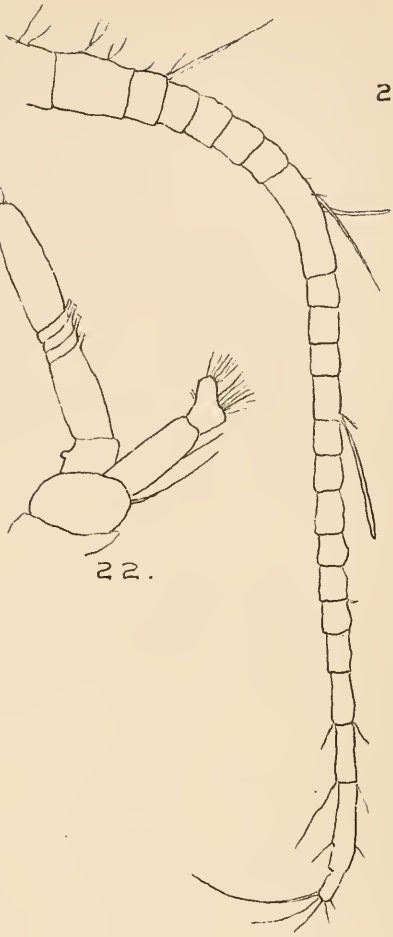

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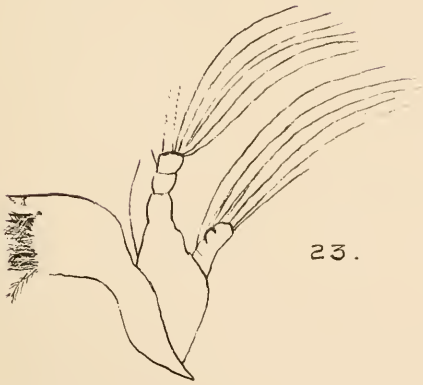

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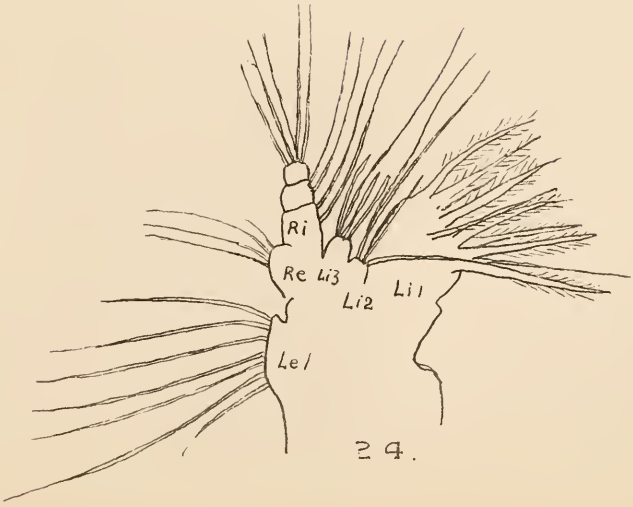

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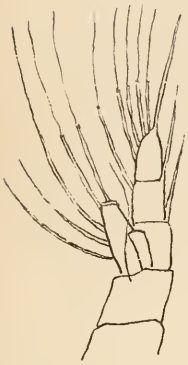

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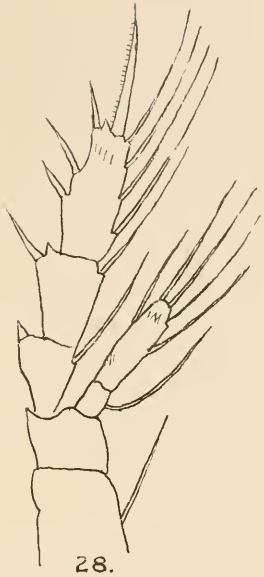

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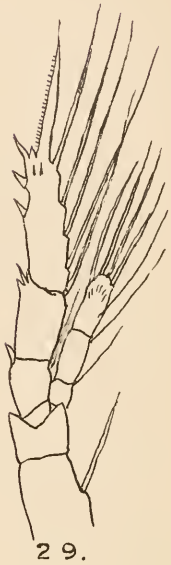

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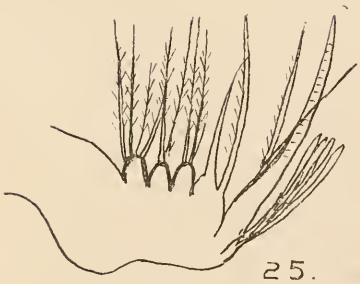

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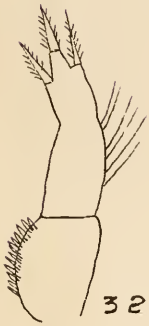

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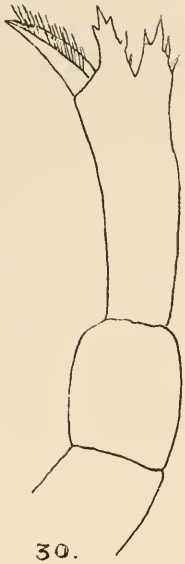

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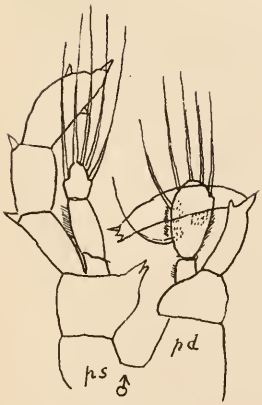

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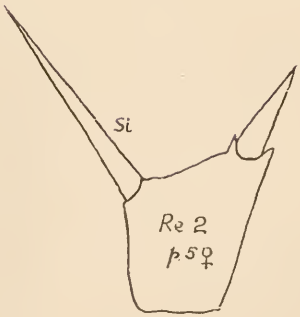

33.

THE ALCYONARIA

OF THE CAPE OF GOOD HOPE

PART II.

BY

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Two parcels of Alcyonaria were sent to me in the year 1900. With the exception of a dried specimen of Gorgonia albicans, all the specimens were, as before, carefully preserved and in excellent condition for histological examination.

I regret that a heavy pressure of work has prevented me from completing my anatomical description of the species, but rather than delay the statement as to the species occurring in Cape waters, I have put together in this preliminary paper the notes I have made upon the species.

In these two consignments there are twelve species of Alcyonaria and one of Stylasterina. Very striking peculiarities in the structure of two Gorgonacea have necessitated the foundation of two new genera—Malacogorgia and Trichogorgia—and, in addition, four species of old-established genera must be regarded as new to science, namely, Alcyonium purpureum, Ceratoisis ramosa, Eugorgia gilchristi, and Juncella spiralis. Of the remaining seven species, three have not hitherto been known to occur in Cape waters, and one, of which a small specimen was incorrectly described in my last paper as Primnoisis, is now referred to the species Wrightella coccinea, which is also new to Cape waters. One specimen of a Gorgonia, probably belonging to a new species, is too incomplete to describe adequately.

The following is a complete list of the Alcyonaria which have at present been found in Cape waters:—

Sub-Order **STOLONIFERA**

Family **Clavulariidae.**

Anthelia capensis, Studer (15). 33° S. 17° W. 50 Fathoms.

Sub-Order **ALCYONACEA**

Family **Xeniidae**

Heteroxenia capensis, Hickson (6). False Bay. 20 Fathoms.

Family **Alcyoniidae.**

Alcyonium pachyclados, Klz (8). Off Cape St. Blaize, etc. 15–18 Fathoms.

Alcyonium antarcticum, W. and S. (23). Off East London. 45 Fathoms.

Alcyonium purpureum, n. sp. Mossel Bay, etc. Shore.

Acrophytum claviger, Hickson (6). Algoa Bay. 26 Fathoms.

Sarcophytum trochiforme, Hickson (6). Off East London. 45 Fathoms.

Anthomastus grandiflorus, Verrill (18). Off C. Recife. 256 Fathoms.

Family **Nephthyidae**

Eunephthya thyrsoides, Verrill (20). False Bay. 20 Fathoms.

Sub-Order **GORGONACEA**

Family **Briareidae**

Spongioderma verrucosum, Möbius (12). Several localities. Shallow water.

Family **Melitodidae.**

Melitodes dichotoma, Pall. (13). Several localities. 41 Fathoms.

Wrightella coccinea, Gray (4). { Mossel Bay. Shore.
Off Algoa Bay. 25 Fathoms.

Family **Dasygorgiidae.**

Trichogorgia flexilis, N. G. et. sp. Off Cape Recife. 56 Fathoms.

Family **Isidae.**

Primnoisis capensis, Studer (15). 33° S. 17° W. 50 Fathoms.

Ceratoisis ramosa, N. sp. Off Vasco de Gama Peak. 230 Fathoms.

Family **Muriceidae.**

Villogorgia mauritiensis, Ridley (14). Off East London. 85 Fathoms.

Acanthogorgia armata, Verrill. Vasco de Gama Peak. 230 Fathoms.

Family **Plexauridae.**

Eunicella papillosa, Esper (3). { Rij Bank. 25 Fathoms. Table Bay. 50 Fathoms.

Euplexaura capensis, Verrill (20).

New Family **Malacogorgiidae.**

Malacogorgia capensis, N. G. et sp. Algoa Bay. 25 Fathoms.

Family **Gorgoniidae.**

Gorgonia flammea, E. et S. (2). Common in Shallow water.

Gorgonia capensis, Hickson (6). Off Cape St. Blaize. 40 Fathoms.

Gorgonia albicans, Kölliker (9). Several localities. 17-20 Fathoms.

Eugorgia gilchristi, N. sp. 34° S. 25° E. 52 Fathoms.

Gorgonia Sp. (?). 34° S. 25° E. 52 Fathoms.

Gorgonia (?) crista, Möbius (12). ? ?

Family **Gorgonellidae.**

Gorgonella stricta, Lamarck. Mossel Bay. 30 Fathoms. Sent to me by Mr. Strugwell.

Juncella elongata, Pall. (13). Off Algoa Bay. 25 Fathoms.

Juncella spiralis, N. sp. Off Cape Morgan. 36 Fathoms.

Sub-Order **PENNATULACEA.**

Family **Virgulariidae.**

Virgularia reinwardti, Herklots. St. Francis Bay. 30 Fathoms.

Family **Anthoptilidae.**

Anthoptilum grandiflorum, Verrill (19). Off Lion's Head. 136 Fathoms.

Family **Cavernulariidae.**

Cavernularia elegans, Herklots. False Bay. 25 Fathoms.
Cavernularia obesa, Val. Port Alfred. 43 Fathoms.

Specimens of all these species except Anthelia capensis, Eunephythya thyrsoides, Primnoisis capensis, Gorgonia (Lophogorgia) crista, Euplexaura capensis and Gorgonella stricta have been collected by Dr. Gilchrist and sent to me for examination.

The specimen I have provisionally marked Gorgonia ? may be of the same species as Verrill's Euplexaura capensis, but the spicules of our specimen are smaller and more uniform in shape.

The present paper contains an account of the following species:—

Alcyonium purpureum. N. sp.
Anthomastus grandiflorus. Verrill.
Wrightella coccinea. Gray.
Trichogorgia flexilis. N. G. et Sp.
Ceratoisis ramosa. N. sp.
Acanthogorgia armata. Verrill.
Gorgonia albicans. Kölliker.
Gorgonia. ?
Eugorgia gilchristi. N. sp.
Malacogorgia capensis. N. G. et Sp.
Juncella spiralis. N. sp.
Anthoptilum grandiflorum. Verrill.

Geographical Distribution.—The general features of the Alcyonarian fauna of Cape waters are particularly interesting. Affinities with the Atlantic fauna are seen in the occurrence of the genera Anthomastus, Acanthogorgia, Ceratoisis, Anthoptilum, and possibly Eugorgia. Affinities with the Indian Ocean fauna in the occurrence of the genera Wrightella, Juncella, Sarcophytum and Cavernularia.

The genera Acrophytum, Spongioderma, Malacogorgia and Trichogorgia appear to be peculiar to the district, and among the peculiar and characteristic species of the district may be mentioned Alcyonium purpureum, Sarcophytum trochiforme, Gorgonia flammea, Gorgonia capensis, Eugorgia gilchristi and Juncella spiralis.

We have, therefore, assembled together in this region representatives of the Indian Ocean, of the Atlantic Ocean, and possibly in Alcyonium antarcticum a representative of the Southern Ocean, but, at the same time, we find a considerable number of species which appear to be peculiar to the district.

It may be of interest, for comparison with this statement, to quote the following sentence from Agassiz's report on the "Challenger" Echinoidea (p. 263).

"The assemblage of species at the Cape of Good Hope is most peculiar, it is the meeting of the western boundaries of the African Indian Pacific and of the Indo-African, the southern boundary of the Atlantic and the northern extremities of the Southern Ocean faunae, and it has no species characteristic of its own in the continental or abyssal range."

Family **Alcyoniidae.**

Alcyonium purpureum, n.sp.

Plate VII., fig. 1. Plate IX., fig. 18.

Locality: Jetty at Mossel Bay.

Some specimens of this Alcyonium growing upon Tunicate tests and worm tubes were taken from the piles of the jetty at Mossel Bay. Dr. Gilchrist states that he has found the same species in Saldanha Bay. With some hesitation I have decided to constitute for them a new species. They are clearly distinct from the A. pachyclados described in my last contribution (6), and they are also distinct from A. antarcticum, which they resemble superficially in some respects. They appear to differ from all species of the genus about which we have adequate information in the fact that, when alive, they are of a brilliant purple colour. Dr. Gilchrist tried all sorts of expedients, in vain, to get the specimens to retain their colour. Sometimes he seemed to have succeeded, but when the colony was apparently quite dead, the pigment would pour out into the preservative fluid in streams. I do not call to mind any description of a species of Alcyonium in which a soluble colour of this kind is mentioned, and I have never noticed anything of the kind in the living specimens I have examined. In the British specimens of Alcyonium digitatum there is frequently noticed a pale pink colour, which gradually fades when the colonies are pre-

served. It is by no means constant, however, some specimens, particularly those in very shallow water, being devoid of it. The "brilliant purple" colour of this species is particularly interesting, and is deserving of further investigation.

The colour character by itself is not one which would justify us in constituting a new species for the specimens.

The Mossel Bay Alcyonium, however, differs from other species in a variety of other characters.

It resembles A. antarcticum in the hemispherial shape of some of the colonies and in the general transparency of the coenenchym. It differs from it in the general character and distribution of the spicules and in the absence of a stalk. It comes nearest, perhaps, to Alcyonium sphaerophorum Ehrb., as described by Klunzinger (8), but differs from it in the greater size of the lobes, the entire absence of a stalk, the absence of smooth calcareous corpuscles, and in the shape and size of the spicules. Ehrenberg described the colour of his species as "pallida, polypis fuscis." This is a good description of the colour of A. purpureum after the purple colour has been washed out.

In all the specimens the zooids are partially expanded. I have little doubt that if they had been carelessly killed and preserved, their resemblance to Alcyonium sphaerophorum would have been closer than it is.

The largest colony sent to me is attached to a Tunicate test. It is roughly hemispherical in shape, 40 mm. in diameter, 20 mm. in height. It springs from a flattened incrusting base bearing polyps, there being no stalk (sterile Füss), as in A. fulvum Forsk. There are fifteen lobes, varying from 15 mm.—8 mm. in diameter. The zooids are large, being in the specimens nearly 1. mm. in diameter at the base of the anthocodiae. The other colonies are much smaller, and consist of only one or two lobes.

The six ventral mesenteries are well developed. The figure given by Kükenthal (11), in a recent paper, of Alcyonium fulvum Forsk. has some resemblance to our new species, but in the size and character of the spicules it is clearly distinct.

The general coenenchym and the body walls of the anthocodiae are singularly transparent. At the surface of the coenenchym the spicules are closely crowded together, but a little way below the surface they are isolated and scattered. At the base of the tentacles there are eight triangular shields, pointed above, of scattered spindle-shaped spicules. The tentacles themselves are dark brown in colour and entirely devoid of spicules. The spicules of the coenenchym vary considerably in shape, but are mostly double clubs or double balls with a narrow neck. Their average size is about 0·1 mm. The spindles and clubs of the anthocodial body-wall are about 0·14 mm. in length. All the spicules are provided with numerous protuberant tubercles (fig. 18.)

The sex of the specimens were not determined, but the gonads are not mature.

Alcyonium purpureum.—Colony impregnated with a soluble purple pigment. Without a stalk (sterile füss). Lobes hemispherical up to 15 mm. in diameter. Spicules of the coenenchym double clubs and double spheres about 0·1 mm. in diameter.

Anthomastus Grandiflorus, Verrill.

Plate VII., fig. 2.

Verrill (18). Amer. J. Sci. XVI., 1878, p. 376.

Locality : Off Cape Recife, 34° 27′ S. 25° 42′ E. 256 fathoms. One specimen.

The single specimen obtained clearly belongs to Verrill's species A. grandiflorus, of which many specimens have been obtained in deep water 500-1,000 fms. off the East Coast of North America and the West Indies. It has close affinities, too, with Studer's (17) species A. agaricus, which was found in 1,267 metres in 46°04′ 40″ N., 49°02′ W., but differs from it in the fact that the autozooids of A. agaricus are smaller, more numerous, and more rigid.

The measurements given are as follows :—

	A. agaricus.	A. grandiflorus. Verrill.	A. grandiflorus. mihi.
	mm.	mm.	mm.
Length of autozooid anthocodiae	9	36	22
Diameter of ,, ,,	5	7–9	9
Length of tentacles	5	12	10
Height of Colony	20	about 40	40
Diameter of Colony	20–38	50–82	14–18

Verrill (21) had a large number of colonies to examine, and the specimen he measured he described as "a well-grown specimen, but not the largest."

In the Cape specimen there are five autozooids with their anthocodiae apparently fully expanded. In the specimens obtained by Verrill the number of autozooids varied from two in the smallest specimen to twenty or more in the larger ones. In Studer's specimen of A. agaricus there were ten autozooids.

The anthocodiae of the autozooids are nearly transparent, the body wall being provided with only a few scattered spicules; the tentacles are also transparent, but bear rather more spicules. It is very probable that they are capable of complete retraction.

The siphonozooids are minute and very numerous. It is difficult to give in figures any measurement of these siphono-

zooids that is satisfactory for comparison, as their size must depend very much on the degree of contraction of the general coenenchym. Between two points of the compasses fixed at 5 mm. apart from 7-9 siphonozooids may be counted. In A. agaricus the siphonozooids are 0·7 mm. apart.

The spicules are of two kinds. At the surface of the coenenchym they are very irregular in form and very abundant. They may be technically called clubs or double clubs or spindles, but with their form masked by the long spiny tubercles. The majority of them are about ·15 mm. in length. Below the immediate surface of the coenenchym there are many long needles irregularly spined and warted. They may be swollen in the middle or at one extremity, but more usually are fairly uniform in diameter. These needles vary very much in length, but some I have measured are over 0·7 mm. in length, with a maximum diameter of 0·04 mm. Similar needles have been described in A canariensis (0·5) and A. steenstrupii (0·5) by Wright and Studer, and in A. agaricus by Studer, but they do not appear to reach quite such a length as they do in the Cape specimen of A. grandiflorus.

The spicules of the body wall of the anthocodiae are spiny sclerites 0·05-0·07 mm. in length, and of the tentacles tuberculated rods 0·1 × ·03 mm. The colour of all the spicules is red.

The occurrence of this genus and species in Cape waters is a fact of considerable interest. It is the first recorded instance of the genus occurring elsewhere than in the Atlantic Ocean, north of the Equator (except A. steenstrupii W. and S. (23), off Japan). This is just the region from which the genus Sarcophytum, so common and abundant in the shallow waters of the Indian and Pacific Oceans, is absent.

In my last paper I recorded the existence in 32°53 S., 28°12 E., 45 fathoms, of a species which I placed in the genus Sarcophytum under the name S. trochiforme. At the time I hesitated whether S. trochiforme should be placed in the genus Sarcophytum or the genus Anthomastus. The small size of the autozooids and the relatively large size of the siphonozooids, however, appeared to me to point to its proper place being in the genus Sarcophytum. I see no reason to dissent from that view now. At the same time, there are some respects in which S. trochiforme does approach the genus Anthomastus, and it is clearly an intermediate form.

It is an interesting fact that, whereas Sarcophytum is essentially a shallow water genus (only two species occurring in water as deep as 18 fathoms), and Anthomastus is a deep-water genus, occurring in water from 200 to over 1,000 fathoms in depth; Sarcophytum trochiforme, the intermediate form, was found in 45 fathoms.

Family **Melitodidae.**

Melitodes dichotoma, Pallas (13).

Localities: 1. Vasco de Gama Peak, N.W. $\frac{3}{4}$ N., 8 miles. 41 fathoms. Rock. April 27, 1900.

2. East of Cape Agulhas (Sebastian Bluff), W. by N. $\frac{3}{4}$ W., 6 miles. 26 fathoms. Mud.

In the first dredging two specimens were obtained, one red and one yellow. It is interesting to find the two varieties of the species in the same haul of the dredge in this locality. In my last communication (6) I pointed out that the two varieties occur in the same locality in False Bay. Beyond the fact that the yellow variety in this new locality is rather more orange coloured than pale yellow, as the specimens of the yellow variety were in False Bay, no important differences were observed. In the second dredging a small piece of (probably) the same species was found growing on a shell of Terebratula rosea.

Wrightella Coccinea, Gray.

Gray (4), Catalogue Lithophyt., B. Mus., p. 32.

Ridley (14), Zool. of Alert, p. 581.

Locality: Fairly abundant on the piles of the jetty at Mossel Bay.

The specimens from Mossel Bay are very closely related to the specimens described by Gray as Wrightella coccinea from the Seychelles. Unfortunately, the genus Wrightella is not very well known, and is not very well defined from its neighbours.

The specimens in the collection agree with the description of the genus in having foliaceous clubs in the cortex; in the fact that the nodes are not perforated by canals, and that the branches arise from the nodes.

The foliaceous clubs (Blattkeule) are not very numerous, but are very variable in form. Ridley says that the genus is distinguished by the "very massive form of the Blattkeule and the swelling out of their 'Blatt' into rounded bodies with scarcely perceptible edges." This description is perhaps a little difficult to understand. It appears to me that the Blattkeule are formed by the exaggerated growth of the tubercles at one end of a tuberculated club. They may become expanded and anastomose, forming leaf-like processes of irregular shape, or, as in the case under description, the tubercles of nearly two-thirds of the thicker end of many of the clubs may be prolonged into long rod-like process with rounded ends. There is so much variety in the spicules of this species, however, that it is impossible to

describe any one form as typical. Ridley does not mention the size of the spicules. Klunzinger (8), in his description of Mopsea erythraea from the Red Sea, which Ridley places in this genus, says the spicules are from 0·16-·02 mm. in length and ·03-0·06 in breadth. The spicules I have measured in these specimens vary in size up to about 0·15 mm. in length.

An examination of a fragment of the type specimen of Wrightella coccinea in the British Museum shows that the spicules are much more crowded in the superficial coenenchym than they are in the Cape specimens and the foliaceous clubs larger (·2 mm. in length), and much more numerous. The differences in this respect are so great that I was tempted to constitute a new species for the Cape specimens, but when I examined a considerable number of specimens, and found that there is a great variability in respect of the number and crowding together of the spicules in the coenenchym and in the relative number of clubs and foliaceous clubs, it appeared to me wiser to include them in the species named by Gray.

There is a difference of 30° latitude between Mossel Bay and the Seychelles, and it is not surprising that the specimens of Wrightella from the former locality should differ in this respect from those found in the latter. There are other species of Alcyonarians in which the tropical varieties exhibit larger and more numerous spicules than the temperate varieties.

The genus is characterised by its dwarf size. Wrightella chrysanthus is $2\frac{1}{2}$ inches in height, and Wrightella (Mopsea) erythraea is said to be 40-60 mm. in height by Klunzinger (8). The average height of the Cape specimens is about 40 mm.

The colour of the majority of specimens is red, but some are orange or an intermediate colour between red and orange and some pink. Ridley says that the verrucae of W. coccinea are yellow. In this respect the Cape specimens differ from the type, all the verrucae being red. The anthocodiae are white and transparent, as described by Klunzinger for W. erythraea from the Red Sea.

I may here call attention to an erratum in my last paper on the Cape Alcyonaria. When I examined Wrightella coccinea I was strongly reminded of the specimen I described in that paper as Primnoisis capensis (Studer), and I was led to a re-examination of its structure. I am now convinced that it belongs to this species. The pink colour and the somewhat stronger habit may be associated with the fact that it was found in 20 fathoms of water, *i.e.*, much deeper than the Mossel Bay specimens, but the comparison of the spicule preparations revealed so many general similarities of form that there can be no longer doubt of their identity. The Blattkeule, which I overlooked in my first examination, do occur, although they are not numerous.

I have not had the opportunity of examining Studer's specimen from 50 fathoms in latitude 33° 59′ S. and longitude 17° 52′ E., which he named first Isidella and subsequently Primnoisis capensis, but although this nominally belongs to another family, the Isidae, I am convinced that it must be closely related to, if not identical with, Wrightella coccinea.

Family **Dasygorgiidae**, W. and S.

The family Dasygorgiidae of Wright and Studer (23) was defined as follows:—

Colony consisting of a simple or branched axis. Main axis: calcareous at its base, which latter is either flattened and disc-like, or ramifying into numerous root-like processes; the fibrous portions of the stems and branches with calcareous particles intermixed; often brilliantly iridescent. Coenenchyma; for the most part thin, sometimes without spicules, at other times with numerous transparent glassy, fusiform often spiny spicules, or with irregular scale-like spicules; sometimes the spicules are in two layers. Polyps; large, prominent, inserted on the axis either at right angles or obliquely; covered with spicules variously arranged; tentacles retractile, sometimes only imperfectly so."

In his recent important paper on the Gorgoniidae of the Siboga Expedition, Dr. Versluys (22) has revised the genera and species included in this family, and has reinstituted Verrill's original name Chrysogorgiidae for the family, and given a more restricted definition of it. The specimen I am about to describe should be clearly included in the family as described by Wright and Studer, but in the fact that the zooids are situated on all sides and not on one line only of the branches it would not be included in the more restricted family as defined by Versluys. The same difficulty arises with regard to the species Chrysogorgia constricta Hiles (7), in which the zooids are situated on at least two sides of the branches.

Two courses are open therefore. Either to constitute a new family for Hiles' Chrysogorgia constricta and this Cape specimen, or to adopt Wright and Studer's definition of the group and include them in the family Dasygorgiidae.

The latter course appears to me the more reasonable of the two. The new genus, which I propose to call Trichogorgia, is clearly related closely to many species of the genus Dasygorgia (W. and S.) or Chrysogorgia (Versluys), in the mode of origin of the branches, in the character and disposition of the spicules, in the arrangement of the calcareous deposits in the axis and in the mode of retraction of the tentacles, etc. To constitute a new

family for a form so closely related to a well known genus would be clearly inconvenient. I have re-examined the type specimen of Chrysogorgia constricta (Hiles), and I am convinced that its affinities with the genus Chrysogorgia as defined by Wright and Studer are pronounced. In neither case is there sufficient justification for the establishment of a new family. The specimen from which Miss Hiles described her new species was fragmentary, and the question whether a new genus should be constituted for it may be postponed until complete specimens are forthcoming.

Trichogorgia Flexilis N. gen et spec.

Plate VIII., fig. 13. Plate IX., figs. 16 and 17.

Locality : Off Cape Recife, 34° 7′ S., 25° 43′ E. 56 fathoms.

This species was obtained not very far from the station where Malacogorgia capensis was found but in deeper water. The colony is attached by a short main unbranched stem 8 mm. long, 2 mm. in diameter, expanding into an irregular disc 6 mm. in greatest diameter. Branching begins by a long but narrow branch 8 mm. from the base, and this is soon followed by what appears to be dichotomy, and then a third branch is given off at a considerable distance from the right hand division of this dichotomy, and finally a fourth.

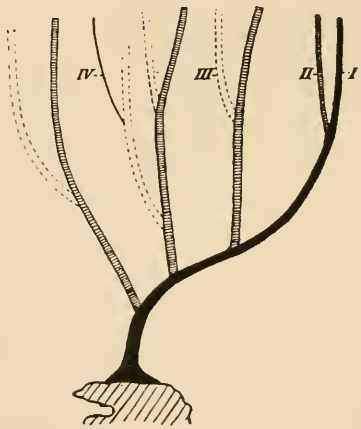

Diagram of the Branching of Trichogorgia. — I., Main axis; II., primary branches; III., secondary branches; IV., tertiary branches.

If we consider that, in the position in which the specimen is drawn, the branch to the right is in all cases the main axis, then

there is a close similarity to the branching of such a species as Dasygorgia (Chrysogorgia) flexilis (W. and S.) all the primary branches being given off along a definite line on one side of the axis. This line is, however, not spirally twisted, and the colony is consequently branched in one plane only, and does not form, therefore, a bushy or shrubby colony, as is usually the case with the branched species of the family. Secondary, tertiary and in some cases quaternary branches are given off from the primary branches. The terminal branches may be 20 mm. in length, but it is characteristic of the species that the axes of the terminal and subterminal branches are very fine and hair-like 0.1-0.02 mm. in diameter. The axis is throughout fibrous and horny, but it contains a considerable quantity of calcium carbonate in the form of fine amorphous granules.

The coenenchym is missing on the unbranched stem and very thin on the larger branches, but it becomes thicker proportionately on the secondary branches, and reaches its greatest relative thickness at the end of the terminal branches. At a distance of 2.5 mm. from the extremity of a branch I found that the total diameter of the branch was .15 mm. and of the axis .025 mm.

The anthocodiae are all partially retracted into long cylindrical calicles 1 mm. in length. These calicles are set at an acute angle, and are directed towards the terminal extremity of the branch. The calices are very numerous, crowded on all sides of the terminal branches and closely set on the sub-terminal branches. Both calices and coenenchym are protected by a great number of calcareous overlapping scale-like spicules, arranged in a single layer.

The characteristic feature of the species is that nearly all these spicules are of the same general shape, i.e., a very thin, flat double disc or double paddle. The size varies from 0·1 × 0·04 (greatest breadth or 0·03 breadth across the neck) to 0·15 × ·035 (·03 across the neck). A few simple spindles of the shape shown in fig. 13c. may be found, and these and all other varieties are rare or very rare. The spicules are very nearly smooth, but in some cases a fine pattern and a minute serration of the edges may be seen (fig. 13d.).

The colony is female. Each zooid contains not more than one ripe ovum; but young zooids and adult with no ova occur on the same branch. (Plate IX., fig. 17.)

The genus may be characterised as follows:—

Colony branching in one plane. Axis becoming very thin in the terminal branches. Calices numerous and situated on all sides of the terminal and subterminal branches. Spicules very thin double discs or double paddles, numerous, overlapping, in one layer on calices and coenenchym.

Family **Isidae.**

Ceratoisis ramosa, n. sp.

Plate VII., figs. 3 and 4. Plate VIII., fig 12.

Locality: Vasco de Gama Peak, N. 71 E., 18½ miles. 230 fathoms. Stones. May 4, 1900.

This specimen is a good deal broken, but considering its extremely fragile character it is sufficiently well preserved to merit congratulation on its arrival.

The base is missing, and the terminal branches have in many places been lost, but I estimate its total height to have been about 100 mm. The main stem is relatively thick (3 mm. in diameter) and made up of calcareous internodes 3-5 mm. in length, alternating with horny nodes 1 mm. in length. The calcareous internodes give rise to the calcareous internodes of the branches, and the calcareous internodes of the branches give rise in a similar manner to the internodes of the secondary branches. The bronze colour of the nodes contrasts finely with the ivory-white calcareous internodes as described by Verrill in C. ornata. The branches arise very irregularly in all planes, and the whole colony has the appearance of a low, dwarfed, finely branched shrub. The smaller and terminal branches are very slender, and have very long internodes with relatively short nodes. The terminal branches are about 0.2 mm. in diameter, with internodes 5 mm. long and pad-like nodes 0.4 mm. thick.

Throughout the whole colony the coenenchym is extremely thin. The main stem has the appearance of being quite naked, but an extremely thin membrane bearing a few isolated zooids can be seen on closer examination. The zooids are irregularly scattered on the main stem, but are arranged on the branches at intervals of 2 to 4 mm. apart. In some places on the terminal branches three or four zooids may be close together, but they are never so crowded as they are represented to be in Ceratoisis grayii (4). The zooids with the tentacles folded over the crown are about 1 mm. in height. The surface of the zooids and the coenenchym is covered by plate-like spicules which in dried specimens overlap in places, giving the surface a primnoid appearance.

The aboral side of the bases of the tentacles are usually protected by spicules of the shape given in fig. 4b., and remind one of the opercular spicules of Primnoidae. Surrounding the neck of the zooid there are curved spindle-shaped flat spicules about 9·4 mm. in length (Fig. 4c.). On other parts of the zooids and on the general coenenchym the spicules are very irregular in size and shape, but long flat spindles up to 0.6 mm. in length predominate. Irregular plates such as those drawn in Fig. 4a. and Fig. 4d. are also found on the general coenenchym.

This species differs from all the other known species of the genus in its profuse ramification, but the justification for referring it to the genus lies in the fact that the branches arise solely from the calcareous internodes, and that the coenenchym is throughout extremely thin. In its profuse ramification it resembles the genus Acanella belonging to the same family, the general character of the spicules recalls that of many species of the Dasygorgiidae, whilst the large flat plates covering the bases of the tentacles indicate some affinities with Primnoidae.

The distribution of the species of Ceratoisis is interesting. The original type specimen of C. grayii (Wright 24) was obtained in 400 fms. off Setubal, in Portugal. Verrill (21a) records C. ornata as occurring in 250 fathoms off Nova Scotia. C. palmae was obtained by the Challenger in 1,125 fathoms off the Canary Islands. The other species are Pacific Ocean forms. C. Phillippinensis was found off the Phillippines in 82 fathoms. C. grandiflora in 210-255 fathoms, and C. nuda on the reefs off Fiji. C. paucispinosa in 345 fathoms on the Hyalonema grounds off Japan (23).

Family **Muriceidae.**

Acanthogorgia armata, Verrill.

Verrill: Am J. Sci XVI., 1878, p. 376.
„ Bull. Mus. Comp. Zool., 1883, XI., p. 31.

Locality: Vasco de Gama Peak, N. 71 E., 18½ miles. 230 fathoms, stones.

This species is fully described by Verrill (1883). It was first brought by the Gloucester fishermen from the fishing banks of Nova Scotia and Newfoundland, and it was also obtained by the U.S. Fish Commission in 1882 off Martha's Vineyard. It is essentially a deep water form, occurring in 220 fathoms off George's Bank down to 640 fathoms off Martha's Vineyard. It is closely allied to and perhaps identical with specimens obtained in deep water by the "Blake" off the West Indian Islands, and with A. hirsuta Gray obtained in deep water off Madeira. The genus Acanthogorgia is principally found in the Atlantic waters, A. longiflora from 700 fms. off the Phillippines, Acanthogorgia muricata off Funafuti (7a), and Acanthogorgia spinosa off New Britain (7), being the only species which up to the present time have been described as occurring outside this area. The species have been found off the Eastern shores of America, from Newfoundland to Patagonia, and the species A. ramosissima has been found in the Southern Ocean off Prince Edward's Island. Studer (17) records the genus from the Gulf of Gascony and the Azores, and the species A. hirsuta was originally described from Madeira.

The specimens obtained by Dr. Gilchrist are probably fragmentary. One specimen is 52 mm. and another 72 mm. in length. They correspond with the description of the type specimens in that the calices are from 5-7 mm. in height and 2 mm. in diameter, and the large bent spicules are about 0.8 mm. in length, and correspond in shape and variation with the description of the type spicules. The species that comes nearest to this geographically is A. ramosissma (23) from Prince Edward's Island, but this species has smaller spicules and a more regular arrangement of the calices on the stem.

New Family **Malacogorgiidae.**

This family is constituted for the reception of the remarkable specimen described below. Its characters are: Colony branched and upright. Axis slender, horny. Spicules and all other forms of calcareous skeleton absent.

The position of this family in our system must for the present remain uncertain. In general form the single specimen resembles Trichogorgia flexilis, which is undoubtedly a member of the family Dasygorgiidae, but as there is no calcareous deposit in the axis and the method of branching differs from that of the Dasygorgiidae in some respects, I think it is best, as a temporary measure, to place it next to the family Gorgoniidae.

Malacogorgia Capensis, N. Gen. et Spec

Plates VII., fig. 5, and VIII., figs. 10 and 11.

Locality: Algoa Bay. Lat. 35° 40 S., Long. 35° 56 E. 25 fathoms.

This remarkable specimen shows absolutely no calcareous structures. As it was possible that the preservative might have contained sufficient acid to dissolve the spicules, sections were prepared and carefully examined with the high power of the microscope, but they revealed no spaces from which the spicules could have been dissolved out. The spicules of none of the other specimens collected at the same time show signs of corrosion by acid, and it is extremely difficult to believe that any acid fluid acting for a short time could have so completely dissolved away every trace of lime. The only conclusion that can be reached, with reason, is that this is a Gorgonian devoid of spicules.

Whether we should be justified in including this genus in the family Gorgoniidae, or whether it should be made the type of a

new family are questions which the future must decide. For the present I think it is better to place it in a new family. The single specimen consists of a cylindrical stem 15 mm. long by 1.75 mm. in diameter attached to a stone by a broad base. It gives rise to four main branches which after a course of 10-20 mm. again divide into 12 secondary branches. The secondary branches are very slender, about 70 mm. in length, and alone bear the zooids. The zooids are fully expanded 0.65 mm. in length from the base of the anthocodia to the base of the tentacles and about 0.3 mm. in diameter. The tentacles are 0.4 mm. in length, and bear from 12-14 pinnae in a single row on each side.

The stomodaeum of the zooids is long and bears a very well-marked siphonoglyph.

The zooids increase in numbers partly by additions at the base of the secondary branches (Fig. 10) where there may be seen two rows, one on each side of the branch, of very young zooids, the youngest being nearest to the primary branch. In the lower two-thirds of the secondary branches the bilateral arrangement is preserved, but in the upper third other zooids are added, and then they appear to be distributed on all sides of the branch in a dense cluster. The colony was female, a few of the polyps bearing a single immature ovum 0.05 mm. in diameter. The genus may be described as follows:—

Genus Malacogorgia.—Colony slightly branched. Axis horny with no trace of lime. No spicules in any part of the colony. Polyps arranged bilaterally in the plane of branching at the basal two-thirds of the secondary branches and on all sides of the terminal one-third of the secondary branches.

M. capensis with the characters of the genus. Colour in spirit white.

Family **Gorgoniidae**.

There are many unsatisfactory features about the present day definition of this family, and a thorough revision of the genera is very necessary.

The species in Cape waters which is clearly Platygorgia albicans of Studer (16) and Eunicella palma of Verrill, and considered by these authors to be the same as Gorgonia albicans of Kölliker (9), Gorgonia palma var. alba of Esper (3) and Lophogorgia palma of E. and H. exhibits the peculiar torch-shaped spicules of the Plexaurid Eunicella, but it differs from the Plexauridae in having a very thin and not a thick fleshy coenenchym on the main axis. The remarkable flattening of the axis is similar to that of Gorgonia flammea, in which species there may also be noticed a very remarkable scantiness of coenenchym on the main branches. Until the anatomy of these

corals is more thoroughly investigated, I am inclined to include Gorgonia albicans in the family Gorgoniidae notwithstanding the remarkable difference between it and Gorgonia flammea in the character of the spicules.

Studer (16) in his original description of the genus Platygorgia stated that the spicules, although similar to the spicules of Eunicella in form, are characterised by the fact that the clubs attain the same length as the spindles. "Die spiculen sind characteristisch in dem die Keulen hier die Länge der Spindeln erreichen." This is not confirmed by my specimens. I have been able to compare carefully the spicules of my preparations of Platygorgia (Gorgonia albicans) with those of Eunicella papillosa, and I have found them remarkably alike. The torches (clubs) of both are on an average 0.1 mm. in length and the spindles 0.14 mm. The torches are fairly uniform in size when full grown, the spindles are much more variable. The most striking point, however, of the comparison is the extraordinary resemblance in detailed structure between the torches of the Eunicella and of the Gorgonia albicans. The examination of my preparations of spicules alone would lead any one to the conclusion that they were taken from the same species. Yet the specimen of Eunicella papillosa obtained on Rij Bank 25 fathoms has a cylindrical axis and prominent verrucae, whilst the specimen of Gorgonia albicans picked up on the beach at Port Alfred has a very much flattened axis, thin coenenchym and inconspicuous verrucae.

These facts seem to point to the conclusion that Eunicella papillosa and Gorgonia albicans should be included in the same genus and family. Further investigation of the anatomy of the two forms is necessary to justify the suggestion that Eunicella papillosa should be placed in the Genus Gorgonia, but I think we should be justified in transferring Eunicella papillosa to the family Gorgoniidae.

Gorgonia Albicans, Kölliker.

Gorgonia albicans, Kölliker, Icones hist.
Eunicella palma, Verrill.
Platygorgia albican, Studer, Archiv. Naturg. 53, 1, p. 60.
? *Gorgonia palma., var. alba.* Esper., Pflanzenthiere.

Localities: (1.) Port Alfred. Beach dried.
(2.) Off Cape St. Blaize, S.W. Seal Island, W. ½ S. 17 fathoms. Sand.

The colony of the first-named specimen is upright, 300 mm. in height, branching in one plane, the branches free, not anastomosing. The stem and the inferior parts of the branches are very much flattened in the plane of branching.

The diameters of the main stem are 5 mm. and 22 mm., the axis being bare, of the lower branches are about 4 mm. and 10 mm., including the coenenchym. The terminal branches are almost cylindrical in shape. The coenenchym is thin. The axis is horny, with very little or no lime. The verrucae are small 0·5 mm. in diameter and scattered unevenly on all sides of the branches.

The surface of the coenenchym presents a series of peculiar torch-like spicules similar to those of Eunicella (Hickson 6 Plate v.c.). They are about 0.1 mm. in length. The other spicules are spindles with very pronounced and regularly arranged tubercles, varying considerably in size, but frequently reaching 0.15 mm. in length.

The second specimen, which is well preserved, is a good deal smaller, being not more than 70 mm. in height. The coenenchym of the base is very largely destroyed, and the horny axis is covered with a varied fauna of zoophytes, of which a species of Hydrozoon allied to Bimeria is a predominant feature. The most important fact about this specimen is that the stem and branches are not flattened but nearly cylindrical throughout, and the branching is not strictly in one plane. The coenenchym moreover, is in many parts of the branches swollen to form oval knobs, or knuckle-like nodes. These two features are noteworthy because, to a superficial observer, they might seem sufficient to separate the specimen from a species to which the generic name Platygorgia has been applied. I am very strongly of opinion that the flattening of the stem and branches so frequently noticed in this species and in Gorgonia (Lophogorgia) flammea (Ellis) is a character produced by local circumstances, and should be used very cautiously for diagnostic purposes. For this reason I have adopted Kölliker's view that the species should be retained in the genus Gorgonia for the present. The colour of both specimens is pale cream to white.

The second specimen is, in external features, very similar to the specimen that is described next (Gorgonia species?), but it differs from it decidedly in the character of the spicules. In Gorgonia albicans, moreover, the elongated slit-shaped openings of the calices are irregularly arranged, not parallel with the axis as they are in Gorgonia lütkeni, G. capensis and the unnamed specimen in the collection.

Gorgonia, Sp. (?).

Locality: Lat. 34° 5′ 20″ S., Long. 25° 43′ E. 52 fathoms. Rock.

Syn. Euplexaura capensis (?) Verrill, 20.

In the bottle containing Eugorgia gilchristi (p. 230) there was a fragment of what may have been a large Gorgonian consisting

of an axis 120 mm. long with six lateral branches, themselves supporting a few small branchlets. The branches are 4 mm. × 2 mm. in diameter, the axis being decidedly flattened, and they terminate distally in distinctly swollen extremities. The zooids are few in number and confined to the lateral areas of the flattened branches. The coenenchym is thick and fleshy on the terminal branches, but very thin on the principal branch or axis. The spicules are warted spindles about .1 mm. in length and fairly uniform in size. Some longer pointed spindles with fewer tubercles occur in the calices. The surface of the branches is smooth, the position of the calices being represented by slit-shaped pores parallel with the axis and in some cases with a slight mound or convexity round them. The specimen is probably related to Gorgonia lütkeni (W. and S.) and Gorgonia capensis (Hickson), but differs from both in some particulars. The terminal branches are a good deal more fleshy than in both, and in colour it is white not yellow or yellowish red. In these particulars the specimen approaches Verrill's Euplexaura capensis. The axis is devoid of calcium carbonate.

Eugorgia Gilchristi, n. sp.

Plate IX., figs. 15 and 19.

Locality: Lat. 34° 5′ 20″ S., Long. 25° 43′ E. 52 fathoms. Rock.

Considerable difficulty was found in determining the proper position of this form. In its mode of growth the character of the superficial coenenchym, the character of the verrucae, it has a close resemblance to the genus Verrucella, and at first it seemed to correspond with the Verrucella granifera, Köll, obtained by Möbius off the coast of Africa (sic!) But it differs from Verrucella and the family Gorgonellidae to which Verrucella belongs in the fact that the axis is not calcified. I have decided, therefore, with some hesitation, to place it in the genus Eugorgia (Verrill), with which it agrees in the horny character of the axis, the general character of the spicules, and the "finely granulous" nature of the surface. It seems to approach most nearly the description of Eugorgia Daniana (Verrill) from Panama and Pearl Islands, but I think it may justifiably be regarded as a distinct species.

It is a large flexible coral springing from a single horny stem 4.5 mm. in diameter and reaching a total height of 240 mm. It branches profusely, pinnately or irregularly with occasional anastomoses. The terminal branches are of variable length, and about 1 mm. in diameter. The axis is horny throughout and very slender indeed in the terminal branches. The verrucæ are dome-shaped, quite distinct, but not very prominent, and they are

evenly distributed on all sides of the branches. The coenenchym is very thin on the thicker branches, but relatively thick on the smaller ones. The surface is finely granular.

The spicules are very numerous, and consist of spindles with prominent tubercles of various sizes up to .12 mm. in length, double wheels up to ·05 mm. in length, Maltese crosses, fig. 19 c, rough stars or warted spheres .03 mm. in diameter. In the calices there are finely pointed spindles with relatively few tubercles and some which are distinctly flattened, fig. 19 e, as in Verrucella granifera.

The specimen is almost white.

Family **Gorgonellidae.**

Juncella spiralis. n. sp.

Plate VIII., figs. 6, 7, 8 and 9.

Locality : Off Cape Morgan, 32° 45′ 45″ S., 28° 26′ 15″ E. 36 fathoms. Stones, 29 specimens. January 12, 1900.

Twenty fine specimens of this remarkable, new, spirally twisted Juncella were sent to me, with the remark, "There were no specimens showing the tendril-like stock twisting round any support."

The longest specimen was 220 mm. in length when slightly stretched, but this was imperfect, the base having broken off. The longest perfect specimen was 150 mm. Two small perfect specimens which are not spirally twisted, are 50 and 55 mm. in length. The greatest breadth is 4-5 mm. in some large fragments. The smaller specimens are only 2-3 mm. in breadth. The stock is unbranched in all the specimens. The axis is pale brown in colour, and has rings of lime imbedded in the horny matrix. The verrucæ are all prominent, and arranged irregularly on two-thirds of the circumference of the stock, leaving a bare track on one side free from verrucæ for the whole length of the stock. In a large specimen the bare track is 1·75 mm. wide, and the verrucæ project about 1·5 mm. The tentacles are in all cases retracted. In colour, the bare track is orange red, and the verrucæ are a pale yellow. A specimen that I dried became yellow all over, and I have noticed that the spirit in which the specimens are preserved has a pink colour. The red colour may therefore fade away in the course of time. The bare track and verrucæ are covered with a dense armature of spicules, and it is difficult to believe that the verrucæ can be ever retracted. The spicules covering the surface of the verrucæ are irregularly tuberculated plates about ·1 mm. in length and rather less in breadth, but

mixed with these are a number of clubs (Fig. 8) and spindles with thick coarse tubercles about ·1 mm. × ·05 mm. in size. On the coenenchym the surface is armed principally with these clubs and spindles, but a few more flattened forms may be found among them. It is impossible to describe the many variations in form and character of the spicules. Many of them are like the types described, but others are quite irregular. When a fragment of the hard crust which covers the surface is detached with needles and examined with the microscope it is seen that the spicules are tightly jammed together to form an impenetrable armour. The surface of the verrucæ has a distinctly squamate appearance, the plate like spicules slightly overlapping (Fig. 9b.). There are also some long needles 0·4 mm. in length (Fig. 9a) in the deeper parts of the zooids. There can be little doubt I think that the species is rightly placed in the genus Juncella, and it appears to be most closely related to Studer's (15) Juncella flexilis from between Flat Island and Mauritius in 25 fathoms. It differs from this, however, in its smaller size (the specimen of J. flexilis was 20 cm. in length), in its spiral form, in the more irregular arrangement of the verrucæ on the stock, in the presence of a bare track on one side, and in some other peculiarities.

This bare track is seen in some other species of Juncella. In the description of Juncella juncea from the Isle of Bourbon Milne-Edwards and Haime state that the calices leave some trace of a median coenenchymatous space. Ridley (14) also states that there is a distinct median groove in the specimen of Juncella juncea obtained by the "Alert."

The squamate armature of the verrucæ shows some affinities with the characters of the Primnoidae, but, as the plate-like spicules are so small and there are no definite opercular plates, its affinities with Juncella are closer. It is noteworthy, however, that in the Primnoine genus Calypterinus the calices do not occur on one side of the stock. The track which is free from the calices in Calypterinus, however, is covered by the overlapping scales of the lateral calices so as to form a tube. These bare tracks on one side of the stock in Juncella spiralis and Calypterinus allmani have a certain resemblance to the bare tracks on one side of the smaller branches of some forms of Solenocaulon, and suggest the presence of symbiotic crustacea. There is no evidence in support of this at present, but it would be worth the trouble for any naturalist who has the opportunity of dredging in these waters to note the character of any Alpheidae or other animals that might possibly live with this Juncella. Dr. Gilchrist's note that nothing was found around which the stock twisted is of the nature of a support for the suggestion that the spiral form of the larger stocks is associated with the presence of some epizoic animal. We may for the present regard the spiral form and the bare track as characters of the species, but if they prove to be mere adaptations to an

epizoic animal their importance must be considerably discounted.

The species may be described as follows:—

Colony unbranched; in the larger forms spirally twisted. Verrucæ prominent, situated irregularly and closely on three-fourths of the circumference of the stock, leaving a bare track on one side free from verrucæ. Spicules of the surface of verrucæ and coenenchym densely packed, irregular in form or clubs or spindles with prominent blunt tubercles, all about 0·1 mm. in length. A few long needles 0·4 mm. in the more deep-seated tissues.

Colour of the coenenchym orange red, of the verrucæ yellow.

NOTE ON JUNCELLA ELONGATA (PALLAS).

Since the publication of my last paper on the Cape Alcyonaria I have had the opportunity of examining a large number of preparations of spicules of specimens of the genus Juncella from the Indian Ocean and elsewhere. In none of them can be found a single spicule of the kind which I called "triple stars." These peculiar spicules are very abundant in the preparations made from the Cape Juncella elongata, and might be regarded as a character sufficient to distinguish the Cape specimens as a distinct species. Other characters, however, that they exhibit are so strikingly similar to those of Juncella elongata that I do not propose to take this step at present. They may be regarded, however, as constituting a distinct variety, and should be called Juncella elongata (Pall.), var. capensis.

Sub-Order **PENNATULACEA**.

Family **Anthoptilidae**, Köll.

Anthoptilum grandiflorum, Verrill.

Virgularia grandiflora, Verrill (19).
Anthoptilum thomsoni, Kölliker (10).

Plate VIII., fig. 14.

Locality: Lion's Head, N. 67° E. 25 miles. Depth: 131-136 fathoms. Bottom: Black specks on the lead; no deposit obtained by the dredge.

The following notes were kindly sent by Dr. Gilchrist:—

"The colour when fresh was a uniform bright brick red. "Some difficulty was experienced in preventing the polyps from "being washed off by the motion of the preservative fluid owing "to the roll of the vessel.

"They seem to occur in great abundance in particular places, "probably forming miniature forests at the bottom of the sea. "They are not straight when fresh, but more or less bent, with "three gentle curvatures."

Fifty-four specimens were obtained on March 28, 1900, of which twelve were sent to me.

There can be no doubt of the identity of this species with that obtained by the "Challenger" in the Atlantic Ocean, S. of Buenos Ayres, depth 600 fathoms; and described by Kölliker as Anthoptilum thomsoni; but it is difficult to distinguish the species from Verrill's Virgularia grandiflora described in 1879.

The largest unbroken* specimen had the following measurements :—

	Cape Specimen.	"Challenger."
Length of Polypidom	1010 mm.	560 mm.
Length of stalk...	160 mm.	87 mm.
Breadth of stalk bulb... ...	30 mm.	18 mm.
Length of polyps	16 mm.	17·5 mm.
Length of tentacles...	6 mm.	6·8 mm.

In the second column are given the measurements of the largest specimen of the species obtained by the "Challenger."

The other specimens sent from the Cape were a little smaller than the one mentioned above, but I have not measured them accurately, as there is no sufficient reason for supposing that they belong to different species. The main point of interest is that the specimens found on the Eastern side of the Atlantic are larger than those obtained by the "Challenger" on the Western side; but whether this is to be associated with the fact that the "Challenger" specimens were found in deeper water (600 fathoms, against 135 fathoms) or that they were obtained in 20 degrees of latitude further South, or whether the difference in size is simply a matter of geographical isolation, is a question which it is premature at present to discuss. It is noteworthy, however, that notwithstanding the difference in size of the polypidoms, the autozooids and the tentacles of the autozooids of specimens from the Eastern and Western waters are approximately of the same size. Accurate measurements have not been made, and, as it is impossible to prevent a certain amount of shrinkage in the preservation, cannot be made; but the difference in the measurements of the autozooids and their tentacles given by Kölliker and those of my specimens is so slight that it is probable that when alive in their native habitats they were exactly the same.

* Some of the specimens that were cut into two or three pieces for transit were probably larger than this.

The specimens agree with the general description given by Kölliker in most respects, but there are a few minor differences which are worthy of record.

Kölliker remarks that very often the lowest parts of two or three or more polyps of a row are united so as to produce the appearance of very small pinnules, but in no place are all the polyps of one row united in such a manner. This fusion of the bases of the autozooids is much more pronounced in the Cape specimens. Most of the autozooids of a row are fused at their bases for a distance of 3-5 mm. in the middle rows, but there are usually one or two gaps irregular in position in each row where the fusion of the bases is reduced to a mere trace. In the lower rows the fusion of the bases is scarcely noticeable. (Fig. 14.)

The siphonozooids are, as in Kölliker's specimens, very numerous, but, unlike Kölliker's specimens, they exhibit an almost continuous dorsal* series uninterrupted at the bases of the rows of autozooids. I have also found no siphonozooids between the individuals of the rows of autozooids.

I have searched for the calcareous corpuscles found in the muscular layers at the base of the stalk without success. I cannot find any calcareous corpuscles in any part of the colony. This may be an oversight on my part, but it is practically impossible in seapens of this gigantic size to search all parts of the fleshy substance with equal care.

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* The dorsal side of this pennatulid was called "ventral" by Kölliker. For a full discussion of this point, the reader is referred to the important memoir by H. F. E. Jungersen on the "Pennatulida of the Danish Ingolf Expedition, 1904," a copy of which was kindly sent to me by the author, and came to hand as I was passing the proofs of this paper for the press.—S. J. H.

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DESCRIPTION OF THE PLATES.

Plate VII.

Fig. 1. Alcyonium purpureum. New species. The largest colony obtained, attached to a Tunicate test. Natural size.

Fig. 2. Anthomastus grandiflorus. Verrill. Natural size. Au. Autozooids. Si. siphonozooids.

Fig. 3. Ceratoisis ramosa. New species. The specimen was a good deal broken, but it will be noticed from the drawing that the branching is profuse and not confined to any one plane. Twice natural size. See also Pl. VIII., fig. 12.

Fig. 4. Spicules of Ceratoisis ramosa. N. sp. a. and d. Irregular plates found on the surface of the general coenenchym; b. triangular plate found on the aboral side of the base of the tentacles; c. flat spindle-shaped spicule from the neck of the anthocodia.

Fig. 5. Malacogorgia capensis. New genus and species. This species has no spicules. See also Pl. VIII., figs. 10 and 11.

Plate VIII.

Fig. 6. Juncella spiralis. New species. A large but incomplete specimen of the species. All the larger specimens are spirally twisted. Natural size.

Fig. 7. Juncella spiralis. N. sp. A small portion enlarged showing the "bare track" (b.t.) on one side of the stem and the prominent club-shaped verrucæ (ca.) on the other.

Fig. 8. Club-shaped spicule of Juncella spiralis from the surface of the general coenenchym.

Fig. 9. Spicules from the verrucæ of Juncella spiralis. a. Needle; b. plate from surface of the verruca.

Fig. 10. Malacogorgia capensis. N. sp. A portion of the colony at the origin of the primary branches to show the origin of the young zooids.

Fig. 11. Malacogorgia capensis. N. sp. A portion of a terminal branch showing the expanded zooids.

Fig. 12. Ceratoisis ramosa. N. sp. A portion of a terminal branch, much enlarged.

Fig. 13. Spicules of Trichogorgia flexilis. New genus and species. a., b., c. different forms of the flat scale-like spicules which cover the anthocodiae and general coenenchym; d. a portion of one of these spicules, very much enlarged.

Fig. 14. Anthoptilum grandiflorum. Verrill. A portion of the rachis is figured to show the connection between the bases of the autozooids (au) to form rudimentary leaves. In nearly all the rows a gap (g) is seen. Si. the scattered siphonozooids.

Plate IX.

Fig. 15. A small portion of the flabellum of Eugorgia gilchristi (N. sp.), showing at a.a. the occasional anastomoses of the branches. Natural size.

Fig. 16. Trichogorgia flexilis. New genus and species. A small portion of a colony. Natural size.

Fig. 17. Trichogorgia flexilis. New genus and species. A fragment of a branch highly magnified, showing at a. a young zooid, b, b. two large zooids each containing a single ovum, c. a bud, d. a cylindrical zooid not containing an ovum.

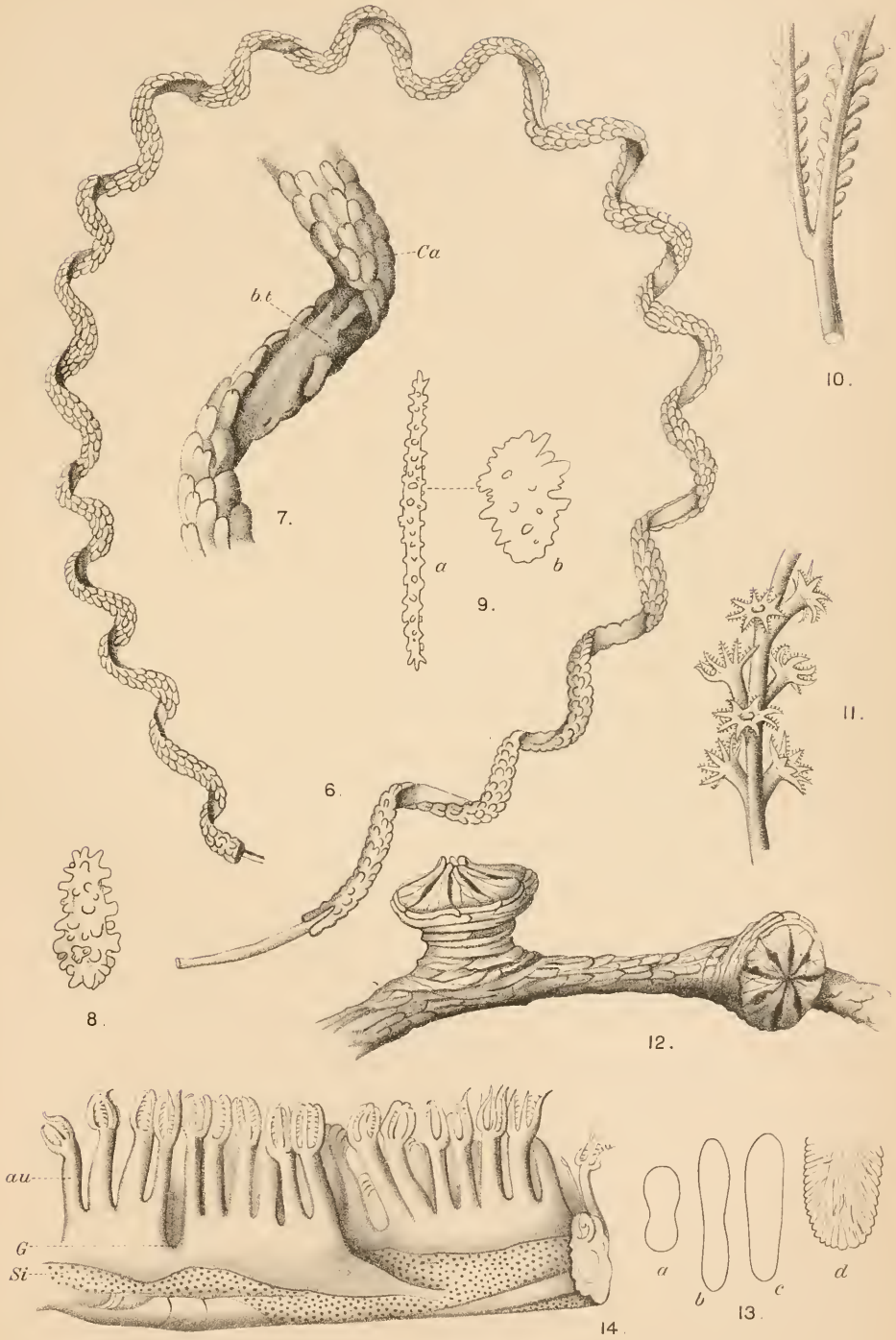
Fig. 18. Spicules of Alcyonium purpureum (n. sp.), a. a typical tuberculated spicule of the coenenchym, b. a club.

Fig. 19. Spicules of Eugorgia gilchristi (n. sp.), a. b. two of the many varieties of spicules of the coenenchym, c. one of the very minute Maltese crosses, d. and e. spicules of the anthocodiae.

(Published 15th December, 1904.)

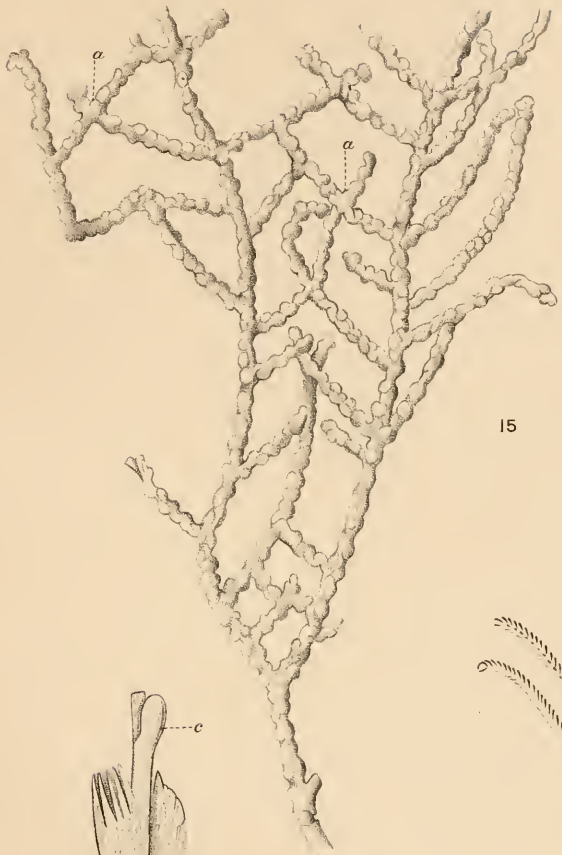
1 ALCYONIUM PURPUREUM.
2 ANTHOMASTUS GRANDIFLORUS.
3,4 CERATOISIS RAMOSA.
5 MALACOGORGIA CAPENSIS.

E. Wilson, Cambridge.

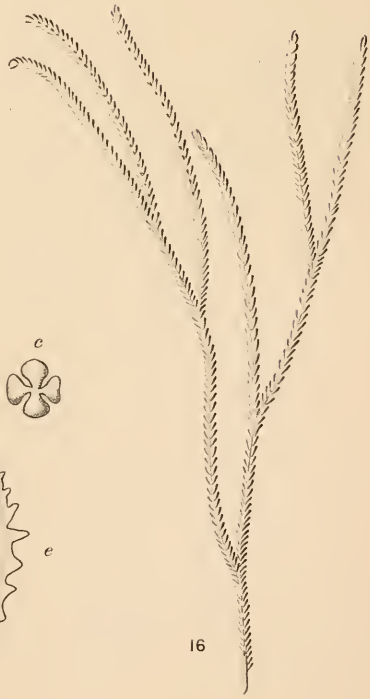


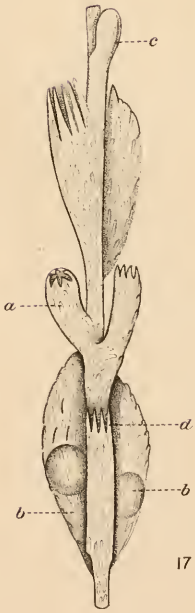
6,7,8,9 JUNCELLA SPIRALIS. 12 CERATOISIS RAMOSA.
10,11 MALACOGORGIA CAPENSIS. 13 TRICHOGORGIA FLEXILIS.
14 ANTHOPTILUM GRANDIFLORUM.

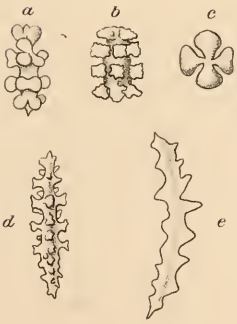
E. Wilson, Cambridge



18







15,19 EUGORGIA GILCHRISTI. 16,17 TRICHOGORGIA FLEXILIS.
18 ALCYONIUM PURPUREUM.

E. Wilson, Cambridge.

ON THE

ECHINODERMA

FOUND OFF THE COAST OF SOUTH AFRICA.

PART II. ASTEROIDEA.

BY

F. JEFFREY BELL, M.A.,

Emeritus Professor in King's College, London.

For the convenience of others, I propose to adopt the order in which the genera are arranged in the "Challenger" report, but the careful student will remember that an improved disposition of the genera is to be found in Bronn's Thierreich.

A very large number of specimens has been sent me, and the investigation has been laborious, but instructive, for the only new species has been made on a single specimen! The very long series of *Astropecten pontoporæus* forms an interesting object-lesson in variation; I have kept for the collection of the British Museum a most interesting and instructive series of what I took at first to be several new species of *Pentagonaster*, but which are now seen to be different stages in the growth of the till now rare and little known *Pentagonaster tuberculatus* of Gray.

Not only do the Cape Starfishes show an alliance with those of the North Atlantic, but there are also indications of the presence of species best known as yet from the Indian Ocean; this is indeed only to be expected when we examine the trend of the currents round the southern peninsula of the Old World.

It is unfortunate that a large part of the collection was put (I do not say preserved) in formol, with the result that some of the specimens had to be destroyed at once. I have already* called attention to the dangers attendant on the use of this

* "Collections of the 'Southern Cross'" (1902), p. 214.

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
Bird Island Lighthouse, N. ½ W., 8½ miles.	By shrimp trawl	57–59	Mud and dark sand.	14025
Cape Natal, W. by N., 4½ miles	By large dredge	47	Sand and shells	10639
Cape Infanta, N. ¾ E., 12 miles	By small dredge	44	Sand and shells	9054
About 16 miles West of East London, Lat. 33° 13′ 30″ S., Long. 27° 39′ 40″ E.	By large dredge	37–42	—	757½
Bird Island, Cape Point Lighthouse, W. ¾ N., 7¾ miles.	By dredge	22	Fine sand	13095
False Bay, Cape Point Lighthouse, N.W. by W. ½ W., 7¾ miles.	By dredge	45	Rough bottom and a small quantity of mud	305a
Off Mossel Bay, Cape St. Blaize, N.W. ¼ N., 3 miles	By large trawl	31	Mud	1210
Cape St. Blaize, N.E. ¼ E., 27 miles (Position by D.R.)	By large trawl	45–46	Fine sand	1259
Cape St. Blaize, S.W. by W. ¼ W., about 6¼ miles.	By dredge	15–18	Stones	215a
Buffalo Bay (near Knysna), Walker Point, N.W. by W. ½ W., 1½ miles.	By shrimp trawl	14 to 33	Fine sand	10287
Along Coast, between Cape St. Blaize and Anchorage, Mossel Bay.	By dredge	4	Sand	107
Lat. 35° 54′ 15″, Long. 25° 53′ 30″	By dredge	31	Fine dark sand	537
From mouth of Nahoon River	Shore collecting	—	-	123

4. Astropecten capensis.

Astropecten capensis, Studer, Abh. Akad., Berl. 1884, ii, p. 44.

Dredged off Cape Natal, W. ¾ N. 12½ miles; depth, 85 fms. Bottom: Sand and shells. Reference No. 171.

5. Psilaster acuminatus.

Psilater acuminatus, Sladen, Chall. Report, Aster. (1887), p. 225.

Obtained as follows:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
Off Lion's Head, S.E. 22 miles	By large dredge	95	Rough	2040a
Cape Point Lighthouse, N.E. by N. 7¾ miles	By shrimp trawl	85	Fine green sand	15436
Cape Point, N.E. by E. ¾ E. 8 miles	By shrimp trawl	91	Sand and specks	17523
Cape Point, N.E. by E. ¾ E. 8 miles	By shrimp trawl	91	Sand and specks	17522

A young form was dredged off Vasco De Gama, N. 40° E. 13½ miles; depth, 120 fathoms; bottom rough.

There are small and doubtful examples of *Astropecten* from the following localities which I cannot determine specifically. Most are probably varieties of *Astropecten pontoporæus*:—(1) Bluff Light House, S.W. 5 miles (Refer. No. 12528); (2) Lat. 34° 17′ 54″, Long. 15° 35′ 6″ (Refer. No. 133); (3) Sebastian Bluff, N.W. 2½ miles (Refer. No. 6069); (4) East side of Riy Bank, off Port Elizabeth (Refer. No. 1089A).

6. Luidia africana.

Luidia africana, Sladen, Chall. Report, Aster. (1887), p. 256.

Obtained at the following localities:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
Cape St. Blaize, N. by E. ¼ E., 65 miles.	By large dredge	85 to	Rough	1887
Vasco De Gama, N., 10 E., 13 miles.	By fish trawl	85	Green sand	2739
False Bay, Buffels Bay ...	By trawl	—	—	409
Cape Point Lighthouse N., 10 E., 10 miles.	By shrimp trawl	85	Green mud and hard ground.	15362

In connection with the apparent affinities of the Cape species with those of the North Atlantic it should be noted that this species is said by Mr. Sladen to be "nearly allied to *Luidia sarsii* of the North Atlantic," and that, further, he recognised it from a locality 35° north of the Equator. A series of forms from intermediate localities may show that the species should be united.*

PENTAGONASTERIDÆ.

7. Pentagonaster tuberculatus.

Astrogonium tuberculatum, Gray, Proc. Zool. Soc. 1847, p. 79; id., Synopsis Starfish. (1866), p. 10, pl. I., fig. 2.

Pentagonaster tuberculatus, Perrier, Arch. Zool. expér. v. (1876), p. 37; Studer, Abh. Ak., Berl. 1884, ii., p. 33.

Till now this species has been regarded as very rare; the specimen described by Gray in 1847 from Port Natal had no companion till 1898, when the Government Biologist sent one specimen from False Bay; one specimen was collected by Professor Studer in 117 fathoms south of the Cape of Good Hope. The species is now well represented, and is found to grow to a good size.

The species was obtained in the following localities:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of Bottom.	Reference No.
Lat. 34° 43′ 15″ S. Long. 18° 30′ 00″ E.	By shrimp trawl	123	—	465
Cape St. Blaize, N.E. ¼ E. 27 miles.	By large trawl	44–46	Fine sand	1253
Cape St. Blaize, N. 42° E. mag. 11 miles and 25 miles S.W. ¼ W. from Cape St. Blaize.	By bag tangles on bar of large trawl	44–46	Fine sand	60 and 75 a
Cape St. Blaize, N. 10° W. 33 miles.	By otter trawl	50½		201

* It may be noted that the author of the above quoted sentence goes on to say "of which it is unquestionably the representative." If by this the taxonomic representative is meant, I submit it is tautologous, and so an offence against style; if bionomic representative is meant, it is to be regretted that evidence was not given in place of the always suspicious-looking word 'unquestionably."

Locality.	Means of Capture.	Depth in fathoms.	Nature of Bottom.	Reference No.
23 miles S.W. from Cape St. Blaize.	By small shrimp trawl.	44	——	246
Cape St. Blaize, N. 36 miles ...	By shrimp trawl	54	Sand and shells	1852
Lion's Head, East, 18 miles ...	By large dredge	104	Blackish specks and rocks.	2212
Vasco De Gama, S. 75 E., 13½ miles.	By large dredge	166	Black specks	2584
Vasco De Gama, N. 10° East, 13 miles.	By fish trawl ...	85	Dark green sand	2743
Same Locality, etc., as No. 2743	— —	—	——	2744
Table Mountain, S.E. by S., ¾ S. 45½ miles.	By shrimp trawl	120	Green sand	15203
False Bay	-		——	--

8. Calliaster baccatus.

Calliaster baccatus, Sladen, Chall. Report, Aster. (1887), p. 280.

Reasons for separating *Calliaster* from *Pentagonaster* are definitely given by Professor Perrier on page 337 of his report on the Starfishes of the "Talisman"-"Travailleur" expeditions.

The species was obtained as follows:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
Rocky Bank, False Bay ...	By dredge	17 27	Rocks	15611
Cape St. Blaize, N. by E., ¾ E., 6¼ miles.	By large trawl	35	Mud and sand	1710
Cove Rock, N.W., ¾ W., 13½ miles.	By dredge	80 130	Coral and rock	13201
(Magnetic) S.W., ¼ W., 10 miles from Cape St. Blaize.	Large otter trawl	--	——	28

PENTACEROTIDÆ.

9. Culcita veneris.

Culcita veneris, Perrier, Arch. Zool., expér. viii. (1879), p. 48.

Of this species there is only one specimen known; it has not hitherto been represented in the National collection. The specimen was obtained as follows:—Lat. 34° 12′ 54″, Long. 18° 36′ 9″. Depth, 23-37 fms. Station V.

ASTERINIDÆ.

10. Asterina coccinea.

Asteriscus coccineus, M. Tr., Syst. Ast. (1842), p. 43.

Asterina coccinea, Perrier, Arch. Zool., expér. v. (1876), p. 234.

Was obtained as follows:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
Seal Island, False Bay, N.W., ¼ N., 6½ miles.	By dredge	22	Broken shells	16211
Between River and Sebastian Bluff, nearer the former.	Collected at low tide.	—	—	10004
Mossel Bay	Collected at low tide.	—		1620

11. Palmipes novemradiatus.

Although there is but a single specimen of this, I think I am entitled to regard it as new, since no *Palmipes* is known with more than five rays.

Rays nine, disc very thin, thicker and carinate along the dorsal line of each ambulacrum, cream-white in alcohol, yellower along the ventral line of each ambulacrum; the free part of each ray obtusely conical. Dorsal ossicles small, set in very regular rows.

R. = 28. r = 21.

Cape Natal, 48 fathoms, fine sand.*

* Since writing the above I have found two very much injured specimens that are twice as large as my type, from off the Tugela, and one much smaller off the Itongazi River, N.W. ¾ W. 3 miles; depth, 25 fathoms; bottom, rocks and stones. I have not altered my diagnosis, with which they agree.—26th May, 1904.

STICHASTERIDÆ.

12. Stichaster felipes.

Stichaster felipes, Sladen, op. cit., p. 433.

This species was obtained as follows:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
Mossel Bay	By shrimp trawl	18	Fine sand	70
Cape Point Lighthouse, N.E. by N. 7¾ miles.	By shrimp trawl	85	Fine green sand	15434
Lion's Head, 22 miles... ...	By large dredge	25	Rough.	2049B

SOLASTERIDÆ.

13. Solaster penicillatus.

Crossaster penicillatus, Sladen, op. cit., p. 446.

A well-marked and quite common form. Obtained from the following localities:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
Cape Point, N.E. by E., ¼ E., 46 miles.	By net on beam	—	——	17055
Lion's Head, E. by S., ¼ S., 37 miles.	By large dredge	171	Green sand and rocks.	2157
Lion's Head, S., 72° E., 47 miles.	By large dredge	190	Green sand and black specks.	2144
Table Mountain, N., 79° E., 40 miles.	By shrimp trawl	250	Green sand	2462
Sebastian Bluff, N., ½ W., 6½ miles.	By shrimp trawl	39	Mud	6037
Table Mountain, S.E. by S., ½ S., 51 miles.	By shrimp trawl	196	Green sand and black specks.	15181

PTERASTERIDÆ.

14. Retaster capensis.

Pteraster capensis, Gray, P. Z. S. (1847), p. 82; Perrier, op. cit., p. 302.

Retaster capensis, Sladen, op. cit., p. 477.

From Vasco di Gama, Cape St. Blaize, Lion's Head. Young examples of the genus were procured as follows:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
Buffels Bay, False Bay. (The specimen was injured by formol.)	By large trawl	—	—	391
Table Mountain, South Head, E. by S., ½ S., 25 miles.	By shrimp trawl	190	Green sand and black specks.	15140
Constable Hill, E. ¾ S., 19½ miles.	By shrimp trawl	145	Green sand and black specks.	14764
Hoetjes Bay, 24 12 97 ...	Shore collecting	—	—	178

15. Hymenaster sp.

A small injured specimen from Cape Point, N. 86° E. 43 miles. Depth, 900-1,000 fathoms. Bottom, greyish mud. Procured by shrimp trawl.

ECHINASTERIDÆ.

16. Henricia ornata.

Echinaster (Cribella) ornatus, Perrier, Ann. Sci. Nat. xii. (1869). p. 251.

Cribrella ornata, id., Arch. Zool. expér. iv. (1875), p. 377.
Cribrella simplex, Sladen, op. cit., p. 547.

Reasons for using Gray's generic name will be found in Ann. and Mag. Nat. Hist., vi. (1890), p. 473. I can see no reason for distinguishing *C. simplex* from *C. ornata*; Mr. Sladen can never have thought of comparing it with the widely distributed

species described by Perrier; there are very many specimens, and I think I have arrived at a right conclusion.

The specimens were obtained at the following localities:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of Bottom.	Reference No.
Cape Point, N. 50° E., 18½ miles	By shrimp trawl	180	Green sand and black specks.	14535
Seal Island, S.W. ½ S., ¾ miles	By dredge	11	Rocks.	15907
Lion's Head, East, 18 miles ...	By large dredge	104	Black specks and rocks.	2219
Hoetjes Bay	Shore collecting	—	—	122
Lat. 34° 17′ 54″, Long. 15° 35′ 6″	By trawl	31–37	—	133
From Buffalo Bay, 7-10-98 ...	—	31	—	134
Cape Point, E. by N., 29 miles	By shrimp trawl	250 to 300	Green sand and mud.	17576
False Bay, Seal Island, N.W. by W., ¾ W. 7½ miles.	By dredge	17	Broken shells	16320
Mossel Bay	By otter trawl	—	—	12
Between Mossel Bay Pier and St. Blaize Lighthouse.	On shore	—	—	36j
Mossel Bay	On shore	—	—	202
Vasco De Gama, S. 75° E., 13½ miles.	By large dredge	166	Black specks	2584
Table Mountain, S.E. by S. ½ S., 51 miles.	By shrimp trawl	196	Green sand and black specks.	15182
Table Mountain, S.E. by S. ¾ S., 45½ miles	By shrimp trawl	120	Green sand	15204

ASTERIIDÆ.

17. Asterias calamaria.

Asterias calamaria, Gray, Ann. and Mag. N. H., vi. (1840), p. 179.

This species, which is common off New Zealand, has already been recorded from Mauritius; it would appear to be rare off the Cape. The specimen was obtained at low tide in the rock pools, Three Anchor Bay.

18. Asterias capensis.

Asterias capensis, Perrier, Arch .Zool., expér., iv. (1875), p. 338.

Dredged off Cape St. Blaize, N. by E. $\frac{1}{4}$ E. 65 miles. Depth, 89-90 fathoms. Bottom, rough.

19. Asterias glacialis.

Asterias glacialis, Linn., Syst. Nat., x. (1758), p. 661; Bell, Catal. Brit. Echinod. (1902), p. 98.

In 1882 I pointed out (Zool. Anzeig. v., p. 282) the great variations exhibited by *A. glacialis*, but, if I have correctly identified No. 18 as *A. capensis*, my implied suggestion that it and *A. glacialis* were one is not correct.

The specimens were procured as follows:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of bottom.	Reference No.
W.S.W., off Bird Island, Lat. 33° 51′ S., Long. 26° 11′ 45″ E.	By dredge	42	Sand and mud	1117
Knysna, low tide along shore, from jetty towards village.	Shore collecting	—	—	314
Cape St. Blaize, N.W. by N. $\frac{1}{2}$ N., 7 miles.	By large trawl	36	Mud	1435

20. Asterias volsellata.

Asterias (*Stolasterias*) *volsellata*, Sladen, op. cit., p. 584.

I have ascribed some remarkable fragments to this species, which far more than some species of Mr. Sladen's deserves a special genus for its reception.

Dredged off Great Fish Point Light House, N. by W. $\frac{3}{4}$ W. 17 miles. Depth, 100 fathoms. Bottom, sand, shells, and stones.

In addition to the twenty forms here enumerated, I note the presence of two examples of *Echinaster* which closely resemble a specimen from Port Natal which has been many years in the

Museum, and which I was unable to determine when I went over the whole of the Museum series; the two specimens in the present collection are so similar to it that they do not help to link it on to any of the many described species of the genus; I cannot help thinking that *Perknaster* is only an aberrant *Echinaster*. Dr. Gilchrist's examples are from the shore at Somerset West, and from Simon's Bay by trawl.

From Mossel Bay and off Cape Point N.E. by E. $\frac{1}{4}$ E., distant 46 miles, come small specimens of an Archasterid which I am enable to identify more closely.

A few Asteroids were so injured by the formol in which they were sent that they had to be destroyed.

[PUBLISHED 9TH MAY, 1905.]

ON THE

ECHINODERMA

FOUND OFF THE COAST OF SOUTH AFRICA.

PART III. OPHIUROIDEA.

BY

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The number of species of Ophiuroids in the collection is not large. What there are are not very interesting, with the exeeption of the new species of *Ophiozona* and *Ophiura*, and the addition of a good series of the hitherto rare *Ophiothamnus remotus*, which was dredged by the "Challenger" in the neighbourhood of the Cape. Though Mr. Lyman has described a large number of Ophiuroids from the Southern sea-area, it would, no doubt, be possible to find among the small specimens in the present collection several that might well appear to be the "types of new species." But the study of Ophiuroids has suffered enough from the description of isolated "species" based on one or a few specimens; this is notably the case with *Ophiothrix*, of which a revision based on a long series ought to be made before ever another species of it is described.

I. ZYGOPHIURÆ.

1. Ophioderma wahlbergi.

Ophioderma wahlbergi, M. Tr., Syst. Ast. (1842), p. 86.

This species, which was originally described from Port Natal, appears to be widely distributed, as there are examples in the Museum from the Red Sea and from Puerto Cabello.

2. **Ophiozona capensis.** (Pl. I., Figs. 1 and 2).

No tentacle-scales to most of the ossicles, three or four minute spines, and moderately sized, irregularly shaped radial shields.

This diagnosis will show that the Cape *Ophiozona* is distinct from those enumerated by Mr. Lyman in his "Challenger" report, while the species lately described by Professor Koehler has two tentacle-scales along the whole length of the arm. That which intrigued me most was the disposition of the tentacular pores on the arms; they are limited to the three proximal joints, are quite large, and are protected by several scales each; this is a very abnormal arrangement among Ophiuroids, and is, so far as I know, only known in the apparently distant genus *Ophiolipus*; in spirit preserved specimens there are no signs of podia; in his definition of Ophiolipus Mr. Lyman says merely "tentacle pores only at the basal under arm plates," and makes no reference to the presence or absence of podia.

The comparatively large size of the pores in this species and the apparent absence of podia may, in general terms, be translated into the statement that the respiratory apparatus is not diffused along the whole arm as in most Ophiuroids, but localised; if this is true, it would follow that we should expect to find hæmoglobin or some other oxygen-bearing compound; hæmoglobin was, of course, detected several years since by Foettinger in *Ophiactis virens*. The resolution of this question is not possible for me with the preserved specimens which I have, but it could easily be settled by naturalists on the spot; and it is one which I should very much like to see investigated.

I may be allowed to remark that the typical arrangement of the podia on the arms, as described in text books, is probably very often altered; we know now of two genera, not apparently closely allied, in which the proximal pores are alone retained; scattered through the writings of the describers of brittle-stars there are indications of variations, which, had the writers been morphologists, rather than systematists, they would have dilated on.

Put in general terms, it may be said that a comparative investigation of the disposition of "tentacle-pores" and "tentacle-scales" promises to be of great interest.

The specimens were obtained as follows:—

Locality.	How Procured.	Depth in fathoms.	Nature of bottom.	Reference No.
Cape Point, N.E. by E., ¼ E., 40 miles.	By shrimp trawl	800-900	Green mud	16928a
Cape St. Blaize, N. by E., 73 miles.	By large dredge	125	Sand and shells (rough.)	1871
Cape St. Blaize, N. by E. ¼ E., 65 miles.	By large dredge	85-90	Rough.	1886
Lion's Head, S.E., 22 miles	By large dredge	25	Rough	2049
Lion's Head, East 18 miles	By large dredge	104	Black specks and rocks.	2211
Lion's Head, N., 78° E. 12 miles.	By shrimp trawl	60	Sand and small black specks.	2252
Cape St. Francis, N.E., 29 miles (D.R.)	By dredge	75	Sand, shells and rocks.	14237

3. **Ophiura trimeni.** (Pl. I., Figs. 3 and 4).

No arm comb, the radial shields of moderate size, separate and diverging; scales of disc small, but not minute; three arm spines, which break off very easily; the uppermost the longest, and about as long as an arm joint; pores at base of arm large and guarded by about six scales; more distally both pores and scales seem to disappear altogether; the side arm plates are of great size, and cause the almost total disappearance of the lowermost plates. Colour in alcohol whitish.

Diameter of disc, 8; 7; 9.

*Length of arm 21 (ca); 28; 25.

Breadth of arm at base, 2·2; 2·5; 2·5.

The specimens were obtained as follows:—

Locality.	How Procured.	Depth in fathoms.	Nature of bottom.	Reference No.
Lion's Head, S.E ½ E., 42 miles	By large dredge	156	Dark green sand	2085
South Head, Table Mountain, E. by S., 25 miles.	By shrimp trawl	190	Green sand and black specks.	15109
Lion's Head, S.E., ¼ E., 50 miles.	By shrimp trawl	230	Green sand	15034
Lion's Head, S.E. ½ E. 47 miles	By shrimp trawl	175	Green sand	14985

* No specimen had an unbroken arm.

I have named this species in remembrance of Mr. Roland Trimen, F.R.S., who was for many years the leader of South African Zoologists.

It will be observed that the pores on the arms present very much the same characters as in *Ophiozona capensis*.

4. Amphiura incana.

Amphiura incana, Lyman, Bull. Mus. C. Z. v. (1878),

This species was obtained off the South Head, Tugela River, N. by W., $4\frac{3}{4}$ miles. Depth, 25 fathoms, black mud. Refer. No. 11480A. I am not very confident of the accuracy of this determination.

Other species of the genus were collected off Lion's Head, S.E. $\frac{1}{4}$ S., $10\frac{3}{4}$ miles. Depth, 69 fathoms. Bottom, red and green sand. Refer. No. 2038. But the specimens were not in good condition, and I cannot assign them to any known species.

5. Ophiothamnus remotus.

Ophiothamnus remotus, Lyman, Chall. Rep., p. 212.

The "type" of this species was a single specimen taken off the Agulhas Bank; it is well, therefore, that a good set was obtained from Cape Natal, N.W. $\frac{1}{2}$ W., $5\frac{1}{2}$ mi., Refer. No. 187A, and a few from off Algoa Bay, close to Riy Bank, Refer. No. 97.

6. Ophiothrix aristulata.

Ophiothrix aristulata, Lyman, Bull. Mus., C. Z., vi. (1879), p. 50.

Obtained as follows:—

(1) Mossel Bay fishing ground, Cape St. Blaize, N.W. $\frac{1}{2}$ N. Lat. 34-12-45 S. Long. 22-15-00 E. 35 fathoms. Mud. Refer. No. 1180.

(2) Great Fish Point Lighthouse, W. by N., 5 miles. By dredge. Depth, 22 fathoms. Bottom, rocks, stony Polyzoa and coral. Refer. No. 13619A.

7. Ophiothrix roseo-coerulans.

Ophiothrix roseo-coerulans, Grube, JB. Schles. Gesell. (1868), p. 45.

This species (from St. Helena) was so briefly described that one cannot be certain of recognising it.

Obtained on Rocky Bank, False Bay. Depth, 17-27 fathoms, Bottom, rocks. Refer. No. 15612.

8. Ophiothrix triglochis.

Ophiothrix triglochis, M. Tr., Syst. Aster. (1842), p. 114.

Obtained off Rocky Bank, False Bay. Depth, 17 fathoms. Bottom, rock and coral. Refer. No. 15599.

Specimens of this genus, which I cannot specifically determine, were obtained as follows; those from the two last localities in the table appear to be of the same species:—

Locality.	Means of Capture.	Depth in fathoms.	Nature of Bottom.	Reference No.
Tugela River Mouth, N.W. by W., 3½ miles.	By large dredge	14	Rocks	11387
Lion's Head, S.E. ½ E., 47 miles.	By shrimp trawl	175	Green sand	14984
South Head, Table Mountain, E. by S., ½ S., 25 miles.	By shrimp trawl	190	Green sand and black specks.	15110

STREPTOPHIURÆ.

9. Ophioscolex dentatus.

Ophioscolex dentatus, Lyman, Bull. Mus. C. Z., v. (1878), p. 157.

This species was taken by the "Challenger" off the Agulhas Bank; I know of no other record of its capture.

The specimens were taken by the "Pieter Faure" off Buffalo, N.N.E., 17 miles, by shrimp trawl (Refer. No. 12836), at a depth of 195 fathoms, or 45 fathoms deeper than the "Challenger" haul.

CLADOPHIURÆ.

10. Gorgonocephalus pourtalesi.

Astrophyton pourtalesii, Lyman, Ill. Cat., Mus. C. Z., viii. (1875), p. 28.

Obtained off Vasco de Gama, S. 75° E., 13½ miles, by large dredge. Depth, 166 fathoms. Bottom, black specks. Refer. No. 2565.

11. Gorgonocephalus verrucosus.

Euryale verrucosum, Lamk., An. s. Vert. ii. (1816), p. 537.
Astrophyton verrucosum, M. Tr., Syst. Ast. (1842), p. 121.
Gorgonocephalus verrucosus, Lyman, Chall. Rep. (1882).

Obtained as follows:—

(1) Off Buffels Bay by shrimp trawl. Depth, 30 fathoms. Bottom, sand, with stony polyzoa. Refer. No. 2647.

(2) Off Sebastian Bluff, N.W. by W. $\frac{1}{4}$ W., $8\frac{1}{2}$ miles. By shrimp trawl. Depth, 34 fathoms. Bottom, mud. Refer. No. 7050.

DESCRIPTION OF PLATE I.

Fig. 1., *Ophiozona capensis*, from above, to show the scaling of the disc, and the form of the upper arm plates; fig. 2, the same from below to show the mouth-parts the under arm-plates and the size of the spines.

Fig. 3 and 4, *Ophiura trimeni*, to show the same points.

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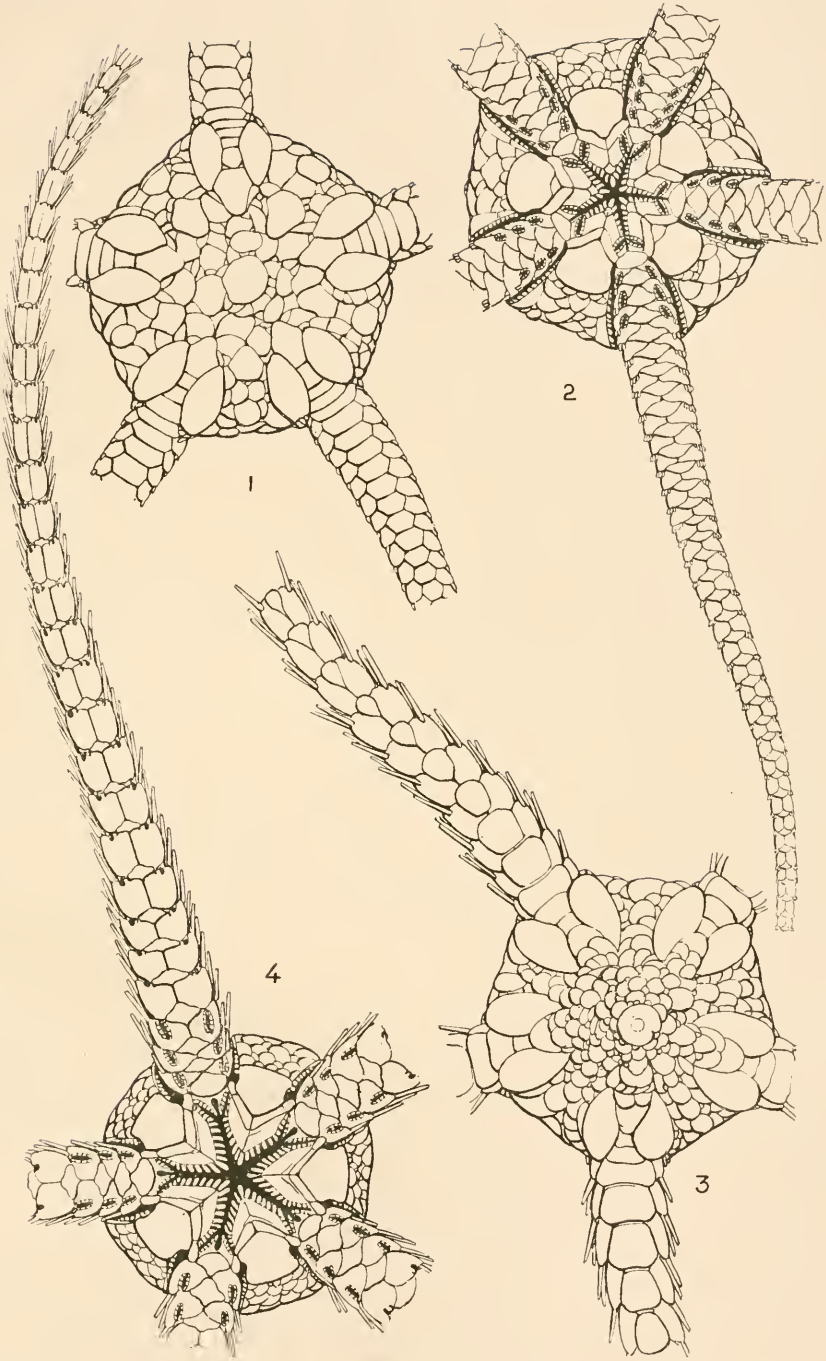

C. Berjeau. Butterworth

1, 2. OPHIOZONA CAPENSIS × $2\frac{1}{2}$

3, 4. OPHIURA TRIMENI × 5.

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