ANNALS

OF THE

NATAL GOVERNMENT MUSEUM

EDITED BY

ERNEST WARREN, D.Sc.(Lond.), Director.

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Descriptions of new or little-known Fishes from the Coast of Natal.[1]

By

C. Tate Regan, B.A.

With Plates I—V.

Pliotrema gen. nov.

Differs from *Pristiophorus* Müll. u. Henle in having six gill-clefts on each side.

Pliotrema warreni sp. n. (Pl. I).

Body elongate, about as broad as deep, the flat lower surface margined on each side by a ridge which is scarcely distinct on the trunk, but well-developed on the tail. Denticles small, pointed, with a median keel and sometimes with a pair of lateral keels, close set on the lower parts of the body and the anterior margins of the fins; distal parts of the fins naked. Length of snout in front of eye $4\frac{2}{5}$ times its breadth at the base. Teeth of the rostrum compressed, pointed, unequal in length, the larger ones with denticulated posterior edge. Barbel, when laid back, reaching the nostril, which is slightly nearer to the angle of the mouth than to the root of the barbel. Upper jaw with 40 to 44 series of teeth, lower jaw with 31 to 34. First dorsal scarcely larger than the second, originating

[1] The fishes here described form part of a collection sent to the British Museum by Dr. E. Warren, who has retained a duplicate set for the Natal Government Museum, Pietermaritzburg. The specimens were obtained by the Museum Collector, Mr. F. Toppin.

above the extremity of the inner edge of the pectoral. Caudal feebly heterocercal, with upper lobe well developed.

Two specimens, each about 750 mm. in total length, the one from the coast of Natal, taken at a depth of forty fathoms, the other from False Bay, Cape of Good Hope, received in 1899 from Dr. J. D. F. Gilchrist.

The presence of six gill-clefts in a Pristiophorid is a most unexpected feature. As has been pointed out by Jaekel, the Pristiophoridæ are closely allied to the Squalidæ (Spinacidæ), a family in which the gill-clefts are constantly five in number. The anatomy of the fish described above is extremely similar to that of Pristiophorus cirratus and there is no evidence of relationship to the Notidanoids. It may be that the large number of gill-clefts is a primitive feature retained in this fish and lost in its allies,[1] in which case it would follow that the reduction in number to five has been independently arrived at in different groups. On the other hand, there is the possibility that an increased number of gill-clefts may sometimes be a feature of specialisation, just as in the case of certain groups of Teleosts with an increased number of vertebræ or of pectoral pterygials, which are now regarded as derived from forms with a lower number.

Raia ocellifera sp. n. (Pl. II).

Snout with a short, obtuse, triangular projection. Diameter of eye $3\frac{1}{2}$–$3\frac{2}{3}$ in the length of snout and $1\frac{2}{5}$–$1\frac{1}{2}$ in the interorbital width. Distance between outer edges of nostrils greater than their distance from the tip of the snout. Teeth obtuse, in 48–50 series in the upper jaw. Anterior border of pectoral undulated. Body smooth, except for some small asperities along the anterior margin of each pectoral. Three

[1] This view is supported by the presence in Raia of a structure which has been interpreted as the remnant of a sixth gill-cleft, and by the recent discovery of a sixth branchial arch in the embryonic Cestracion (Mrs. Hawkes, 'Journ. Anat. and Phys.,' xi, 1905, pp. 81–84).

or four spines in front of and three behind the orbit. One or two median spines on the back in front of the supra-scapulary region. A median series of spines commencing on the posterior part of the body and extending on to the tail; tail with one or two series of spines on each side. A large bluish-black white-edged ocellus near the middle of the base of each pectoral.

Two specimens of nearly the same size, 460 and 480 mm. in total length, a male from Algoa Bay, received in 1895 from H. A. Spencer, Esq., and a female from the coast of Natal, at a depth of forty fathoms.

The male specimen has mixopterygia which extend only a little more than half the distance from their base to the origin of the first dorsal fin, a group of small spines on the anterior part of each side of the pectoral, and a double series of spines on each pectoral near the outer angle of the fin. The median series of spines commences scarcely before the tail, which has only one series of spines on each side.

The female specimen has a group of small spines on the posterior part of the pectoral. The median series of spines commences further forward than in the male, and the tail has two series of spines on each side.

Raia rhizacanthus sp. n. (Pl. III).

Snout with a short, obtuse, triangular projection. Diameter of eye $3\frac{3}{4}$ in the length of snout and $1\frac{1}{3}$ in the interorbital width. Distance between the outer edges of nostrils a little less than their distance from the tip of snout. Teeth more or less distinctly pointed, in 36 series in the upper jaw. Anterior border of pectoral undulated. Snout, interorbital space and anterior parts of pectoral fins with numerous small, four-rooted spines. Two strong spines in front of and three behind each orbit. A series of strong spines along the median line of the back and tail; a pair of supra-scapulary spines. Tail with two series of small spines on each side. Upper part of the body brownish, with some large oblong or oval lighter spots. An oblong, blackish, ocellated spot near the middle of the base of each pectoral.

A single specimen, a young male, 210 mm. in total length, from the Coast of Natal, at a depth of forty fathoms.

Clupæa durbanensis sp. n. (Pl. IV).

Depth of body $2\frac{2}{3}$ in the length, length of head $3\frac{3}{4}$. Snout as long as eye, the diameter of which is 4 in the length of head, interorbital width $3\frac{1}{2}$. Lower jaw shutting within the upper; maxillary extending to below middle of eye or slightly beyond; no teeth on the palate or tongue. Gill-rakers fine, long, and very numerous; lower branch of the anterior branchial arch scarcely bent, the two portions meeting at a very obtuse angle. Scales regularly arranged, finely striated, and with the margin more or less distinctly ciliated, 43 to 45 in a longitudinal, 14 in a transverse series; 12 scutes behind the ventral fins. Dorsal III 14, equidistant from the tip of snout and from the procurrent caudal rays; the longest ray equal to the length of the base of the fin and twice as long as the last ray. Anal III 17–18. Pectoral $\frac{2}{3}$–$\frac{3}{4}$ the length of head, extending $\frac{3}{4}$–$\frac{5}{6}$ of the distance from its base to the origin of ventral, which is a little in advance of the middle of the dorsal. Caudal deeply forked. A bluish humeral spot; upper edge of the dorsal fin blackish.

Two specimens, 190 and 200 mm. in total length, from Durban Bay.

This species is nearest to the West African C. dorsalis, which has more scales in a transverse series, the lower branch of the anterior branchial arch more distinctly bent, and the post-orbital part of the head considerably longer than the rest of the head, instead of equal to it, as in the species described above.

Merluccius capensis *Casteln.*

Depth of body about 6 in the length; length of head about $3\frac{1}{2}$. Diameter of eye $4\frac{1}{4}$–$5\frac{1}{4}$ in the length of head, length of snout 3–$3\frac{1}{5}$, interorbital width $3\frac{2}{3}$–$3\frac{1}{5}$. Lower jaw projecting; maxillary extending to or beyond the vertical from the posterior margin of pupil; 13 or 14 gill-rakers on the lower part of the anterior arch. Dorsal 10–11, 38–40. Anal 38–39. Pectoral $\frac{2}{3}$–$\frac{3}{4}$ the length of head, extending beyond the origin of anal. Ventrals 7-rayed, $\frac{3}{5}$ (adult) to $\frac{2}{3}$ (young) the length of head. Caudal truncate. About 130 scales in a longitudinal series above the lateral line, about 12 in a transverse series between base of first ray of anterior dorsal and lateral line. Greyish; inner surface of pectoral blackish.

Three specimens, 160 to 370 mm. in total length, from the Cape of Good Hope and from Natal. This species is very distinct from the European M. vulgaris, with which it has been confounded.

Scorpæna natalensis sp. n. (Pl. V).

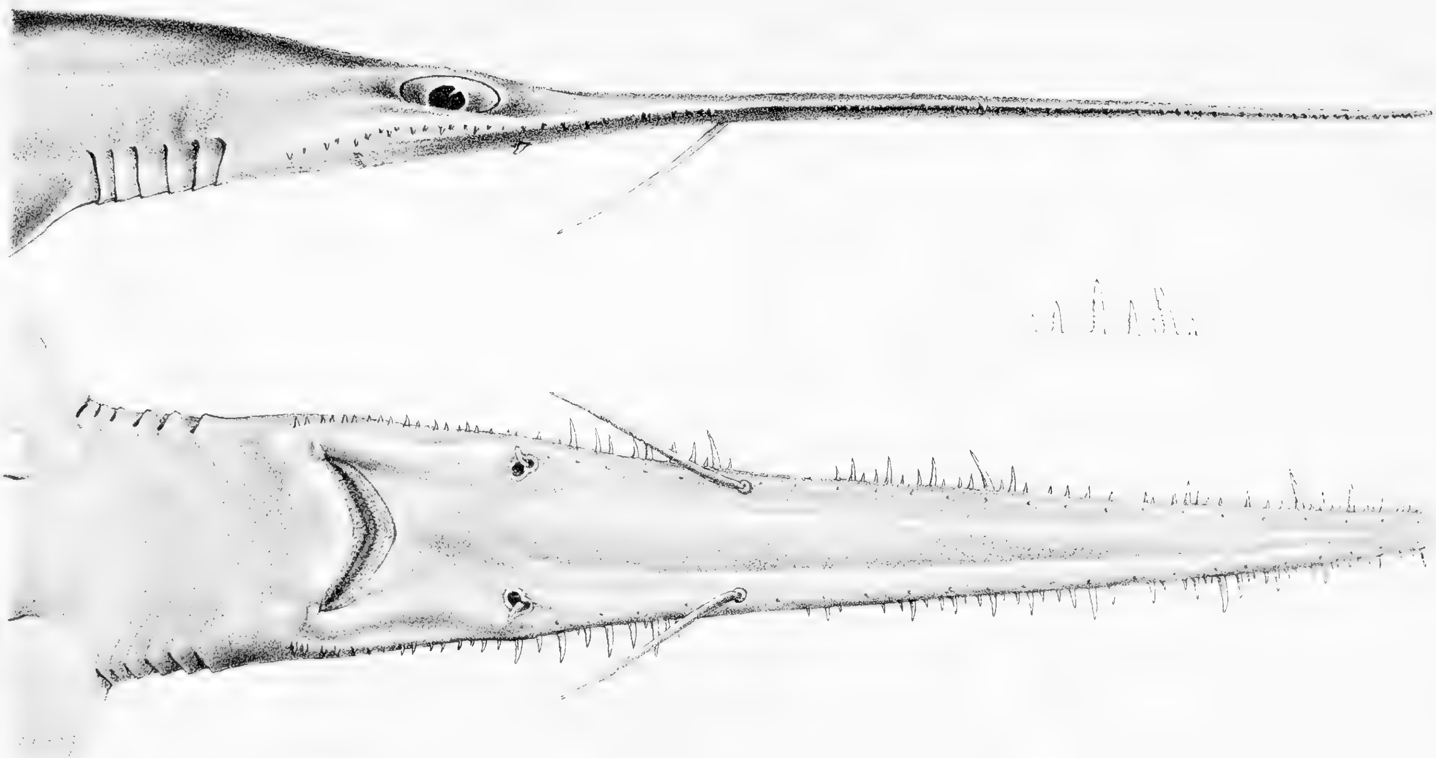
Depth of body $2\frac{5}{6}$ in the length, length of head $2\frac{3}{5}$. Snout longer than eye, the diameter of which is 5 in the length of head and equal to the interorbital width. Jaws equal anteriorly; maxillary extending to below the middle of eye; palatine teeth present. Head naked, except for a few rudimentary scales. Interorbital space concave, with a pair of weak ridges; occiput with a quadrangular depression. A pair of nasal spines; each supra-orbital ridge with 3 spines; a pair of spines near the extremities of the interorbital ridges; on each side 2 spines in the parieto-occipital region and below them 2 temporal spines; sub-orbital ridge with 3 spines leading to a double spine on the præoperculum, below which are 3 præopercular spines; 9 gill-rakers on the lower part of the anterior arch. Dorsal XII 10, the third and fourth spines the longest, as long as the longest soft rays and nearly half the length of head. Anal III 5, the second spine scarcely longer than the third, one third the length of head. Pectoral with 9 branched and 10 simple rays, $\frac{5}{7}$ the length of head, not quite reaching the origin of anal. Ventrals extending to the vent. Caudal rounded. Scales $48\frac{5}{25}$. Lateral line 26. Body and fins spotted and marbled with blackish.

A single specimen, 255 mm. in total length, from the Coast of Natal, at a depth of forty fathoms.

Genypterus capensis *A. Smith.*

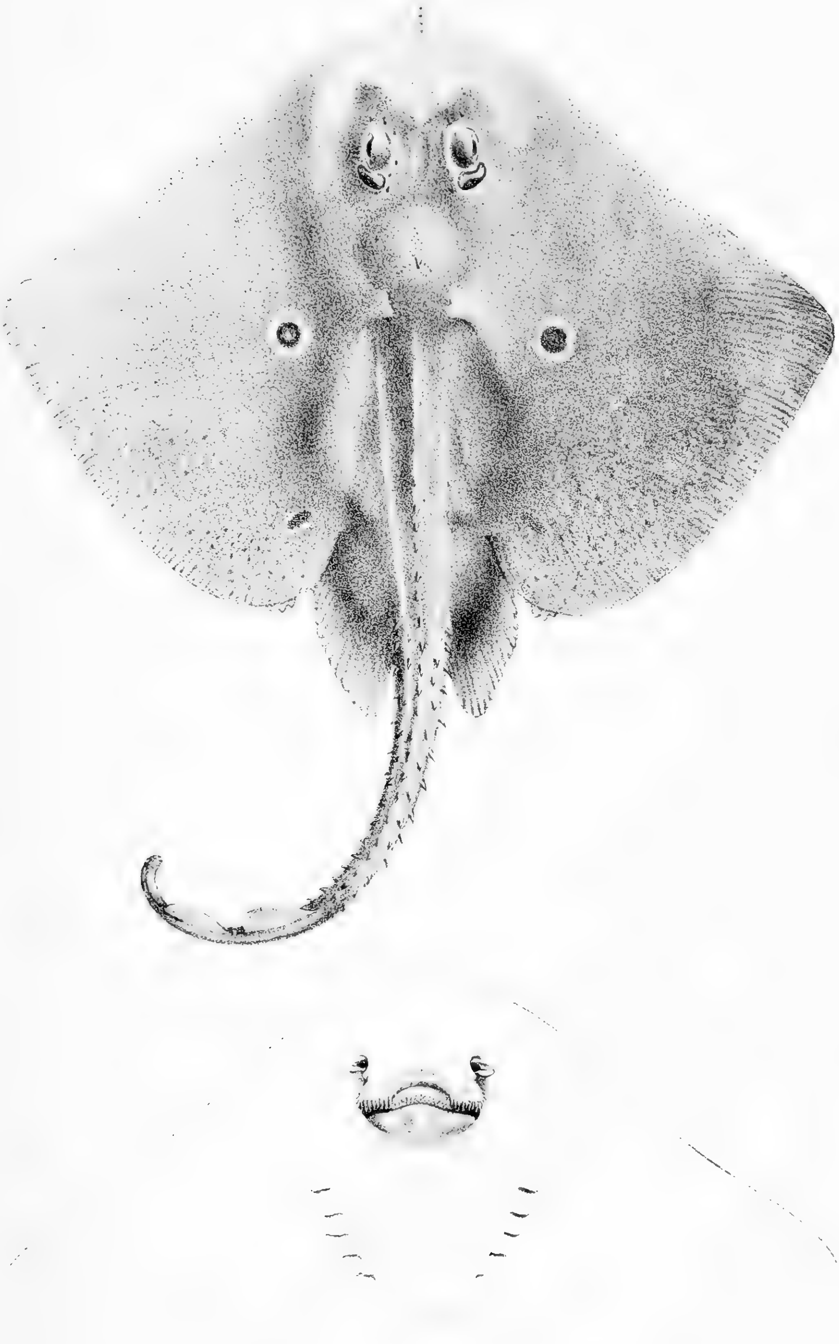
Depth of body 8 in the length, length of head 5. Snout a little longer than eye, the diameter of which is 7 in the length of head, interorbital width $7\frac{1}{2}$. Maxillary extending well beyond the vertical from the posterior margin of eye, the width of its distal extremity slightly greater than the diameter of eye. Longest gill-rakers half the diameter of eye; 4 and some rudiments on the lower part of the anterior arch. Dorsal commencing in advance of middle of pectoral; pectoral $\frac{3}{7}$ the length of head; longest ray of ventral nearly $\frac{1}{2}$ the length of head. Scales more or less distinct on cheeks and opercles, wanting on the upper surface of the head. Thirteen series of scales between anterior dorsal rays and lateral line. Uniformly greyish.

A single specimen, 460 mm. in total length. This is the first spirit specimen of this species to reach the British Museum.



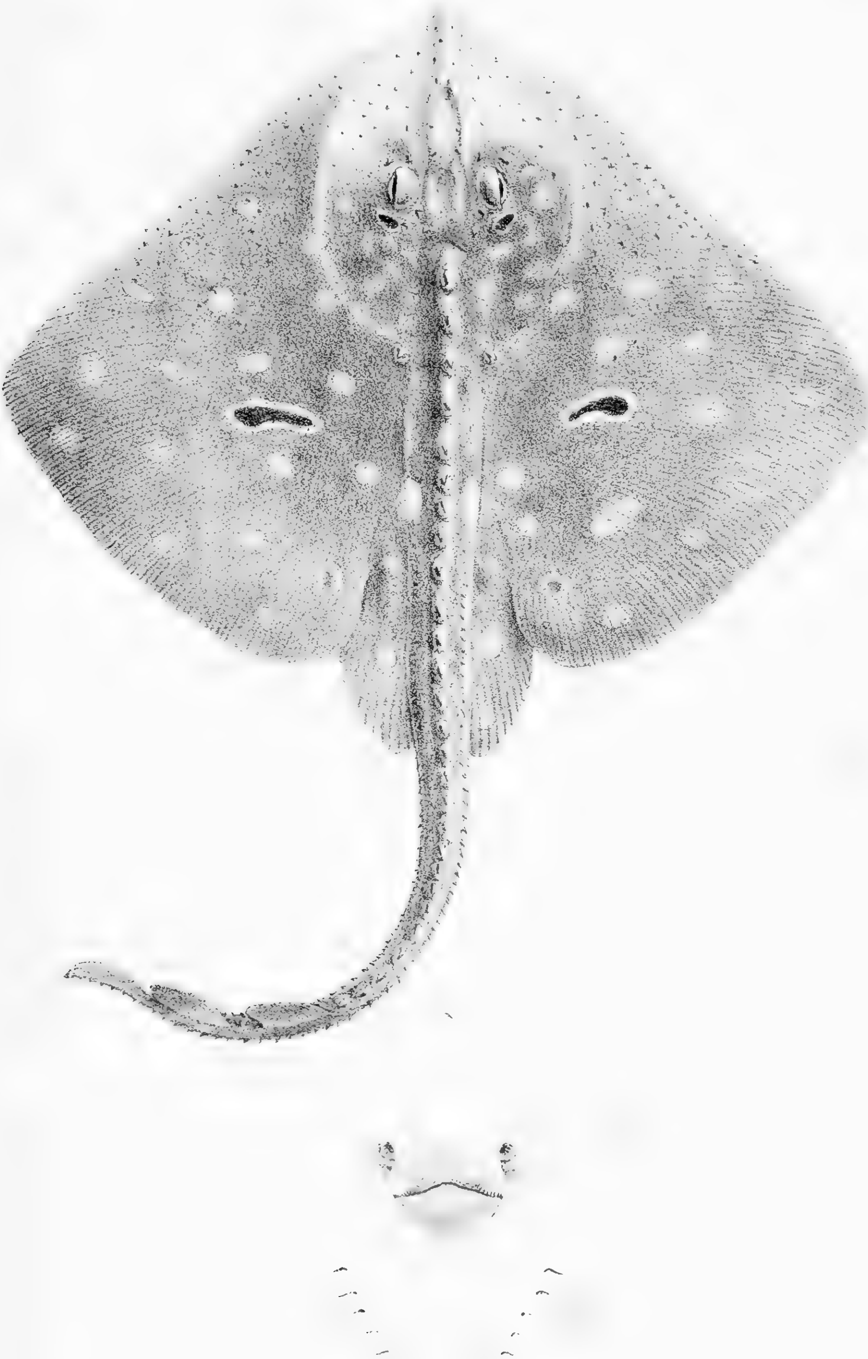
J. Green del. et lith.

PLIOTREMA WARRENI.



RAIA OCELLIFERA.

J. Green del. et lith.



RAIA RHIZACANTHUS

J. Green del. et lith.

J. Green del et lith.

CLUPEA DURBANENSIS.

J. Green del et lith.

SCORPAENA NATALENSIS.

On Bertramia kirkmani sp. nov.; a Myxosporidium occurring in a South African Rotifer.

By

Ernest Warren, D.Sc.Lond.,
Director of the Natal Government Museum.

With Plate VI.

In March, 1905, the Hon. Thomas Kirkman, of Natal, who was working at rotifers in the laboratory of the Natal Government Museum, showed to me a living specimen which was apparently parasitised by containing a number of granular sausage-shaped bodies lying unattached in the body-cavity. The rotifer in question is a species of Copeus of the Notommatidæ; it possesses the curious sac of chalky matter found in several members of this family, and it is characterised by a curious hump towards the posterior end of the body. I believe Mr. Charles Rousselet is about to describe the species. This rotifer appears to be local in its occurrence: Mr. Kirkman, its discoverer, has found it in the neighbourhood of the Botanical Gardens, Pietermaritzburg, and also at Richmond, Natal, some twenty miles distant.

Nearly the whole of the following account had been written before I discovered that a similar organism in rotifers had been previously partially described. Prof. E. A. Minchin[1] in his recent article on Sporozoa gives some original figures of the organism. It was called by L. Cohn[2] (1902) Ber-

[1] 'A Treatise on Zoology,' edited by Prof. E. Ray Lankester, Pt. I, 1903.

[2] 'Zool. Anzeiger,' xxv, 1902, pp. 497–502.

tramia asperospora (*Fritsch*), and was originally described by Bertram[1] in 1892. It will be seen that the species about to be described differs in some important characters from B. asperospora; but for the present the generic name may be retained, and the species will be called after its discoverer —Bertramia kirkmani.

(1) Structure and growth of the organism.—The species of rotifer in which alone this parasite was found lives in shallow pools among conferva, etc. It is by no means a common species, but the percentage of parasitised individuals was exceedingly high. Out of some thirty-five specimens collected and examined during the months of April, May, and June about twenty infected individuals were discovered; that is, nearly 60 per cent. were infected. In an allied species, Copeus spicatus, which was very common in the same water, the parasite was never found; it appeared to be confined to the rarer species. During the same period a number of specimens were collected at Richmond, Natal, but all these were non-infected. It would thus appear that the disease is prevalent in the particular spot near Pietermaritzburg where the species has been found for several consecutive years.

The youngest stage found in the life-history of the parasite occurred in only a single specimen of rotifer. The body-cavity of the host contained some thirty irregularly-shaped bodies, which were the youngest trophozoites discovered. Some of these, the more curiously shaped ones in particular, are shown in fig. 5. The smallest trophozoite in this rotifer possessed two nuclei, and is shown in section in fig. 1. The nuclei are relatively large; they are provided with a definite nuclear membrane and a karyosome. In the living condition the general cytoplasm in this early stage is exceedingly hyaline, and there is but little distinction between ectosarc and endosarc. No amœboid movements were observed in any stage of growth of the parasite.

[1] "Beiträge zur Kenntnis der Sarcosporidien," 'Zool. Jahrb. Abth. f. Anat.,' V.

With reference to the technique employed, it should be mentioned that the rotifers were fixed with hot corrosive sublimate solution;[1] they were then carefully imbedded in paraffin, and serial sections of $4\frac{1}{2}$ μ in thickness were cut. The sections were stained with iron-hæmatoxylin or Delafield, followed by orange, eosin, or fuchsin. Flemming's solution was employed on two occasions, but the parasite becomes intensely blackened with this reagent.

The trophozoite grows and the number of nuclei increases by karyokinesis. It is rather remarkable that in the younger stages, if not later, all the nuclei in the trophozoite are approximately in the same condition at the same time; that is, they are either all in the resting condition or all are undergoing karyokinesis. This phenomenon would seem to demonstrate the controlling action of the general cytoplasm on the nuclei.

The individual shown in section in fig. 2 contained about six nuclei, and all of these were in a state of division. In the process of karyokinesis the nuclear membrane gradually disappears, and the chromatin becomes concentrated around the circumference of the karyosome (fig. 17, 1–3). The chromatin now divides into two granular sheets (4), which become associated with two vesicles, formed apparently by the division of the original karyosome, and are connected together by achromatic fibres (5). The chromatic plate extends over the surface of the vesicle (6), and, finally, the chromatic substance becomes uniformly dispersed (7). In fig. 17 (8) the nuclear membrane is being separated off from the nucleus, and ultimately the karyosome diminishes very considerably in size (9). In fig. 4 it is seen that all the nuclei are preparing for division; the nuclear membrane has disappeared, and the chromatin has become concentrated around the periphery of the karyosome. In fig. 6 the condition is shown where the nuclear membrane is reappearing.

[1] A half-saturated solution of corrosive sublimate in 30 per cent. spirit with $1\frac{1}{2}$ per cent. acetic acid.

It will be noticed that all the nuclei in the trophozoite are in the same stage at the same time.

The trophozoite is able to reproduce by fission, and also by a kind of budding. In fig. 5 (3 and 7) the trophozoite is about to divide by binary fission. The **Y**-shaped trophozoites break up into three individuals. These phenomena have been termed plasmotomy by Doflein, and although their occurrence has been denied, they undoubtedly take place in Bertramia kirkmani. An individual undergoing binary fission is shown in section in fig. 3, and it should be noticed that the fission appears to be in no way directly connected with the division of the nuclei. Plasmotomy appears to be only possible in the early stages of growth.

The trophozoites grow into sausage-shaped bodies, which may be equal to half the length or more of the entire rotifer. The whole of the body-cavity of the rotifer may become almost completely choked with these bodies, which vary very much in size, and I have counted as many as forty individuals in one host.

As the trophozoite grows the protoplasm becomes charged with refringent granules, which at first tend to be confined towards the centre; but later on they extend throughout its substance, and the hyaline protoplasm ultimately becomes densely granular and opaque.

Fig. 7 shows a portion of an individual which has nearly completed its growth: the protoplasm is fairly granular and the nuclei are numerous. In a large individual the number of nuclei would be considerably over a hundred. It may be noticed that the nuclei of the adult trophozoite are only about half the size of those of the youngest trophozoite (c f. fig. 1 and fig. 7).

The trophozoite next passes into the spore-producing stage. In fig. 8 it will be seen that the cytoplasm contains very numerous large, refringent granules. The karyosome has apparently become swollen, so as to occupy the whole area of the nucleus, and the nuclear membrane is not distinct from it (c f. figs. 17, 7, 8). The nucleus is now surrounded by an area of protoplasm clear of granules (fig. 8, *c. a*). At this stage the trophozoite may become surrounded by a membrane of very various thickness; sometimes it is almost or quite imperceptible (fig. 10); or it is thin, as in fig. 9; or it may form a thick cyst-wall, as in figs. 12 and 13. In the same host and at the same time we can find all these conditions among the different trophozoites.

In the case of fig. 12 the individual was surrounded by a thick cyst-wall (*cy*); but whether or not this is produced, the mode of formation of the spores is the same (c f. figs. 10 and 13).

In fig. 12 it can be seen that the densely granular trophozoite is becoming divided up by trabeculæ in a manner somewhat similar to that which occurs in Sarcocystis. Ultimately the trabeculæ are so formed that each nucleus, together with a certain amount of the cytoplasm, becomes shut off from the remainder (fig. 9). The trabeculæ will form the future spore-membrane (fig. 11). In fig. 12 it may be observed that at the time of killing a certain amount of the trophozoite at the two ends (*un. p.*) had not been invaded by the trabeculæ. Such a condition may frequently be observed in Sarcocystis.

During spore-formation the large granules in the cytoplasm tend to disappear, and the substance of the trophozoite becomes rather homogeneous in appearance. In the great majority of cases which I have observed the whole substance of the trophozoite is completely divided up into compartments, each of which is converted into a single spore. In one or two cases, however, a certain amount of the trophozoite had not become involved in the spore-formation, although such spores as had been formed were completely ripe (fig. 14, *r. p.*) and had mostly escaped out of the thin cyst.

These isolated cases may perhaps be regarded as a reversion to a more typical Myxosporidium ancestor, for in the great majority of the specimens observed such residual plasmodium is not present, and it cannot be regarded as normal in this species.

(2) The formation of the spore.—The wall of the trabeculæ becomes the spore-membrane; the nucleus has a somewhat irregular outline. The chromatin becomes concentrated towards the periphery (figs. 9 and 16, *n*), and ultimately separates from the nucleolar element either in the form of a band or of a hoop (fig. 18). There appears, however, to be no inherent difference in these; for in either case the band or hoop divides into two directly without mitosis (fig. 18), and ultimately into six, eight, or ten (figs. 4 and 8) masses of chromatin, which stain readily with safranin or hæmatoxylin. The vesicle or "vacuole" which remains (fig. 19, *v*) does not stain at all readily; iodine has no particular effect on it, neither has it any marked affinity for aniline stains or hæmatoxylin. A minute granule can generally be found in the vacuole towards the more rounded end of the spore (fig. 19, *g*). The spore-membrane has a kind of operculum at the narrower end (*l*), and such may be seen in many Myxosporidium spores. Doubtless the young sporozoite escapes through the operculum.

Fig. 19 represents a ripe spore. In the sporoplasm can be seen some ten nuclei, each surrounded by a clear area, and the "vacuole" is situated towards the broader end.

Average length of spore is 6·1 μ and breadth 2·9 μ; the spore is slightly curved or falciform in shape, thus recalling the spore of Sarcocystis.

(3) Life-history of the species.—Several infested rotifers were kept alive in a small bulk of water and examined daily. The following is an account of one specimen. On July 5th the rotifer contained about fifteen of the parasitic bodies, which were of various sizes, the average of four of the largest being about 60 μ in length and 18 μ in breadth. The outer border of the bodies consisted of hyaline protoplasm; internally they were slightly granular.

On July 6th the number of the bodies had increased by plasmotomy to about 25.

On July 7th the bodies were becoming opaque, owing to the development of granules in the protoplasm.

On July 8th the average size of the four largest bodies was 96 μ in length and 24 μ in breadth. The specimen was now unobserved until July 14th, when all the bodies except one had become divided up into a mass of spores without encysting. One specimen had become encysted; it was rounded in shape, and about 39 μ in diameter. The thickness of the cyst was about 5·5 μ. The protoplasm had not become divided up into spores.

On July 24th the encysted specimen burst, and the spores were liberated. The non-encysted individuals had broken up into loose spores several days previously. The rotifer had died on the 20th of the month. The cyst-wall is highly elastic, for on the liberation of the spores the empty cyst contracted to half of its previous size. This elasticity of the cyst-wall must act very effectively in forcing out the contained spores. From this account we can see that the rotifer must have lived for more than three weeks in a parasitised condition.

In a few days the body of the rotifer disintegrated, and the spores were scattered through the water. Into the water a non-parasitised specimen was introduced; but the animal died in about a fortnight and did not become infected.

Another specimen containing trophozoites was observed on June 21st. The host was dead on the 23rd, and the parasites had completely broken up into loose spores on the 27th.

In the material at my disposal I have been unable to trace the path of the sporozoite into the body-cavity of the host. It is, of course, probable that the spores are swallowed, and that the sporozoites escape through the operculum of the spore-membrane and penetrate some part of the alimentary canal; but in all my sections no trace of sporozoites in the wall of the alimentary canal could be detected.

The youngest trophozoite found contained, as already stated, two nuclei; while the number of nuclei in the sporoplasm amounts to six to ten, on the supposition that the isolated masses of chromatin above described are to be regarded as nuclei. It would consequently follow that the greater number of these nuclei must be absorbed or fuse together, on the transformation of the sporozoite into the trophozoite.

It is highly remarkable that the formation of a cyst-wall is such a variable character. The cyst may be quite thin, or it may attain a thickness of 6 μ or more. Encysted and non-encysted specimens frequently occur in the same host. The character of the trophozoite and the spores ultimately produced appear to be quite the same in either case.

I have noticed that in the same host those specimens which are encysted tend to form their spores more slowly than those which are non-encysted. For example, in one case there were some twenty non-encysted bodies which had completely divided up into spores, while the remaining eight bodies, which were surrounded by a thick cyst-wall, had not become split up by the trabeculæ.

I have not had sufficient material to test the matter in a practical manner, but I suggest that the thick cysts are formed so that if the pool should dry up in which the host is living the trophozoite enclosed would be able to resist a considerable amount of desiccation. On falling into water the encysted trophozoite would, without doubt, quickly break up into spores which would be liberated by the bursting of the cyst.

The spores themselves are only enclosed by a very thin spore-membrane, and it is extremely improbable that isolated spores could resist desiccation.

The cyst-wall is apparently homogeneous and is tough and elastic. It tends to break up under the knife of the microtome.

(4) Affinities of the organism.—The present observations throw considerable light on the affinities of the organism. The genus has been placed under the provisional order of Haplosporidia, which includes a number of allied forms.

Bertramia kirkmani exhibits undoubted affinities with the Sarcosporidia, but it differs from them in that the trabeculæ divide the trophoplasm into single spores, and not into pansporoblasts. No trace of a polar capsule, or even the striated area described in the spores of Sarcocystis, could be detected. It differs from a typical Myxosporidium in that spore-formation typically terminates the trophozoite stage, the whole of the trophoplasm being converted into the spores. In two or three cases, however, in about 100 specimens, the whole of the trophoplasm was not involved in the spore-formation. I consider that these cases are to be regarded as a reversion to a more typical Myxosporidium ancestor, where the formation of spores is indefinitely continued. The organism may be regarded as having become adapted to the relatively brief life of its host.

The so-called "vacuole" at the broader end of the spore recalls the iodinophilous vacuole found in so many spores. In Bertramia kirkmani it shows no particular affinity for iodine, and it appears to arise from the original nucleus.

It is interesting, also, to note that ten chromatic masses, or nuclei, are frequently found in the sporoplasm, thus recalling, for example, the ten nuclei which are formed in the pansporoblasts of Myxobolus.

To conclude, Bertramia kirkmani is to be regarded as being derived from a Myxosporidium ancestor, in which the typical structure and life-history have become modified and simplified, in accordance with the special conditions occurring in its comparatively short-lived host.

EXPLANATION OF PLATE VI,

Illustrating Dr. Ernest Warren's paper on "Bertramia kirkmani sp. nov., a Myxosporidium occurring in a South African Rotifer."

Fig. 1.—× 2000 diameters. Youngest trophozoite found, possesses two nuclei (*n.*) and distinct nuclear membrane (*n. m.*).

Fig. 2.—× 2000 diameters. Trophozoite in which the nuclei are in a state of division. *d.* Dyaster stage showing achromatic fibres. *d. n.* Daughter nuclei after the disappearance of the achromatic fibres; the chromatin is extending around the periphery of the nucleus.

Fig. 3.—× 2000 diameters. Trophozoite undergoing fission at the place of constriction. The trophoplasm is vacuolated, and granules (*s. gr.*) are beginning to appear in it.

Fig. 4.—× 2000 diameters. Trophozoite in which all the nuclei are preparing for division; the nuclear membrane is disappearing (*d. n. m.*), and the chromatin is becoming concentrated around the periphery of the karyosome (*n. d.*). Ectosarc and endosarc are distinguishable.

Fig. 5.—× 300 diameters. A series of young trophozoites, all taken from one host. These exhibit the phenomena of plasmotomy both in the form of fission and of budding.

Fig. 6.—× 2000 diameters. Older trophozoite with numerous large and small granules (*l. gr. s. gr.*) in the endosarc. The nuclei are just passing into a resting-condition, the nuclear membrane (*n. m. f.*) is being formed.

Fig. 7.—× 2000 diameters. A portion of a nearly full-grown trophozoite. Nucleus has a well-marked nuclear membrane and karyosome. It should be noticed that the nuclei in the adult stage are not more than half the size of those in the younger trophozoites (Figs. 1—6).

Fig. 8.—× 2000 diameters. A portion of a full-grown trophozoite. The trophoplasm is densely crowded with granules (*gr.*). The karyosome of the nucleus has swollen, and the nuclear membrane has disappeared. The nucleus is surrounded by a layer of clear protoplasm containing no granules (*c. a.*). The opaque trophozoite is now in a preparatory condition for the formation of spores.

Fig. 9.—× 2000 diameters. Section through trophozoite, showing the formation of the trabeculæ (*t.* and *t. f.*). The whole of the trophoplasm had not become involved (*un. p.*) at the time of killing and fixing the specimen. In several of the areas two nuclei can be seen; doubtless these would subsequently have divided. Each area will produce one spore. The nucleus is without nuclear membrane (*n.*), and the chromatin is concentrated towards the periphery.

Fig. 10.—× 2000 diameters. Surface view where the whole of the trophozoite has been converted into spores.

Fig. 11.—× 5500 diameters. Surface view, still further enlarged; the spores are nearly ripe, and are seen to contain a "vacuole" (*v.*) and small nuclei (*n.*).

Fig. 12.—× 1100 diameters. Elongated trophozoite surrounded by a thick cyst (*cy.*). The trophoplasm is beginning to be divided up by trabeculæ (*t. f.*). The two ends (*un. p.*) are still undivided, thus somewhat recalling the condition seen in Sarcocystis.

Fig. 13.—× 2000 diameters. Rounded encysted specimen with ripe spores.

FIG. 14.—× 2000 diameters. This trophozoite was surrounded by a thin cyst (*t. cy.*), and it contained ripe spores and also a considerable amount of residual trophoplasm (*r. p.*). The presence of residual trophoplasm is apparently quite abnormal in this organism; and probably it should be regarded as a reversion to a more typical myxosporidium ancestor.

FIG. 15.—× 2000. A cyst which has burst and liberated the spores by its elasticity.

FIG. 16.—× 4000 diameters. Youngest spore, drawn from a specimen in the same condition as Fig. 9. The nucleus (*n.*), which is the same as the nuclei in Fig 8, *n.*, has no nuclear membrane, and the chromatin lies around the periphery.

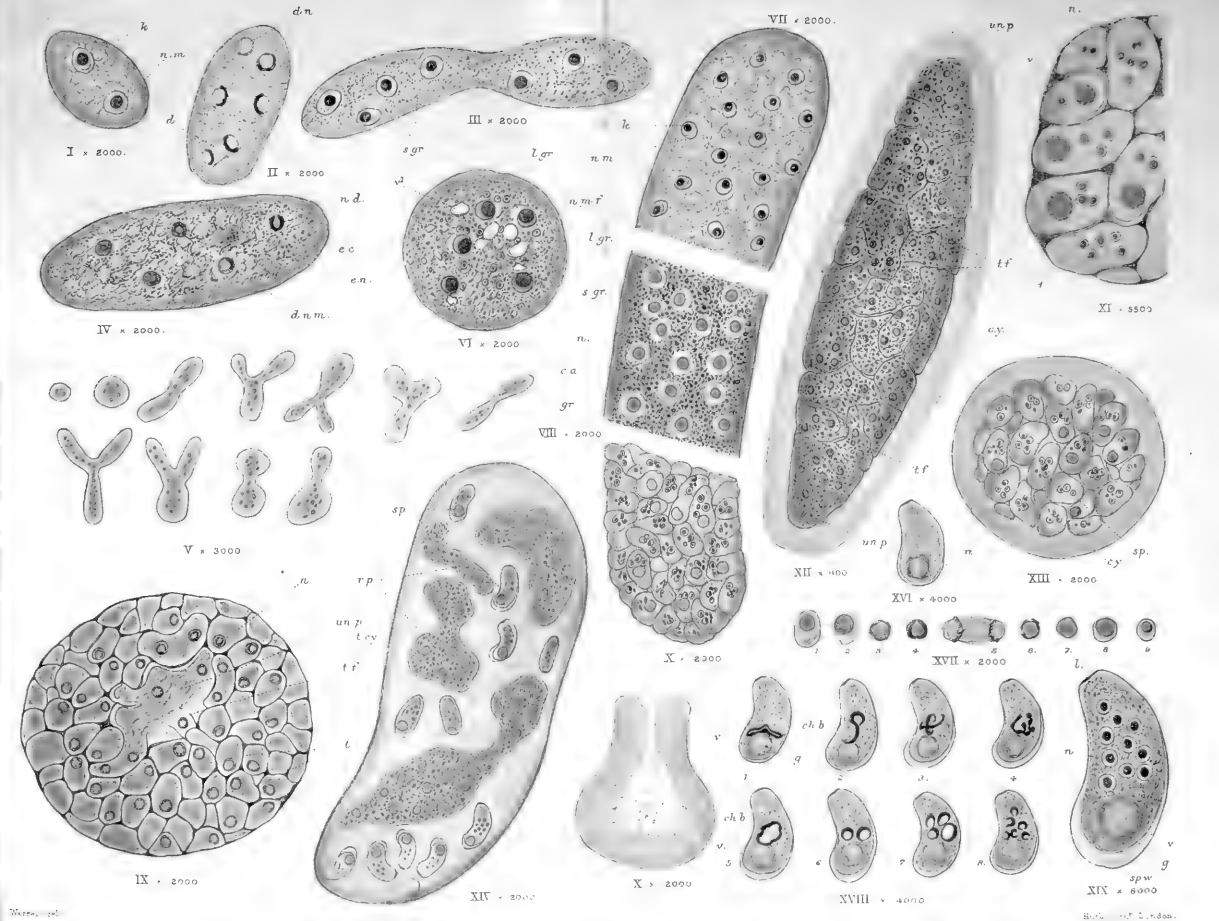
FIG. 17.—× 2000 diameters. (1) Nucleus in youngest trophozoite (Fig. 1). (2) Nucleus preparing to divide, nuclear membrane disappearing (Fig. 4). (3) Nucleus preparing to divide. (4) Nucleus preparing to divide, the chromatin around the periphery dividing into two plates (Fig. 4). (5) Chromatin plates separated and connected together by achromatic spindle (Fig. 2). (6) One of the daughter nuclei (Fig. 2, *d. n.*). (7) Daughter nucleus passing into the resting condition. (8) Formation of nuclear membrane (Fig. 6). (9) Resting nucleus of adult trophozoite; it is about half the size of (1) (Fig. 7). Preparatory to the formation of spores the karyosome swells up until it reaches about the diameter of the whole nucleus (7). The nuclear membrane is not distinct (Fig. 8).

FIG. 18.—× 4000 diameters. (1–4) Stages in the formation of the 6–10 nuclei of the ripe spore; the chromatin first appearing in the form of a band. (5–8) Stages in the formation of the 6–10 nuclei of the ripe spore; the chromatin first appearing in the form of a ring or hoop.

FIG. 19.—× 8000 diameters. Ripe spore showing operculum (*l.*), ten nuclei (*n.*), so-called "vacuole" (*v.*), and problematical granule (*g.*).

EXPLANATION OF REFERENCE LETTERS.

c. a. Clear area around nucleus. *cy.* Thick-walled cyst. *ch. b.* Chromatic body of spore. *d.* Dyaster stage in dividing nucleus. *d. n.* Daughter nuclei after division. *d. n. m.* Disappearing nuclear membrane. *ec.* Ectoplasm. *en.* Endoplasm. *g.* Granule imbedded in vacuole of spore. *gr.* Granules in endoplasm. *k.* Karyosome. *l.* Lid or operculum of spore membrane. *l. gr.* Large granule surrounded by clear area. *n.* Nucleus. *n. d.* Nuclei preparing for karyokinesis. *n. m.* Nuclear membrane. *n. m. f.* Nuclear membrane forming. *r. p.* Residual trophoplasm. *s. gr.* Small granules. *sp.* Spore. *sp. w.* Spore-wall. *t.* Trabecula. *t. cy.* Thin-walled cyst. *t. f.* Trabeculæ forming. *un. p.* Undivided trophoplasm. *v.* So-called vacuole of spore. v_1. Vacuole of trophoplasm.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On South African Marine Mollusca, with Descriptions of New Species.

By

Edgar A. Smith, I.S.O., F.Z.S.

Plates VII, VIII.

In the 'Proc. Malac. Soc.,' 1903, vol. v, pp. 354–402, I gave a list of species from South Africa not recorded in Mr. Sowerby's work entitled 'Marine Shells of South Africa.' In the present paper I propose to bring the catalogue of known species up to date, and also to make corrections of a few errors which, unfortunately, occur in the list referred to, and to supply some omissions. These errors and omissions have mostly been very kindly pointed out to me by my friend Mr. H. C. Burnup.

I now also quote in full, giving references, the species mentioned and described by Mr. Sowerby in the 'Marine Investigation in South Africa,' vol. ii, pp. 213–232, which were merely listed in the above-mentioned paper.

By consulting, therefore, the present paper, that in the 'Proc. Malac. Soc.,' and Mr. Sowerby's work, a complete list of the known South African species can be extracted.

Those not in Mr. Sowerby's book or my former paper are marked with an asterisk in the following pages.

The principal papers dealing with the South African fauna published since 1903 are the following:

(1) "Mollusca of South Africa. Pelecypoda." In 'Marine

Investigations in South Africa,' vol. iv, pp. 1–19, Pls. VI, VII. By G. B. Sowerby.

(2) "On a Collection of Marine Shells from Port Alfred, Cape Colony." In the 'Journal of Malacology,' vol. xi, pp. 21–44, Pls. II, III. By Edgar A. Smith.

(3) "Die beschalten Gastropoden der deutschen Tiefsee-Expedition, 1898–1899," in Chun's 'Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer,' "Valdivia," 1898–1899, vol. vii, pp. 26–60, Pls. II–V. By E. von Martens.

Cephalopoda.

*Sepia burnupi *Hoyle.*

Sepia burnupi *Hoyle*, 'J. of Conch.,' vol. xi, p. 27, Pl. I.
Hab.—Umkomaas, Natal, and Port Elizabeth, Cape Colony.

Gastropoda.

*Oncidium peronii *Cuvier.*

Onchidium peronii *Cuvier*: Krauss, 'Südafrik. Moll.,' p. 72.

Hab.—Natal coast (Krauss).

*Oncidium burnupi *Collinge.*

Onchidium burnupi *Collinge*, 'J. of Malac.,' vol. ix, p. 17, figs. 1, 2.

Hab.—Umlaas Lagoon, Natal.

*Ampullarina africana *Smith.*

Ampullarina africana *Smith*, 'J. of Malac.,' vol. xi, p. 38, Pl. III, fig. 14.

Hab.—Port Alfred, Cape Colony.

Retusa truncatula (*Bruguière*).

Retusa truncatula (*Bruguière*): Smith, 'J. of Malac.,' vol. xi, p. 38.

Hab.—Port Alfred, Cape Colony.

Scaphander punctostriatus *Mighels*.

Scapander punctostriatus *Mighels*: Pilsbry, 'Man. Conch.,' vol. xv, p. 246, Pl. XXXI, fig. 16; Sowerby, 'Marine Invest.,' vol. ii, p. 233.

Hab.—Off Cape Colony, 154 and 166 fathoms.

*Dolabella scapula (*Martyn*).

Dolabella scapula *Martyn*: Pilsbry, 'Man. Conch.,' vol. xvi, p. 152, Pl. XXVI, figs. 26–28, Pl. XXVII, figs. 29, 30.

Hab.—Natal.

Martyn's scapula has priority over D. rumphii, under which name this species has been quoted by Krauss and Sowerby.

*Terebra suspensa *Smith*.

Terebra suspensa *Smith*, 'J. of Malac.,' vol. xi, p. 30, Pl. II, fig. 12.

Hab.—Port Alfred, Cape Colony.

*Conus geographus *Linn.*

Conus geographus *Linn.*: Reeve, 'Conch. Icon.,' vol. i, fig. 130.

Hab.—Bluff, Durban (G. W. Westcott).

*Conus punctatus *Gmelin*.

Conus punctatus *Gmelin*, 'Syst. Nat.,' p. 3389.

Conus augur, *Hwass*: Reeve, 'Conch Icon.,' vol. i, fig. 7; Kiener, 'Coq. viv.,' Pl. XVIII, fig. 3.

Hab.—Durban (Burnup), Ceylon, etc.

Conus punctatus of Hwass, also occurring in Natal, is a different species, and now bears the name of C. piperatus, Dillwyn.

*Conus bandanus *Hwass.*

Conus bandanus *Hwass*: Reeve, 'Conch. Icon.,' vol. i, fig. 43.

Hab.—Bluff, Durban (G. W. Westcott).

Conus eucoronatus *Sowerby.*

Conus eucoronatus *Sowerby*, 'Marine Invest.,' vol. ii, p. 217, Pl. III, fig. 9.

Hab.—Off Cape St. Blaize, Cape Colony, 27 fathoms.

Conus gilchristi *Sowerby.*

Conus gilchristi *Sowerby*, 'Marine Invest.,' vol. ii, p. 217, Pl. III, fig. 8.

Hab.—Off Natal, 50 fathoms.

Conus patens *Sowerby.*

Conus patens *Sowerby*, 'Marine Invest.,' vol. ii, p. 218, Pl. III, fig. 7.

Hab.—Off S. Africa, 85 fathoms.

*Conus queketti n. sp. Pl. VII, fig. 1.

Testa parva, elongato-turbinata, supra depressa, coronata, sordide flavescens lineis albis transversis inæqualibus numerosis fusco punctatis ornata, transversim tenuiter sulcata, sulcis confertim et minute punctatis, subæquidistantibus, lineisque incrementi tenuibus striata; spira perpaulum elata, ad apicem mucronata; anfractus 8–9, lente accrescentes, supremi duo (protoconcha) convexi, cæteri angusti, fere plani vel leviter concavi, coronati, striis spiralibus paucis et lineis incrementi curvatis sculpti, ultimus antice oblique sulcatus et fusco tinctus; apertura angusta, alba. Longit. 26 mm., diam. 12·5.

Hab.—Isezela, Natal.

This is a very distinct species and not comparable with any of the known forms. Of the transverse white lines dotted with brown about a dozen are conspicuous to the naked eye, but the narrower intervening ones are hardly visible except with the aid of a lens. The spire, which is very little raised, is whitish, streaked and spotted irregularly with brown. The apex is peculiar, consisting of two convex convoluted whorls which rise as a sort of mamilla above the rest.

*Clionella confusa n. sp. Pl. VII, fig. 2.

Testa C. rosariæ similis, sed major, anfractibus plerumque minus convexis, striis spiralibus vix conspicuis, cingulo infra suturam majori, colore diversa. Longit. 45 mm., diam. 14. Aperture 12 longa, 6 lata.

Hab.—Port Elizabeth, Algoa Bay.

Shell elongate, of an uniform bright red or yellowish colour; whorls 10? (apex broken away), rather flat, constricted at the upper part, leaving a rounded girdle beneath the suture, with about 14 slightly oblique costæ below the constriction, by which they are interrupted, so that they are only faintly indicated upon the cingulum above; ribs upon the body-whorl attenuated anteriorly, but disappearing upon the snout; suture a little oblique and wavy; aperture more or less rosaceous within; columella curved, covered with a thin whitish callus; outer lip distinctly but not deeply notched at the constriction.

This species has been confounded with C. rosaria, Reeve, because of its bright red colour. Reeve's species, however, appears invariably to have the cingulum at the upper part of the whorls whitish, and more or less spotted with brown. The whorls of that species are more convex, and are distinctly transversely striated. It appears to be smaller also, the largest specimen examined being only 25 mm. in length. It is more variable in colour, sometimes bright red with a white girdle, sometimes brown, mottled with white, or yellowish, flecked with white dots.

The so-called species of Clionella are not always easy to distinguish, and beyond a difference of colour and the absence of spiral striation, there is little to distinguish the present new form from that which I described under the name of C. Bornii[1]. The remains of the periostracum in C. confusa are dark or blackish brown.

* Clavatula impages (*Adams* and *Reeve*).

Clionella impages *Ad.* and *R.*: Martens, 'Tiefsee-Exped.,' p. 23.

Hab.—Agulhas Bank, 155 fathoms, and Port Elizabeth, dead.

Smaller, but allied to C. taxus, *Chemn.* and tumida, *Sow.*

Pleurotoma lobata *Sowerby.*

Pleurotoma (Surcula) lobata *Sowerby*, 'Marine Invest.,' vol. ii, p. 213, Pl. IV, fig. 9.

This species, in my opinion, belongs to true Pleurotoma, and should not be referred to the sub-genus Surcula.

Hab.—Off Cape Natal, 440 fathoms.

Clavatula turriplana (*Sowerby*).

Pleurotoma (Clavatula) turriplana *Sowerby*, 'Marine Invest.,' vol. ii, p. 215, Pl. III, fig. 6.

Hab.—Off Cape St. Blaize, Cape Colony, 85–90 fathoms.

Drillia (Clavus) lignaria (*Sowerby*).

Pleurotoma (Clavus) lignaria *Sowerby*, 'Marine Invest.,' vol. ii, p. 215, Pl. III, fig. 4.

Hab.—Off S. Africa, 136 fathoms.

Genotia belæformis (*Sowerby*).

Pleurotoma (Genotia) belæformis *Sowerby*, 'Marine Invest.,' vol. ii, p. 216, Pl. IV, fig. 8.

Hab.—Off S. Africa, 230 fathoms.

[1] 'Ann. Mag. Nat. Hist.,' 1877, vol. xix, p. 499.

*Drillia albonodulosa *Smith.*

Drillia albonodulosa *Smith,* 'J. of Malac.,' vol. xi, p. 27, Pl. II, fig. 3.
Hab.—Port Alfred, Cape Colony.

Drillia scitecostata (*Sowerby*).

Pleurotoma (Drillia) scitecostata *Sowerby,* 'Marine Invest.,' vol. ii, p. 214, Pl. IV, fig. 10.
Hab.—Near Port Alfred, Cape Colony. 100 fathoms.

Drillia fossata (*Sowerby*).

Pleurotoma (Drillia) fossata *Sowerby,* 'Marine Invest.,' vol. ii, p. 214, Pl. III, fig. 5.
Hab.—Cape Vidal, Natal, 80–100 fathoms.

*Drillia nivosa *Smith.*

Drillia nivosa *Smith,* 'J. of Malac.,' vol. xi, p. 27, Pl. II, fig. 5.
Hab.—Port Alfred, Cape Colony.

*Drillia prætermissa *Smith,*

Drillia prætermissa *Smith,* 'J. of Malac.,' vol. xi, p. 27, Pl. II, fig. 4.
Hab.—Port Alfred, Cape Colony.

*Drillia subcontracta *Smith.*

Drillia subcontracta *Smith,* 'J. of Malac.,' vol. xi, p. 26, Pl. II, fig. 2.
Hab.—Port Alfred, Cape Colony.

*Drillia thetis *Smith.*

Drillia thetis *Smith,* 'J. of Malac.,' vol. xi, p. 26, Pl. II, fig. 1.
Hab.—Port Alfred, Cape Colony.

* Drillia albotessellata n. sp. Pl. VII, fig. 3.

Testa elongata, turrita, supra subacuminata, imperforata, olivacea, maculis parvis subquadratis cæruleo-albidis tessellata, circa medium anfractus ultimi olivaceo obscure zonata; anfractus circiter 8, supra excavati, infra costis rotundatis 9–10 leviter obliquis instructi, supra costas striis transversis (in anfr. penult, 4–5, in ultimo circiter 18) vix punctatis sculpti, incrementi lineis tenuiter striati, ultimus infra medium pallidus, ad extremitatem fusco tincta; apertura intus saturate fusca; labrum tenue, intus flavescens, supra mediocriter profunde sinuatum; columella parum arcuata, callo crasso flavo supra tuberculato induta. Longit. 18 mm., diam. 6. Apertura 7·5 longa, 2·5 lata.

Hab.—Port Shepstone (Burnup).

This Drillia is remarkable on account of its peculiar coloration. The ground tint is a sort of olive upon which there is a tesselation of squarish whitish dots. The concavity at the upper part of the whorls is more or less brown, and the slight thickening at the suture is minutely dotted and spotted with brown. The aperture is very deeply coloured within, so that the labrum and columella, being yellowish, contrast strongly. Around the middle of the body-whorl a more or less obscure olivaceous zone is observable.

* Clathurella crassilirata *Smith.*

Clathurella crassilirata *Smith,* 'J. of Malac.,' vol. xi, p. 27, Pl. II, fig. 6.

Hab.—Port Alfred, Cape Colony.

* Glyphostoma siren *Smith.*

Glyphostoma siren *Smith,* 'J. of Malac.,' vol. xi, p. 28, Pl. II, fig. 7.

Hab.—Port Alfred, Cape Colony.

* Mangilia alfredi *Smith.*

Mangilia alfredi *Smith,* 'J. of Malac.,' vol. xi, p. 29, Pl. II, fig. 8.

Hab.—Port Alfred, Cape Colony.

Mangilia africana *Sowerby.*

Mangilia (Eucythara) africana *Sowerby,* 'Marine Invest.,' vol. ii, p. 216, Pl. V, fig. 9.

Hab.—Off mouth of Umhloti River, Natal, 25 fathoms.

Cancellaria producta *Sowerby.*

Cancellaria producta *Sowerby,* 'Marine Invest.,' vol. ii, p. 220, Pl. IV, fig. 5.

Hab.—Off Natal, 40 fathoms.

* Ancilla albozonata *Smith.*

Ancilla albozonata *Smith,* 'J. of Malac.,' vol. xi, p. 29, Pl. II, fig. 9.

Hab.—Port Alfred, Cape Colony.

Ancilla bulloides (*Reeve*).

Ancilla bulloides *Reeve,* Sowerby, 'Marine Invest.,' vol. ii, p. 228.

Hab.—South Africa, 190 fathoms.

Ancilla contusa (*Reeve*).

Ancilla contusa *Reeve*: Sowerby, 'Marine Invest.,' vol. ii, p. 228, Pl. III, fig. 3.

A good figure of this species, described originally from a somewhat abnormal specimen, is given by Mr. Sowerby.

* Ancilla reevei *Smith.*

Ancilla reevei *Smith,* 'J. of Malac.,' vol. xi, p. 29, Pl. II, fig. 10.

Hab.—Port Alfred, Cape Colony.

* Ancilla ordinaria n. sp. Pl. VII, fig. 4.

Testa parva, subovata, supra acuminata, dilute flavescens, strigis vel lineis, pallidis, parum obliquis, obscuris, ornata, interdum omnino nivea; anfractus 4–5, celeriter accrescentes;

spira brevis, ad apicem obtusa; anfr. ultimus antice bisulcatus, sulco superiori supra labrum denticulum inconspicuum formante, ad extremitatem alteram ad partem aperturæ superiorem terminante; labrum supra incrassatum, incurvum, ad insertionem leviter incisum; columella antice callosa, reflexa, leviter sulcata.

Longit. 13 mm., diam. 7; apertura 8 mm. longa, 3 lata.

Hab.—Port Shepstone (Burnup).

Rather like A. sarda *Reeve* in shape, but differing in having a second groove upon the body-whorl higher up than the one around the anterior end of Reeve's species. The habitat of the latter was unknown to its author, but a nice series of it from Zanzibar was received by the British Museum from Mr. J. T. Last. Two specimens of the present species have been examined—the one entirely snow white, the other, viewed at a distance, apparently of an uniform pale-yellow colour, a little darker at the suture and upon the body-whorl below the upper groove. On a closer inspection the yellow tint is broken up by slightly oblique whitish streaks.

*Ancilla hasta (*Martens*).

Ancillaria hasta *Martens*, 'Tiefsee-Exped.,' p. 37, Pl. III, fig. 13.

Hab.—Agulhas current, 270 fathoms.

*Marginella labrosa *Redfield*.

Marginella labrosa *Redfield*, 'Amer. Jour. Conch.,' vol. vi, p. 239.

This name must be employed for the species catalogued by Mr. Sowerby ('Marine Shells S. A.,' p. 21) as M. crassilabrum, as that name was already twice preoccupied.

Marginella angustata *Sowerby*.

Ancilla angustata *Sowerby*, 'Marine Invest.,' vol. ii, p. 229.

Hab.—Off Cape Point, 42 fathoms.

By a curious accident this species was wrongly recorded by Mr. Sowerby under the genus Ancilla.

Marginella biplicata *Krauss.*

Marginella biplicata *Krauss*: Martens, 'Tiefsee-Exped.,' p. 37, Pl. III, fig. 6.

Hab.—Cape Coast (Krauss).

This and the four following species were figured for the first time in the above work. M. chrysea of Watson (Sowerby, 'Marine Shells S. A.,' p. 20) is a synonym of this species. It was described as having three columellar folds, and on this account Martens hesitated to unite it with biplicata. Having examined the types of chrysea and compared them with the figure of biplicata given by Martens, I feel no hesitation in pronouncing them the same species. One of the two "Challenger" examples of chrysea has a very faint third fold, but the other specimen has practically only the slightest trace of it, so that if this existed in Krauss's examples, it was probably overlooked or not considered worthy of notice. The yellowish tint described by Watson has almost faded away, so that the shore specimens, such as Krauss probably had before him, would most likely be destitute of colour also.

Marginella zeyheri *Krauss.*

Marginella (Gibberula) zeyheri *Krauss*: Martens, 'Tiefsee-Exped.,' p. 34, Pl. III, fig. 4.

Marginella pura *Smith*, 'J. of Malac.,' vol. xi, p. 31, Pl. II, fig. 18.

Hab.—Off Cape, 177 fathoms (Martens); Port Alfred (Smith).

When describing this species, under the name of M. pura, I had not seen Martens' figure of zeyheri, and from Krauss's original description, unaccompanied by any figure, it was impossible to know what the form of his shell really was.

Marginella neglecta *Sowerby.*

Marginella (Gibberula) reevei *Krauss*: Martens, 'Tiefsee-Exped.,' p. 35, Pl. III, fig. 3.

Hab.—Agulhas Bank, 84 fathoms.

M. reevei *Krauss* is certainly synonymous with the present species, which has six years' priority of publication.

Marginella multizonata *Krauss.*

Marginella (Volvarina) multizonata *Krauss*: Martens, 'Tiefsee-Exped.,' p. 36, Pl. III, fig. 5.

Hab.—Simon's Bay, Cape Colony, 38 fathoms.

This species appears to be very like M. cylindrica of Sowerby.

*Marginella corusca *Reeve.*

Marginella corusca *Reeve*, 'Conch. Icon.,' vol. xv, figs. 143 *a*, *b*; Smith, 'J. of Malac.,' vol. xi, p. 23.

Hab.—Port Alfred, Cape Colony; Singapore (Reeve).

*Marginella differens *Smith.*

Marginella differens *Smith*, 'J. of Malac.,' vol. xi, p. 32, Pl. II, fig. 19.

Hab.—Port Alfred, Cape Colony.

*Marginella dulcis *Smith.*

Marginella dulcis *Smith*, 'J. of Malac.,' vol. xi, p. 32, Pl. II, fig. 20.

Hab.—Port Alfred.

*Marginella munda *Smith.*

Marginella munda *Smith*, 'J. of Malac.,' vol. xi, p. 31, Pl. II, fig. 14.

Hab.—Port Alfred.

*Marginella pseustes *Smith.*

Marginella pseustes *Smith*, 'J. of Malac.,' vol. xi, p. 32, Pl. II, fig. 21.

Hab.—Port Alfred.

*Marginella ros *Reeve.*

Marginella ros *Reeve*, 'Conch. Icon.,' vol. xv, fig. 147; Martens, 'Tiefsee-Exped.,' p. 36 (in section Granula).

Hab.—Agulhas Bank, 85 fathoms.

*Marginella shepstonensis n. sp. Pl. VII, fig. 5.

Testa parva, oblonga, ovata, alba, lineis longitudinalibus undulatis vel angulatis, flavis, et zonis duabus transversis interruptis ornata; spira obtusa, haud elata; anfractus tres, ultimus convexiusculus, latere sinistro dextro convexiore; apertura angusta, alba; labrum intus incrassatum, tenuiter liratum; columella callo tenui circumscripto induta, denticulis vel plicis circiter decem instructa.

Longit., 6 mm.; diam., 3·6 mm.

Hab.—Port Shepstone.

The coloration of this species is rather like that of M. pulchella *Kiener* ('Coq. Viv.,' Pl. IX, fig. 40), and the form also is very similar. That species, however, is said to have a smooth labrum and only four columellar folds. The angulations of the zigzag lines form transverse zones, but only two of these, one round the middle and one at the upper part of the body-whorl, are specially conspicuous, being darker in colour.

Marginella zonata *Kiener.*

The variety bilineata *Krauss* is said by Martens ('Tiefsee-Exped.,' p. 57) to be the Voluta biannulata of Fabricius.

Voluta (Volutocorbis) abyssicola *Adams* and *Reeve.*

Voluta (Ternivoluta) abyssicola *Adams* and *Reeve*: Martens, 'Tiefsee-Exped.,' p. 31.

As differing, in his opinion, from Volutilithes, to which genus it has often been assigned, Martens placed this species in his sub-genus Ternivoluta (1903), the character of its radula being the same as that of that group. The style of its sculpture, however, is very different. Volutocorbis, Dall (1890).

Fusivoluta pyrrhostoma (*Watson*).

Neptuneopsis pyrrhostoma (*Watson*): Sowerby, 'Marine Invest.,' vol. ii, pp. 213, 226, Pl. III, fig. 1.

Fusivoluta pyrrhostoma (*Watson*): Martens, 'Tiefsee-Exped.,' p. 32, Pl. III, fig. 15.

Mitra punctostriata *A. Adams.* Pl. VII, fig. 6.

Mitra punctostriata *A. Adams*: Smith, 'Proc. Malac. Soc.,' vol. v, p. 366.

? Mitra cylindracea *Reeve*: Sowerby, 'Marine Invest.,' vol. ii, p. 227.

Considered by Sowerby to be the same as M. cylindracea *Reeve.* The type of M. cylindracea, said to be in the Cuming collection, cannot now be found. Judging from the description and figure, I do not feel convinced of the identity of these two forms. In the South African specimens, which I have examined, the upper whorls exhibit five punctured lines, whereas in Reeve's figure of cylindracea only three are indicated. Also the "interrupted band of spots round the middle" of the body-whorl is wanting in these shells, which agree in every detail with punctostriata, the type of which is in the British Museum collection.

* Mitra paupercula (*Linn*).

Mitra paupercula *Linn.*: Reeve, 'Conch. Icon.,' vol. ii, fig. 84.

Hab.—Durban (Burnup); also recorded from the Red Sea, E. Africa, Philippines, Polynesia.

Mitra schrœteri *Dillwyn.*

This species is considered the same as M. picta *Reeve* and tessellata *Kiener* by Martens ('Tiefsee-Exped.,' p. 53).

Dillwyn appears to have been the inventor of the specific name schrœteri and not Chemnitz. At present I am not convinced that the two forms schrœteri and picta as determined by Reeve ('Conch. Icon.,' vol. ii, figs. 167 and 123 respectively) are absolutely identical. The former seems somewhat shorter and to have a broader aperture, the labrum also having a tendency to be a little patulate. A difficult question arises as to which form is the true schrœteri, but at present I am inclined to agree with Martens that the shell known as picta of Reeve is that figured by Schrœter and afterwards called Voluta schrœteri by Dillwyn. If this be correct, then the Mitra schrœteri of Reeve, if distinct, would require a fresh name. Until I have the opportunity of examining a larger series of specimens in good condition I do not think it advisable to attempt any further solution of the difficulty.

Mitra simplex *Dunker.*

With this species Martens ('Tiefsee-Exped.,' p. 53) unites cinnamomea *A. Adams.* The latter, however, I have reason to believe is Tasmanian, and does not occur in Natal, as stated by Adams. There are numerous specimens in the British Museum from Oyster Cove, Tasmania, agreeing exactly with the types in every respect.

Mitra (Turricula) dædala *Reeve.*

Mitra dædala *Reeve*: 'Conch. Icon.,' vol. ii, fig. 281.

Mitra (Costellaria) dædala: Sowerby, 'Marine Invest.,' vol. ii, p. 227.

Hab.—Off Scottsburg, Natal, 92 fathoms; Philippine Islands (*Reeve*).

*Fusus cingulatus *Smith.*

Fusus cingulatus *Smith*: 'J. of Malac.,' vol. xi, p. 30, Pl. II, fig. 11.

Hab.—Port Alfred.

Fasciolaria rutila *Watson.*

Fasciolaria rutila *Watson*: Sowerby, 'Marine Invest.,' vol. ii, p. 222, Pl. III, fig. 2.

Hab.—Off Natal, 40 and 154 fathoms.

A young shell and the radula are figured by Sowerby.

* Latirus burnupi n. sp. Pl. VII, fig. 7.

Testa breviter fusiformis, albida, periostraco fuscescente tenui induta; spira acuminato-conica; anfractus 8–9, supra declives et leviter concavi, dein convexi, costis 8 fortibus rotundatis supra attenuatis instructi, liris tenuibus spiralibus, confertis, infra suturam plus minus granulatis, ornati, ultimus antice attenuatus, breviter caudatus, costis infra medium sensim evanidis, lira unica paulo infra peripheriam cæteris magis conspicua; apertura roseo-purpurea, intus tenuiter lirata, cum canali longit. totius $\frac{1}{2}$ adæquans; labrum pallidum, subexpansum, antice fere patulum; canalis parum obliquus; columella callo roseo-purpureo induta, in medio plicis tribus tenuibus instructa, tuberculo parvo unico superme munita.

Longit. 28 mm., diam. 11·5; apertura cum canali 14 longa, 5 lata.

Hab.—Port Shepstone (Burnup).

Somewhat resembling L. flavidus *A. Adams* and L. mariæ *Crosse*, but apparently distinct. The termination of the more conspicuous lira upon the body-whorl is near the columellar tubercle at one end and is indicated at the other by a faint denticle upon the lower edge of the outer lip. All four specimens examined are rather worn at the apex and upon the anterior rostrum. It looks as if the periostracum is soon lost at these parts.

Cominella lagenaria (*Lamarck*).

Under this species Mr. Sowerby ('Marine Shells S. A.,' p. 10), has placed Purpura dubia *Krauss* as a variety. This is incorrect, as Krauss's species certainly belongs to

Purpura, and is the same as the P. cataracta of Reeve. The Buccinum cataracta of Chemnitz has never been satisfactorily identified.

Tritonidea carinifera (*Küster*).

Tritonidea carinifera (*Küster*), Smith, 'Proc. Malac. Soc.,' vol. v, p. 371 (1903).

Tritonidea natalensis *Smith*: Sowerby, 'Marine Invest.,' vol. ii, p. 229 (1903).

Küster's name carinifera has many years' priority over natalensis of Smith.

* Euthria pura *Martens*.

Euthria pura *Martens*, 'Tiefsee-Exped.,' p. 25, Pl. II, fig. 14.

Hab.—Agulhas Current, 273 fath.

Engina mendicaria (*Lamarck*).

This species, placed by Mr. Sowerby ('Marine Shells S. A.,' p. 22) in the genus Columbella, should be removed to Engina. It has been known for many years that its radula is Buccinoid and very different from that of the Columbellidæ.

* Phos roseatus *Hinds*.

Phos roseatus *Hinds*: Sowerby, 'Thes. Conch.,' vol. iii, Pl. CCXXI, figs. 1–3.

Hab.—Durban (Burnup), Philippines, Moluccas, etc.

Sylvanocochlis ancilla (*Hanley*).

Pseudoliva ancilla *Hanley*: Sowerby, 'Marine Invest.,' vol. ii, p. 228.

Sylvanocochlis ancilla: Melvill, 'J. of Conch.,' vol. x, p. 325, fig.; Smith, 'J. of Malac.,' vol. xi, p. 23.

Hab.—Off South Africa, 40 fathoms (Sowerby); Port Alfred (Smith).

* Nassa circumtexta *Martens*.

Nassa (Amycla) circumtexta *Martens*, 'Tiefsee-Exped.,' p. 27, Pl. III, fig. 18.

Nassa trifasciata *A. Adams*: Sowerby, 'Marine Invest.,' vol. ii, p. 219, Pl. IV, fig. 2.

Hab.—Francis Bay, Algoa Bay, Agulhas Bank, Simon's Bay, 38–64 fathoms.

This species is the N. trifasciata of Adams. The types of that species in the Cuming collection are certainly the same as the South African shell, and I doubt very much if they came from Spain. A species very like it—semistriata *Brocchi*—does occur there, but it is not quite the same. The name trifasciata was preoccupied by Gmelin for a species belonging to the genus Nassa, which he described as a Buccinum.

Nassa analogica *Sowerby*.

Nassa analogica *Sowerby*, 'Marine Invest.,' vol. ii, p. 219, Pl. IV, fig. 3.

Hab.—South Africa, 40 fathoms.

I can hardly believe that this species is distinct from the preceding (circumtexta), notwithstanding the differences pointed out by Mr. Sowerby.

Nassa desmoulioides *Sowerby*.

Nassa desmoulioides *Sowerby*: 'Marine Invest.,' vol. ii, p. 219, Pl. IV, fig. 1.

Hab.—Off Natal, 100 fathoms.

* Nassa pœcilosticta *Smith*.

Nassa pœcilosticta: *Smith*, 'J. of Malac.,' vol. xi, p. 33, Pl. II, fig. 16.

Hab.—Port Alfred, Cape Colony.

* Bullia trifasciata *Smith.*

Bullia trifasciata *Smith*, 'J. of Malac.,' vol. xi, p. 34, Pl. II, fig. 17.

Hab.—Port Alfred.

* Bullia ancillæformis n. sp. Pl. VII, fig. 8.

Testa parva, oblonga, supra acuminata, alba, infra suturam fusco zonata, lævis, lineis incrementi tenuibus arcuatis obliquis sculpta, obsolete spiraliter striata; anfractus 5–6, celeriter accrescentes, fere plani, supra suturam callo tenui induti, ultimus magnus, elongatus, leviter convexus, antice oblique descendens; apertura supra acuminata, infra truncata, lata; columella obliqua, paulo arcuata, infra oblique truncata, callo tenui induta; labrum tenue, inferne haud profunde sinuatum. Longit. 19 mm., diam. 7·5; apertura 8·5 mm. longa, 4 lata.

Hab.—Port Shepstone, about 70 miles south of Durban, Natal (McBean).

This species is quite distinct from any of the other South Africa forms, being remarkable on account of its peculiar shape, recalling somewhat that of certain species of Ancilla. The thin callosity which spreads over the columella winds up the spire and covers the greater part of the surface of the whorls.

Columbella filmeræ *Sowerby.*

Columbella filmeræ, *Sowerby*: Smith, 'Proc. Malac. Soc.,' vol. v, p. 374.

This species was wrongly quoted in the 'Marine Shells of South Africa' as C. sagena *Reeve*, a Japanese form, not yet known as South African.

* Columbella versicolor *Sowerby.*

Columbella versicolor *Sowerby*, 'Thesaurus Conch.,' vol. i, Pl. XXXVII, figs. 41–46; Reeve, 'Conch. Icon.,' vol. xi, figs. 51 *a*, *b*.

Hab.—Natal (Burnup); Annaa, Philippines, etc.

This species is the C. scripta of Lamarck, a name preoccupied by Linné.

Columbella mitriformis *A. Adams.*

This species should be removed from the South African list, as the shells so named ('Proc. Malac. Soc.,' vol. v, p. 375) prove to be C. leptalea *Smith.*

Murex axicornis *Lamarck, var.*?

Murex axicornis *Lamarck*: Reeve, 'Conch. Icon.,' vol. iii, Pl. X, fig. 37, Pl. XV, fig. 37; Sowerby, 'Marine Invest.,' vol. ii, p. 227.

Hab.—Off mouth of Umhloti River, Natal, 110 fathoms.

Murex carduus *Broderip.*

Trophon carduus *Broderip*: Sowerby, 'Marine Invest.,' vol. ii, p. 227.

Hab.—Off Natal, 250 fathoms; Peru (Cuming).

The generic position of this shell appears to be rather uncertain. It might, perhaps, be placed in Coralliophila.

*Ocinebra natalensis n. sp. Pl. VII, fig. 9.

Testa parva, ovato-fusiformis, albida, rimata, sex-varicosa, liris spiralibus tuberculatis (in anfr. superioribus 2, in ultimo circiter 8) instructa, inter liras lineis incrementi lamellosis ornata; anfractus 6, convexi, varicibus squamosis, gradati; apertura ovata, intus lineis nigris 5–6 picta; labrum ad marginem acutum, extra varice ultimo expanso incrassatum; columella arcuata, callo libero induta; canalis angustatus, brevis, obliquus. Longit. 14 mm., diam. 8·5. Apertura intus 4 longa, 2·75 lata.

Hab.—Umkomaas and Port Shepstone (*Burnup*).

This species is remarkable on account of the peculiarity of the sculpture. The spiral ridges between the varices are ornamented in a very unusual manner with close-set tubercles, the varices upon the ridges are squamosely produced and the lines of growth between the ridges are also somewhat squamous. The body-whorl exhibits six principal spirals and two minor ones anteriorly, which are close together, also a basal ridge which is scaled and forms the umbilical rimation. The dark lines within the aperture correspond to the external ridges. The edge of the labrum is somewhat frilled by the termination of the ridges.

Urosalpinx contracta (*Reeve*).

Urosalpinx contracta (*Reeve*): Smith, 'Proc. Malac. Soc.,' vol. v, p. 376.

This is merely a variety of the Ricinula heptagonalis, Reeve, already quoted by Sowerby ('Marine Shells S. A.,' p. 15) as Sistrum heptagonale. According to Professor Gwatkin, who has examined the radula, its position in the genus Urosalpinx appears to be justified. The specific name heptagonalis, having a few months' priority, should be retained.

Latiaxis tortilis *H.* and *A. Adams*.

Latiaxis tortilis *A. Adams*: Sowerby, 'Marine Invest.,' vol. ii, p. 228.

Hab.—South Africa, 166 fathoms.

The shell figured by the late G. B. Sowerby ('Thesaurus Conch.,' vol. v, Pl. CCCCXXIV, fig. 1) is not the actual type specimen in the Cuming collection. It was described by H. and A. Adams (not A. Adams only) and is probably merely a white variety of L. idoleum *Jonas* as suggested by Gray and Tryon. The name idoleum being a substantive cannot be altered to idolea, as given by Tryon and Sowerby.

*Purpura castanea *Küster*.

Purpura castanea *Küster*: Smith, 'J. of Malac.,' vol. xi, p. 33.

Hab.—Port Alfred.

Purpura texturata *Smith.*

Purpura texturata *Smith,* 'J. of Malac.,' vol. xi, p. 32, Pl. II, fig. 15.

Hab.—Port Alfred.

*Pinaxia coronata *A. Adams.*

Pinaxia coronata *A. Adams,* 'Proc. Zool. Soc.,' 1853, p. 185; H. and A. Adams, 'Genera Moll.,' Pl. XIV, fig. 1.

Hab.—Umkomaas (Burnup): Ceylon, Philippines, Sandwich Islands, etc.

Sistrum cancellatum (*Quoy and Gaimard*): Smith, 'Proc. Malac. Soc.,' vol. v, p. 377.

This species is quoted in the 'Marine Shell of S. Africa,' Appendix, p. 6, as Sistrum elongatum *Blainville.* Reeve's figure, there quoted, does not represent Blainville's species, but another form described by that author under the name of Purpura fenestrata, which is a synonym of the present species (cancellata).

Sistrum concatenatum (*Lamarck*).

Sistrum concatenatum *Lamarck*: Sowerby, 'Marin Shells S. A.,' Appendix, p. 6.

It seems to be uncertain whether this species really is South African. The specimens quoted as squamosum *Pease,* var. ('Proc. Malac. Soc.,' vol. v, p. 377) may have been mistaken for it.

Argobuccinum (Fusitriton) murrayi (*Smith*).

Tritonium (Cryotritonium) murrayi *Smith*: 'Martens, 'Tiefsee-Exped.,' p. 38, Pl. III, fig. 16.

Hab.—Off Cape, 97–270 fath.

* Bursa (Bufonaria) lampas (*Lamarck*).

Triton lampas *Lamarck*: Reeve, 'Conch. Icon.,' vol. ii, Pl. IX, fig. 30*a*, Pl. X, fig. 30*b*.
Hab.—Bluff, Durban (G. W. Westcott).

Septa leucostoma (*Lamarck*) var.

Ranella leucostoma *Lamarck*, var. pœcilostoma: Martens, 'Tiefsee-Exped.,' p. 56.
Martens has given this varietal name to the South African specimens, which differ from Australian examples in having "black markings on the lip" (Sowerby, 'Marine Shell S. A.,' p. 9).

Colubraria crebrilirata (*Sowerby*).

Epidromus crebriliratus *Sowerby*, 'Marine Invest.,' vol. ii, p. 220, Pl. IV, fig. 4.
Hab.—Off Port Alfred, 100 fathoms.

* Cassis pirum *Lamarck*.

Cassis pyrum *Lamarck*: Kiener, 'Coq. Viv.,' p. 39, Pl. XIII, fig. 25, Pl. XV, fig. 30; Martens, 'Tiefsee-Exped.,' pp. 54, 56: note 12, var. intercedens.
Hab.—S. Africa.

Oniscia macandrewi *Sowerby*.

Oniscia macandrewi *Sowerby*, 'Proc. Zool. Soc.,' 1888, p. 567, Pl. XXVIII, figs. 1, 2; 'Marine Invest.,' vol. ii, p. 229.
Hab.—Off Natal, 27–250 fathoms.

Dolium fimbriatum *Sowerby*.

Var. natalensis n. var. Pl. VII, fig. 10.

Testa parva, ovato-globosa, rimata, solidiuscula, pallide grisea vel dilute lilacea, costis fuscescentibus ornata, periostraco tenui deciduo flavescente induta; spira mediocriter elata; anfractus 6, superiores tres (protoconcha) fusco-cornei, lævesvs, politi, convexi, cæteri spiraliter costati, costis angustis (in anfractu penultimo 3, in ultimo 13–14); apertura irregulariter elongato-pyriformis, intus fuscescens, labrum versus albida; labrum intus incrassatum, album, denticulatum, ad marginem tenue, fimbriatum, pone varice obliquo conspicuo instructum; columella callo tenui induta, antice plicis obliquis paucis munita, subtuberculata; canalis anticus brevis, haud profundus, leviter recurvus. Longit. 41 mm., diameter 31. Apertura cum labro 34, diam. intus 13.

Hab.—Durban, Bluff, Natal.

This variety was catalogued in Sowerby's 'Marine shells of South Africa,' Appendix, p. 11, as D. fimbriatum without any observation with regard to its differing from the typical form. It is much smaller, has a distinct varix outside the labrum, and shows scarcely any trace of the spotting upon the spiral ridges which is so characteristic of the normal form.

Pedicularia sicula *Swainson.*

Pedicularia sicula *Swainson*: Tryon, 'Man. Conch.,' vol. vii, p. 241, Pl. I, figs. 1–3; Sowerby, 'Marine Invest.,' vol. ii, p. 230.

Hab.—Off Cape St. Blaize, 116 fathoms.

Cypræa barclayi *Reeve.*

Cypræa barclayi *Reeve*: Sowerby, 'Thesaurus Conch.,' vol. iv, Pl. CCCV, figs. 91, 92; 'Marine Invest.,' vol. ii, p. 230.

Hab.—Off Cape St. Blaize, Cape Colony, 55 fathoms.

Cypræa fultoni *Sowerby.*

Cypræa fultoni *Sowerby*, 'Marine Invest.,' vol. ii, p. 218, Pl. IV, fig. 7.

Hab.—S. Africa.

* Trifora convexa *Smith.*

Trifora convexa *Smith*, 'J. of Malac.,' vol. xi, p. 37, Pl. III, fig. 9.

Hab.—Port Alfred.

* Trifora fuscescens *Smith.*

Trifora fuscescens *Smith*, 'J. of Malac.,' vol. xi, p. 37, Pl. III, fig. 6.

Hab.—Port Alfred.

* Trifora fuscomaculata *Smith.*

Trifora fuscomaculata *Smith*, 'J. of Malac.,' vol. xi, p. 37, Pl. III, fig. 7.

Hab.—Port Alfred.

* Trifora cerea n. sp. Pl. VII, figs. 11, 11 *a*.

Testa subulata, flavescens, nitida; anfractus 14 (?), convexi, costis spiralibus tuberculatis quatuor cincti, duobus medianis cæteris majoribus, inter costas oblique costulati, ultimus costis sex instructus, duobus inferioribus vix tuberculatis; columella supra arcuata, callo albo crassiusculo induta; canalis brevis, obliquus, recurvus, haud clausus; labrum subpatulum, extremitatibus costarum leviter dentatum.

Longit. 10·5 mm., diam. 2·25. Apertura 1·25 longa.

Hab.—Port Shepstone (Burnup).

Of a uniform yellow wax colour, ornamented with four rows of granules on each whorl, the lowest row being the smallest, and the two central series rather more prominent than the uppermost row.

* Trifora shepstonensis n. sp. Pl. VII, figs. 12, 12 *a*.

Testa elongata, subulata, fuscescens; anfractus circiter 15, plani, tricingulati, cingulis plus minus moniliformibus, mediani cæteris minori, in sulcis liris longitudinalibus decussati, ultimus liris 5 ornatus; apertura parva, albida; labrum tenue, interdum productum, columellam antice attingens; columella supra arcuata, callo crassiusculo reflexo induta; canalis brevis, obliquus, recurvus. Longit. 10 mm., diam. 2·5.

Hab.—Port Shepstone (Burnup).

The spiral ridges are crossed by oblique shallow sulci so as to produce a somewhat beaded appearance.

Cerithium pingue (*A. Adams*).

Colina pinguis *A. Adams*, 'Proc. Zool. Soc.,' 1854, p. 86.

Cerithium pingue *Sowerby*, 'Thesaurus Conch.,' vol. ii, p. 877, Pl. CLXXXIV, fig. 217 (1855).

Cerithium contractum *Sowerby*, l. c. p. 877, Pl. CLXXXIV, fig. 218.

Cerithium tæniatum *Sowerby*, 'Conch. Icon.,' vol. xv, fig. 119 (1865).

C. contractum and C. tæniatum, regarded as species in the 'Marine Shells of S. A.,' p. 35, are not, in my opinion, worthy of even varietal rank. Both names were preoccupied, the former by Bellardi for a fossil species, and the latter by Quoy and Gaimard. The name C. crumena was proposed by Bayle in 1880 for Sowerby's C. contractum.

The species has a wide range. Adams quoted it from the Philippines, and there are specimens from Muscat and the Persian Gulf in the British Museum.

* Cerithiopsis trilineata (*Philippi*).

Cerithium trilineatum Philippi, 'Enum. Moll. Sicil.,' vol. i, p. 195, Pl. XI, fig. 13.

Cerithiopsis trilineata *Smith*, 'J. of Malac.,' vol. xi, p. 24.

Hab.—Port Alfred.

The specimens quoted under Cerithiopsis purpurea Angas ('Marine Shells S. A.,' p. 27) appear to belong to this species. I am doubtful at present whether any constant distinctions between the two species can be pointed out.

*Cerithiopsis insignis n. sp. Pl. VII, fig. 13.

Testa minima, elongato-pupoidea, corneo-albida, rufo unibalteata; anfractus circiter 8, convexiusculi, lente accrescentes, seriebus tribus tuberculorum ornati; series suprema saturate rubra, mediana cæteris minor; anfr. ultimus seriebus quatuor cinctus; apertura parva; columella brevis, callo crasso induta. Longit. 3·25 mm., diam. 1.

Hab.—Port Shepstone (Burnup).

A very small species, but well characterised by its striking colouring. The tubercles of the three series are joined by longitudinal connections, so that the surface is, in fact, cancellated. The median tubercles are much smaller than those of the upper and lower rows. Quite distinct from C. pulchella *C. B. Adams*, from Jamaica, which is somewhat similarly coloured.

*Cerithiopsis chapmaniana n. sp. Pl. VII, fig. 14.

Testa elongata, turrita, alba, subpellucida, nitens; anfractus 10, leviter convexi, costis longitudinalibus leviter obliquis numerosis tenuibus lirisque spiralibus tribus, supra costas granosis, cancellati, sutura profunda sejuncti; anfr. ultimus liris quatuor cinctus, infra concavus, lævis, sed lineis incrementi tenuissimis striatus; apertura parva; labrum tenue; columella in medio leviter arcuata, antice obliqua; canalis brevissimus, recurvus. Longit. 8 mm., diam. 2·75. Apertura 1·75 mm. longa, 1·25 lata.

Hab.—Isezela (Miss Chapman).

A pure white shell with three principal rows of granules upon each whorl and sometimes a much finer row in the spaces between. The longitudinal costæ are about twenty-two in number, slender, a little oblique and slightly arcuate. The apical whorls are broken away.

Cerithium tricarinatum Pease[1], badly figured by

[1] 'Proc. Zool. Soc.,' 1860, p. 433.

Sowerby [1], is sculptured very similarly, and should, I think, be removed to the genus Cerithiopsis. It is, however, a little more slender, of a light brown colour, more openly latticed, has a different columellar fold, and is distinctly spirally striated between the three principal spiral rows of granules.

Turritella bacillum *Kiener.*

Turritella bacillum *Kiener*: Martens, 'Tiefsee-Exped.,' p. 44.

Its occurrence in South Africa confirmed.

Turritella declivis *Adams* and *Reeve,* var.

Turritella declivis *Adams* and *Reeve,* var.: Martens, 'Tiefsee-Exped.,' p. 44, Pl. IV, fig. 10.

Hab.—Simon's Bay, 38 fathoms.

Turritella punctulata *Sowerby.*

Turritella punctulata *Sowerby*: Martens, 'Tiefsee-Exped.,' p. 43, Pl. IV, figs. 9, 9 *a*, *b*.

Hab.—Francis Bay, Cape Agulhas, Algoa Bay, 44–55 fathoms.

* Littorina scabra (*Linn.*).

Littorina scabra *Linn.*: Reeve, 'Conch. Icon.,' vol. x, figs. 21 *a–c*.

The following so-called species, viz. L. angulifera *Lamarck,* intermedia *Philippi,* ahenea *Reeve,* and newcombi *Reeve,* appear to pass one into the other and also into L. scabra, and without a very deep study of the group it appears hopeless to attempt to give any definite opinion upon the specific value of any of them. They have already been united by Tryon as forms of L. scabra. L. ahenea, newcombi and intermedia are quoted in the 'Marine Shells of S. A.' as distinct species. Specimens have been examined which seem to be inseparable from the L. scabra as determined by Reeve, Weinkauff, etc.

[1] 'Conch. Icon.,' vol. xv, fig. 127. Copied by Tryon, 'Man. Conch.,' vol. ix, pl. xxx, fig. 9.

* Rissoa conspecta *Smith.*

Rissoa conspecta *Smith*, 'J. of Malac.,' vol. xi, p. 35, Pl. II, fig. 26.

Hab.—Port Alfred.

* Rissoa perspecta *Smith.*

Rissoa perspecta *Smith*, 'J. of Malac.,' vol. xi, p. 35, Pl. II, fig. 25.

Hab.—Port Alfred.

* Rissoina alfredi *Smith.*

Rissoina alfredi *Smith*, 'J. of Malac.,' vol. xi, p. 35, Pl. II, fig. 24.

Hab.—Port Alfred.

* Rissoina durbanensis n. sp. Pl. VII, fig. 15.

Testa mediocriter elongata, albida; anfractus 7–8, vix convexi, costis circiter 16 leviter obliquis et liris transversis supra costas tuberculatis (in anfractu penultimo quatuor, in ultimo septem) instructi, sutura profunda sejuncti, ultimus supra liram anticam, cæteris crassiorem, quasi sulcatus; apertura obliqua, irregulariter ovalis, antice haud prófunde sinuata; labrum varice crasso lato extra munitum; columella in medio arcuata, callo albo, antice leviter incrassato, induta.

Longit. 4·5 mm.; diam. 1·5 mm. Apertura intus, 1 longa, ·5 lata.

Hab.—Durban (Burnup).

A small, prettily granuled-cancellated species, with a deep suture, a strongly varixed labrum, and a conspicuous sulcus around the base of the body-whorl, above the most anterior of the transverse liræ, which is rather thicker than those above. It belongs to the same group as R. bicollaris and R. fenestrata of Schwartz.

*Rissoina shepstonensis n. sp. Pl. VII, fig. 16.

Testa elongata, alba, subpellucida, oblique costata, circa basim anfr. ultimi transversim striata; anfractus 9–10, superiores duo rotundati, læves, cæteri mediocriter convexi, costis 16–18 oblique arcuatis instructi, ultimus costis flexuosis, infra medium transversim tenuiter liratus; apertura obliqua, subovalis, antice late sinuata; labrum extra valde incrassatum, ad marginem tenue; columella obliqua, callo, supra et infra labro juncto, induta.

Longit. 7·5 mm., diam. 2·5 mm. Apertura 2 mm. longa, 1·25 mm. lata.

Hab.—Port Shepstone (Burnup).

The convexity of the whorls diminishes as the shell increases, the upper ones having almost a turreted appearance.

Vanikoro cancellata (*Lamarck*).

Vanikoro cancellata *Lamarck*: Tryon, 'Man. Conch.,' vol. viii, p. 67, Pl. XXIX, figs. 60, 61; Sowerby, 'Marine Invest.,' vol. ii, p. 229.

Hab.—Off Natal, 43 fathoms.

*Natica areolata *Récluz.*

Natica areolata *Récluz*, 'Proc. Zool. Soc.,' 1843, p. 206; Philippi, 'Conch. Cab.,' p. 67, Pl. XI, fig. 2; Tryon, 'Man. Conch.,' vol. viii, Pl. VI, fig. 23.

Hab.—Scottsburg, Natal.

*Natica decipiens *Smith.*

Natica decipiens *Smith*, 'J. of Malac.,' vol. xi, p. 34, Pl. II, fig. 23.

Hab.—Port Alfred.

Natica forata *Reeve.*

This species, wrongly quoted as of Récluz both in the 'Thesaurus Conch.' and the 'Marine Shells of South Africa,' according to Martens, is the same as N. pygmæa *Philippi*. At present I am unable to concur in that opinion.

*Natica napus *Smith.*

Natica napus *Smith*, 'J. of Malac.,' vol. xi, p. 34, Pl. II, fig. 22.

Hab.—Port Alfred.

Natica sagraiana *d'Orbigny*, var.

Natica sagraiana *d'Orbigny*: Reeve, 'Conch. Icon.,' vol. ix, fig. 111 *a*, *b*; Sowerby, 'Marine Invest.,' vol. ii, p. 229.

Hab.—Saldanha Bay, Cape Coast, 28 fathoms.

*Scala bullata *Sowerby.*

Scalaria bullata *Sowerby*, 'Thesaurus Conch.,' vol. i, p. 94, Pl. XXXIV, fig. 87; 'Conch. Icon.,' vol. xix, fig. 8.

Hab.—Durban (Burnup); Philippine Islands.

Scala tenebrosa *Sowerby.*

Scala tenebrosa *Sowerby*, 'Marine Invest.,' vol. ii, p. 224, Pl. IV, fig. 6.

Hab.—S. Africa.

*Scala durbanensis n. sp. Pl. VII, fig. 17.

Testa parva, elongata, alba, solidiuscula; anfractus 10, supremi tres læves, convexi, cæteri normales convexi, costis obliquis 14 valde reflexis, supra spiram peroblique continuis, instructa, costis in anfr. ultimo versus aperturam sensim latioribus, inter costas minute spiraliter striati; apertura oblique ovata.

Longit. 10 mm.; diam. 4 mm. Apertura intus 2 longa, 1·5 lata.

Hab.—Durban (Burnup).

Remarkable on account of the very reflexed and rather numerous costæ, a few of which upon the body-whorl, near the aperture, are much broader than the rest. The spiral, close-set striæ between the riblets are only visible under a strong lens.

*Scala eborea n. sp. Pl. VIII, fig. 1.

Testa parva, elongata, acuminata, alba, nitida; anfractus 10, supremi tres convexi, læves, cæteri convexi, sutura obliqua sejuncti, costis tenuibus obliquis decem reflexis, costis in anfractu ultimo versus aperturam sensim crassioribus; apertura rotunde ovata.

Longit. 9 mm.; diam. 3·75 mm. Apertura intus 2 longa, 1·5 lata.

Hab.—Port Shepstone and Durban (Burnup).

More acuminate than S. durbanensis, with fewer costæ, and without any transverse striæ. The riblets are very fine, and so much rolled back that they appear to form thread-like hollow liræ.

* Acrilla gracilis *H. Adams.*

Acrilla gracilis *H. Adams*: Smith, 'J. of Malac.,' vol. xi, p. 24.

Scalaria minor *Sowerby*: Reeve's 'Conch. Icon.,' vol. xix, fig. 70.

Hab.—Port Alfred, Cape Colony.

Eulima dilecta *Smith.*

Eulima dilecta *Smith*: 'Proc. Malac. Soc.,' vol. v, p. 386.

Under this species it should have been stated that the E. solida of the 'Marine Shells of South Africa' is the same form, and distinct from the true solida, the locality of which is said to be Sandwich Islands.

* Eulima distincta *Smith.*

Eulima distincta *Smith*: 'J. of Malac.,' vol. xi, p. 35, Pl. III, fig. 1.

Hab.—Port Alfred.

* Niso interrupta *Sowerby.*

Niso interrupta *Sowerby*: Reeve's 'Conch. Icon.,' vol. xv, fig. 8 *a, b*; Smith, 'J. of Malac.,' vol. xi, p. 24.
Hab.—Port Alfred.

Turbonilla hofmani *Angas.*

Turbonilla hofmani *Angas* (1877): Smith, 'J. of Malac.,' vol. xi, p. 24.
T. candida *A. Adams*: Sowerby, 'Marine Shells of South Africa,' p. 26; Smith, 'Proc. Malac. Soc.,' vol. v, p. 386.

The shells formerly considered to belong to T. candida are certainly distinct from that species. They appear to be inseparable from T. hofmani. The name lactea of Krauss (1848), afterwards changed by Clessin (1900) to kraussi, was preoccupied by Linnæus for a northern species.

* Turbonilla decora *Smith.*

Turbonilla decora *Smith*: 'J. of Malac.,' vol xi, p. 36, Pl. III, fig. 5.
Hab.—Port Alfred.

* Turbonilla gemmula *Smith.*

Turbonilla gemmula *Smith*: 'J. of Malac.,' vol. xi, p. 36, Pl. III, fig. 4.
Hab.—Port Alfred.

* Mormula rissoina *A. Adams.* Pl. VIII, fig. 2.

Mormula rissoina *A. Adams*: 'Journ. Linn. Soc.,' 1863, vol. vii, p. 1; Smith, 'J. of Malac.,' vol. xi, p. 24.
Hab.—Port Alfred.

* Elusa natalensis n. sp. Pl. VIII, fig. 3.

Testa elongata, subulata, ad apicem obtusa, alba, polita; anfractus 8, superiores duo convexi, læves, cæteri fere plani, superne tenuiter oblique striati, sutura fere canaliculata sejuncti, ultimus infra medium transversim striatus, antice leviter ascendens; apertura piriformis, parva; peristoma continuum, margine dextro incrassato, extra subvaricoso, columellari supra anfractum posito, tenui, intus in medio oblique uniplicato.

Longit. 7·25 mm., diam. 2·5. Apertura 2 mm. longa, 1·25 lata.

Hab.—Port Shepstone (Burnup).

A glossy white shell with oblique striæ, which are stronger at the upper part of the whorls than below, and with some transverse striæ upon the lower half of the body-whorl, those quite at the anterior end being closer together than those above. The inner lip might be described as a callus upon the whorl, joining the basal margin of the labrum to its point of insertion above. To the naked eye the shell looks almost smooth and glossy. E. aclis, A. Adams, described originally as a Pyramidella, is somewhat like the present species in form, but is distinctly costate.

* Eulimella minor *Smith.*

Eulimella minor *Smith*: 'J. of Malac.,' vol. vi, p. 36, Pl. III, fig. 3.

Hab.—Port Alfred.

* Eulimella nivea *Smith.*

Eulimella nivea *Smith*: 'J. of Malac.,' vol. xi, p. 36, Pl. III, fig. 2.

Hab.—Port Alfred.

Astralium andersoni *Smith.*

Astralium andersoni *Smith*: Sowerby, 'Marine Invest.,' vol. ii, p. 230, Pl. V, fig. 5.

Hab.—Off south coast of Cape Colony, 36 fath.

A good figure of an adult shell is given by Mr. Sowerby.

Astralium gilchristi *Sowerby.*

Astralium (Cyclocantha) gilchristi *Sowerby*: 'Marine Invest.,' vol. ii, p. 221, Pl. V, fig. 6.

Hab.—Off Natal, 90 and 92 fathoms.

* Astralium henicus (*Watson*).

Turbo (Calcar) henicus *Watson*: 'Challenger,' Gasteropoda, p. 130, Pl. VI, figs. 11 *a–c*; Martens, 'Tiefsee-Exped.,' p. 46.

Hab.—Agulhas Bank, 55 fathoms; Sumatra and Fiji.

* Leptothyra armillata (*A. Adams, Sowerby*).

Leptothyra armillata *A. Adams*: Smith, 'J. of Malac.,' vol. xi, p. 24.

Hab.—Port Alfred.

* Ethalia africana *Smith.*

Ethalia africana *Smith,* 'J. of Malac.,' vol. xi, p. 38, Pl. III, figs. 10, 11.

Hab.—Port Alfred.

* Liotia bicarinata *Martens.*

Liotia bicarinata *Martens,* 'Tiefsee-Exped.,' p. 46, Pl. V, fig. 4.

Hab.—Near Agulhas Bank, 271 fathoms.

* Cyclostrema (Tubiola) semisculptum *Martens.*

Cyclostrema (Tubiola) semisculptum *Martens,* 'Tiefsee-Exped.,' p. 49, Pl. V, fig. 6.

Hab.—Outside Agulhas Bank, 1490 fathoms.

* Cynisca forticostata *Smith.*

Cynisca forticostata *Smith,* 'J. of Malac.,' vol. xi, p. 38, Pl. III, figs. 12, 13.

Hab.—Port Alfred.

Calliostoma perfragile *Sowerby.*

Calliostoma perfragile *Sowerby*, 'Marine Invest.,' vol. ii, p. 222, Pl. V, fig. 3.

Hab.—Off Cape coast, 154 and 166 fathoms.

*Calliostoma bisculptum n. sp. Pl. VIII, fig. 4.

Testa acute conica, angulata, subrimata, griseo-albida, fusco strigata, strigis plus minus duplicatis; anfractus 7, superiores 1–2 convexi, læves, cæteri fere plani liris tenuibus numerosis spiralibus ornati, lineis obliquis incrementi sculpti, ultimus ad peripheriam angulatus, infra liris concentricis circiter 10, quam superioribus fortioribus cinctus, inter liras transversim striatus; apertura subquadrata; labrum acutum, intus leviter incrassatum; columella leviter arcuata, alba, reflexa, callo tenui labro juncta.

Diam. maj. 8 mm., min. 7, alt. 10.

Hab.—Durban (Burnup).

The spirals above the angle, about fifteen in number, are much finer than those upon the base. The slight umbilical perforation is perhaps sometimes covered by the reflexed columella.

The colour may be variable, but in the unique example examined the brown stripes are divided down the middle by a whitish line. They are slightly undulating and the basal liræ are spotted with the same colour, which is blackish brown. The whorls are not quite flat, as the rounded keel, which passes above the suture, causes a faint swelling at the lower part.

Calliostoma granoliratum *Sowerby.*

Calliostoma (Lischkeia) granoliratum *Sowerby*, 'Marine Invest.,' vol. ii, p. 222, Pl. V, fig. 7.

Hab.—Off Cape Point, 45 fathoms.

Calliostoma (Astele) iridescens *Sowerby.*

Calliostoma (Astele) iridescens *Sowerby*, 'Marine Invest.,' vol. ii, p. 223, Pl. V, fig. 4.

Hab.—Off Cape Natal, 55 fath.

Oxystele impervia *Menke*.

This species should stand under the name variegata *Anton*, if both forms really belong to one and the same species. Anton's species was described in 1839 and Menke's about four years later. Krauss and Martens have united them, but, on the other hand, Philippi decided to keep them separate.

*Euchelus natalensis n. sp. Pl. VIII, fig. 5.

Testa minima, rotunde turbinata, sordide albida, anguste perforata, spiraliter carinata et inter carinas fortiter oblique lirata vel lamellata; anfractus 4–4½, supremi 1½ rotundati, fere læves, ad apicem involuti, penultimus carinis duobus cinctus, ultimus carinis sex acutis prominentibus instructus; superficies inter carinas et liris obliquis margaritacea; apertura rotundata, intus margaritacea; labrum carinis extus dentatum; columella arcuata, callo reflexo induta.

Longi. 3 mm., diam. maj. 3; apertura 1·5 mm. longa, 1·3 lata.

Hab.—Durban (Burnup).

A beautiful little species allied to E. foveolatus *A Adams*, from Lord Hood Island. It is, however, much smaller than that species, is more delicately sculptured, the spiral keels being regular and simple, whereas in foveolatus they are subspinose where the oblique lamellæ join them. Besides the six carinæ mentioned above, a seventh is noticeable upon the body-whorl close to the suture, and this may be traced upon the penultimate volution also.

Solariella undata (*Sowerby*).

Minolia undata *Sowerby*: Martens, 'Tiefsee-Exped.,' p. 47, Pl. V, fig. 5.

Hab.—Agulhas Bank and off the Cape, 84 and 173 fathoms.

Solariella congener (*Sowerby*).

Minolia (Nachæroplax) congener *Sowerby*, 'Marine Invest.,' vol. ii, p. 223, Pl. V, fig. 2.

Hab.—Off S. coast of Cape Colony, 37 fathoms.

Machæroplax is misprinted Nachæroplax in the 'Marine Invest.'

*Solariella infundibulum (*Watson*).

Solariella infundibulum *Watson*: Martens, 'Tiefsee-Exped.,' p. 48, Pl. IV, fig. 22.

Hab.—Outside Agulhas Bank, 1719 fathoms.

Solariella lævissima *Martens*.

Solariella lævissima *Martens*: 'Tiefsee-Exped.,' p. 49, Pl. V, fig. 2; Smith, 'Proc. Malac. Soc.,' vol. v, p. 390, as Minolia; Sowerby, 'Marine Invest.,' vol. ii, p. 231, Pl. V, fig. 2, as Minolia.

Solariella persculpta *Sowerby*.

Solariella persculpta *Sowerby*, 'Marine Invest.,' vol. ii, p. 223, Pl. V, fig. 8.

Hab.—Off Cape Natal, 440 fathoms.

*Glyphis fuscocrenulata n. sp. Pl. VIII, fig. 6.

Testa parva ?, ovata, antice leviter angustata, mediocriter elata, fusca vel purpureo-fusca, tenuiter cancellata, costis radiantibus numerosis inæqualibus lirisque concentricis circiter 20, supra costas squamatis, instructa; foramen parvum, antemedianum, ad longitudinis $\frac{1}{3}$ situm; superficies interna callo tenui albo nitente induta, tenuiter crenulata vel denticulata, et inter denticulos fusco punctata.

Longit. 16 mm., diam. 11·25 alt. 6.

Hab.—Port Shepstone and Umkomaas, Natal.

The radiating costæ in this species are fine, and, as in many other species, of different thicknesses. A few upon the hinder half of the shell are more conspicuous than the rest. The concentric liræ form thickened scales upon the costæ, and, when a little worn, have a bead-like appearance. The foramen, situated at about one third of the length from the front margin, is roundly ovate, small, and thickened within with a white collar, which is truncate behind. The interior of the shell has a thin deposit of white, glossy callus, through which the external costæ are visible, producing a radiate-lineated appearance. The dotting upon the margin is formed by the terminations of the costæ, the dots being in minute depressions between the denticulations. It is impossible to say whether this species attains much larger dimensions than those given above. However, the specimen described appears to be fairly mature.

Puncturella noachina (*Linn.*).

Puncturella noachina *Linn.*: Sowerby, 'Marine Invest.,' vol. ii, p. 231.

Hab.—Off South Africa, 125 fathoms.

This northern species also occurs as far south as the Straits of Magellan and Kerguelen Island.

*Puncturella fastigiata (*A. Adams*).

Cemoria fastigiata *A. Adams*; Sowerby's 'Thesaurus Conch.,' vol. iii, p. 208, Pl. CCXLV, figs. 15, 16; Martens, 'Tiefsee-Exped.,' p. 50, as Puncturella.

Hab.—Simon's Bay, 38 fathoms.

Hanleya sykesi (*Sowerby*).

Chiton (Hanleya) Sykesi *Sowerby*, 'Marine Invest.,' vol. ii, p. 225, Pl. V, fig. 13.

Hab.—South Africa, 166 and 210 fathoms.

Scaphopoda.

Dentalium plurifissuratum *Sowerby*.

Dentalium plurifissuratum *Sowerby*: Pilsbry, 'Man. Conch.,' vol. xvii, p. 82, Pl. VI, figs. 87–89; Sowerby, 'Marine Invest.,' vol. ii, p. 231.

Hab.—Off Cape St. Blaize, 55–100 fathoms.

Dentalium novemcostatum *Lamarck.*

Dentalium novemcostatum *Lamarck*: Pilsbry, 'Man. Conch.,' vol. xvii, p. 51, Pl. IX, figs. 44–48; Sowerby, 'Marine Invest.,' vol. ii, p. 231.

Hab.—Off Cape St. Blaize, 85–90 fathoms.

A species occurring off the north Coast of France.

Dentalium africanum *Sowerby.*

Dentalium africanum *Sowerby*, 'Marine Invest.,' vol. ii, p. 224, Pl. V, fig. 10.

Hab.—Off Natal, 25 fathoms.

Dentalium belcheri *Sowerby.*

Dentalium belcheri *Sowerby*: Pilsbry, 'Man. Conch.,' vol. xvii, p. 60, Pl. XIV, figs. 29, 30; Smith, 'Jour. of Malac.,' vol. xi, p. 25; Sowerby, 'Marine Invest.,' vol. ii, p. 231.

Hab.—Port Alfred (Turton); off Cape 35 fathoms.

Dentalium exasperatum *Sowerby.*

Dentalium exasperatum *Sowerby*, 'Marine Invest.,' vol. ii, p. 225, Pl. V, fig. 12.

Hab.—Off Natal, 27 fathoms.

Dentalium inflexum *Sowerby.*

Dentalium inflexum *Sowerby*, 'Marine Invest.,' vol. ii, p. 224, Pl. V, fig. 11.

Hab.—Mouth of Tugela River, Natal, 14 fathoms.

*Dentalium politum *Linn.*

Dentalium politum *Linn.*: Pilsbry, 'Man. Conch.,' vol. xvii, p. 128, Pl. XIX, figs. 18–21.

Hab.—Off Natal, 54 fathoms.

Pelecypoda.

*Lima perfecta *Smith.*

Lima perfecta *Smith*, 'Jour. of Malac.,' vol. xi, p. 43, Pl. III, fig. 29.

Hab.—Port Alfred.

*Chlamys humilis *Sowerby.*

Chlamys humilis *Sowerby*, 'Marine Invest.,' vol. iv, p. 3, Pl. VI, fig. 3.

Hab.—Off Cape Colony, 51 and 90 fathoms.

*Chlamys gilchristi *Sowerby.*

Chlamys gilchristi *Sowerby*, 'Marine Invest.,' vol. iv, p. 1, Pl. VI, fig. 6.

Hab.—False Bay, 230 fathoms.

*Chlamys fultoni *Sowerby.*

Chlamys fultoni *Sowerby*, 'Marine Invest.,' vol. iv, p. 2, Pl. VI, fig. 5.

Hab.—Off the Cape, 26 fathoms.

Chlamys tinctus (*Reeve*).

Pecten tinctus *Reeve*, 'Conch. Icon.,' vol. viii, fig. 106; Smith, 'Jour. of Malac.,' vol. xi, p. 25.

Pecten textilis *Reeve*, loc. cit., fig. 174.

Pecten effulgens *Reeve*, loc. cit., fig. 156.

Pecten pusio *Reeve* (nec. Linn.), loc. cit., fig. 157; Sowerby, 'Marine Shells S. Africa,' p. 66.

Hab.—Port Alfred, Algoa Bay, and Natal.

I am inclined to believe that this South African shell is distinct from the European P. pusio (multistriatus *Poli*). It does not exhibit any of the microscopical longitudinal striæ which are characteristic of that species.

* Chlamys natalensis n. sp. Pl. VIII, figs. 7, 8 *a*.

Testa parva, mediocriter compressa, inæquilateralis, fere æquivalvis, altior quam longa, grisea, radiis nigris interruptis et maculis albis supra valvam sinistram picta; valva dextra costis tenuibus circiter 40 fere lævibus fusco notatis instructa, in interstitiis pulcherrime cancellatim sculpta, auricula antica magna, pallida, costis circiter 9 squamatis instructa, postica parva, costis 5–6 squamatis ornata; valva sinistra costis squamis numerosis brevibus; pagina interna alba nigro-fusco interruptim lineata.

Longit. 20 mm., alt. 23·5, diam. 7·5.

Hab.—Durban (McBean).

This species is separable from Ch. tinctus on account of its coarser and more equal ribs and the very different sculpture in the intervening grooves. This consists of a fine cross-hatching of crisscross striæ, in some places looking like the remains of a periostracum. The partial absence of scales upon the right valve is in some measure due to attrition.

* Pinna afra *Sowerby*.

Pinna afra *Sowerby*, 'Proc. Zool. Soc.,' 1835, p. 85.

Hab.—Cape of Good Hope.

Known only from the brief description.

* Pinna æquilatera *Martens*.

Pinna æquilatera *Martens*, 'Paetel's Cat.' (1890), 4th ed., Abt. iii, p. 208.

Hab.—"Afric. mer."

I have so far been unable to find any description of this species.

* Pinna natalensis n. sp. Pl. VIII, fig. 9.

Pinna madida *Sowerby* (*nec* Reeve), 'Marine Shells S. A.,' Appendix, p. 27.

Testa elongata, oblique triangularis, ad marginem ligamenti recta, vel leviter incurva, ad marginem ventralem apicem versus paulo incurva, deinde subexcurva, postice oblique arcuatim truncata, versus umbones pallida, viridi-albida, deinde fuscescens vel fumosa, costis radiantibus circiter 15, haud squamulatis, instructa, lineis incrementi tenuissimis sculpta; valvæ tenues, supra latus ventralem apicem versus oblique corrugatæ.

Longit. 155 mm., diam. obliqua max. 86, cross. 20.

Hab.—Durban.

Although somewhat resembling P. madida *Reeve*, I think this species may be separated. It is not quite of the same form, the ventral margin being less concave, the coloration is different, the costæ are more prominent, and the lines or lamellæ of growth are finer.

One of the two specimens at hand is more obliquely truncated posteriorly. The ribs in the other specimen are in certain lights of an obscure golden tint.

* Modiola tenerrima *Smith.*

Modiola tenerrima *Smith,* 'J. of Malac.,' vol. xi, p. 42, Pl. III, fig. 26.

Hab.—Port Alfred.

* Hochstetteria velaini *Smith.*

Hochstetteria velaini *Smith,* 'J. of Malac.,' vol. xi, p. 42, Pl. III, fig. 24.

Hab.—Port Alfred.

* Hochstetteria limoides *Smith.*

Hochstetteria limoides *Smith,* 'J. of Malac.,' vol. xi, p. 42, Pl. III, fig. 25.

Hab.—Port Alfred.

*Crenella striatissima *Sowerby.*

Crenella striatissima *Sowerby,* 'Marine Invest.,' vol. iv, p. 3, Pl. VI, fig. 1.

Hab.—Off Cape Colony, 56 and 100 fathoms.

*Arca (Scapharca) africana *Sowerby.*

Arca (Scapharca) africana *Sowerby,* 'Marine Invest.,' vol. iv, p. 4, Pl. VI, fig. 4.

Hab.—Off the mouth of the Tugela River, 46–55 fathoms.

*Limopsis pumilio *Smith.*

Limopsis pumilio *Smith,* 'J. of Malac.,' vol. xi, p. 43, Pl. III, figs. 27, 28.

Hab.—Port Alfred.

*Nucula sculpturata *Sowerby.*

Nucula sculpturata *Sowerby,* 'Marine Invest.,' vol. iv, p. 7, Pl. VI, fig. 11.

Hab.—Off Cape Colony, 34 fathoms.

*Nucula irregularis *Sowerby.*

Nucula irregularis *Sowerby,* 'Marine Invest.,' vol. iv, p. 7, Pl. VI, fig. 12.

Hab.—Off Struis Point, Cape Colony, 48 fathoms.

*Nuculana belcheri (*Hinds*).

Nuculana belcheri *Hinds,* Sowerby, 'Marine Invest.,' vol. iv, p. 4, Pl. VI, fig. 7.

Hab.—Off Cape Colony and Natal, 34–440 fathoms.

*Nuculana compta *Sowerby.*

Nuculana compta *Sowerby,* 'Marine Invest.,' vol. iv, p. 6, Pl. VI, fig. 10.

Hab.—Off Cape Natal, 440 fathoms.

*Nuculana gemmulata *Sowerby.*

Nuculana gemmulata *Sowerby,* 'Marine Invest.,' vol. iv, p. 6, Pl. VI, fig. 9.

Hab.—Off mouth of Tugela River, 37 fathoms; off Umvoti River, 27 fathoms.

*Nuculana lamellata *Sowerby.*

Nuculana lamellata *Sowerby,* 'Marine Invest.,' vol. iv, p. 5, pl. VI, fig. 8.

Hab.—Cape Natal, 54 and 85 fathoms.

* Cardita pulcherrima *Sowerby.*

Cardita pulcherrima *Sowerby,* 'Marine Invest.,' vol. iv, p. 7, Pl. VI, fig. 2.

Hab.—Off Cape Natal, 54 fathoms.

* Cardita (?) minima *Smith.*

Cardita (?) minima *Smith,* 'J. of Malac.,' vol. xi, p. 41, Pl. III, fig. 22.

Hab.—Port Alfred.

* Carditella laticosta *Smith.*

Carditella laticosta *Smith,* 'J. of Malac.,' vol. xi, p. 41, Pl. III, fig. 23.

Hab.—Port Alfred.

* Crassatella abrupta *Sowerby.*

Crassatella abrupta *Sowerby,* 'Marine Invest.,' vol. iv, p. 10, Pl. VI, fig. 15.

Hab.—Mouth of Umhloti River, 100 fathoms.

*Crassatella africana *Sowerby.*

Crassatella africana *Sowerby,* 'Marine Invest.,' vol. iv, p. 9, Pl. VI, fig. 13.

Hab.—Off Cape Infanta, 43 fathoms.

* Crassatella angulata *Sowerby.*

Crassatella angulata *Sowerby,* 'Marine Invest.,' vol. iv, p. 9, Pl. VI, fig. 16.

Hab.—Off mouth of Umhlangakulu River, 50 fathoms.

*Crassatella gilchristi *Sowerby.*

Crassatella gilchristi *Sowerby*, 'Marine Invest.,' vol. iv, p. 8, Pl. VI, fig. 14.

Hab.—Off Martha Point, 42 fathoms.

*Crassatella tenuis *Sowerby.*

Crassatella tenuis *Sowerby*, 'Marine Invest.,' vol. iv, p. 10, Pl. VI, fig. 17.

Hab.—Off Cape St. Blaize, 90 fathoms.

*Montacuta macandrewi (*Fischer*).

Kellia macandrewi, *Fischer*, 'J. de Conch.,' 1867, p. 194, Pl. IX, fig. 1; Smith, 'J. of Malac.,' vol. xi, p. 26 (as Montacuta).

Hab.—Port Alfred: Spain, and Faro, Portugal.

*Tellimya similis *Smith.*

Tellimya similis *Smith*, 'J. of Malac.,' vol. xi, p. 41, Pl. III, fig. 21.

Hab.—Port Alfred.

*Lepton fortidentatus *Smith.*

Lepton fortidentatus *Smith*, 'J. of Malac.,' vol. xi, p. 41, Pl. III, fig. 20.

Hab.—Port Alfred.

*Tridacna sp.

Hab.—Durban (McBean).

A young shell, probably belonging to T. elongata, was found at the above locality.

*Cardium gilchristi *Sowerby.*

Cardium gilchristi *Sowerby*, 'Marine Invest.,' vol. iv, p. 11, Pl. VII, fig. 1.

Hab.—Algoa Bay, 15 fathoms.

Venus (Timoclea) arakana *Nevill.*

Erroneously quoted by me ('Proc. Malac. Soc.,' vol. v, p. 397) as V. arakanensis.

*Venus (Anaitis) intersculpta *Sowerby.*

Venus (Anaitis) intersculpta *Sowerby,* 'Marine Invest.,' vol. iv, p. 11, Pl. VII, fig. 2.

Hab.—Off Algoa Bay, 10–16 fathoms.

Tapes corrugatus (*Gmelin*).

Tapes corrugatus *Deshayes*: Sowerby, 'Marine Shells S. Africa,' p. 59.

The author of this species was Gmelin, and not Deshayes as given by Reeve ('Conch. Icon.,' vol. xiv, sp. 72). Mr. Sowerby may have been misled by Reeve's mistake. It is curious that Deshayes has quoted this species ('Cat. Conchifera Brit. Mus.,' pp. 184, 185) both under the name corrugata *Gmelin* and obsoleta *Chemnitz,* both being founded on the same figure in the Conchylien-Cabinet.

Petricola robusta *Sowerby.*

With this species should be united P. typica Jonas.

*Donax madagascariensis *Wood.*

Donax madagascariensis *Wood*: Reeve, 'Conch. Icon.,' vol. viii, fig. 50; Pilsbry, 'Proc. Acad. Nat. Sci.,' Philad., 1901, vol. liii, p. 190.

Hab.—South Africa (Pilsbry); Madagascar, Mozambique.

This and the two following species are recorded by Mr. Pilsbry as occurring "in ballast from South Africa," a rather unsatisfactory locality.

*Donax erythræensis *Bertin.*

Donax erythræensis *Bertin,* 'Nouv. Arch. Mus.,' Paris (2), vol. iv, p. 99, Pl. III, figs. 7 *a–d*; Pilsbry, 'Proc. Acad. Nat. Sci.,' Philad., 1901, vol. liii, p. 190.

Hab.—South Africa (Pilsbry); Red Sea (Bertin).

* Donax spiculum *Reeve.*

Donax spiculum *Reeve*: 'Conch. Icon.,' vol. viii, figs. 67 *a, b*; Pilsbry, 'Proc. Acad. Nat. Sci.,' Philad., 1901, vol. liii, p. 190.

Hab.—South Africa (Pilsbry).

* Cultellus decipiens *Smith.*

Cultellus decipiens *Smith*, 'J. of Malac.,' vol. xi, p. 39.

Hab.—Port Alfred.

* Ervilia scaliola *Issel.* Pl. VIII, figs. 10, 11.

Ervilia scaliola *Issel*: 'Malac. Mar. Rosso,' 1869, p. 53, Pl. I, fig. 2.

Ervilia purpurea *Deshayes*: Sowerby, 'Marine Invest.,' vol. iv, p. 15.

Hab.—Buffalo River, two miles above the jetty (Sowerby).

E. purpurea, which is probably the same as Ervilia scaliola of Issel, does not appear to have been described. There are specimens in the British Museum from the Dahlac Archipelago, Red Sea, named by Deshayes Ervilia purpurea, but he did not, as far as I can ascertain, publish any description of them. They are elongate, inequilateral, narrower behind than in front, sharply rounded at both ends, brownish-purple, with two or three whitish rays, two down the middle of the valves, and sometimes a third at the posterior end. Valves moderately strong, sculptured with fine striæ of growth. Interior purplish-brown, obscurely rayed with white, especially at the ventral margin. Muscular scars moderately large, and the pallial sinus extending $\frac{5}{12}$ of the length of the shell from the posterior end.

Length 12·5 mm., height 7, diam. 4·25.

The shells described by Issel were very small, only 5 mm. in length, and were apparently of an uniform, pale-rose tint, without any colour rays. Their form, however, was exactly the same as that of the larger shells from the Dahlac Islands, so that I am inclined to believe that Issel's specimens from Suez were very young examples of the same species.

Loripes clausus (*Philippi*).

Loripes clausus *Philippi*: Smith, 'J. of Malac.,' vol. xi, p. 40.

Hab.—Port Alfred (Smith); Natal (Sowerby).

* Lucina despecta *Smith*.

Lucina despecta *Smith*: 'J. of Malac.,' vol. xi, p. 40.

Hab.—Port Alfred.

* Lucina valida *Smith*.

Lucina valida *Smith*, 'J. of Malac.,' vol. xi, p. 40, Pl. III, fig. 19.

Hab.—Port Alfred.

* Cryptodon investigatoris *Smith*.

Cryptodon investigatoris *Smith*: Sowerby, 'Marine Invest.,' vol. iv, p. 12.

Hab.—Off Cape Point, 800 fathoms.

* Tellina analogica *Sowerby*.

Tellina analogica *Sowerby*: 'Marine Invest.,' vol. iv, p. 12, Pl. VII, fig. 4.

Hab.—Off Saldanha Bay, 55 fathoms.

* Tellina gilchristi *Sowerby*.

Tellina gilchristi *Sowerby*: 'Marine Invest.,' vol. iv, p. 12, Pl. VII, fig. 3.

Hab.—Off Cape, 30–50 fath.

* Tellina regularis *Smith*.

Tellina regularis *Smith*, 'J. of Malac.,' vol. xi, p. 39, Pl. III, fig. 18.

Hab.—Port Alfred.

* Tellina vidalensis *Sowerby*.

Tellina vidalensis *Sowerby*, 'Marine Invest.,' vol. iv, p. 13, Pl. VII, fig. 5.

Hab.—Off Cape Vidal, 13 fathoms.

* Macoma africana (*Sowerby*).

Tellina (Macoma) africana *Sowerby*, 'Marine Invest.,' vol. iv, p. 14, Pl. VII, fig. 8.

Hab.—Algoa Bay, 16 fathoms.

* Macoma inclinata (*Sowerby*).

Tellina (Macoma) inclinata *Sowerby*, 'Marine Invest.,' vol. iv, p. 14, Pl. VII, fig. 9.

Hab.—Off mouth of Tugela River, 27 fathoms.

* Macoma levior (*Sowerby*).

Tellina (Macoma) levior *Sowerby*, 'Marine Invest.,' vol. iv, p. 13, Pl. VII, fig. 6.

Hab.—Off Amatikulu River, 26 fathoms, and off Tugela River, 25 fathoms.

* Macoma ordinaria (*Sowerby*).

Tellina (Macoma) ordinaria *Sowerby*, 'Marine Invest.,' vol. iv, p. 14, Pl. VII, fig. 7.

Hab.—Saldanha Bay, 10 fathoms.

* Theora ovalis *Smith*.

Theora ovalis *Smith*, 'J. of Malac.,' vol. xi, p. 39, Pl. III, fig. 17.

Hab.—Port Alfred.

* Semele capensis *Smith*.

Semele capensis *Smith*, 'J. of Malac.,' vol. xi, p. 39, Pl. III, figs. 15, 16.

Hab.—Port Alfred.

* Cuspidaria nasuta *Sowerby.*

Cuspidaria nasuta *Sowerby*, 'Marine Invest.,' vol. iv, p. 18, Pl. VII, fig. 14.
Hab.—Off Cape Point, 85 fathoms.

* Cuspidaria optima *Sowerby.*

Cuspidaria optima *Sowerby*, 'Marine Invest.,' vol. iv, p. 17, Pl. VII, fig. 16.
Hab.—Off Umtwalumi River, 50 fathoms.

* Cuspidaria (Cardiomya) forticostata *Sowerby.*

Cuspidaria (Cardiomya) forticostata *Sowerby*, 'Marine Invest.,' vol. iv, p. 18, Pl. VII, fig. 15.
Hab.—Off Cape Natal, 440 fathoms.

* Cuspidaria (Cardiomya) gilchristi *Sowerby.*

Cuspidaria (Cardiomya) gilchristi *Sowerby*, 'Marine Invest.,' vol. iv, p. 18, Pl. VII, fig. 17.
Hab.—Off Cape Natal, 85 fathoms.

* Poromya curta *Sowerby.*

Poromya curta *Sowerby*, 'Marine Invest.,' vol. iv, p. 17, Pl. VII, fig. 13.
Hab.—Off Cape Natal, 440 fath.

* Poromya gilchristi *Sowerby.*

Poromya gilchristi *Sowerby*, 'Marine Invest.,' vol. iv, p. 15, Pl. VII, fig. 10.
Hab.—Off mouth of Umtwalumi River, 50 fathoms.

* Poromya granosissima *Sowerby.*

Poromya granosissima *Sowerby*, 'Marine Invest.,' vol. iv, p. 16, Pl. VII, fig. 12.
Hab.—Cape Natal, 54 fathoms.

* Poromya striata *Sowerby.*

Poromya striata *Sowerby*, 'Marine Invest.,' vol. iv, p. 16, Pl. VII, fig. 11.

Hab.—Off False Bay, 166 fathoms.

EXPLANATIONS OF PLATES VII AND VIII,

Illustrating Mr. Edgar A. Smith's paper "On South African Marine Mollusca, with Descriptions of New Species."

PLATE VII.

Fig. 1.—Conus queketti n. sp.
Fig. 2.—Clionella confusa n. sp.
Fig. 3.—Drillia albotessellata n. sp.
Fig. 4.—Ancilla ordinaria n. sp.
Fig. 5.—Marginella shepstonensis n. sp.
Fig. 6.—Mitra punctostriata *A. Ad.*
Fig. 7.—Latirus burnupi n. sp.
Fig. 8.—Bullia ancillæformis n. sp.
Fig. 9.—Ocinebra natalensis n. sp.
Fig. 10.—Dolium fimbriatum, var. natalensis n. var.
Fig. 11.—Trifora cerea n. sp.
Fig. 11a.—Trifora cerea, sculpture magnified.
Fig. 12.—Trifora shepstonensis n. sp.
Fig. 12a.—Trifora shepstonensis, sculpture magnified.
Fig. 13.—Cerithiopsis insignis n. sp.
Fig. 14.—Cerithiopsis chapmaniana n. sp.
Fig. 15.—Rissoina durbanensis n. sp.
Fig. 16.—Rissoina shepstonensis n. sp.
Fig. 17.—Scala durbanensis n. sp.

PLATE VIII.

Fig. 1.—Scala eborea n. sp.
Fig. 2.—Mormula rissoina *A. Ad.*

FIG. 3.—Elusa natalensis n. sp.

FIG. 4.—Calliostoma bisculptum n. sp.

FIG. 5.—Euchelus natalensis n. sp.

FIG. 6.—Glyphis fuscocrenulata n. sp.

FIG. 7.—Chlamys natalensis n. sp., left valve.

FIG. 7A.—Chlamys natalensis, sculpture magnified.

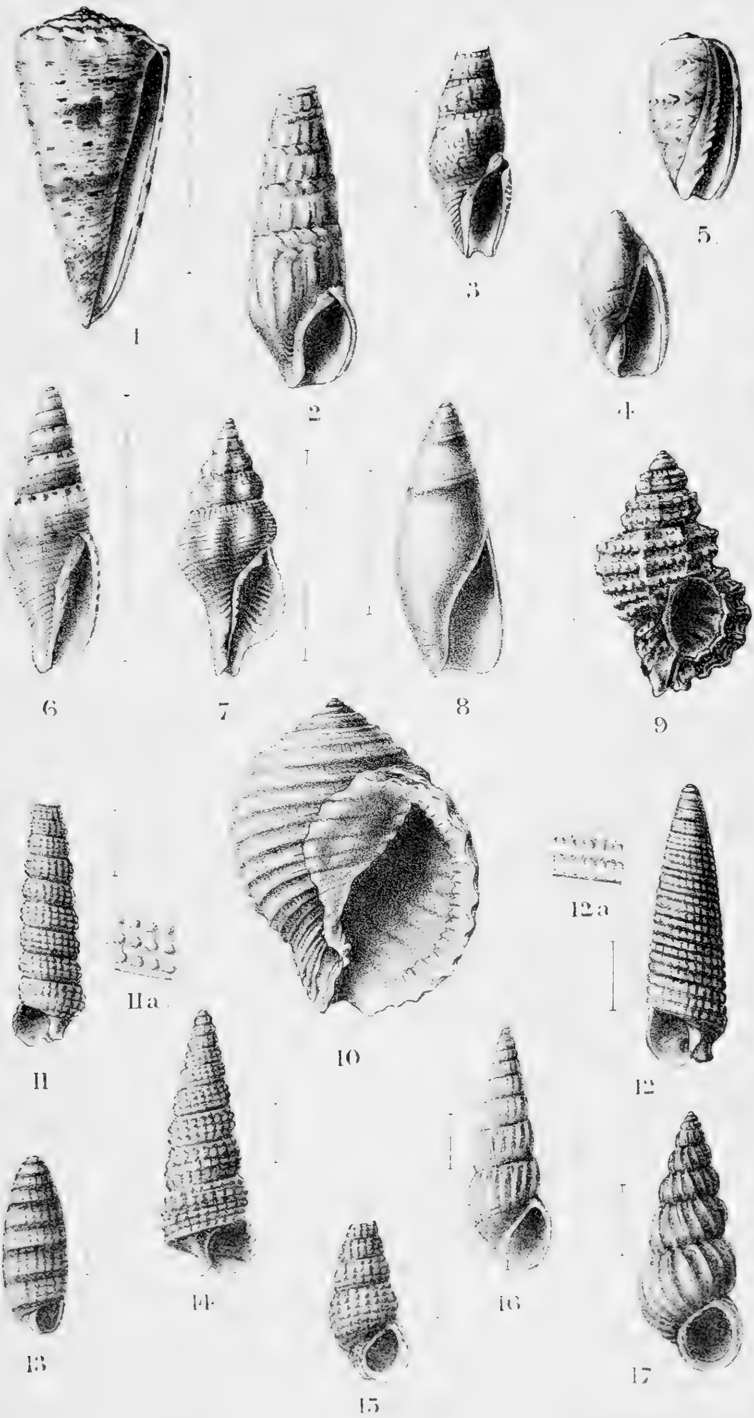
FIG. 8.—Chlamys natalensis, right valve.

FIG. 8A.—Chlamys natalensis, sculpture magnified.

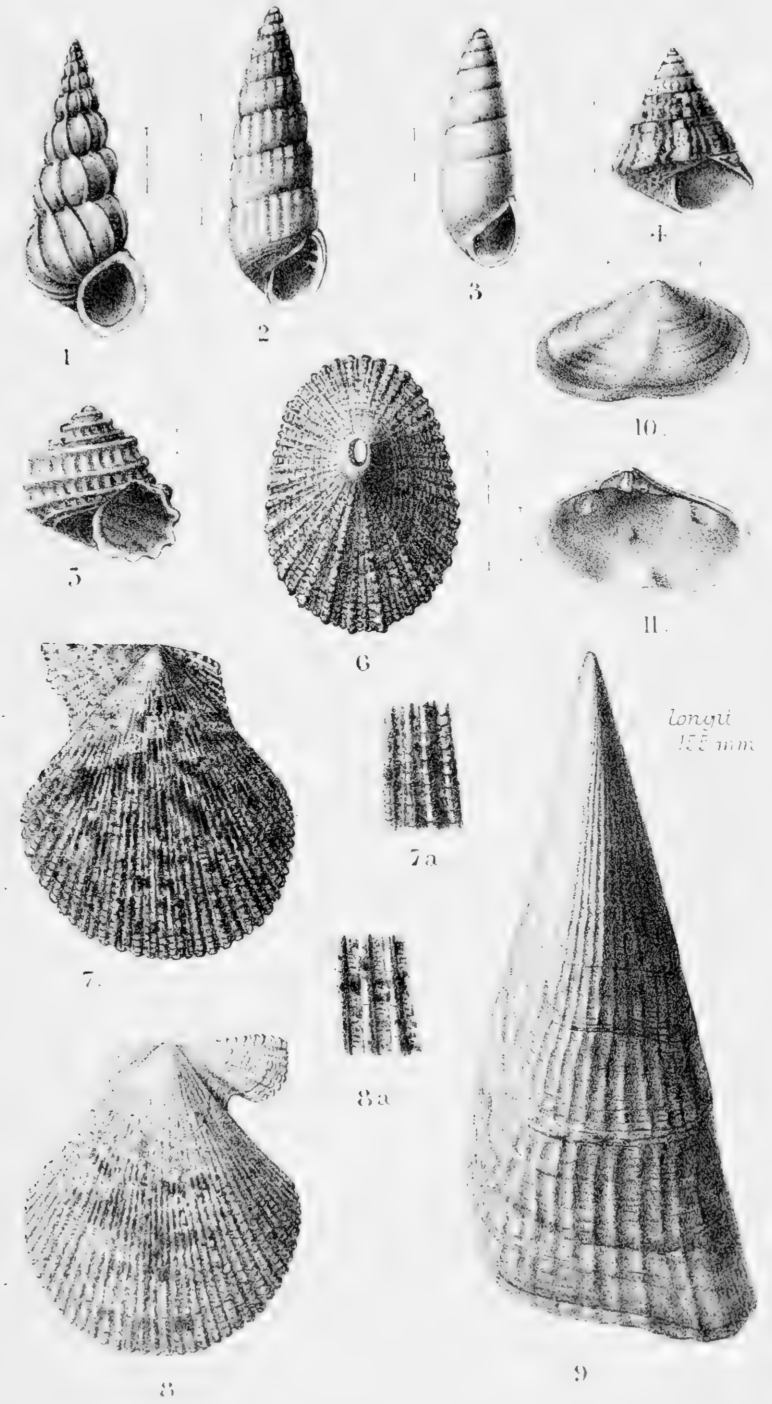
FIG. 9.—Pinna natalensis n. sp.

FIG. 10.—Ervilia scaliola *Issel.*

FIG. 11.—Ervilia scaliola, interior.



SOUTH AFRICAN MOLLUSCA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On Halocordyle cooperi sp. nov., a Hydroid from the Natal Coast.

By
Ernest Warren, D.Sc.Lond.,
Director of the Natal Government Museum.

With Plate IX.

The hydroid was found at Scottsburg, Natal, in the rock pools near low water. It occurs generally among the sea-weeds, etc., covering polychæt worm-tubes, especially old disused tubes, which often become much encrusted with many forms of plant life, sponges, tunicates, etc.

(1) Trophosome.—The trophosome possesses a creeping, branched hydrorhiza from which upright stems (fig. 1) arise. They may attain a height of 2 inches or more. The main stem curves gradually from base to summit, and is slightly zig-zag from right to left, where the lateral or primary branches are given off alternately in a regularly distichous manner. This condition of branching, as pointed out by Allman, is common in the Sertularians, but rare among the gymnoblastic hydroids. The hydranths are carried at the summits of the main stem and primary branches, and are also carried on secondary branches or ramuli, which are regularly disposed along the distal border of the primary branches (fig. 2).

The number and arrangement of the polyps on the upright stems approximate to the following plan :

Apex of Main Stem (one Terminal Polyp).

First right primary branch . .	1 polyp (terminal).
First left ,, ,, . .	2 polyps (last terminal).
Second right ,, ,, . .	3 ,, ,, ,,
Second left ,, ,, . .	3 ,, ,, ,,
Third right ,, ,, . .	4 ,, ,, ,,
Third left ,, ,, . .	5 ,, ,, ,,
Fourth right ,, ,, . .	5 ,, ,, ,,
Fourth left ,, ,, . .	6 ,, ,, ,,
Fifth right ,, ,, . .	6 ,, ,, ,,
Fifth left ,, ,, . .	6 ,, ,, ,,
Sixth right ,, ,, . .	6 ,, ,, ,,
Sixth left ,, ,, . .	5 ,, ,, ,,
Seventh right ,, ,, . .	5 ,, ,, ,,
Seventh left ,, ,, . .	5 ,, ,, ,,
Eighth right ,, ,, . .	5 ,, ,, ,,

A perisarc is well developed, and the main stem is annulated with four or five rings immediately above the origin of the primary branches. At the base, where the main stem arises from the hydrorhiza, there may be as many as twenty rings. Occasionally an internodal group of annulations may be found (fig. 2, *i. a.*).

The lateral or primary branches are annulated at their base, and also just in front of the origin of the secondary branches or ramuli bearing the polyps. There is considerable variation in the nature of the annulation; sometimes it consists of true rings, at other times it is a spiral ridge running three, four, or five times around the stem, and the spiral may be either a right-handed or a left-handed one. The secondary branches bearing the polyps are annulated towards their base. There can be little doubt that a mechanical principle is involved in the presence of these annulations, and that they strengthen the stem, for they appear just in those places where there is most strain.

The perisarc is of considerable thickness. It is nearly black over the main stem and greater part of the primary branches; but it becomes pale brown towards the extremities, and over the secondary branches bearing the polyps it is very transparent and thin.

Polyp is flask-shaped; its average height from base to summit is 0·844 mm. The endoderm of the swollen basal portion is red in the living condition. There are two kinds of tentacles:

(1) A single whorl of basal filiform tentacles; the typical number appears to be eight, although there may be nine or ten.

(2) Typically there appear to be two whorls or verticils of capitate tentacles, with four in each whorl; but there is variation in this arrangement. The tentacles of the two whorls are arranged alternately, and they are inserted on the sides of the hypostome. The swollen extremities of the capitate tentacles are provided with very large nematocysts, 0·0387 mm. in length and 0·017 mm. in breadth; while the filiform tentacles and the general ectoderm of the polyp have nematocysts, about 0·0112 mm. in length and 0·0054 mm. in breadth, but they are far more variable in size than the large nematocysts, and perhaps there are several kinds.

In Pennaria cavolinii *Ehren.* Allman describes the filiform tentacles as being slightly swollen at their extremities; such does not appear to be always the case in H. cooperi.

In the fully expanded condition the mouth is large and funnel-shaped.

(2) Histology.—Ectoderm: The ectoderm is of the usual type, and contains, as we have seen, two kinds of nematocysts. The nematocysts appear to be confined to the ectoderm, as I have been unable to find any in the endoderm; although in the hydroid Tubularia solitaria, which is also described in this journal, nematocysts are exceedingly abundant in the inner layer.

The large nematocysts are mostly confined to the swollen extremities of the capitate tentacles (fig. 6, *l. n.*), although I have occasionally found them in the ectoderm of the cœnosarc. The small nematocysts occur on the capitate tentacles and generally throughout the ectoderm.

At the base of the hydranth the perisarc terminates in a well-defined groove (fig. 6, *p. g.*), which is lined by a special epithelium of granular cells. This groove is the remnant of the chitin-secreting zone of ectoderm at the growing point. It is from such a groove, or zone, that the perisarc is secreted at the growing apices of stem, branches, or hydrorhiza.

Fig. 7 is a vertical section through the growing apex of a branch of the hydrorhiza, and the zone of ectoderm marked *p. s. e.* is seen to be densely granular, and it is here that the perisarc is secreted. I do not believe that the ordinary ectoderm below (*o. e.*) takes any part in the production of the perisarc (*p.*). The apical portion of the growing branch is naked (*n. l.*).

Endoderm.—The hypostome is lined by a regular columnar epithelium, between the cells of which are wedged small, vacuolated, and apparently glandular cells (fig. 6, *v. c.*). They stain deeply with hæmatoxylin, and consequently stand out sharply from the surrounding columnar epithelium.

Below the region of the hypostome the endoderm consists of elongated, more or less amœboid cells, with vacuoles. Between these, sometimes in clusters and sometimes solitary, are inserted large, irregularly-shaped, glandular cells (fig. 6, *g. e. c.*), with large nuclei, and the cytoplasm is densely crowded with large granules, which blacken with osmic acid. These densely granular cells occur throughout the endoderm of the general cœnosarc.

At the base of the polyp the endoderm cells are taller and constitute a more regular epithelium (fig. 6, *b. c.*); towards their base, inserted on the mesoglea, the cells contain very large vacuoles. Often in this region the endoderm does not consist of a single layer of cells. A sheet of smaller, more rounded cells, with denser protoplasm, may cover a considerable area of the tall columnar epithelium at the base of the polyp (fig. 6, *c. e. c.*).

The endoderm of the filiform tentacles is of the usual septate character. In the capitate tentacles the endoderm scarcely enters the "head."

The chief food of the hydroid appears to be copepods. As far as could be ascertained from my sections, digestion takes place solely in the digestive cavity, the pieces of food never being found in the epithelium. In some sections recently cut of an Eudendrium, which feeds on similar organisms, the separate eggs of the egg-clusters of the devoured copepods are seen to have been taken bodily into the endodermal epithelium.

(3) Gonosome.—The female gonophore is long and ovate. In P. cavolinii it is phanerocodonic, but in the present species I have never found the umbrella cavity open to the exterior, and it is therefore probably adelocodonic. The hydroid is far from common, and consequently I have not had an unlimited supply of material. Unfortunately, I have not seen a gonophore empty of its contents, but I think there can be little doubt that it is adelocodonic. The section of an apparently ripe gonophore (fig. 4) gives no impression of any further development. The gonophores arise from the base of the polyp just above the verticil of filiform tentacles. There are four radial canals, but no circular canal. The radial canals are not connected together by an endodermal lamella (fig. 5). The umbrella cavity is lined externally by a definite ectodermal epithelium (*e. e*). Apically the radial canals slightly expand, and contain a deeply staining gelatinous (?) mass (fig. 4, *g. m*), which is probably of the nature of a basal bulb. No rudiment of ocellus has been detected. The spadix is well developed, and is covered with germinal epithelium four or five layers thick.

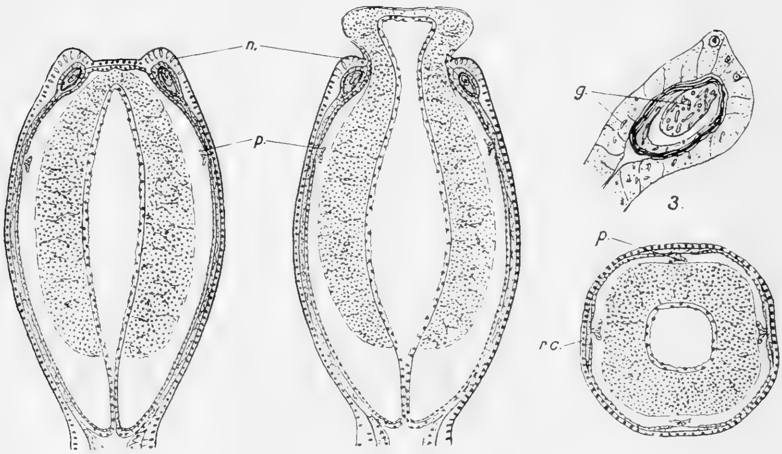
The germinal epithelium arises in situ as a thickening of the ectoderm of the young gonophore bud (fig. 4, *e. u*). I have been unable to observe any migration or wandering of sexual cells.

Since the above paragraph was written I have obtained specimens of the male colony, which appears to be much scarcer than the female. Out of some thirty colonies collected eight were females, two were male, and the remainder were undetermined as they were not producing gonophores.

In one of the male colonies examined the filiform tentacles of the polyps were distinctly swollen at their extremities; but there appeared to be no increase in the development of the nematocysts, and I am not inclined to regard the condition as of any special significance.

The average length of a mature male gonophore is 0·84 mm. and breadth 0·60 mm. The female gonophores examined were not quite mature, but it is probable that they are slightly smaller.

The male gonophore is provided with four tentacular knobs



bearing large nematocysts. There is no circular canal. The blind ends of the radial canals are occupied by a gelatinous, deeply-staining mass which shows concentric lamination, and is crowded with irregularly-shaped, somewhat refringent, bodies (text-figure 3, *g*), which are probably the granules giving the endoderm its scarlet colour during life. The general ectoderm of the radial canals, etc., contains such granules, but they are not present in great abundance. In the distal portion of the radial canals of the female gonophore there is a special middle strip of swollen cells both in the inner and outer layer of the canal, and here, also, the granules are more abundant than elsewhere.

The male gonophore is adelocodonic, there being no opening to the umbrella cavity.

The male gonophore is characterised by the presence of four little papillæ of ectoderm projecting into the umbrella cavity (text-figures 1 and 2, *p*). They arise opposite the fourth radial canals (fig. 4) towards the upper end of the gonophore. It may be noticed that the flat layer of ectoderm lining the umbrella cavity thins off and apparently disappears around the base of the mushroom-shaped papilla. It is not possible, at present, to suggest any function or meaning to these very curious structures. They consist of elongated ectoderm cells with fairly conspicuous nuclei. They have not been found in the female gonophore, but they occur in all the mature male gonophores that have been examined. I am not aware that similar structures have been recorded in other gonophores or medusæ. Their position on the radial canals recalls the gonads of calyptoblastic medusæ.

The male gonophore dehisces by the expansion of the endodermal spadix, which forces its way through the distal extremity of the gonophore (fig. 2).

(4) Systematic position.—The present species differs from P. cavolinii *Ehren*, and P. gibbosa *Agass*, and agrees with Halocordyle tiarella (*Ayres*), from the Atlantic shores of North America, in that the capitate tentacles tend to be arranged in whorls instead of being irregularly scattered. It is very interesting, however, to note that this verticillate character seems to be on the point of being acquired. In several colonies collected, which appear to differ in no other character, I have found great irregularity in the disposition of the capitate tentacles. In these colonies some of the polyps may have a distinct distal verticil of four capitate tentacles, while below these there are scattered seven or eight capitate tentacles with no obvious arrangement. In a very few of the polyps some twelve capitate tentacles are irregularly scattered, and even the distal verticil is indistinguishable. It is important to notice that this tendency to vary in the arrangement of the tentacles concerns the colony as a whole,

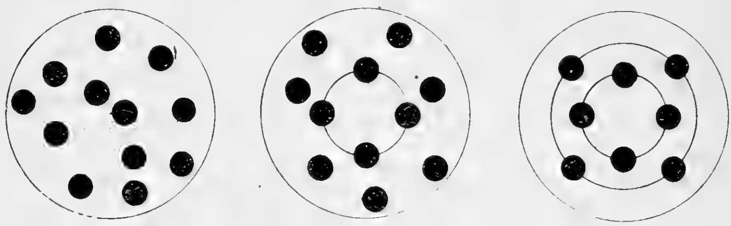
and it is not merely an individual polyp variation. Thus, all the polyps of a colony tend to have the capitate tentacles in whorls, or all tend to be irregular in the character.

In the accompanying diagram a view from above is supposed to be taken. The circles are the "heads" of the tentacles. Three distinct stages may be observed:

In fig. 1 some twelve tentacles are irregularly scattered.

In fig. 2 the distal verticil of four is acquired, and these are joined together by a circle as in a floral diagram.

In fig. 3 the number of tentacles is reduced to eight, and they are arranged in two whorls in the typical manner.



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If more material comes to hand, a statistical investigation with respect to this matter will be made.

The present species also agrees with Halocordyle tiarella, in that the gonophores arise above the whorl of filiform tentacles and not in the verticil.

It differs from Halocordyle tiarella and from Pennaria in that the gonophores are adelocodonic, and no processes representing marginal tentacles on the umbrella were found in the female gonophore.

The species Halocodyle cooperi is named after my friend Mr. Arnold Cooper, who was shore-collecting with me at the time it was discovered.

EXPLANATION OF PLATE IX,

Illustrating Dr. Ernest Warren's paper "On Halocordyle cooperi sp. nov., a Hydroid from the Natal Coast."

Fig. 1.—H. cooperi; natural size, showing three main stems arising from the branched hydrorhiza.

Fig. 2.—× 7. Small portion of frond, with an internodal group of annulations (*i. a.*).

Fig. 3.—× 15. Primary branch with hydranths bearing female gonophores, arising just above the verticil of filiform tentacles. The capitate tentacles are in two alternating whorls.

Fig. 4.—× 50. Female gonophores in longitudinal section in various stages of development. *e. u.* is the ectoderm from which the generative epithelium and ectoderm lining umbrella cavity originate.

Fig. 5.—× 50. Female gonophore in transverse section, showing absence of endodermal lamella between the radial canals.

Fig. 6.—× 75. Longitudinal section of hydranth, showing its general histological character and the perisarc-groove (*p. g.*).

Fig. 7.—× 75. Growing point of hydrorhiza, showing the epithelium secreting the perisarc (*p. s. e.*), and the naked terminal portion of cœnosarc (*n. c.*).

Explanation of Reference Letters.

b. c. Cells of basal endodermal epithelium. *c. e. c.* Covering endodermal cells. *c. m.* Closed mouth. *d. c.* Digestive cavity. *e.* Endoderm. *e. u.* Ectoderm of umbrella (including germinal epithelium) in gonophore bud. *e. e.* External ectoderm of umbrella cavity. *g. e.* Generative epithelium. *g. e. c.* Glandular endodermal cells. *g. m.* Gelatinous mass (?) at termination of radial canal. *h. e.* Hypostomal endoderm. *i. a.* Internodal annulation. *l. n.* Large nematocyst. *m.* Mouth. *m. s.* Main stem. *n. c.* Naked cœnosarc. *o. e.* Ordinary ectoderm. *o. m.* Open funnel-shaped mouth. *p. b.* Primary branch. *p.* Perisarc. *p. g.* Perisarc-groove. *p. s. e.* Perisarc-secreting ectoderm. *r.* Ramulus or secondary branch. *r. c.* Radial canal. *s.* Spadix or manubrium. *s. e.* Septate endoderm of tentacle. *s. n.* Small nematocyst. *u. c.* Umbrella cavity. *v. c.* Vacuolated deeply staining cells of hypostome and basal epithelium.

Warren, del.

Huth, Lith. London.

On Tubularia solitaria sp. nov., a Hydroid from the Natal Coast.

By
Ernest Warren, D.Sc.Lond.,
Director of the Natal Government Museum.

With Plates X and XI.

This hydroid has been collected at several places along the Natal Coast. It is solitary in habit, and I have only found it attached to sponges. The species of sponge is not a matter of indifference; for, although a certain siliceous scarlet sponge is exceedingly common on this coast, yet I have never found the hydroid attached to it. I have only discovered it on a certain siliceous dark maroon coloured sponge and on a siliceous white sponge. The hydroid occurs between the tide marks, and is imbedded in sponges covering the surfaces of rocks which happen to be somewhat protected from the violence of the waves. The individual hydroids may generally be seen in clumps irregularly scattered, and spreading over a considerable area of sponge.

Trophosome.—The hydroid varies in height, but its maximum length projecting beyond the general surface of the sponge is about half an inch (Pl. X, figs. 1 and 2). It may be seen by the naked eye that the endoderm of the hydranth and of the gonophores is of a beautiful rose-red colour, while the tentacles and the hydrocaulus are translucent and whitish. The hydroid is fixed to a considerable depth in the substance of the sponge by a branching root or hydrorhiza (figs. 3 and 4).

Around the mouth is a ring of oral or distal tentacles sixteen to twenty-one in number. These originate in as many prominent ridges which run down the hypostome. It is as if the tentacles spring from the sides of the hypostome and adhere to it, becoming free around the mouth.

The hydranth is somewhat expanded towards the base, and from this region there arises a single verticil of basal or proximal tentacles about sixteen to twenty-one in number.

The gonophores arise in small clusters from short semi-erect peduncles, which spring from the body of the hydranth just above the verticil of basal tentacles (fig. 4). In each cluster there are three or four gonophores.

Both male and female gonophores are produced by the same hydranth; but as far as I have observed they are invariably formed on distinct peduncles. This fact favours the view of regarding the peduncles as blastostyles which are either male or female.

The hydrocaulus is covered by a thin, soft perisarc covering, which commences in the perisarc-groove situated just below the attachment of the hydranth (fig. 5 *p. g.*). As the hydrocaulus elongates the perisarc substance is secreted by the epithelium of the groove. The softness of the perisarc differentiates the present species from the typical tubularia.

The area of attachment of the hydranth and hydrocaulus is small, and under certain conditions the hydranth appears to become decrepit and withers or drops off. The blind end (fig. 3 *a, b*) of the hydrocaulus can, without doubt, produce another hydranth. I have not, however, been fortunate enough to find a specimen in which such re-formation of the hydranth was taking place; but in specimens in which the hydranth is withering it seems certain that the life of the individual is not drawing to a close, for at the same time it may possess rich supplies of food-material stored up in the hydrorhiza (fig. 4 *t*).

The basal end of the hydrocaulus is imbedded in the sponge to a quite variable extent. At least half of the stem (fig. 3) is usually below the surface. At the base of the imbedded hydrocaulus is the hydrorhiza, and from it may be given out branches of two kinds: (1) thin rootlets which penetrate into the substance of the sponge and fix the hydroid in its bed (fig. 4, *r*); (2) thickened fleshy structures (fig. 4, *t*) in which apparently nutritive substances are stored in the endoderm in a manner recalling the storage of carbohydrates, etc., in the tubers of a plant. These thickened branches are of a characteristic yellow colour in preserved specimens. In some individuals no special "tubers" are formed, but the hydrorhiza as a whole expands and takes on the function (fig. 3; 2 and 4).

The apices of the rootlets are swollen into a sort of cap (fig. 3, *a*); this appearance, recalling the root-cap of a plant, is due to a marked thickening in the ectoderm at the apex.

(2) Histology.—The ectoderm of the hydroid is of typical structure; but the endoderm shows much differentiation and is highly specialised.

Both large and small nematocysts occur in the ectoderm, and the endoderm is richly supplied with the large variety (figs. 8 and 10, *l. n.*). The large nematocysts are nearly spherical in shape; their average size in spirit specimens is 12·1 μ in length and 11·6 μ in breadth. The small nematocysts are probably of several kinds, as they tend to vary considerably in size and shape; their average size is 6·24 μ in length and 4·6 μ in breadth.

Fig. 5 is a vertical median section of the hydranth and upper part of hydrocaulus. The oral or distal tentacles (*o. t.*) adhere to the sides of the hypostome, and the ectoderm is, so to speak, squeezed out between the endoderm of the tentacle and that of the hypostome, and only a thin layer of mesoglea remains (fig. 8, *mes.*). The endoderm of the oral tentacles is not regularly septate in character. The endoderm of the hypostome is markedly ridged, so that in transverse section (fig. 11, *e. r.*) eight to ten prominent projections may be seen. These ridges hang down into the digestive cavity of the hydranth as conspicuous lobes (*s.w.*). The endoderm of the hypostome is supplied with the usual deeply-staining secretory cells (figs. 5, 7, 8 *s. c.*). The tall endoderm cells are not amœboid to any extent.

Below the hypotome we pass into the digestive cavity (fig. 5, *d. c.*). Here the ordinary endoderm cells are exceedingly amœboid, and are of very irregular outline (*a. e.*). Wedged between the ordinary cells are special digestive or gland cells (*g. l.*) which stain intensely with hæmatoxylin and other stains; also large cnidoblast cells are fairly abundant. At the expanded basal region of the hydranth the endoderm is markedly differentiated into three layers: (1), a covering layer of somewhat short amœboid cells (*b. ep.*) and gland cells (fig. 5 *a*, *gl. c.*) which are separated by a kind of basement membrane or mesoglea from (2), a middle-thick layer of highly vacuolated cells (*r. ed.*) and (3), smaller less vacuolated cells which lie in immediate contact with the mesoglea (*b. ed.*).

The covering layer of amœboid cells marked *b. ep.* is shown enlarged in fig. 5 *a*, and it is especially characterised by containing in greater abundance than the rest of the endoderm large granular masses enclosed in vacuoles (*pr.*). These masses appear to escape from the cells and pass down into the hydrocaulus, where a couple may be seen, marked *pr.*, in fig. 5. I suggest that these bodies are to be regarded as masses of worked-up food material which are being distributed to different parts of the hydroid.

An open channel leads from the digestive cavity of the hydranth into the cœlenteron of the hydrocaulus (fig. 5, *c. ch.*). The upper portion of this channel is narrow, and is lined by small amœboid endoderm cells continuous with the layer of covering cells on the floor of the digestive cavity (see fig. 12, *c. e. p.*). As the passage approaches the diaphragm (fig. 5, *d*) it greatly expands and is lined by long, flat, non-amœboid cells. The passage is greatly constricted as it passes through the small aperture of the diaphragm.

The basal or proximal tentacles arise from the margin of the basal expansion of the hydranth (figs. 5 and 12, *b. t.*). The endoderm of the tentacles is continuous with the middle layer of the endoderm of the polyp (*r. ed.*). It is far from regularly septate in character, although it approaches this condition more closely than in the case of the distal tentacles.

The mesoglea projects inwards between the hydrocaulus and the hydranth, forming a kind of diaphragm, and leaves open only a small pore of communication (fig. 5, *d.*). The possession of this diaphragm is perhaps associated with the habit of renewing the hydranth. The wound resulting from the casting off of the old hydranth would be reduced to a minimum, and healing could very rapidly be effected.

Immediately below the hydranth can be seen the perisarc groove (fig. 5, *p. g.*). An enlarged view is shown in fig. 6. The secretory cells (*p. s. c.*) are richly granular, and towards the free surface the perisarc substance can be observed to run in for some little distance between them. The perisarc groove is shown in horizontal section in fig. 13.

The modification of the endoderm in the hydrocaulus is considerable. In the middle region a longitudinal banding, due to the presence of endodermal canals, can readily be seen in the preserved specimen (fig. 4). This banding is more conspicuous in the living animal, and can be traced up to the hydranth, in the immediate neighbourhood of which they become closely applied to each other.

Fig. 10 is a transverse section of the middle region, showing in this case sixteen endodermal canals. A reticulum of fine branching endoderm cells with large nematocysts occupies the greater part of the cœlenteron. An enlarged view of a couple of canals is seen in fig. 15. Each canal consists of an outer wall of regular columnar epithelium on which no cilia could be detected with certainty. The inner surface of this epithelium is concave, and the canal is completed by branching cells (*c. c.*) forming a thin roof.

These canals anastomose to some extent, and at the upper end of the hydrocaulus they fuse into some nine to twelve canals. At some little distance below the diaphragm the cavity of the canals, roofed over by thin branching cells, expands considerably, and in the region of the perisarc groove these coverings of thin cells come into close contact and constitute some nine to twelve radial septa (fig. 13, *v. s.*). The cells in contact with the mesoglea do not appear columnar in fig. 13 *ed.* owing to the fact that the cells, hanging down from the diaphragm (fig. 5 *ed.*), are cut obliquely. The endodermal canals (*e. c.*) open into the vesicular endoderm of the hydranth by irregular channels, which pass round the edge of the diaphragm-pore (fig. 5, *o. e. c.*). Bodies similar to those seen in the endoderm cells of the floor of the hydranth (figs. 5 and 5 *a, pr.*) can be observed in the hydrocaulus (fig. 13, *g. m.*, and fig. 5, *pr.*).

The endodermal canals probably serve to convey nutritive fluids. It must be remarked that cilia were not clearly seen on the columnar cells, although the specimens were carefully fixed.[1] The general histological condition of the sections was very good. I believe, however, that cilia or flagella are present, which are of too delicate a nature to remain clearly visible after the ordinary processes of fixation and imbedding, etc. In some of the specimens examined the columnar cells of the endodermal canals contained a considerable number of globules similar to those which are so abundant in the endoderm of the tuber-like expansions of the hydrorhiza. Towards the base of the hydrocaulus the endodermal canals gradually fuse together and constitute a regular layer of columnar epithelium, and the canals, as such, disappear. As the tuber-like expansions are approached, the endoderm cells become taller and more crowded with globules. Fig. 16 is a small piece of a transverse section of a tuber. Here the endoderm is so tall that the lumen of the tuber is almost obliterated. The cells are densely crowded with fairly large globules of a wonderfully uniform size. The globules appear perfectly homogeneous, and without doubt consist of reserve food material.

[1] Fixation was accomplished by (1), Flemming's solution, six hours; (2), half concentrated corrosive sublimate in 30 per cent. spirit and $1\frac{1}{2}$ per cent. acetic acid, applied hot.

I regard the canals as being for the purpose of conveying down to the tuber nutritive fluids, which are elaborated by the endoderm cells into the globules so abundantly stored up in the tuber.

The ectoderm below the perisarc groove is of considerable thickness. In several specimens which were sectioned, but not in all, the ectoderm, especially in this region, was crowded with large granular bodies (fig. 14, *g. m.*), which stain with much intensity with hæmatoxylin. The bodies were of irregular shape, and some of them, especially those in the neighbourhood of the mesoglea, were apparently in the condition of breaking up into small granules. These bodies stain similarly, and have quite the same aspect as the bodies marked *g. m.* in fig. 13, or *pr.* in fig. 5. I consider it probable that active growth was taking place in this region, and that the bodies in question are coagulated albumens or some other substances, which had been passed out through the mesoglea into the ectoderm.

In the ectoderm of the hydrorhiza and the tubers the wedge-shaped cells are characterised by being finely granular in nature, and in this respect they resemble the cells forming the perisarc groove (fig. 16). It is probable that these cells still retain their power of secreting perisarc substances.

It would be interesting to ascertain whether there is any symbiotic or parasitic interaction between the hydroid and the sponge further than the mechanical support rendered by the latter to the former. The sponge appears to attempt to shut itself off as much as possible from the hydroid; the tissues of the sponge in the immediate neighbourhood of the hydroid are denser and more fibrous than further in, thus forming a kind of cyst-wall (fig. 16 *s. p.*).

(3) Gonosome.—The gonophores spring in clumps of three to five from short semi-erect peduncles (or blastostyles) (fig. 5 *ped.*), which arise from the hydranth just above the verticil of basal tentacles. A gonophore originates as a swelling or out-pushing from the peduncle. The ectoderm at the apex of the swelling thickens, and the endoderm grows

up around it. This thickening of ectoderm will produce the ectoderm-lining to the umbrella cavity and the germinal tissue. I have not observed any migration or wandering of the sexual elements. As we have already seen, male and female gonophores are invariably produced on distinct peduncles, but both kinds of peduncles occur on the same hydranth. In a transverse section of a mature gonophore (fig. 9) we find—(1) the outer ectoderm; (2) two thin layers of endoderm with no development of radial canals; (3) a thin layer of ectoderm, which is the outer ectodermal wall of the umbrella cavity; (4) umbrella cavity, which is mostly occupied by (5), germinal tissue covering (6), manubrium or spadix.

When the gonophore is mature the umbrella cavity opens to the exterior by a small apical aperture (fig. 19, *o*), and it is probable that fertilisation takes place through this opening. No rudiments of umbrella tentacles in the form of processes or knobs are produced. Thus, with the exception of the small aperture to the exterior, the gonophore may be called adelocodonic, since no radial canals and no marginal tentacles are formed.

Among the clumps of gonophores one frequently meets with abortive or semi-abortive specimens (fig. 18). These abortive gonophores appear to be almost invariably the terminal gonophore of the peduncle, although it must be remembered that the terminal gonophore is not always abortive. The terminal gonophore of a peduncle differs from the laterals in (1) the great thickness of the mesoglea, and in this it agrees with that of the peduncle; (2) the great thickness of the outer ectoderm. These two differences can be picked out at once in the sections, and are shown in the comparison of an abortive and normal gonophore in fig. 18.

An abortive gonophore, male or female, tends to be about one half or two thirds of the size of a normal gonophore. The endoderm of the spadix is relatively larger than in a normal gonophore, and contains swollen nuclei. The umbrella cavity is completely filled with a tissue of small stringy ectoderm-cells continuous with a thick layer of ectoderm on the outside of the gonophore.

In the fibrous mass of ectoderm (*e. a. u.*) there can occasionally be distinguished one or more small rounded cells (*a. o.*); these can be regarded as abortive ova.

Abortive female gonophores of this nature are absolutely sterile; but in the case of male gonophores the sterility may not be complete. In the semi-abortive male gonophores a variable number of ripe spermatozoa may be found scattered amongst the fibrous or stringy ectoderm filling the umbrella cavity.

This difference in structure and the very frequent abortion or semi-abortion of the terminal gonophore are remarkable; but before any safe conclusions can be arrived at a comparison must be made with other hydroids which bear gonophores on peduncles or blastostyles.

(4) Formation of the actinula.—I have only made a few observations in connection with the development of the actinula. Among the ripe female gonophores one can find cases in which the ova are apparently fusing together (fig. 20, *g. e. m.*). This may almost certainly be regarded as the ingestion of ova by some one or more fertilised eggs. It may be noticed that in fig. 20 the germinal epithelium has slightly extruded itself through the opening of the umbrella, and it is from this point, where fertilisation would readily occur, that the ingestion of ova is taking place.

Fig. 21 represents the youngest condition found. Here I cannot say with certainty which is the fertilised nucleus; it is quite possible that the enlarged swollen nuclei sn_1 and sn_2 may both be fertilised nuclei, as it is extremely probable that a considerable number of the ova would be fertilised. The reason for regarding these nuclei as distinct from the others may be explained by reference to fig. 25. The ingested ova (*i. o.*) can be seen, but the remarkably swollen condition of the nucleus (fig. 21) is not apparent. The germinal epithelium is ultimately fused into one or two masses, according to whether one or two actinulæ will ultimately be developed in the gonophore. Whether fertilised or unfertilised, the ova of the germinal epithelium fuse, in the majority of cases, into a single egg-mass (fig. 22); but occasionally there are two such masses. In a densely granular mass, with nuclei in all stages of disintegration (fig. 25), I have been unable to distinguish with certainty the first segmentation nucleus. The nearest approach is seen in fig. 22, where the egg-mass contains about four nuclei, one of which is shown in a state of division (*dy.*). Towards the centre the egg-mass consists of vacuolated protoplasm, with a number of large yolk masses and granules; towards the periphery the protoplasm is dense and finely granular and there are no vacuoles. The nuclei are contained in this outer, denser portion. On the formation of the egg-mass the manubrium shrinks considerably (figs. 22–24). Fig. 26 is an enlarged piece of an egg-mass, similar to that in fig. 22, and containing some four or six nuclei. The nucleus (*n.*) is surrounded by a clear area, and is characterised by staining exceedingly faintly, owing to the small amount of chromatin it contains. The nucleus consists of a delicate nuclear membrane and a fine reticulum of chromatin.

The egg-mass secretes a firm egg-membrane (fig. 26, *e. m.*). In fig. 23 the embryo has developed further, and it is often remarkably irregular in shape. At this period it consists of some eighteen to twenty blastomeres, which are not separable from one another by cell-outlines nor from the central vacuolated mass containing innumerable granules and yolk-masses.

The material at my disposal has not permitted further observations on the development of the actinula.

In fig. 17 is represented a gonophore containing an actinula. Such is shown in section in fig. 24. The remainder of the yolk-spheres are contained in the endoderm. The number of tentacles varies from about nine to twelve, although ten seems to be the typical number.

It is probable that these tentacles correspond to the basal or proximal tentacles of the hydranth. The actinula in fig. 17 has every appearance of being ready to emerge from the gonophore, but I have not found a mouth or oral tentacles developed in any of the specimens. In fig. 24 the part of the actinula next to the manubrium will probably be the portion which will elongate and form the hydrocaulus; the opposite pole would then be the future oral pole.

(5) Systematic position.—The present species is somewhat intermediate in its characters between the genera Corymorpha and Tubularia, but the occurrence of an actinula seems sufficient to place it in the genus Tubularia.

It agrees with Corymorpha in the following characters:

(1) Solitary hydrocaulus.

(2) The softness of the perisarc.

(3) The base of hydranth occupied by differentiated layers of endoderm.

(4) The arrangement of the endodermal canals approaches the condition seen in Corymorpha rather than in Tubularia.

It agrees with Tubularia in the following:

(1) Occurrence of an actinula.

(2) No papilliform or filamentary appendages at the proximal end of hydrocaulus.

(3) The comparative fewness of the oral or distal tentacles—sixteen to twenty-one instead of about eighty, as in Corymorpha.

(4) Pendulous endodermal lobes hanging down from hypostome.

(5) The number of basal or proximal tentacles—sixteen to twenty-one.

(6) The shape of the nematocysts.

On the whole it may be considered that in the trophosome it is closely related with Corymorpha, and in the gonosome with Tubularia; however, the presence of an actinula is so characteristic of Tubularia that I have considered it advisable not to found a new genus for the reception of the present species.

EXPLANATION OF PLATES X AND XI,

Illustrating Dr. Ernest Warren's paper "On Tubularia solitaria sp. nov., a Hydroid from the Natal Coast."

Fig. 1.—Natural size. A group of hydroids attached to a white siliceous sponge.

Fig. 2.—× 5. Somewhat enlarged view of a specimen attached to sponge.

Fig. 3.—× 5. Six specimens showing the variable extent to which the hydrocaulus is imbedded in the sponge, and also the variable character of the hydrorhiza.

Fig. 3 a.—× 10. A specimen in which the hydranth has shrivelled away or dropped off.

Fig. 4.—× 25. Enlarged drawing of side view of specimen. Notice the ridges on the hypostome, which are the continuations of the oral tentacles; the gonophores arising in clusters from semi-erect peduncles, which spring just above the verticil of basal tentacles; the longitudinal banding, which is more particularly obvious over the middle region of the hydrocaulus, due to the presence of the endodermal canals; a thin "rootlet" (*r*) on the right of the hydrocaulus, and a thick "tuber" filled with reserve food on the left.

Fig. 5.—× 75.—Longitudinal vertical section of hydranth and upper portion of stem. Notice: longitudinal ridge of hypostome projecting down as a lobe (*l.*) into digestive cavity; base of hydranth occupied by endoderm, consisting of (1) basal endodermal epithelium (*b. ep.*); (2) reticular layer of vesicular endoderm; (3) smaller endoderm cells lying next to the mesoglea (*b. ed.*); diaphragm (*d.*) with an endodermal epithelium (*ed.*) on one side and a vertical septum (*v. s.*) on the other; perisarc groove (*p. g.*).

Fig. 5 a.—× 300. Basal epithelium from the floor of the digestive cavity of hydranth. It consists of amœboid cells enclosing masses of apparently worked-up food material (*p. r.*) and of glandular cells.

Fig. 6.—× 300. Perisarc-secreting groove showing the production of the perisarc (*p*).

Fig. 7.—× 300. Hypostome endoderm with the secreting cells, which stain intensely. Such are usually found in the hypostome of the hydroid-polyp.

Fig. 8.—× 300.—Cross section of hypostome region; it shows the absence of ectoderm over the contact-plane of the tentacular ridge.

FIG. 9.— × 125.—Cross section of female gonophore; it shows the absence of distinct radial canals in the endoderm of the umbrella wall.

FIG. 10.— × 75. Cross section towards the basal end of hydrocaulus to show the endodermal canal system. The vesicular endoderm, occupying a considerable portion of the cavity, contains large nematocysts (*l. n.*).

FIG. 11.— × 50. Cross section of hypostome region to show the tentacular and endodermal ridges.

FIG. 12.— × 50. Cross section through the base of polyp showing: (1) Central channel lined by an irregular epithelium: (2) vesicular endoderm; (3) the origin of the basal or proximal tentacles.

FIG. 13.— × 100. Cross section through the region of the perisarc-secreting groove. It shows (1) expanded endodermal canals (*e. c.*) with vertical radial septa (*v. s.*); (2) horizontal section through the endodermal epithelium (*ed.*) hanging down from the diaphragm; (3) the tall glandular epithelium secreting the perisarc.

FIG. 14.— × 200. Small piece of cross section just below the region of the perisarc-secreting groove. In this specimen the ectoderm is charged with large granular masses of deeply-staining substance, similar in appearance to the masses marked *pr.* in the basal epithelium (Fig. 5A), *pr*, Fig. 5, and *g. m.*, Fig. 13. Such masses are by no means invariably found in the ectoderm below the perisarc groove.

FIG. 15.— × 200. Small portion of Fig. 10 to show endodermal canals.

FIG. 16.— × 200.—Cross section through the tuber-like outgrowth from hydrorhiza, as it lies in situ in the sponge. The modified tissue of sponge contiguous with the hydroid is also shown (*sp.*). The tall endoderm cells are crowded with globules.

FIG. 17.— × 50. Gonophore with enclosed actinula and shrivelled manubrium.

FIG. 18.— × 75. Peduncle carrying terminally an abortive gonophore and laterally an ordinary fertile gonophore.

FIG. 19.— × 200. Apical portion of gonophore showing the opening of the umbrella to the exterior.

FIG. 20.— × 150. Longitudinal section of gonophore with the ova being absorbed into an egg-mass (*g. e. m.*). The first segmentation nucleus has not been identified with certainty.

FIG. 21.— × 500. The beginning of the formation of the egg-mass. It is suggested that sn_1 and sn_2 may be fertilised nuclei.

FIG. 22.— × 150. Longitudinal section of gonophore occupied by embryo surrounded by egg-membrane (*e. m.*), and possessing several nuclei, one of which is in a state of division (*dy.*).

Fig. 23.—× 150. Longitudinal section of gonophore with irregularly shaped embryo, consisting of large blastomeres with nuclei which stain with difficulty, and apparently contain but little chromatin. The yolk is concentrated towards the centre.

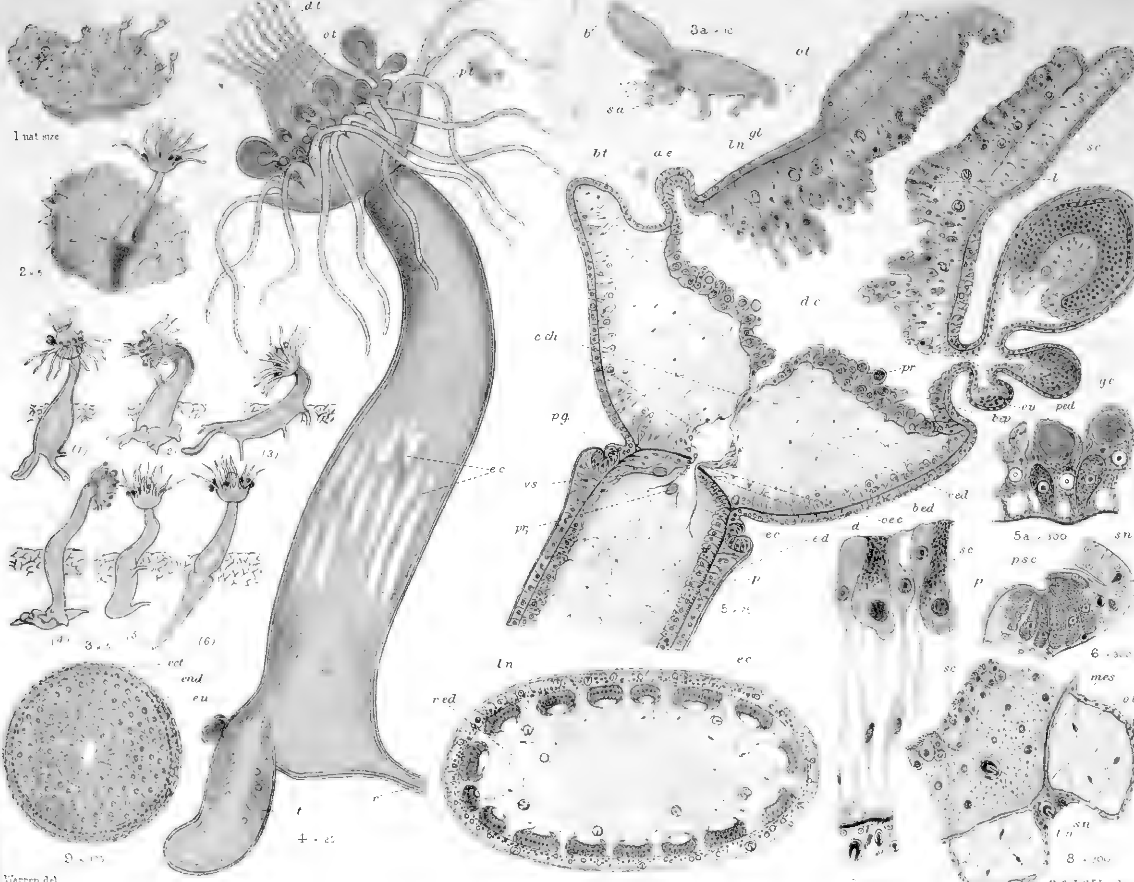
Fig. 24.—× 150. Longitudinal section of gonophore with fully-developed actinula.

Fig. 25.—× 350. Egg-mass with ingested ova. It may be noticed that the nuclei are not swollen as in Fig. 21 sn_1 and sn_2.

Fig. 26.—× 300. Egg-mass with several nuclei, of which *n* is one. The centre of the mass is occupied by vacuolated protoplasm and yolk.

Explanatory References.

a. Actinula. *a. o.* Abortive ovum. *a. e.* Amœboid endoderm cells. *b.* Truncated end of hydroid after the hydranth has dropped off. *b. ed.* Basal endoderm cells lying in contact with the mesoglea. *b. ep.* Basal endodermal epithelium. *b. t.* Basal or proximal tentacles. *c. c.* Covering cells roofing over the endodermal canals. *c. e. p.* Central endoderm passage. *c. ch.* Central channel. *d.* Diaphragm. *dy.* Dyaster. *d. c.* Digestive cavity of hydranth. *d. t.* Distal tentacles. *d. a.* Digestive cavity of actinula. *ect.* Ectoderm. *end.* Endoderm. *e. c.* Endodermal canal. *e. r.* Endodermal ridge. *e. rh.* Ectoderm of hydrorhiza. *e. a. u.* Ectoderm filling abortive umbrella-cavity. *e. u.* Ectoderm of umbrella, including both the germinal epithelium and the ectoderm lining the umbrella-cavity. ed_1. Endoderm covering diaphragm on the under surface. *ed.* Endoderm running up under the diaphragm. *e. m.* Egg-membrane. *g. m.* Granular masses of worked-up food material (?). *g. e. m.* Generative epithelium fusing into an egg-mass. *g. e.* Germinal epithelium. *gl.* Gland cell. *gl. c.* Glandular cell of endoderm. *l.* Endodermal lobe. *l. n.* Large nematocyst. *mes.* Mesoglea. *i. o.* Ingested ova. m_1. The ordinary thin mesoglea of gonophore. m_2. The thick mesoglea of abortive gonophore. *n.* Nucleus. *o.* Opening of umbrella cavity to the exterior. *o. e. c.* Opening of endodermal canals into hydranth. *o. t.* Adhering portion of oral or distal tentacles. *p.* Perisarc. *pr.* Mass of worked-up food material in floor of hydranth. pr_1. Ditto in hydrocaulus. *p. t.* Proximal tentacles. *p. g.* Perisarc groove. *pr.* Proteid-like mass. *ped.* Peduncle. *p. s. c.* Perisarc-secreting cells. *r.* Rootlet of hydrorhiza. *r. ed.* Reticular endoderm. *r. f. g.* Reserve food-globules of endoderm. *s. a.* Swollen apex of rootlet. *sp.* The modified sponge-tissue contiguous with hydrorhiza. *s. c.* Secreting cells. *s. c. p. g.* Secreting cells of perisarc-groove. *s. n.* Small nematocyst. *s. m.* Shrivelled manubrium. $s. n_1$. Swollen nucleus with nucleolus. $s. n_2$. Swollen nucleus with chromatin reticulum. *t.* Tuber-like portion of hydrorhiza. *v. s.* Vertical septum. *v. ed.* Vesicular endoderm. *v. p.* Vacuolated protoplasm. *y.* Yolk-mass.



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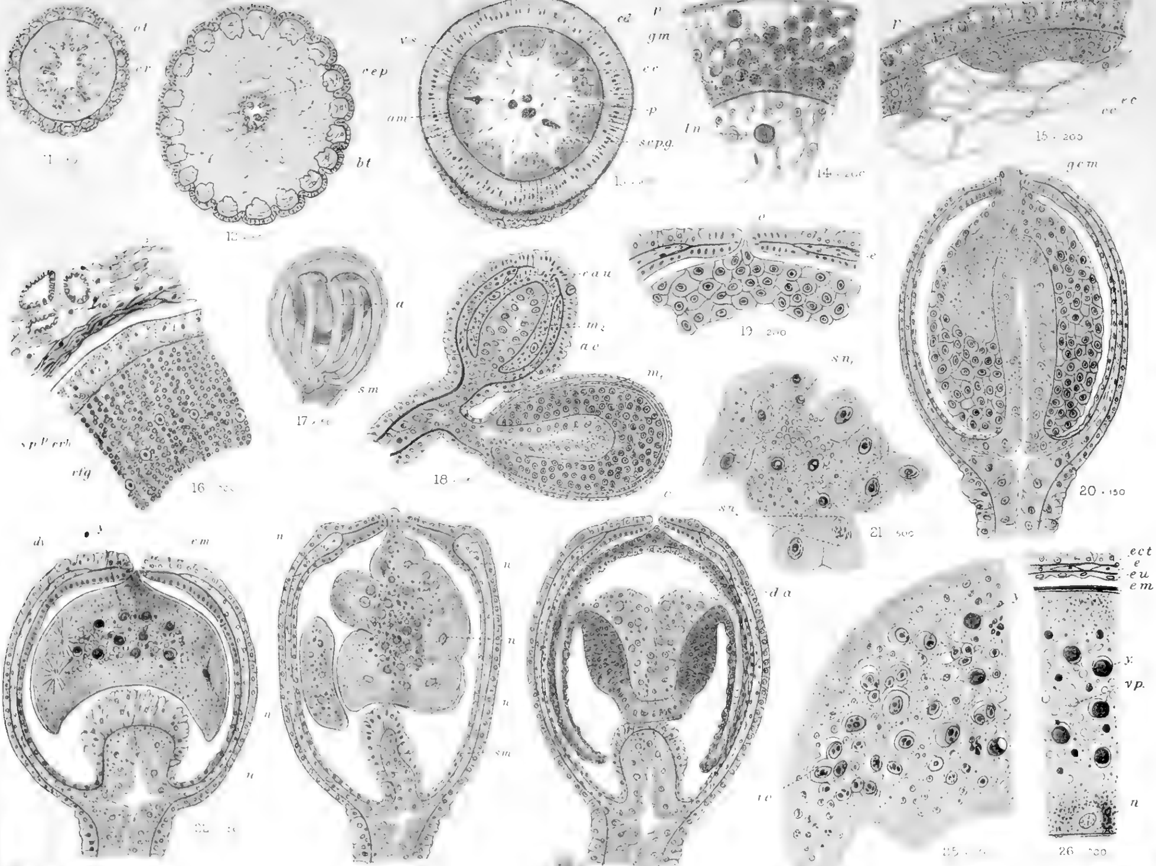

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Hth Lith London

Notes on a New Species of Gymnoplea from Richmond, Natal, South Africa; Adiaptomus natalensis (gen. et sp. nov.).

By

Arnold W. Cooper, F.R.M.S., etc.

With Plate XII.

The following notes on a new species of Gymnoplea found by Mr. J. Y. Gibson and myself near Richmond in November, 1905, may be of interest. During the latter part of 1905 we had been making periodical visits to several pools in a marsh with the view of ascertaining what varieties of aquatic life occur during the cycle of the year. During the months of August, September, and October Diaptomus orientalis was plentiful; the new species now being described first appeared in November. I have no reason to think it had been overlooked earlier because of its larger size and distinctive features. It is, however, rather local, not being found in all the pools examined, although its range has extended since first being observed. This species and D. orientalis are the only two Gymnoplea which have been seen in this locality during our visits, which have been made fortnightly. A marked peculiarity of the new species is that both antennæ in the female and the left antenna in the male have twenty-six joints; I have not seen any Gymnoplea described with more than twenty-five. There are other differences from Diaptomus and Paradiaptomus, which will be seen from the following description.

I have not seen any note mentioning the extreme elasticity of the spermatophores which the following incident exemplifies. Having mounted a specimen in damar after the usual fixation in perchloride of mercury and acetic acid, passing through absolute alcohol after staining, and clearing in oil of cloves, a slight accident happened to the mount. In trying to re-arrange the specimen with a fine needle, one of the spermatophores attached to the vulva became detached and stretched to nearly twice its normal length, the two ends being connected by a thread-like portion only; in less than an hour afterwards it had assumed nearly its former shape and proportions.

Description:

Body.

Total length of female 1·8–1·9 mm. Male somewhat smaller.

Male.—Thoracic segments five, the anterior segment being partially fused with the head, the last thoracic segment being rounded along the posterior edge. Abdomen five segments. Furca symmetrical, each fork with five plumous bristles (fig. 2). Genital aperture at the anterior end of the second abdominal segment. No median dorsal spine.

Female similar to the male, except that the last thoracic segment is drawn out into a right and left backwardly directed flange (fig. 3). Abdomen consists of two segments, the vulva being in the middle of the first. Furca symmetrical, each fork bearing five short swollen plumous setæ. No median dorsal spine.

Cephalic Appendages.

Antennæ 1, Male.—The right antenna consists of twenty-three joints (fig. 4), the terminal prehensile portion having four joints, the first of these (twentieth joint) with well-developed terminal hinges; joints fifteenth to nineteenth greatly swollen; a hyaline membrane extends along the inner side of the eighteenth, nineteenth, and twentieth joints.

Female.—Right and left antennæ symmetrical, similar to the left antenna of the male, with twenty-six joints (fig. 5).

Antennæ 2.—Similar in male and female. Basipodites two joints. Endopodite two joints, the first being slightly longer than the terminal joint, provided with two clumps of five non-plumous bristles. Exopodite with seven joints, the second and last being the longest; provided with three terminal bristles and nine non-plumous lateral setæ (fig. 6).

Mandibles.—Similar in male and female, the biting blade being provided with one large anterior tooth and a posterior serration of seven teeth, of which the anterior one is the largest. Basipodite two-jointed, provided with three setæ on the inner edge. Exopodite not distinctly jointed off from the Basipodite; provided with seven large bristles. Endopodite bi-lobed, the terminal lobe provided with seven bristles, the lower lobe with four (fig. 7).

Maxilla 1.—Basipodite not obviously divided into two joints; provided on the inner edge with a clump of nine strong bristles; on the outer side are two lobes, each provided with about four bristles. Exopodite and Endopodite not distinctly jointed off from Basipodite; Exopodite provided with a clump of nine bristles; Endopodite considerably lobed, each lobe provided with four or more bristles (fig. 8) (these bristles are finely plumous; a good light and definition are necessary to observe this).

Maxilla 2.—Basipodite provided with six lobes on the inner edge, each with a pair of finely plumous bristles. Endopodite, constituting the remaining portion of the appendage, is not obviously jointed off from the Basipodite; it carries five long, finely plumous bristles (fig. 9).

Maxilliped.—Basipodite consists of two long joints, the basal proximal joint provided with a prominent keel anteriorly directed. Endopodite three-jointed; these joints are provided with small lobes which carry very finely plumous bristles (fig. 10).

Thoracic Appendages.

First pair.—First thoracic appendages: Basipodite two-jointed; Exopodite three-jointed; first and third joints provided on the outer edge each with a short seta bearing four or five short spines; no seta present on the second joint; the inner edge of the third joint is provided with six plumous bristles; the terminal two serrated on the outer edge. Endopodite two-jointed; setæ absent on the outer edge; the inner edge bears seven long plumous bristles (fig. 11).

Second, third, and fourth pair.—Basipodite two joints; Exopodite three joints, each bearing on the outer edge a swollen seta with spines; on the inner edge seven plumous bristles and a terminal serrated seta. Endopodite three joints, bearing along the outer edge and terminally ten plumous bristles (fig. 12).

Fifth pair.—Male asymmetrical, the right appendage being the larger, consisting of (1) Basipodite with two joints, (2) Exopodite, two-jointed; the second joint with a small spine on the outer edge, and long terminal curved claw without serrations. Endopodite three-jointed without bristles. Left: Exopodite not obviously jointed off from Basipodite, bearing on the inner edge two smooth pads or cushions; no "appendage" present on the outer edge; two claws, the outer being the larger. No endopodite has been observed (fig. 13).

Female.—Right and left symmetrical. Basipodite two-jointed, Exopodite two-jointed, the second joint bearing a prominent claw serrated on the inner edge; the place of the third joint is occupied by a prominent spine (*s.*), two accessory spines (*a. s.*) on the posterior surface. Endopodite one joint, with two terminal stout spines (fig. 14).

Systematic Position.

The characters in which the present species agrees with Diaptomus are numerous, and it is scarcely necessary to enumerate them; the characters in which it differs are:

(1) Abdomen of female two-jointed instead of three.

(2) Antenna 1, male, left, twenty-six joints; female, both twenty-six instead of twenty-five.

(3) Mandible: Exopodite consists of one joint instead of five.

(4) Maxilla 2: Basipodite not obviously jointed, as in Diaptomus; proximal and distal setæ equal in length instead of unequal.

(5) Thoracic 5, male, right, endopodite consists of three joints instead of one. Left, exopodite one-jointed, two cushions with smooth surfaces, and no "appendage." (In Diaptomus, exopodite two joints, the two cushions having a fringe of fine spines, and an "appendage" is present.) Endopodite not found, but described in Diaptomus. Female, third joint of exopodite absent, being replaced by a spine (*s.*) (a small third joint present in Diaptomus).

This species agrees with Paradiaptomus in:

(1) Abdomen of female two-jointed.

(2) Maxilliped: Endopodite three-jointed instead of five, as in Diaptomus.

(3) Thoracic five, male, left, "no appendage" on the outer side of end joint of exopodite, present in Diaptomus.

Character Peculiar to Present Species.

Antenna 1: Left of male, and right and left of female, twenty-six joints. This very peculiar character appears to be due to the division of the second joint. In the great majority of the Gymnoplea this second joint is longer than the third, fourth, etc., while in the new species the difference in size is not observable, and the position of the spine (s_2), fig. 5, at the proximal end instead of in the middle of the third joint, favours this view—that the additional joint is obtained by the division of the second joint of a typical antenna. The hypothesis is supported both by the size of the second joint and the position of the spine in Diaptomus orientalis (see fig. 5*a*, $s._2$).

It appears impossible, with these differences, to place this species with Diaptomus or Paradiaptomus, and accordingly a new genus (Adiaptomus) has been made for its reception.

The descriptions of Diaptomus and Paradiaptomus have been taken from the Das Tierreich, Copepoda, Gymnoplea, by W. Giesbrecht and D. Schmeil.

I am also indebted to Dr. Ernest Warren (Director of the Museum) for much valuable assistance with regard to this paper.

EXPLANATION OF PLATE XII,

Illustrating Mr. Arnold W. Cooper's "Notes on a New Species of Gymnoplea from Richmond, Natal, South Africa; Adiaptomus natalensis (gen. et sp. nov.)."

FIG. 1.—× 30. Side view of female of Adiaptomus natalensis.

FIG. 2.—× 40. Abdomen, male, side view; note the rounded posterior edge of the last thoracic segment.

FIG. 3.—× 40. Abdomen, female, ventral view; note the backwardly directed flange of last thoracic segment.

FIG. 4.—× 40. Antenna 1, male. Right, twenty-three joints; twentieth joint double-hinged, fifteenth to nineteenth swollen. Left, twenty-six joints like Fig. 4.

FIG. 5.—× 40. Antenna 1, female; twenty-six joints, the additional joint apparently due to the division of the second joint of typical limb. The spine ($s._2$), which is usually in the middle of the second joint, is found at the proximal end of the third joint.

FIG. 5 *a*.—× 40. Proximal joints of antenna 1, female of Diaptomus orientalis, to show position of spine $s._2$ on second joint, and to compare with the position of spine $s._2$ in Fig. 5.

FIG. 6.—× 80. Antenna 2, male.

FIG. 6 *a*.—Face view of terminal joint of endopodite.

FIG. 7.—× 80. Mandible, right; exopodite, one joint, not separable from basipodite.

FIG. 8.—× 80. Maxilla 1, left; note the two outer lobes as in Diaptomus.

Fig. 9.—× 80. Maxilla 2, left; endopodite not obviously jointed off from basipodite.

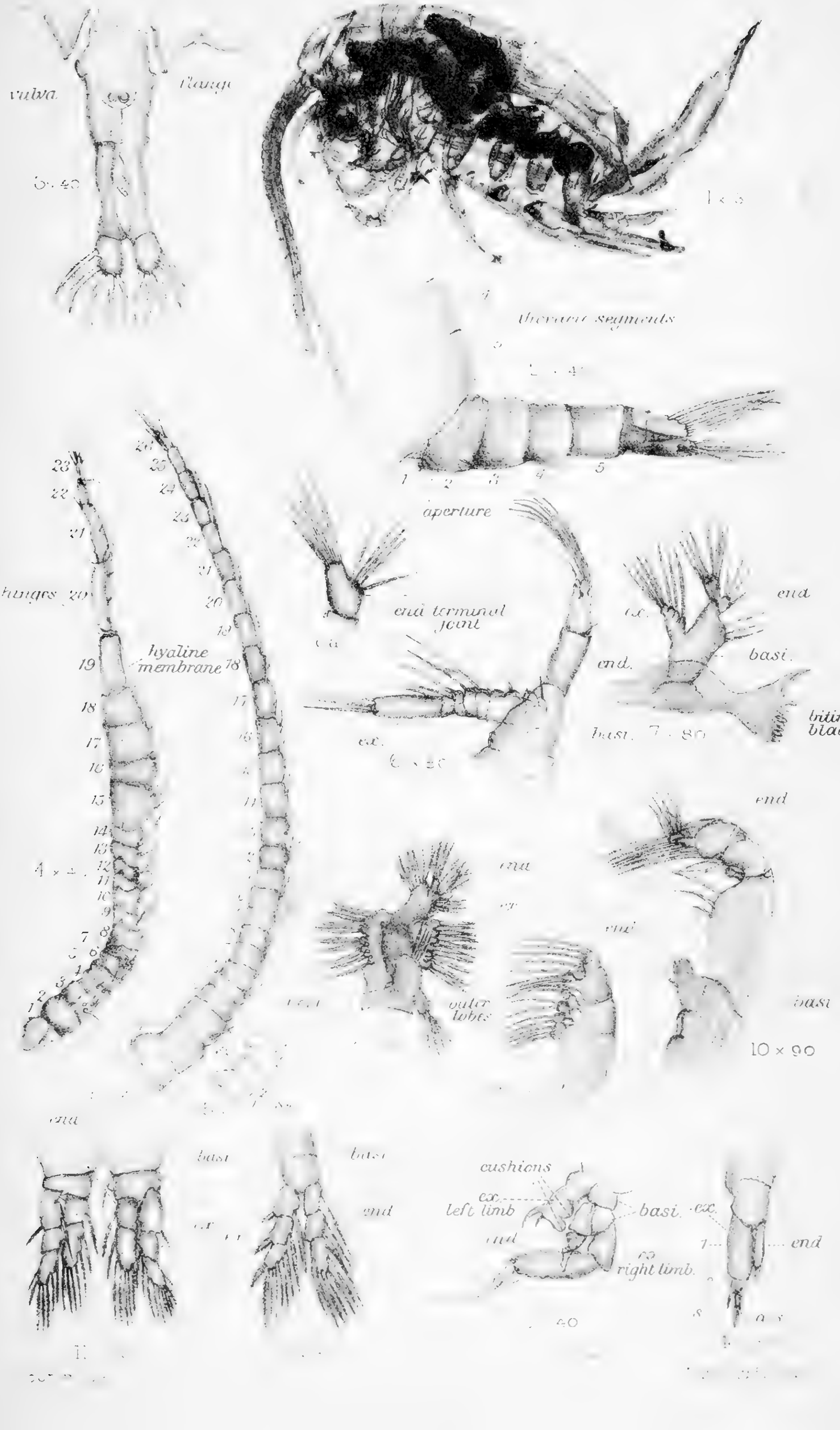
Fig. 10.—× 90. Maxilliped, left; endopodite three-jointed.

Fig. 11.—× 30. Thoracic leg 1; second joint of exopodite without spine on outer edge.

Fig. 12.—× 30. Thoracic leg, second to fourth, inclusive.

Fig. 13.—× 40. Thoracic leg 5, male; right, three-jointed endopodite; left, one-jointed exopodite, two cushions, no "appendage," no endopodite found.

Fig. 14.—× 50. Thoracic leg 5, female; right and left symmetrical; third joint of exopodite absent and replaced by a spine (*s.*); two accessory spines on posterior surface of second joint (*a. s.*).


vulva
flange
thoracic segments
aperture
end terminal joint
hinges
hyaline membrane
ex.
end.
basi.
biting blade
basi. 7×80
outer lobes
10×90
cushions
ex.
left limb
basi.
ex.
end
right limb
end

Note on Convoluta roscoffensis Graff. collected on the Natal Coast.

By

Ernest Warren, D.Sc.Lond.,
Director of the Natal Government Museum.

With Plate XIII.

At Scottsburg, on the Natal Coast, about forty miles south of Durban, a Convoluta was discovered in September, 1904, and in May, 1905. It is of a bright green colour and lives in the sand. The animals crawl on the surface of the sand grains, and also penetrate between the grains to a depth of a quarter of an inch or more. They were found in the little pools on the sand left by the tide, and occurred in such vast numbers as to give the sand a bright green tint. The convoluta has only been found over a distance of a few hundred yards. I have searched a considerable portion of the coast both north and south of this spot, but the animal has not been discovered elsewhere.

I have carefully examined the species, and I have not been able to separate it from C. roscoffensis. It possesses the same longitudinal nerve-bands, two eyes, otocyst, and the same disposition of the generative organs. The only marked difference appears to be that the mouth is situated further forwards than is described by v. Graff in the typical C. roscoffensis. The animal is capable of contracting its body at the anterior end in such a manner as to form a sucker-like depression or vestibule around the mouth. This condition is especially noticeable when the animal has been fixed with hot corrosive or Flemming's solution; but it may be observed during life. Very possibly this character is also possessed by the typical C. roscoffensis.

In the vestibule the ectoderm is only thinly clothed with cilia, and they are only about half the height of those on the rest of the ectoderm (fig. 5, c f., *c. v.* and *c. b.*). The general ectoderm is so closely packed with cilia that they constitute a definite layer (*c. b.*), which in section appears as thick or thicker than the ectoderm cells themselves. The difference in this respect between the ectoderm of the vestibule and the general ectoderm is very apparent. The average size of mature specimens alive is about 4 mm. in length and 0·35 mm. in breadth. The usual length of the large sagittocysts is about 30μ. The animal undoubtedly feeds on diatoms (fig. 2 and fig. 3 *f.*) and other unicellular organisms, in addition to any nutritive substances it may obtain from the chlorophyll bodies.

All stages of growth were collected both in September and in May. When very young the animal resembles a ciliated planula (fig. 1) in general appearance, and I could observe no obvious differentiation of organs or tissues, save into a ciliated ectoderm and a homogeneous inner mass of cells. The first sign of differentiation to appear is a row of four or five cells on each side just behind the oral aperture. These are the germinal cells which will develop into the ova (figs. 2 and 5, *g. c.*). The germinal cells, which will form the scattered testes, seem to originate at a later period in their definitive position, and do not appear to arise from the two rows of cells above mentioned. The ova, during their growth and maturation, are remarkable for their branched and stellate condition (fig. 3, *d. o.*). I suggest that this is associated with the fact that there appear to be no follicle or feeding cells, and consequently the ova themselves obtain their nourishment by sending out pseudopodia into the surrounding parenchyma.

The drawings on the accompanying plate have been made chiefly for the purpose of illustrating the peculiar amœboid character of the ova.

EXPLANATION OF PLATE XIII,

Illustrating Dr. Ernest Warren's "Note on Convoluta roscoffensis *Graff*; collected on the Natal Coast."

Fig. 1.—× 100. Young specimen resembling a planula.

Fig. 2.—× 100. Somewhat older specimen, showing the formation of the oral vestibule (*o. v.*), and the germinal cells (*g. c.*). Some ingested diatoms can be seen (*f.*).

Fig. 3.—× 100. Anterior portion of an individual nearly mature. *b.* Brain. *b. s.* Bursa seminalis. *ch.* Chitinous tube. *ch. b.* Chlorophyll bodies. *d. o.* Developing ova in a remarkably branched condition. *e.* Eye. *f.* Food. *f. o.* Frontal organ. *g. c.* Germinal cells. *m.* Mouth. *o.* Otocyst or statocyst. *o. v.* Oral vestibule. *t.* Testes. ♀ *a.* Female aperture.

Fig. 4.—× 350. Chitinous tube of bursa seminalis.

Fig. 5.—× 200. Horizontal section through the anterior end, showing: *f. o.* Frontal organ. *o. v.* Oral vestibule, with its scattered short cilia (*c. v.*). *g. c.* Germinal cells. *ch. b.* Chlorophyll bodies. *c. b.* Cilia forming a compact layer on the general surface of the body.


f.o.
o.v
g.c
me.
d.o.
o.v
g.c
♀a.
ch
b.s
Ch.b.
f.o.
o.v.
e.v.
Ch.b
g.c
c.b.
1
2
3
4
5

Note on the Abnormal Hoofs of a Sheep.

By

Ernest Warren, D.Sc.Lond.,
Director of the Natal Government Museum.

With Plate XIV.

In 1905 Miss Shirley Moor, of Greystone, Estcourt, Natal, sent to the Museum the left foot of a sheep exhibiting a striking abnormality.

The annexed illustration shows the abnormal foot, and for comparison a normal foot of a Kafir sheep is shown with it.

With reference to the specimen the donor writes: "The sheep, so far as I can trace back, was a cross between the Merino and the ordinary Kafir sheep. The hind feet were the only ones so deformed; the other hind foot was somewhat broken, and was not so regularly formed as that which I sent you."

The sheep used all its feet for walking, apparently without very great inconvenience, but the spirally twisted hoofs exhibited little sign of wear.

On the occasion of the visit of the British Association to Natal Dr. S. F. Harmer informed me that such spiral growth of the hoofs is known in the horse, ox, and perhaps in the sheep; also Miss Moor informs me that she has heard of the same or of a similar abnormality in the hoof of a bull from the same locality (Estcourt) as that from which the sheep came. The present specimen is, however, worthy of record for the following two reasons:

(1) The spirals for the two hoofs both run in the same

direction (i. e. looking from above the spirals run from left to right), and not in opposite directions. It would be interesting to ascertain if such is generally the case in abnormalities of this nature, since the slight spiral tendencies in the normal hoofs of a foot are in opposite directions (see figure). It is possible that the fact of the spirals running in the same direction for the two abnormal hoofs may be due to the essentially asymmetrical nature of the two hoofs of a ruminant, as they are the third and fourth digits of the typical pentadactyle limb.

On inquiry Miss Moor further informs me that in the case of the right foot both of the twisted hoofs grew in the same spiral, but that this spiral ran in an opposite direction (i. e. from right to left) to that of the left foot.

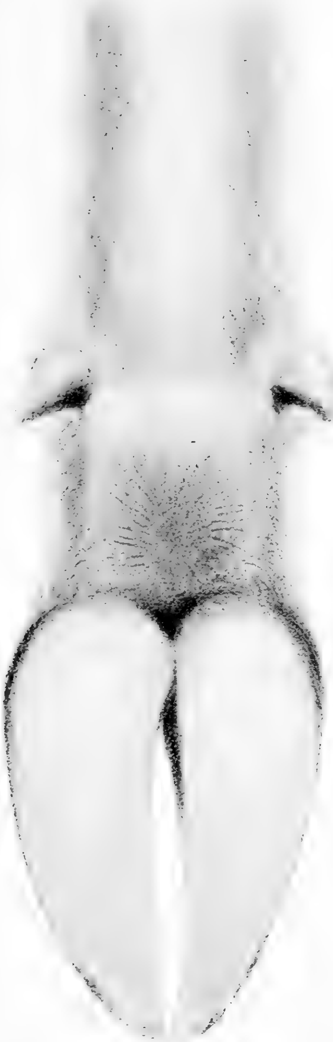
(2) The rudimentary hoofs of the fetlock show a distinct tendency for abnormal growth (see figure); thus the causes which produced the abnormality were effective over the whole of the foot, and the abnormality was not due to a mere local disturbance in the growing bases of the hoofs of the third and fourth digits.

EXPLANATION OF PLATE XIV,

Illustrating Dr. Ernest Warren's paper on "Note on the Abnormal Hoofs of a Sheep."

FIG. 1.—Plantar surface of normal left hind foot of Kafir sheep. (Natural size.)

FIG. 2.—Plantar surface of abnormal left hind foot of supposed cross between Merino and Kafir sheep. (Natural size.)



(1)

(2)

Adlard & Son, Impr.

Vol. I, part 2, issued March 8th, 1907.

A Contribution to the Study of the Characteristics of Larvæ of Species of Anophelina in South Africa.

By

Ernest Hill, D.P.H.Camb.,

and

L. G. Haydon, M.B., C.M., D.P.H.Aberd.

With Plates XV—XXVI.

PREFATORY NOTE.

When this paper had been completed and was about to be sent to press a letter was received from Colonel Giles, who had with his usual kindness examined specimens of the species which we have throughout called Myzomyia funesta, and states that they are of Pyretophorus pitchfordi *Power*. Colonel Giles, however, admits that the difference between the palpal banding of our specimens and those sent him by Mr. Power is so marked that his description of the latter is hardly appropriate to the former. We have the greatest respect for the opinion of Colonel Giles on such a matter, but this species which we have called funesta, as represented in our collection, appears to us to differ, both in respect of the markings of wings and palpi, quite as much from Giles' description of pitchfordi as it does from Theobald's description of funesta, while we should have had no hesitation in describing wing scales as mostly long and narrow, which is the chief point, as we understand it, by which Myzomyia is distinguished by Theobald from Pyretophorus, in which the scales are described as lanceolate. Further, some while back, specimens were sent to Mr. Power, who first despatched specimens of pitchfordi to Giles, and he expressed himself as unable to determine them, without reference to works on the subject, whereas it might surely be anticipated that he would recognise a species first determined as new by himself.

In the circumstances it seemed advisable to let the name funesta stand in the paper with this note, indicating the doubts, rather than to alter the naming, seeing that in the present confused condition of the subject of Anophelina it might be within range of possibility that pitchfordi might later on rank as a variety of funesta or other species.

PART I—Introduction.

Fifteen species of the sub-family Anophelina have, to the present, been found in the territory of the Colony of Natal. These, grouped according to genera defined by Theobald in 'A Monograph of the Culicidæ of the World,' are as follows:

Genus.	Species.
Myzomyia	funesta *Giles.**
,,	rhodesiensis *Theobald.*
Pyretophorus	costalis *Loew.**
,,	cinereus *Theobald.**
,,	pitchfordi *Power.*[1]
,,	superpictus *Grassi.*
,,	ardensis *Power.**[2]
,,	marshalli *Theobald.**
Nyssorhynchus	maculipalpis *Giles.*
,,	pretoriensis *Theobald.**
Cellia	squamosa *Theobald.**
,,	jacobi. New species.*[3]
Myzorhynchus	paludis *Theobald.**
,,	mauritianus *Grandpre.**
,,	natalensis. New species.*[3]

Those marked with an asterisk are represented in our collection, in many cases by a considerable number of specimens. The species called jacobi and natalensis respectively

[1] First recognised by Mr. H. S. Power, and described by Col. Giles in his revision of 'Gnats and Mosquitoes,' 1905.

[2] First recognised by Mr. H. S. Power, of Natal; examined by Theobald.

[3] Named by the authors of this paper.

appear to conform quite satisfactorily to Theobald's definition of the respective genera, but are not identified with any described species.

In a contribution to the 'Journal of Hygiene' by us (vol. v, No. 4) on the subject of an epidemic of malarial fever, statements were made as to relative prevalence and habits of certain species of Anophelina. The determination of species was, in most instances, made for us. We have since given attention to the matter, and have found it necessary to revise the determination of three species. There may thus be discrepancy between portions of that paper and of this. For the present determination we are solely responsible; photographic illustrations of the wing and palpi of each species herein noticed are put in, by which the determination may be checked.

The original intention of this paper was to contribute to the study of Anophelina by a description of the characteristics of the larvæ of some African species, as to which very little, and that little very meagre, has been published. In collecting and sorting material, it became increasingly borne in upon us that Theobald's grouping into genera is by no means in all respects satisfactory, and that, admirable as are his description of imagines, and notwithstanding that in the introductory pages he briefly mentions that markings are not constant, yet there is so much rigidity both in the definitions of the size, and of the wing and leg markings, that great difficulty confronts the ordinary collector, in attempting to assign specimens to their proper species. This is a matter of importance in the case of disease-carrying insects.

Generic distinctions are largely based on the shape of scales. On this point we take the liberty of quoting from 'A Monograph of the Anopheles Mosquitoes of India,' by James and Liston, a work to which we are indebted for much assistance. On page 20 we find objections laid against present generic grouping as follows:

"(2) The classification is based in great part on the shape and not on the presence or absence of scales. Scales of various shapes are present on different parts of the thorax, abdomen, and especially the wings of 'Anopheles,' and it is a matter of great difficulty to decide in some instances what form of scale predominates; nor does Mr. Theobald give us any indication of what portion of a wing should be examined to decide this point.

"(3) The terms 'lanceolate,' 'long and narrow,' 'true scales,' etc., are not sufficiently definite to permit of such scales being easily distinguished from one another. . . . It is obvious that the distinction between 'hair-like curved scales' and 'narrow curved scales' is not great, and also that it would be difficult to decide whether the abdomen is 'hairy,' or whether it is covered with 'hair-like scales,' which apparently resemble hairs so closely that they cannot be termed 'true scales.' As regards the wing again, it would certainly be difficult to decide whether most of the scales were 'lanceolate,' or whether they were 'mostly long and narrow' especially as the part of the wing to be examined is not stated, but on this decision alone depends the distinction between the genera Anopheles and Myzomyia.

"(4) One of the objects of classification is to simplify the identification of species, but the new classification does not aid this in any way. In practice, it will be found much easier to determine the specific name of any specimen of 'Anopheles' than its generic name, according to the new system."

With this criticism we are for the most part in accord, but some genera, particularly Myzorhynchus and Cellia, appear to be sufficiently distinct; Nyssorhynchus, however, touches closely on the latter, and both of the genera are relatively uncommon.

A genus should possess one or more characteristics which are prominent, and by which it can be readily and certainly distinguished from other genera, and this characteristic or these characteristics should be, at any rate in broad terms, common to all species in that genus, and shared by none in any other. A classification by genera which fails in these requirements has neither scientific basis nor practical advantage. The requirements are not complied with throughout Theobald's grouping, which is based also entirely on imagines.

If the points of difference between the larvæ of different species of Anophelina generally were slight and unimportant, there might be sound reason for generic groupings on the features of imagines alone, but the differences are certainly as great and quite as definite as those between the different imagines. It is therefore desirable that the larval characteristics be given an equal weight with those of the fly. In Theobald's 'Monograph of the Culicidæ of the World' (vol. iii, p. 10) is found a table of genera with characteristics which are here abbreviated:

Anopheles . .	Thorax and abdomen with hair-like curved scales	Wing scales lanceolate.
Myzomyia . .	Ditto	Wing scales mostly long and narrow.
Pyretophorus .	Thorax with narrow curved scales; abdomen hairy	Wing scales small, lanceolate, or narrowed.
Nyssorhynchus .	Thorax and abdomen with true scales; lateral tufts and dorsal patches of small flat scales	Wing scales bluntly lanceolate.
Cellia . . .	Thorax and abdomen true scales. Abdomen nearly completely scaled with lateral tufts	Ditto.
Myzorhynchus .	Thorax with hair-like curved scales. Abdominal scales on venter only, with distinct apical tuft; no lateral tufts	Wing scales broadly lanceolate.

Of the last two genera the characteristics appear to be definite and distinctive, but the features of the first three are very variable in practice, and such as to render distinction very difficult. Nyssorhynchus, as far as can be judged from description of different species, merges in Cellia on the one hand, and the group Anopheles, Myzomyia, and Pyretophorus on the other, for in the species stephensi (vol. iii, p. 93) the abdomen is described as covered with scales, while maculipalpis (vol. iii, p. 97) is credited with a very few scales on the apical segment only (apparently a characteristic also of Myzorhynchus), while in pretoriensis we can detect but some seven or eight in all on the last segment. On page 111, vol. iii, albipes is called both Cellia and Nyssorhynchus.

The shape of wing scales, as described, might be thought sufficiently to distinguish the latter from Myzomyia, but Theobald expresses doubt as to whether the species elegans is not of the genus Nyssorhynchus rather than of Myzomyia, to which he has allotted it, and says that it is very near to stephensi, a species of which the abdomen is thickly scaled (vol. iii, p. 53). Again, the descriptive slip on Plate V in the same volume indicates that pretoriensis barely escaped from the genus Pyretophorus.

From the table in 'Monograph of the Anopheles Mosquitoes of India,' and from illustrations and descriptions in 'Monograph of the Culicidæ of the World,' a table of larval characteristics has been compiled to which are added in their place the nine species identified by us :

Genus.	Species.	Frontal hairs.		External.		Antenna shaft.		Palmate hairs.	
		Branched, some or all.	All plain.	Dendriform.	Penniform.	Branched hair.	No branched hair.	Filamentous.	No definite filament.
Anopheles . .	maculipennis	+	—	+	—	+	—	?	?
	bifurcatus .	—	+	—	—	?	?	?	?
	lindesayi . .	—	+	—	—	+	—	?	?
	aitkeni . . .	+	—	—	—	—	+	—	+
Myzomyia . .	rossi	—	+	—	—	—	+	+	—
	culicifacies .	—	+	—	—	—	+	+	—
	elegans . . .	—	+	—	—	—	+	—	+
	turkhudi . .	—	+	—	—	—	+	—	+
	funesta . . .	+	—	—	—	—	+	+	—
	listoni . . .	—	+	—	—	—	+	+	—

Genus.	Species	Frontal hairs.		External.		Antenna shaft.		Palmate hairs.	
		Branched, some or all.	All plain.	Dendriform.	Penniform.	Branched hair.	No branched hair.	Filamentous.	No definite filaments.
Pyretophorus .	jeyporensis .	+	—	—	—	—	+	+	—
	superpictus .	+	—	—	—	—	+	?	?
	cinereus . .	—	+	—	—	—	+	—	+
	ardensis. . .	+	—	—	—	—	+	+	—
	costalis . . .	+	—	—	—	—	+	+	—
Nyssorhynchus	maculipalpis	+	—	—	—	—	+	+	—
	maculatus. .	—	+	—	—	—	+	?	?
	fuliginosus .	+	—	—	+	—	+	+	—
	theobaldi . .	—	+	—	—	—	+	—	+
	stephensi . .	—	+	—	—	—	+	+	—
	karwari . . .	—	+	—	—	—	+	?	?
	annulipes . .	—	+	—	+	—	+	?	?
	pretoriensis .	—	+	—	—	—	+	+	—
Cellia	albipes . . .	—	+	—	—	—	+	+	—
	pulcherrima .	+	—	—	—	—	+	+	—
	squamosa . .	+	—	*+	*+	—	+	+	—
	jacobi . . .	+	—	—	—	—	+	+	—
Myzorhynchus	barbirostis .	+	—	+	—	+	—	—	+
	nigerrimus .	—	+	+	—	+	—	—	?
	sinensis. . .	+	—	+	—	?	—	—	+
	paludis . . .	—	+	+	—	+	—	—	+
	natalensis. .	+	—	—	—	—	+	+	—

Theobald writes (vol. iii, p. 10): "It will be noticed that by these characters (i. e. his generic features) a natural grouping is formed, and that it, in the main, tallies with what we know of grouping them by their larval structure. I do not think that the minute structural differences in the larvæ should be taken as of greater value than specific characters; but it is of interest to find that classification by certain larval and certain adult characters give the same result." The meaning of the last sentence is not quite clear, but from the context generally it would appear to indicate that the generic classification by scale structure is supported by the genera having common larval characteristics. This must have been

* Either dendriform or penniform.

written with a then limited acquaintance with larvæ, for if, from the above table of thirty-two species, we endeavour to pick out certain characteristics forming natural groups corresponding with Theobald's generic classification the difficulties are even greater. Considering, in the first instance, the antennæ we see that a multibranched hair is found starting from the intero-anterior aspect of five, its presence or absence not specified in two, and that it is definitely absent from twenty-five. Of the five, two belong to genus Anopheles, three to Myzorhynchus. Even if it were possible to find affinities between these two species of Anopheles and the genus Myzorhynchus, which would justify their inclusion in the latter genus, the difficulty would not be surmounted, because the prominent dendriform external frontal hair (Pl. XXII, fig. *d*) forms at least an equally distinctive feature, and is found in Anopheles maculipennis, but not in lindesayi, and again is absent from natalensis. In six species of the six genera represented in the table, the external frontal hair is dendriform (Pls. XX and XXII *d*). One of these is an Anopheles, one a Cellia, and four belong to genus Myzorhynchus; but of all the genera that which has the most pronounced characteristics in the imago is Cellia. Again, we find that of four mounted specimens of Cellia squamosa, which we have kept, the external frontal hair is penniform in one, dendriform in three. There can be no doubt of the identity of the former, seeing that it differs in no other shade from the latter. The distinction between the two types is barely appreciable with a lower magnification than × 100, and might readily be overlooked.

The most striking feature which we have seen in any larva is a large dendriform hair found on the first abdominal segment of a species of Myzorhynchus, which we take, despite the difference as to the amount of white in the second hind tarsus of imago, to be Theobald's paludis (Pl. XXII, fig. *f*). This hair certainly engendered expectation of its being of some specific value, but we are forced to regard it as merely an individual peculiarity. We have only seen it in three instances. On the first occasion it was observed in a living larva. Six others collected at the same time were closely examined, but no such hair was detected. It is translucent, and overlies the palmate hair in a different plane, and in hurried examination of a lively larva might readily be overlooked, unless the observer were especially alert for it, when it cannot be missed. Subsequently, in looking through some mounted specimens, this hair was found in a second instance. A large collection was made from the pool from which the latter had been taken some months earlier. Thirty individuals were carefully examined, and a similar hair was found in one only. Both larvæ developed into imagines. No difference was observed between the markings of these two and of others, greater than between any of the combinations given on page 149. Both proved to be males, but male insects were obtained from larvæ on which this dendriform hair was not present.

The principle of grouping into a genus different species, of which the points of resemblance in imago are no stronger than the features of difference in larva is unsound, but it must be readily admitted that any attempt to give equal consideration to larval characters would make all attempts at generic classification hopeless.

James and Liston propose to divide Anophelina into groups, taking into consideration the characters of egg, larva and imago, together with habitat, habits and pathological affinities, particularly the last. This is doubtless satisfactory for a country in which these particulars are known, but may be misleading if applied to the sub-family generally. In such an arrangement the South African species funesta, ardensis, cinereus, pretoriensis and natalensis would be grouped with the malaria-carriers listoni (or christophersi, according to Giles) and culicifacies, but costalis, as the authors themselves state, with stephensi and rossi. Funesta is a known malaria-carrier, but there is no evidence against the other four, whereas costalis, although placed with rossi, which apparently does not act as host to the malaria parasite in natural conditions, is, as we have shown elsewhere, probably the premier agent in conveying the disease in Natal. Further, until all details of an Anophelina were ascertained, it would need go nameless, in regard to group.

It is, on the whole, unfortunate that generic grouping on narrow and refined differences was ever attempted. It appears to us that the need is for a better representation of specific characters. Descriptions which will adequately convey the writers' meaning to the reader are difficult to draw up. Such terms as "spot" "patch," "small spot," etc., are too vague to give sound guidance. There is also much variation in the markings of the wings of individuals of a species. A photograph of a wing showing clearly all markings with a tabular statement, giving variations met with in a given number of species, is a much greater aid in making determinations. This method we have adopted to the extent admitted by the number of specimens of a species in our possession.

Some points to which specific importance has been attached in Theobald's 'Monograph' cannot be admitted to have the value attributed to them. Stress is laid in descriptions of Myzorhynchus paludis and mauritianus on the proportion of the second hind tarsus which is white, and the presence or absence of a wing spot, as distinctive points. As will be seen from particulars given in the systematic portion of this paper, the wing spots vary much in size to the point of total extinction, and the proportion of white in the second hind tarsus from seven-eighths to one-fourth, but the variations in the wing spots do not coincide with the amount of white in the tarsus, nor have we been able to make out any corresponding difference in the larvæ.

In our collection we have a single specimen of a female imago, in which there is marked difference in the two wings. The insect belongs to a species, which more nearly corresponds to Theobald's Myzomyia funesta than to any other of his species, although of a larger size. On one wing, the middle of the three main white or yellow spots, described as marking costa and first longitudinal vein, is entirely absent, on the other it is present. Some of Theobald's species are based on a single female. If this specimen had been defective in this spot on both wings, it would appear at least possible for it to found a new species. There is, however, no reason why such a variation should not occur on both equally with one wing.

The Nyssorhynchus pretoriensis of Theobald is described as 5 to 5·5 mm. long. This would make it, according to him, to be of the same size as Myzorhynchus paludis. In our collection, however, we find that the specimens of a species, which accords in all important particulars with Theobald's pretoriensis, are very much smaller; while the frontal hairs of the larvæ correspond with Theobald's statement. We think it scarcely credible that two mosquitoes from places near by on the same continent so very nearly alike can belong to totally different species.

Individuals of the same species are subject to much variation in size, and in the pattern on the wings (although the main costal spots are mostly constant) and the relative breadth of the bands on the palpi. The most uniform of those which are dealt with in this paper is Pyretophorus costalis, the most variable Myzomyia funesta. General appearance is sometimes more helpful to distinction than detailed description of markings. Theobald, in describing Pyretophorus cinereus, says that at first sight it looks like a large funesta. We have a number of specimens which we do not doubt are large funesta. This for a time we took to be cinereus, although Theobald describes the latter as having four white bands on the palpi against three in funesta. He says elsewhere (vol. iii, p. 5) that specific value cannot be attached to the palpal bandings. In some of our specimens a few dark scales are visible in the middle of the last segment, which in two is certainly divided by a dark ring into two white bands. The larva of this larger variety, however, differs in no way, except in size, from that which results in funesta of the described size. On the other hand, we have an imago, herein referred to as Pyretophorus cinereus, which is much larger than the largest funesta, and by its naked-eye appearance is obviously different, much more than can be shown by any detailed description (Pl. XXV, fig. C). The larva of this comes near in resemblance to that of funesta, but the position of palmate hairs and the shape at termination are different (Pls. XV, XVII, fig. B).

Variations in size are to some extent due to external circumstances. Nearly all our specimens were obtained from larvæ kept in basins until the insects emerged from pupal stage. Those which were young and small when captured, more particularly in cool weather, when larval existence was prolonged to seven weeks, developed generally into smaller insects. Their growth was stunted, and they suffered from debility, as a result of unnatural conditions. It was observed that after some weeks' captivity the metamorphosis into pupa took place, when the larva appeared still some way short of full grown; the pupa was smaller, the imago also, which experienced much difficulty in getting free of pupa skin, often losing hind legs, and not seldom life, in the process. This did not happen to larvæ which were full-grown at time of capture, unless shaken up in travelling.

We have identified the larva of nine of the fifteen species enumerated on page 112. The most certain method of identifying larvæ of a species is to breed from the imago and watch the larva from egg to final metamorphosis. This proved impracticable, because conjugation did not take place in captivity, and impregnated females were not captured when required. Larvæ were collected, examined alive, sorted into groups, watched to metamorphosis, and specimens preserved from time to time, and last larval moults mounted. With a little practice familiarity is gained and distinction between different species readily appreciated. The characters of each species are sufficiently defined to leave little room for error if sufficient care is taken.

The points of importance for differentiation of larvæ have been set forth by Christophers and Stephens, and we do not find specific value in any additional character.

(1) Antenna.—(*a*) Presence or absence of a branched hair on the shaft. This hair is found on the antero-internal aspect. There is in some species a spikelet on the outer side, which is not constant in any species in our list, except possibly Cellia jacobi; (*b*) number of branches or divisions of the hair between the terminal spines.

The former is of value in that the larvæ in which it is found form a numerically small group; the latter may be used as a supplementary point in final distinction between similar larvæ of different species. For instance, ardensis and natalensis come in some respects near together (Pls. XVIII, XXIII, XXIV), but in ardensis the hair divides into two, in natalensis into six or eight. The number, however, is not constant. In most specimens of funesta three divisions were observed, but in one half-grown larva there were four, which is the usual number in costalis. The relative size, one to the other, of the two spines is not, in our experience, of use—in fact, we find them practically equal in all our species, variation being no greater than is found in the two sides of a lobster's claw, which they much resemble.

James and Liston lay stress on the importance of a branched hair outside and parallel to the antenna, which they call the "basal hair." We do not feel quite sure what they mean by this, because they make no mention of it in description of individual species, except in the case of culiciformis, while it is figured in plates of jeyporensis, culicifacies, and aitkeni only in addition. We find a similar hair in all species. It arises from a point outside the antenna, and on a slightly lower plane only, and therefore comes into view under the microscope with the antenna, and is shown accordingly in the plates. This is present on the head of paludis, but in all our specimens arises on a much lower plane than the antenna. It is necessary in most instances to focus especially for it; it cannot conveniently be drawn in relation to the dorsal aspect of the larva, and is omitted on that account from the figure. If this be the "basal hair" it is not of differential import in our species.

(2) Frontal or Clypeal hairs.—In all larvæ examined by us three pairs are found, two near to the anterior extremity of the head, and a third a little behind the median pair. The posterior may be very small and require relatively high magnification to detect in the first instance (Pl. XXII, a_1, a_2). The frontal hairs are of prime specific importance, and it is generally necessary to consider the three pairs together. They exhibit much individual variation, especially the posterior (vide Pls. XV–XXIII, fig. *a*). In funesta they *may* be quite free of branches, while in pretoriensis they invariably are. The lateral hairs also vary, though to less extent (Pls. XVI, XVIII, XXI, XXIII); but it is to be observed that in natalensis (Pl. XXIII, fig. *a*) on one side is found a fine branched hair, on the opposite a straight smooth bristle. Attention is needed both to structure and to relative size of posterior to anterior median, which, for instance, is much less in pretoriensis than in funesta or cinereus. Relative position of point of origin is not available for comparison, because of the impracticability of arranging a preserved specimen precisely flat in such a manner that exact measurements can be made; it is not possible to secure uniformity of plane without crushing the larva, which is thereby distorted and the hairs frequently broken and detached.

Thus it happens that in drawings of larvæ the proportions, except of palmate hairs, are approximate, although a micrometer scale was scrupulously applied to every detail as far as circumstances admitted. This more particularly applies to instances in which one or two specimens only were available for drawing. In these instances, however, it so happened that the anterior frontal hairs lie in an uniform plane, and it is mainly the segments of the bodies as to which there is a margin of inaccuracy. Where several specimens are available greater accuracy is attained. Palmate hairs can be detached and mounted absolutely flat, and error entirely avoided.

(3) Thorax.—A difference in hair ornamentation as between Myzorhynchus paludis and others is observable, but we hesitate to assign significance to this.

(4) Palmate hairs.—These are of decided specific importance in regard to: (*a*) relative size; (*b*) relation of filament to leaflet; (*c*) character of filament and of "shoulder" (the term "shoulder" is adopted from Christophers and Stephens as meaning the abrupt widening at the point where the filament runs into the leaflet—vide Pl. XXIV); (*d*) position in which palmate hairs are found.

A palmate hair may be found on the thorax and all the first seven abdominal segments, or it may be absent from thorax, first and occasionally second abdominal segments. Great care in examination is necessary before concluding the absence entirely from any segment, because on thorax it is always, and on the first abdominal generally, rudimentary, and in instances close scrutiny with a magnification of × 250 or so is required for certainty where the hair is closely folded in death (c f. Pl. XXI, fig. *c*, 1). If the larva be examined alive the rudimentary hairs are found expanded, as the fully developed, but they are generally quite translucent; the leaflets, smooth and free from shoulder in most species, do not terminate in any filament, but in smooth, narrow lanceolate extremity (Pl. XXI, fig. *c*, 2). They appear, however, to be functionally active (vide Pl. XXIV, fig. *l*, first and second abdominal segments).

It is said that these hairs aid the larva in maintaining its horizontal position, and that the long plumose lateral hairs act as balancers. They are, however, liable to be broken or torn off, and the larva appears little, if at all, incommoded by their loss. On one occasion a larva of species paludis (in which the palmate hairs are pigmented and easily discerned) was watched for a considerable time; there were no balancers on the thorax, two broken stumps on the first abdominal segments on one side, and none on the other, nor on the second on either side; palmate hairs lost from fourth, fifth, and sixth abdominal segments on one side, and from third and fifth on the opposite, but the larva behaved in all respects, and assumed a similar attitude to others, in which the hairs were complete.

Relative length, in the average, of filament to leaflet is of general value in determination of species, although the relation differs in individual leaflets and individual specimens, but in some species, as funesta, it is more inconstant than in others. This species, which exhibits the least constancy in larval features, is also the most variable in the wing pattern of imago.

In our limited experience we find that, although larvæ—and some species more than others—are subject to much individual variation in some essential points, yet the sum total of the characters is sufficiently pronounced to enable the identity of any one of the nine species which we present to be readily recognised, even in the living larva.

We have not followed up larvæ systematically from youth to maturity, observing any changes of character in important features, but from a limited number of measurements it appears that in very young larvæ the frontal and palmate hairs, though relatively large, are absolutely small, whereas, when about half-growth is attained, both are in absolute measurement about the size found in the mature larva. In very young larvæ the characteristic shape of the palmate leaflets, as a rule, is not defined, but in larvæ which have passed through but a quarter of their career the features are quite distinct.

Duration of life.—The length of time occupied in each stage varies with the temperature. In warm summer weather, mean daily temperature about 73° F., very tiny larvæ will arrive at pupation in twelve to fourteen days, the imago emerging in a further period of two; but in autumn and winter, mean daily temperature about 56° F., the larval stage is prolonged to seven weeks, and the pupal existence to five days. We have observed larvæ certainly not one third of average mature length as long as six weeks after collection, when certainly no insect has had access to the water.

PART II—Systematic.

Myzomyia funesta *Giles.*

The following description of certain features of the female is given by Theobald (vol. i, p. 178):

"Palpi black, with a white apex and two white rings, the one nearest the apex sometimes involving both sides of the last two joints.

"Legs dark brown to nearly black, with a few pale apical scales to the metatarsi and tarsi, often indistinct unless seen under the microscope.

"Wings with the black costa with six pale creamy almost white spots, the three apical ones extending on to the first long vein, remaining veins with patches of white and black scales as follows: One small and one large dusky patch on each of the branches of the first submarginal cell, the greater part of its stalk dark scaled, a dark patch at the base and apex of the third long vein, two dark patches on each branch of the second fork-cell, and the greater part of the root and stem dusky, two dark patches on the upper and one on the lower branch of the fifth vein, another at the fork, and another at the base of the vein, two small dusky patches on the sixth. . . . Fringe black, with pale spots at the junctions of all the veins, except the sixth; apex mostly yellow, but with a black spot between the two branches of the first submarginal cell. Length, 3 to 3·5 mm."

In vol. iii, p. 34, two varieties are described: "umbrosa—costa black at base, unbroken by the typical small pale spot. Veins with dusky scales predominating, the pale scaled areas restricted to the region of the cross veins, and bases of the fork-cells, and on the fifth long vein; the third long vein dark, as in rhodesiensis. Wing fringe spotted as in the type. Subumbrosa—costa black at the base, unbroken by any pale spot. Dusky scales predominating, but not contrasted, as in the type, with the pale scaled areas. Third long vein pale scaled in the middle, and pale scaled areas also on the fourth, fifth, and sixth."

This species has been found in Natal, from sea level to an elevation of 4000 ft., above which we have not made search, and the larvæ have been taken, and imagines obtained from them throughout the year. It is the commonest and most widely distributed of Anophelina.

Two definite varieties are found: a smaller, of which the average measurement of detached wing is 3 mm., a larger of average measurement 3·8 mm. Intermediate sizes are also observed. Dark individuals, corresponding more or less with umbrosa and subumbrosa, are very occasionally encountered, the larvæ being captured among the ordinary type. Insects of greater and lesser measurement are about equally common on higher grounds, as at Maritzburg, 2200 ft., but in our present collection of some fifty females we have none of the larger variety from coast districts.

The width of the bands on the palpi vary considerably, and the apical band is rarely as narrow as figured in 'Monograph Culicidæ,' vol. iii, p. 36, and on that account is inadmissible as a specific distinction.

Theobald's description of the wing does not tally with his diagram on page 36, in which a lengthening of the second yellow spot on the first long vein is shown, which is not mentioned in the text. In the species as found in Natal, this feature is always present, generally as shown on Plate XXV, fig. A, less frequently as a distinct spot, separated by a few, or several, black scales from the spot beneath that on the costa. The figure is representative of the markings of both varieties, but considerable variation is found, as shown in the table below, in which we have found it more convenient to specify "pale" spots rather than "dusky" spots, seeing that black scales predominate in the second and fourth longitudinal veins. The three main white or cream spots on costa are fairly constant, the apical is always present, but varies in size, while at the base there is one spot only in 18 per cent. of our specimens; there is, in all, a pale spot on the shaft of the second and fourth longitudinal veins, though it may be very narrow, and, except in the dark varieties, there is no important deviation in the third, fifth, or sixth. In all we find a pale spot at the point of bifurcation of the second and fourth veins.

Table showing important variations in pale spots on palpi and wings of female *Myzomyia funesta*.

Number of specimens.		Number of specimens in which palpal bands are:			Presence or absence of spots[1] on:				Number in which spot occurs on fringe opposite veins:		
					1st fork cell.		2nd fork cell.				
		Broad.	Medium.	Narrow.	Anterior branch.	Posterior branch.	Anterior branch.	Posterior branch.	"4½."	"5."	"6."
Theobald's type		—	—	+	+	+	+	+	—	+	—
Large mosquitoes from upland districts—high levels	8	3	2	3	+	—	+	+	3	4	1
	4	—	1	3	—	+	+	—	—	2	2
	2	—	2	—	—	—	+	+	—	2	—
	2	—	1	1	—	—	—	—	—	2	—
Small mosquitoes: 10 from upland districts; 16 from coast level.	7	3	3	1	+	—	+	+	—	4	3
	6	2	2	2	+	—	+	—	—	4	2
	2	—	—	2	—	+	+	+	—	2	—
	2	—	2	—	—	—	+	+	—	1	1
	3	—	3	—	—	—	+	—	—	2	1
	6	—	5	1	—	—	—	—	1	3	2
	42	8	21	13	+ 21, — 21	+ 6, — 36	+ 34, — 8	+ 21, — 21	4	26	12
		42			42	42	42	42	42		

[1] The minute spot always present just at the point where the vein runs into the fringe is not included. The presence of a pale spot indicates that there are two "dusky" spots; its absence that the whole branch is dusky except at its immediate commencement as such and at its termination.

The Larva (Pl. XV).—The species was determined from over thirty specimens which were examined and identified alive, and all subsequently emerged as the same species. The drawings were made from a comparison of twelve specimens.

There are no structural differences between the larva of the large and small variety, but there is an appreciable difference in size. It is small, short, and appears rather broad for its length. When about one third of growth is attained, there is generally observable a brown central strip, while the sides are translucent; this appearance is retained to the time of pupation, if the larva is reared in captivity, but larvæ of the small variety, when full-grown or nearly so at time of collection, are commonly deeply pigmented, frequently quite black, whereas the larger are pale like younger specimens. This is probably attributable to character of food.

Antenna.—No branched hair on shaft, terminal spines equal, and between them a hair, which divides into three branches, generally, though four have been observed.

Frontal hairs.—Three pairs. Anterior constant in all specimens examined; posterior pair long and prominent, and subject to much variation (Pl. XV, fig. *a*). In one instance in a live larva four branches were observed on one hair.

Palmate hairs.—On thorax and first seven abdominal segments; on thorax of good size but rudimentary in shape (fig. *c*); on first abdominal intermediate; on other segments well developed and defined (fig. *b*, and Pl. XXIV, fig. *a*). Radius, 0·127 mm. to 0·138 mm.; relation of length of filament to total length of leaflet, including filament, fairly constant in any particular batch, varies considerably in different batches; extreme average of leaflets of individual specimens as 0·28 to 0·38 to one, and extremes of individual leaflets as from 0·22 to 0·45 to one. The larva is, nevertheless, readily distinguished from others described in this paper, by the general character of palmate hairs, position in which they occur, and above all by the features of posterior frontal; both are quite distinct from those of Nyssorhynchus pretoriensis (Pl. XIX, figs. *a*, *b*), and the former from Pyretophorus cinereus (Pl. XVII, fig. *a*) which it most nearly resembles.

James and Liston express an opinion that this species is one with listoni.[1] They represent the latter as having no posterior hairs. This would appear to negative such assumption.

Habitat.—Elective spots for larvæ; under overhanging banks of brisk streams, among bits of thick grass, etc., in eddies of similar streams, but also among grass and rushes, and in small spring waters. Not found in puddles or stagnant waters.

Season.—Perennial. In October numbers were collected from a tiny roadside spring-pool among dead bamboo leaves, by pressing down the leaves and dipping up water, but no other species was found. In January in the same spot a few funesta were gathered and great numbers of Pyretophorus costalis.

Relation to Malaria.—This larva is abundant both in malarious and non-malarious districts, but in the malaria season, in places where the disease is epidemic, we have always found costalis also, which is absent in the cooler months. The imago is found in houses, but cannot be said to frequent them as costalis does. We have not found it in dwellings of persons infected with malaria, but possibly because it is more difficult to distinguish than costalis. On the other hand, in Maritzburg a few indigenous cases of malarial fever occurred in 1906. Costalis larvæ were not found in the neighbourhood, but in the vicinity of a part where some cases were reported, funesta larvæ were collected; larvæ of N. pretoriensis, and M. paludis, however, were found at the same time, and in the same place.

Pyretophorus costalis *Loew.*

The following description is given by Theobald (vol. 1, p. 157) of certain markings of the female imago:

[1] If this species of which we describe the larva is, as Giles says, not funesta, the latter may be one with listoni.

"Palpi black scaled, apical joint yellowish white, and the apices of the two preceding also banded white, the bands being narrow.

"Legs with the femora and tibiæ brown, spotted and mottled with yellowish scales; in the fore legs the joints are broadly banded with yellow, the bands involving both sides of the joints, in the mid and hind legs these bands are not so marked, and only now and then partially spread on to the bases of the joints, the major part of the bands being apical.

"Wings with four large and two small black spots on the costa, the two median large ones are the longest; on the first long vein there is a black mark under the apical spot and two under the next costal spot and two under the next large one, a single one under the fourth; a black patch at the tip of each vein, and at the fork of the first submarginal cell. On the stem of the first submarginal cell, just at the fork and under the third costal spot, is a small patch, another on each side of the mid cross vein on the third vein, another at the fork of the fourth vein, and one on each branch of the second posterior cell, and another past the cross veins; two on the stem of the fifth, with three on its upper branch and three on the sixth; first submarginal cell longer, but little narrower than the second posterior cell. . . . Fringe black with yellow patches, where the veins join the border of the wing. Length, 3 to 4·5 mm."

Variations in wing spots are noted, particularly in the first long vein.

This is the commonest and most widely distributed of Anophelina in Natal on low levels near the sea in the warmer months of the year. We have not encountered it in inland districts, and have not found the larva before October nor later than early May.

The wing markings do not correspond in all respects with Theobald's description (*vide* Pl. XXV, fig. *b*). Twenty-four females were carefully examined; the black spot at the fork of the first submarginal cell was absent in three, and consisted of few black or brown scales on other three; there was no "black" spot at the fork of the second cell in any of the twenty-four; in six there was no pale spot on the wing fringe opposite the sixth vein; in nine an additional spot was noted between the fifth and sixth; in seven a further spot on the basal side of the sixth, and the last mentioned was observed in two, in which there was no spot between the fifth and sixth veins.

The wing pattern of this species is, however, fairly constant, and though differences are observable they are not sufficient to justify any tabular representation. The species is very readily identified. The dark scales are, in most individuals, brown rather than black, giving a general colour appearance of brown. The wing viewed through a hand lens has a rather unkempt appearance in contrast with the sleek, well-groomed aspect of funesta, and the row of small dark spots of even size at the extremity of the veins, just separated by a yellow dot from the fringe, is noticeable. The mottled appearance of femora and tibiæ is, as Theobald says, the chief character in identification. The word "mottled" very ably expresses the appearance. The legs of Pyretophorus ardensis are also spotted, but the spots are brighter in colour and sharper in outline, the distinction being enhanced by the black ground-tint in this species.

Average length of detached wing, 3·3 mm.

The Larva (Pl. XVI).—Determined on over fifty specimens, drawn from comparison of ten. This species can generally be distinguished from others described in this paper by the unaided eye. There is nothing particularly noticeable in respect of length and breadth relative to other species; both might be stated as medium, the latter a little under than over medium size; longer, but narrower, than funesta, and narrow as compared with ardensis. There is in nearly all specimens, when alive, an irregular central patch of much deeper brown, which is particularly noticeable in the second to the fifth abdominal segments. This appearance is scarcely capable of description, but has been observed in no other species.

Antenna.—No branched hair on shaft, terminal spines equal, hair divides into four.

Frontal hairs.—Three pairs. Anterior median straight with fine spicular branches, often difficult to discern in living larvæ; antero-external and posterior small, fine, and in instances bifurcate; subject to variation (vide Pl. XVI, fig. *a*).

Palmate hairs.—Relative to larva very small; average radius, 0·094 mm.; entirely absent from thorax, rudimentary on first abdominal segment (Pl. XVI, fig. *c*) well developed on second to seventh (Pl. XVI, fig. *b*; Pl. XXIV, fig. *b*). Relation of length of filament to length of leaflet, together with filament, averages as 0·34 to 1; maximum, 0·37, minimum, 0·29.

The combination of frontal and palmate hairs is quite distinctive.

Habitat.—Preferential situation rather dirty water, by reason of which this larva, much more than any other Natal species, is found covered with vorticellæ. It is found in rain-water pools, cattle foot-prints by streams and marshes, roadside puddles, especially where refreshed by a slight flow from a temporary spring, and residual pools in rocky streams, (but only very occasionally in the actual watercourse), drains and trenches in fields and marshy areas.

Season.—Summer, from October to May. The summer months happen to be the rainy season, and it may be the lack of suitable water which limits the breeding. It is noticeable, however, that, in general, the water in which it is found is quite bare of shade, and commonly quite warm to the hand.

Relation to Malaria.—Found throughout parts where malarial fever is epidemic, but not encountered where the disease is absent or sporadic; the appearance of larvæ precedes the rise in malaria incidence, which commences sharply about five or six weeks later, and sinks to minimum a few weeks after larvæ cease to be found. Almost all the imagines captured by us in infected habitations in 1905 were of this species, and in 16 per cent. sporozoites indistinguishable from those of malaria were demonstrated.

Pyretophorus cinereus *Theobald.*

Essential points in the markings of the female of this species are thus described by Theobald (vol. i, p. 161, and vol. iii, p. 78):

"Palpi quite straight, of nearly equal thickness throughout, but slightly dilated at the base owing to long scales, dark purplish brown, with four white rings, the last apical, the three median ones involving both sides of the joints, apex with a brush of golden bristles.

"Legs very thin, deep black, coxæ and trochanters very pale yellowish white, greatly contrasted with the dark femora; apex of the femora and tibiæ with a pure white spot, apices of the fore and hind metatarsi and tarsi with minute yellow apical bands, which seem absent in the mid legs; last larval joint of all three pairs rather paler than the rest, hind metatarsi longer than the tibiæ.

"Wings with the costa black scaled, with three yellow spots and yellow and black apical fringe; the yellow spots extend on to the first longitudinal, which has also yellow scales at the base and a small spot in the middle, two small ones on the upper branch of the first fork cell, one on the lower branch and one at the base, the greater part of the third vein pale with three black spots, two on the upper, one on the lower branch of the second posterior cell, and one at the base and another on the stem; two black spots on the upper and one on the lower branches of the fifth long vein, one at the fork, and another black spot near the base of the fifth vein; the sixth mostly pale with three black spots; . . . . fringe yellow at the apex, with or without two small dark spots, remainder brown, but the scales where the branches of the fourth and fifth join the border somewhat paler.

"Length, 5 to 5·2 mm."

This species is rare in Natal, only less so than Myzorhynchus natalensis. We have taken few specimens, most of them in inland districts on higher levels, but some from sea level also. Our specimens (Pl. XXV, fig. *c*) differ in wing pattern in some particulars from the description, principally in having two small yellow spots at the base of the costa and bright patches on the fringe, where the branches of all veins except the sixth join the border. We have not sufficient specimens to judge of the amount of individual variation.

Average length of detached wing, 5·2 mm., the measurement in Theobald's figure being 5·5 mm.

The species is readily identified by its large size, the predominance of very pale yellow in the wing pattern, the long thin palpi with four pale bands and the long black legs. The imago has been taken two or three times in a house in Maritzburg.

The Larva (Pl. XVII).—Determined on one specimen, drawn from two. Owing to paucity of specimens we do not write with the same absolute confidence of identity as in the case of the other species. There was, however, no room for doubt as to the larva being different from funesta, and the imago, a male, appears to be certainly cinereus.

General aspect.—A medium length larva, with long, large head, moderately pigmented in the middle strip of the body.

Antenna.—No branched hair on shaft; terminal spines equal, hair bifurcate.

Frontal hairs (Pl. XVII, fig. *a*).—Three pairs, all straight and smooth, the posterior longer and finer than of any other species of our knowledge.

Palmate hairs.—Absent from thorax, rudimentary on the first abdominal segment (Pl. XVII, fig. *c*), intermediate in character on second (that is, the hair as a whole is fairly developed, but on most leaflets the notching of shoulder is scarcely perceptible (c f. Pl. XXI, fig. *c*, 2), large, with well-defined shoulder on third to seventh segments inclusive (Pl. XVII, fig. *b*; Pl. XXIV, fig. *c*). Average radius 0·140 mm.

There is no proper filament, but a lanceolate ending tapering to a point; average relation of lancet to leaflet with lancet as 0·20 to 1; maximum, 0·23; minimum, 0·19. There is not much variation as between individual leaflets.

The larva of this species comes near to that of funesta, particularly the large variety, and jacobi. Points of distinction are that the posterior frontal hairs are relatively longer and finer than those of funesta, in which also is a rudimentary palmate hair of ten or twelve leaflets on the thorax and a well-developed hair on the first abdominal segment, and the palmate hairs are provided with definite filaments, whereas in cinereus there is no hair on the thorax, and the rudimentary hair on the first abdominal segment is smaller. (In one specimen it is very small, indeed.) There is no defined filament. The anterior median frontal hair of jacobi has spicular branches, whereas that of cinereus is smooth.

Habitat.—The few larvæ collected were found in running water—on sea level and at 2200 ft.

Season.—Perennial.

Relation to Malaria.—No evidence of any in Natal.

Pyretophorus ardensis *Power.*

This species is not described in Theobald's 'Monograph.' The following are distinctive features:

Palpi thickly clothed with dark brown scales, the tip of pale cream, and three narrow bands of the same colour, the second and third being far apart.

Legs black, all joints banded with pale yellow, the bands being wider in the larger joints and the hind legs than in the smaller joints and fore and mid legs. Coxa and trochanter very pale. Femora, tibia, and metatarsus of all legs brilliantly marked with clearly defined pale yellow or cream spots and incomplete bands, which are appreciable by the naked eye.

Wings (Pl. XXV, fig. D).—The pattern of the markings is sufficiently indicated in the figure. We have not observed much variation. The small yellow spot on the first longitudinal vein, beneath the large median black patch on the costa in some specimens merges in the adjoining yellow spot, but in most is separated from it by a few dark scales. In some a yellow spot is found in the middle of the posterior branch of the first fork cell. In some specimens the whole shaft of the fourth longitudinal vein is dark. There is a yellow spot on the dark brown fringe opposite the termination of all branches of the first five veins, except the posterior of the second, and sometimes an additional spot on the proximal side of the sixth.

Length of detached wing, 3·5 mm. to 4 mm.

This species is not common. We have found it only in three places on the higher levels, and never at sea level. It is captured in houses. Was first found by Mr. H. S. Power on his property forty miles from the coast, and we are indebted to him for information that it has received generic and specific title from Theobald. It is poorly represented in our collection, and there may be greater variety in wing patterns than we have observed.

The spotted legs cause it to resemble slightly Nyssorhynchus pretoriensis, from which the absence of white hind tarsi enables it to be readily distinguished, apart from other differences, and the dark wing scales are brown as contrasted with black in pretoriensis.

The Larva (Pl. XVIII).—Determined on three specimens, drawn from comparison of five, two being very small.

General appearance.—Of medium length, and rather sturdy build, uniform pale brown colour.

Antenna.—No branched hair on shaft, terminal spines equal, hair short, simple and undivided in the three instances in which examination could be made.

Frontal hairs.—Three pairs. Antero-external and posterior subject to variation (Pl. XVIII, fig. *a*; a_1 is the external frontal hair of a third larva).

Palmate hairs.—Very small and rudimentary on thorax, larger but still rudimentary on first abdominal segment (Pl. XVIII, fig. *c*), very large and well defined on second to seventh segments inclusive (Pl. XVIII, fig. *b*, Pl. XXIV, fig. *d*). Average radius 0·166 mm. Average relation of filament to leaflet and filament together as 0·26 to one; maximum 0·34; minimum 0·18. The palmate hairs are characteristic in exceptional length, breadth and number of leaflets, and this together with the frontal hairs make the species unmistakable.

Habitat.—Found in a quick-running streamlet under overhanging banks in company with the larger variety of funesta.

Season.—Fairly numerous in the one stream in April, May, June and Sept., 1905, rare in Jan., Feb., May, 1906.

Relation to Malaria.—No evidence of any connection.

Nyssorhynchus pretoriensis *Theobald.*

Theobald (vol. III, p. 99) writes as follows:

"Closely related to N. maculipalpis, but the palpi are not mottled and are somewhat longer; the two white apical bands are farther apart. The hind tarsi have also different ornamentation; the second hind tarsus has a small black patch near its base; the metatarsus is mottled with white and black, and has a broad white apical band like the first tarsal. The last two hind tarsi only being all white.

"It is subject to much variation.

"One specimen in the series has the last palpal joint black at the base, so there are four, not three, pale bands; the wings are also darker scaled, the third long vein being entirely black."

The legs and wings of N. maculipalpis are thus described (p. 97):

"Legs black, with the femora and tibiæ, and to some extent the metatarsi, with small clear white spots, first fore tarsi with apical white bands, mid-tarsi plain; in the hind legs the last three and apex of the first tarsi pure white.

"Wings clothed with mostly dusky-black narrow elongate slightly clavate scales, with some white areas, as follows: On the costa five pure white spots, the two apical ones and the fourth spreading on to the first long vein, which is also white at the base, a small white patch on the lower branch of the first fork cell, a few white scales at the base of the fork; a small white spot about the middle of the third long vein, and another near its base; one small white spot on each branch of the second fork cell, and one at the base; three fair-sized white spots on the upper, and one large one on the lower branch of the fifth, and two on the stem; apex and base of the sixth white, and a broadish median white spot; fringe apparently all black.

"Length, 5·5 mm."

This species is not frequently found in Natal, and its breeding grounds appear restricted. It has occasionally been found by us inland at level 2,200 ft., and rarely at sea level or thereabout. The wing (Pl. XXV, fig. *e*) corresponds closely to Theobald's description, except that there are pale spots on the fringe opposite the terminations of all veins, other than the lower branch of the first fork cell, and in one instance, the sixth. The coast specimens are darker than those from inland, and have one small white spot on first longitudinal vein under the long black costal patch as against two in inland specimens. The size varies somewhat, but not so much as in *funesta*.

Average length of detached wing 3·8 mm.

Following table shows important variations in ten females:

Number of specimens.	Number of bands on palpi.	Number with a spot on lower branch of first fork cell.		Size of spot in middle of third long vein.			Proportion of second hind tarsus white.		
		Spot.	No spot.	Large.	Small.	Absent.	$\frac{1}{2}$.	$\frac{2}{3}$.	$\frac{3}{4}$.
5	3	3	2	3	1	1	3	0	2
5	4	3	2	2	2	1	2	2	1
		6	4	5	3	2	5	2	3
10		10		10			10		

The Larva (Pl. XIX).—Determined on fifteen specimens, drawn from comparison of eight of different sizes and five last moults.

General aspect.—About the same size and dimensions as funesta; translucent at sides, brownish in middle.

Antenna.—No branched hair on shaft, terminal spines equal, hair divides into three. Theobald presents it with six branches, besides the termination of the stem. We are unable to make out more than three in any of our specimens in which satisfactory examination is possible. Theobald also states that the spines are unequal, which does not concur with our experience. From this it follows either that this hair is variable and of no specific value, or that, despite the close similarity to his pretoriensis of the imago which we represent, it is really a distinct species.

Frontal hairs.—Remarkably uniform; posterior pair relatively short and fine as compared with unbranched posterior hairs in funesta (Pl. XIX, fig. *a*; Pl. XV, fig. *a*).

Palmate hairs.—Absent entirely from thorax, rudimentary on first abdominal segment (Pl. XIX, fig. *c*) well developed, but relatively small for size of larva on second to seventh inclusive (Pl. XIX, fig. *b*; Pl. XXIV, fig. *e*). Average radius, 0·088 mm. Average relation of length of filament to total length of leaflet, together with filament, as 0·26 to one; maximum, 0·38; minimum, 0·20. The contour of the "shoulder" is somewhat variable in this species, and in some specimens the filament is less tapered, and terminates in an abrupt widening of the leaflet with fewer notches at the "shoulder."

This species is recognised by the three pairs of smooth frontal hairs, the absence of any palmate hair on the thorax, and the relatively small size of these hairs on the abdominal segments. These features of the palmate hairs differentiate it effectively from funesta.

Habitat.—Found in slowly-running water in ditches in October, March, April, May, at one place near sea level and in one locality at 2200 ft.

Relation to Malaria.—No evidence of any.

Cellia squamosa *Theobald.*

Theobald (vol. i, p. 167) thus describes certain features of the female of this species:

"Palpi densely scaled with deep brown scales, which stand out from the surface like A. sinensis, with a few white ones here and there, forming also three narrow bands, one apical.

"Wings with the costa deep black with three distinct very small white spots, two smaller basal ones and two small apical ones, some of these spots pass but very indistinctly into the first long vein; most of the veins dark scaled, the lateral scales being clavate, always dark but paler on the white areas of the vein; the median scales are creamy white on most of the third long vein, the black forming three spots; a small patch on each branch of the second fork cell, a large patch on each branch of the fifth vein, and another on the stem, and two large patches on the sixth long vein; fringe uniformly brown, the lateral scales, even on the pale areas, are very dusky, so that the creamy spots on the wing field do not show up very strongly.

"Legs with the femora dark brown, tibiæ and metatarsi of the fore legs mottled with numerous white scales, also the apex of the first and second tarsal joints of the fore and mid legs broadly white banded; hind legs with the femora swollen, dark brown with white patches, one large patch near the apex, the extreme apex white; tibiæ mottled black and white; metatarsi apically banded, and also the next three tarsal joints, the last black.

"Length, 5 to 5·5 mm."

The genus Cellia is by no means common in Natal. We have encountered two species; the one, of which a wing is reproduced (Pl. XXV, fig. *f*) corresponds fairly accurately with Theobald's description of squamosa. On the first longitudinal vein, however, are two minute additional white spots, not mentioned in the description, and a large spot on the posterior or lower branch of the first fork cell, of which no mention is made, whereas in Theobald's figure is shown a spot on the anterior or upper branch which is not alluded to in the text. The wing figured in 'Monograph of the Culicidæ' is 3·9 mm. in length, that of Natal specimens but little over 3 mm. In the light of the great variation in size which we find in funesta and paludis, this appears to be no obstacle to placing our specimens in the same species. We have but few, and are unable to state how much variation in wing pattern occurs; but we may note that we have observed one specimen with an additional white spot on the fringe opposite the termination of the third longitudinal vein, and a second with yet another spot opposite the anterior branch of the second fork cell. There are also observed in some specimens four narrow white bands on palpi instead of three.

The Larva (Pl. XX).—Determined on four specimens, drawn from comparison of four.

General appearance.—A slender larva with much pigment in median strip.

Antenna.—No branched hair on shaft, terminal spines equal, hair divides into three branches.

Frontal hairs.—Three pairs; anterior median and posterior vary (Pl. XX, fig. *a*). In three of the four specimens the external hair is dendriform (Pl. XX, fig. *d*), in the fourth (fig. *e*) it is rather penniform in shape. This larva was taken from a small collection, of which some five or six developed into imago of squamosa. The exact shape of the hair is scarcely appreciable under a lower magnification than × 100, and is readily overlooked, and can scarcely be differentiated in the living larva. There is no other difference.

Palmate hairs.—Rudimentary on thorax (Pl. XX, fig. *c*), well developed on the first abdominal segment and exceptionally large second to the seventh inclusive. The leaflets are relatively narrow and few, about sixteen in number (as in jacobi) in contrast to ardensis, in which they are broad and numerous, about twenty-five. Average radius 0·144 mm.

Average relation of filament to total length of filament and leaflet as 0·36 to one; maximum, 0·40; minimum, 0·35.

Habitat.—Found occasionally on coast and at levels of 2000 ft. to 2800 ft., once in residual pools in a river bed, and three times in marshy pools directly fed by small springs.

Season.—April to October.

Relation to Malaria.—No evidence of any.

Cellia jacobi *n. sp.*

We have not found any description tallying with this species. It may be described in the following terms:

A large black and white mosquito with spotted legs. Palpi thickly covered with bushy black scales, a few white interspersed; irregular white bands at apex and last joint, a very narrow band about the middle, and a few white scales in an incomplete ring between that and the base. A tuft of white hairs on the clypeus overhanging origin of palpi.

Thorax of sepia, with clothing of narrow curved white scales forming three distinct longitudinal bands; three white bands on lateral aspect of thorax; abdomen black, thickly covered with narrow curved yellow scales and long golden hairs; a thick lateral tuft of black scales on second to seventh segments.

Legs: Coxa and trochanter dark grey, flecked with white scales. Femur and tibia thin, white scales predominating over black, a few white flecks on black metatarsi; white bands at apex of metatarsus, and all tarsi, except in the fore and mid legs the third; tip of last tarsus white in all legs.

Wing (Pl. XXV, fig. *g*): Costa is black; there are three main white spots, which are small; a fourth still smaller at the apex, and two white dots at the base. First longitudinal vein black, one white dot at base, a white spot under each of the four remaining costal spots, mostly smaller than the latter, and a minute group of white scales in the two long black strips. Second longitudinal vein black, a white spot at the fork, and a large white patch on the posterior branch of the first fork cell; third vein mostly white with a black spot at each end; fourth vein black, a white spot near the fork, which also is white, and a large white spot on each branch of the second fork cell, and at the tip of each branch; fifth vein mostly white, a black patch on the stem and at the fork, two on upper and one on lower branch; sixth vein white with three black spots. On the second and fourth veins white scales are interspersed with black in some specimens. Fringe black, with a white spot opposite termination of all branches of veins except second.

Length of detached wing, 4·5 mm.

The principal variations noted in nine females are: Very few white scales at fork of second longitudinal, the stem of the fourth vein almost all or entirely white, and three white spots on the first vein additional to costal spots, instead of two.

The Larva (Pl. XXI).—Determined on three specimens, drawn from one preserved and two living.

General aspect.—Large, deeply pigmented.

Antenna.—No branched hair on shaft, but a prominent curved spicule about one third of length from base on antero-external aspect; spines equal, terminal hair divides immediately into three.

Frontal hairs.—Variations as shown in Pl. XXI, fig. *a*; the spicular branches on the anterior median are difficult to discern with low powers.

Palmate hairs.—Absent from thorax, very fine and rudimentary on first abdominal segment (Pl. XXI, fig. *c*, 1), rudimentary but functionally active on second abdominal (Pl. XXI, fig. *c*, 2), well developed and well defined with broad leaflet on third to seventh inclusive. Average radius, 0·108 mm., leaflets fifteen to eighteen, relation of filament to length of filament and leaflet as 0·20 to one, maximum 0·24, minimum 0·14; in the latter there is really no filament at all.

Habitat.—Found in small springs at sea level in one neighbourhood only.

Season.—Cold weather.

Relation to Malaria.—No evidence of any.

Myzorhynchus paludis *Theobald.*

In 'Monograph of the Culicidæ,' the following descriptions of certain parts of the female are found (vol. i, p. 128):

"Palpi densely scaled with black scales, with four narrow rings of white scales.

"Legs yellowish, with dark brown scales, the apices of the metatarsi and first tarsal joints of the fore and mid legs with a fine yellow band; hind legs with the metatarsus very long, and the extreme tip of the first tarsal joint white, the other three joints pure white.

"Wings clothed with yellow and black scales; the costa dark, broken by two small yellow spots, one near the apex, and the other about a third of the length from the apex, the apical spot extending on to the first long vein and the upper fork of the second long vein, the other spot passing on to the first long vein only; there is a yellowish spot farther back on the first long vein, which does not, however, reach the costa; fringe just as in sinensis."

Of the fringe of sinensis is written:

"Fringe yellow at the apex, a small black patch separating it from the costal spot, a pale patch where the lower half of the fifth vein joins the border, all the rest dusky violet black, except the border scales, which are pale yellow in reflected light.

"Length, 5 to 5·5 mm."

On page 129, vol. i, is found the following on Anopheles paludis, variety similis:

"Palpi densely scaled with black scales, with two, three or four rings of white scales; the apex usually white.

"Legs ochraceous, clothed with deep brown scales, with a bright ochraceous sheen in some lights; the apex of the metatarsi and first two tarsal joints of the fore and mid legs apically banded white, and also, to some extent, may be seen a white basal patch on the metatarsi. In the hind legs the metatarsi are broadly white banded at the base and apex, and the apex of the first is also banded white; the second is almost all white, save a small black basal band, last two pure white.

"Wings densely clothed with black and yellow scales, the former predominating, so that the wings look sooty black. . . . The black scaled costa has two small white spots, one near the apex; this spot extends on to the first long vein and the upper branch of the first submarginal cell; the second costal spot just touches the first long vein. There are also small pale scaled areas on the lower branch of the first submarginal cell, on each of the branches of the second posterior cell, a few pale scales on the bases of the fork cells, and on the third long vein. On the upper branch of the fifth are two small pale areas, the lower branch and stem being mostly pale scaled. The sixth pale scaled with two black spots. Wing fringe entirely brown, the border scales yellowish.

"Length, 5 to 5·5 mm."

Vol. iii, p. 85, this variety is elevated to the dignity of a distinct species, Myzorhynchus mauritianus *Grandpre,* and the following remarks are made:

"The species is quite distinct, and may be told by the four palpal bands, by the last two hind tarsi only being all white, and the absence of the pale wing spot, and thus differs from paludis *Theobald.*"

It may be that the species are quite distinct to the describer, thoroughly familiar with both, but the descriptions would certainly not enable a distinction to be made. Distinction of colour as between white and yellow is not constant. In vol. i it is stated that paludis has four white palpal bands; there are three pale wing spots mentioned as found in paludis, which are not mentioned in the account of paludis, variety similis, viz: one on the first long vein further back than one third of the length from the apex, one on the fringe at the apex, and one at the termination of the lower branch of the fifth vein. Which of these is the pale wing spot, of which the absence distinguishes mauritianus from paludis? The apical spot, too, is absent from fig. 26, p. 129, representing paludis. The remaining point is that in paludis the whole of the second tarsus is white, but in mauritianus there is a small black basal band. This appears to be a refinement.

One or other, or both, is, or are, largely represented in our collection, and thirty-seven females have been carefully examined and the results tabulated. The wings of some are sooty black, of others of a deep sepia. There is much variation in the length of the detached wing, the smallest 3·4 mm., the longest 5·0 mm. (Pl. XXV, *h, k, l*). In all save five there is a spot at the apex, in some quite small, in others very broad; in three there is no spot at all on the costa near the apex; in other two it is very minute. In eight the costal spot one third of the length from the apex is absent, and in these and further twenty-six there are no white scales on the first longitudinal vein at this point. The proportion of the second hind tarsus, which is white, varies from one sixth to seven eighths, or almost all. Differences are set forth in the table, in which it is not possible to represent the marked difference of size of spots, which is very noteworthy.

The variations, as shown in the table, are characteristic of this species in Natal, of which we have examined several score of specimens. They are quite as great as between Theobald's paludis and his mauritianus, and between specimens with any one spot and those deficient in it there is a continuous gradation. Seeing that we have been able to detect no difference in dozens of larvæ examined, we are forced to the conclusion that our collection represents one species only. Whether that species is paludis or mauritianus we are quite at a loss to determine, and have, therefore, retained the earlier designation of Theobald.

The species is very common and widely distributed, falling little, if at all, short of funesta in this respect. It is not infrequently found in houses with onset of cold weather.

The Larva (Pl. XXII).—Determined on over twenty specimens, drawn from comparison of ten of different sizes.

General aspect.—A large larva with small head, which, Table showing different Combinations of Pattern in Thirty-seven Specimens of Female paludis.

	Size of specimen.			White spots on wings. Costa.			1st long vein.			1st fork cell.		3rd long vein.			2nd fork cell		Number in which proportion of 2nd hind tarsus white.						
	Large[1]	Medium.	Small.[1]	At apex.	Near apex.	⅓ from apex.	Near apex.	⅓ from apex.	⅔ from apex[2]	Anterior.	Posterior.	Large.	Small.	No definite spot[3]	Anterior.	Posterior.	1/6	1/4	1/2	2/3	3/4	7/8	8/8
Theobald's type "paludis"	+	—	—	—	+	+	+	+	+	+	+	—	—	+	+	+	—	—	—	—	—	—	+
Theobald's type "mauritianus *Grandpre*"	+	—	—	—	+	+	+	+	—	+	+	—	—	+	+	+	—	—	—	—	—	+	—
Number of specimens. 26	5	9	12	26	26	26	26	2	12	26	26	4	7	15	24	22	—	—	11	8	5	2	—
3	—	2	1	—	3	3	3	—	—	3	3	—	—	3	2	1	—	—	1	2	—		—
3	1	1	1	3	3	—	3	—	1	3	3	2[4]	—	1	2	2[5]	—	2	1	—	—	—	—
3	1	2	—	3	—	—	3	—	1	2	3	3[4]	—	—	2	3	1	2	—	—	—	—	—
2	1	—	1	—	2	—	2	1	—	1	2	2[4]	—	—	2	2	1	1	—	—	—	—	—
Present . .	—	—	—	32	34	29	37	3	14	35	37	11	7	19	32	30	—	—	—	—	—	—	—
Absent . .	—	—	—	5	3	8	—	34	23	2	—				5	7	—	—	—	—	—	—	—
	8	14	15														2	5	13	10	5	2	—
Totals . 37	37			37	37	37	37	37	37	37	37	37			37	37	37						

[1] Compare figs. *k* and *l*, Pl. XXV. [2] This spot in most instances consists of some five or six white scales only. [3] The centre of the vein is to greater or less extent white or yellow in all instances. [4] Almost entire vein yellow or white scaled. [5] In one a spot on each branch; in one on anterior and not posterior; in one on posterior and not on anterior.

when mature, has a sturdy appearance, but when immature looks slender, in part due to deficiency of pigment at the sides, a feature commonly retained throughout in captivity. The full-grown larva is generally richly pigmented in its entire breadth, and exhibits greater colour variations than any other; many specimens are dense black, others brown, brick-red, yellow, green, and even occasionally cobalt. It does not thrive in captivity, and, although living for many weeks, grows very little, and seldom, if not nearly full-grown at time of capture, undergoes metamorphosis to pupa. A feature in its behaviour is quiet submission to microscopic examination, a treatment commonly resented by other species.

Antenna.—A multibranched plumose hair on intero-anterior aspect of shaft, about one third of distance from origin. The number of divisions was eight in eleven of thirteen counted, but in one specimen ten were counted on one side and eleven on the other. (This specimen also exhibited a peculiar hair on the first abdominal segment). Terminal spines equal, and the hair commonly divides into six, but of seven counted eight were found in two and ten in one, and the number was not constantly symmetrical.

Frontal hairs.—Three pairs. Anterior (Pl. XXII, figs. *a*, *d*) constant in all specimens, only slight modifications in the branching of the dendriform being observed. Posterior pair very small and difficult to distinguish, and exhibiting variation (Pl. XXII, fig. *a*).

Thorax.—Median hairs overlapping the occiput, which are constant in the other species which we describe, are absent from this.

Palmate hairs.—Rudimentary but large on thorax (Pl. XXII, fig. *c*), smaller and still rudimentary in character, though stronger, on first and second abdominal segments, well developed and with definite notching on third to seventh segments inclusive (Pls. XXII, *b*, XXIV, *h*). Average radius, 0·116 mm. There is no filament, but a jagged lanceolate termination of characteristic pattern. This is not observed in rudimentary hairs on thorax and first two abdominal segments, the outline of which is quite smooth to the tip. In the young larva in most, but not in all, cases, the palmate hairs are quite transparent, with exceptionally sharp outline ; in the mature larva on the third to seventh segments they are highly pigmented, except in the distal one third, which remains quite clear; the hairs on the first two abdominal segments and the thorax do not acquire pigment, and owing to this may readily be overlooked in the live larva. In the dead the hairs on the lower segments are commonly expanded, but on the anterior and thorax always collapsed, on which account and by reason of flimsy texture they may not be noticed. We have frequently needed to employ brilliant illumination through the body and relatively high powers for demonstration, but have invariably discovered them. Pl. XXIV, fig. *l*, shows a larva of this species with palmate hairs of the first four and the seventh abdominal segments in action; the different character of the first two is well shown, particularly by the shadow on the surface of the water. The plate has been accidentally scratched, and an appearance as of a thin hair arising from the thorax caused, but inspection with a lens shows its nature.

A very curious feature has been observed in three individuals only, which appears to have no specific importance—a large delicate dendriform hair on the first abdominal segment (Pl. XXII, fig. *f*). This overlies the palmate on a higher plane, with origin nearer the middle line (the palmate hair is shown on one side only of Pl. XXII) ; the branches are quite transparent, and in examination of a living larva, if the palmate came at once into focus, might probably be missed. It was first observed in one larva of a small batch, but not in other six gathered at the same time. The collection of preserved larvæ was then examined minutely, and this feature found in one only. More were collected from the pool from which the latter had been taken, but of thirty the dendriform hair was observed in one only, and in ten gathered from another source in none. Imagines were obtained from the two ; both were males but no differences could be detected between them and other males in which its absence had been ascertained. It is strange that so remarkable a feature should have no specific or other importance.

The larva of this species, whether it be paludis or mauritianus, differs from barbirostis, as figured by James and Liston, in the relative thickness and number of branches in the dendriform frontal, in the presence of posterior frontal hairs, and in the character and position of palmate hairs. We have not observed branching of median anterior hairs. The two species must, therefore, be deemed quite distinct.

Habitat.—Rarely, if ever, found in water in which grass and weeds were not growing, otherwise in stagnant (occasionally), very slow or steadily flowing water, clean or polluted, but not actually foul. It is generally possible by the appearance of water to predict whether this species will be found or no. For the most part one only, and rarely more than three mature larvæ will be taken at a single dip. Widely distributed from sea level to 4000 ft.

Season.—Perennial.

Relation to Malaria.—Found in areas of epidemicity, where costalis is more common in the summer, and in places where the disease is of sporadic occurrence, in which, however, funesta is also found.

Myzorhynchus natalensis *n. sp.*

No description, even approximately, representing the characters of this species is found in 'Monograph of the Culicidæ,' or Giles' 'Revision of the Anophelinæ.' It may be thus described:

A medium-sized mosquito, of which the general aspect is black with white and yellow markings; legs brilliantly spotted and banded, hind tarsi white. The closely-set, broad lanceolate scales on the wings and the scaly palpi clearly place it alongside of paludis, that is to say, in the genus Myzorhynchus, although we are unable to detect any ventral scales, as specified in Theobald's description of the generic features.

The female.—Palpi black, scales long and copious at the base, shorter and smoother in the distal portion. Tip white, and in addition four narrow white bands, about equi-distant from one another; first from apex narrower than the second and fourth, and the third very thin indeed, and barely perceptible in some specimens. There are a few white curved scales on the head, but no tuft. Thorax black with the dorsum grey, clothed with short golden hairs, scutellum dark grey, halteres black at extremity. Abdomen black, clad with long golden hairs. No scales observed on the ventral aspect.

Wing (Pl. XXV, fig. *m*; owing to density of scales the contrast of dark and light cannot be adequately reproduced in a photograph, as in most species).—Prevailing colour black with white and yellow markings, the former on the anterior border, the latter in the wing veins. Scales broadly lanceolate, rather longer than in paludis, to which it has the further similarity that light scales are mixed with the dark here and there without forming definite spots. Costa black; a small white spot one third or so of the length from the base, a larger spot two thirds of the length, and a third, which is small, at the commencement of the curve of the wing; a fourth extending to the apex. On the first longitudinal vein are two yellow spots near the base, and white spots beneath the costal spots, with a small additional white mark a little on the distal side of the first costal. Second longitudinal vein black, two small yellow spots opposite to the second costal spot; first fork cell long and narrow, a yellow dot at the end of each branch. On the third longitudinal vein black and yellow scales intermingle, the former predominating in some specimens, the latter in others, hence the number and size of definite spots vary, and is not symmetrical. The stem of the fourth vein is black; there are numerous yellow scales about the fork cell, which may, or not, form definite spots at the bifurcation, and on either branch. The stem of the fifth is mostly black with yellow patches near the base and at the bifurcation; variable yellow spots on the anterior, and a large yellow patch on the posterior branch. Sixth longitudinal vein yellow and black alternately. Fringe black, a golden spot opposite termination of all veins, and in some instances a light patch on the proximal side of the sixth. The number of actual spots other than on costa and first longitudinal vein is uncertain and asymmetrical.

The male.—Wing is less thickly clad, and the proportion of yellow scales is always higher.

Length of detached wing, 3·8 mm. to 4·2 mm.

Legs.—Black; femur and tibia of all brilliantly spotted with pale yellow, and the metatarsus banded with three or four bands of white or pale yellow. On the fore legs is a broad white band at the apical extremity of the metatarsus, and all tarsal segments, except the fourth; the hind legs similarly adorned, but the apical band of the first tarsus very broad, and the distal two thirds to one half of the second, and the third and fourth snow-white. In the mid-legs there is a barely perceptible apical ring on the tarsal segments. Knees black in all legs.

This species is very rarely found, and we have insufficient specimens on which to base a table of wing-markings. It is quite unmistakable; although at first sight, under a magnification of × 10, it resembles Nyssorhynchus pretoriensis, the character of the wing scales immediately shows the difference.

The Larva (Pl. XXIII).—Determined on ten specimens, drawn from comparison of eight and five last larval moults.

General aspect.—A large larva, deeply pigmented generally with dark brown, very like in shape to a three-parts grown paludis; in water it looks slim, but measurement proves the thorax exceptionally broad as contrasted with the small head, and in this respect also it resembles paludis.

Antenna.—There is no branched hair on shaft. Spines equal, terminal hair divides generally into six or eight branches.

Frontal hairs (Pl. XXIII, fig. *a*).—Median anterior fairly constant, with slight variations in number and position of spicular branches shown in drawings; external and posterior very fine and variable.

Palmate hairs.—Large with very long fine filament; rudimentary in shape but with numerous leaflets on thorax (Pl. XXIII, fig. *c*), with a well-defined long filament on first abdominal, but notching at shoulder indistinct and hair generally folded in death; well developed on second to seventh segments inclusive (Pls. XXIII *b*, XXIV *k*). Average radius, 0·166 mm.; maximum 0·187 mm.; minimum 0·154 mm. Relation of filament to combined length of filament and leaflet as 0·33 to one; maximum 0·38; minimum 0·28. It comes near to ardensis, but the general shape is different, and the filament of palmate hairs longer and finer, while the terminal hair on the antenna of ardensis is simple.

Habitat.—Only found three times, once near sea level, twice at 2200 ft., in both situations in eddies in fast-running streams, about shoots of grass and rushes.

Relation to Malaria.—No evidence of any.

DESCRIPTIONS OF PLATES XV—XXVI,

Illustrating Mr. Ernest Hill and Mr. L. G. Haydon's paper on "A Contribution to the Study of the Characteristics of Larvæ of Species of Anophelina in South Africa."

All the figures are on precisely uniform scale. All figures of larvæ and parts are taken from mature specimens unless otherwise stated.

Drawings are taken from the dorsal aspect of larva, and all hairs, which are fairly appreciable at the magnification employed, and which can suitably be brought in from the dorsal aspect, are represented.

Measurements.—A micrometer scale was applied to every detail, although lack of uniformity of plane in some precludes absolute accuracy.

Palmate hairs.—Radius measured from origin of stem on body to extremity of filament or sharp end of leaflet in direct line with the stem. Leaflet for comparison with filament from origin on stem to end of filament. Filament from tip to level of first notch on shoulder on distal extremity. N.B.—Photographs of palmate hairs are necessarily taken from dried specimens mounted in balsam. There is some shrinkage in preparation, which makes a little difference in appearance. The drawings are taken from specimens preserved in formalin. Some points are brought out better in the latter, and on this account both drawing and photograph are reproduced.

PLATES XV—XXIII.

From drawings. Main figure: dorsal aspect of head, thorax, and first three abdominal segments of larva. Figures: (*a*) frontal hairs; hairs represented on opposite sides in corresponding positions of the plate are taken from right and left of the same larva; (*b*) palmate hairs; (*c*) rudimentary palmate hairs; (*d*, *e*) frontal hairs further enlarged; (*f*) dendriform hair on first abdominal segment of rare specimens of Myzorhynchus paludis; (*c* 1, *c* 2) rudimentary hairs on first and second abdominal segments of Cellia jacobi.

PLATE XXIV.

Reproductions of photographs of (*a*—*k*) palmate hairs of larvæ. (*a*) funesta; (*b*) costalis; (*c*) cinereus; (*d*) ardensis; (*e*) pretoriensis; (*f*) squamosa; (*g*) jacobi; (*h*) paludis; (*k*) natalensis. (*l*) larva of Myzorhynchus paludis at surface of water.

PLATE XXV.

Reproductions of photographs of (*a*—*m*) wings of female imago. (*a*) funesta; (*b*) costalis; (*c*) cinereus; (*d*) ardensis; (*e*) pretoriensis; (*f*) squamosa; (*g*) jacobi; (*h*, *k*, *l*) paludis; (*m*) natalensis.

PLATE XXVI.

Reproductions of photographs of: (*a*) funesta: head and palpi; (*b*) costalis: head and palpi; (*c*) cinereus: head, palpi, and part of hind leg; (*d*) ardensis, head, palpi, and legs; (*e*) pretoriensis:[1] head and palpi, part hind and mid legs; (*f*) squamosa: head and palpi; (*g*) jacobi: head and palpi; (*h*) paludis: head and palpi; (*k*) paludis: hind tarsi; (*l*) natalensis: head and palpi; (*l* 2) natalensis: legs.

[1] In specimens obtained from larvæ captured at sea level there is a broad black band at the proximal extremity of the third hind tarsus, which has not been found in specimens taken on higher levels. The photograph was taken from a coast specimen.

Magnifications.

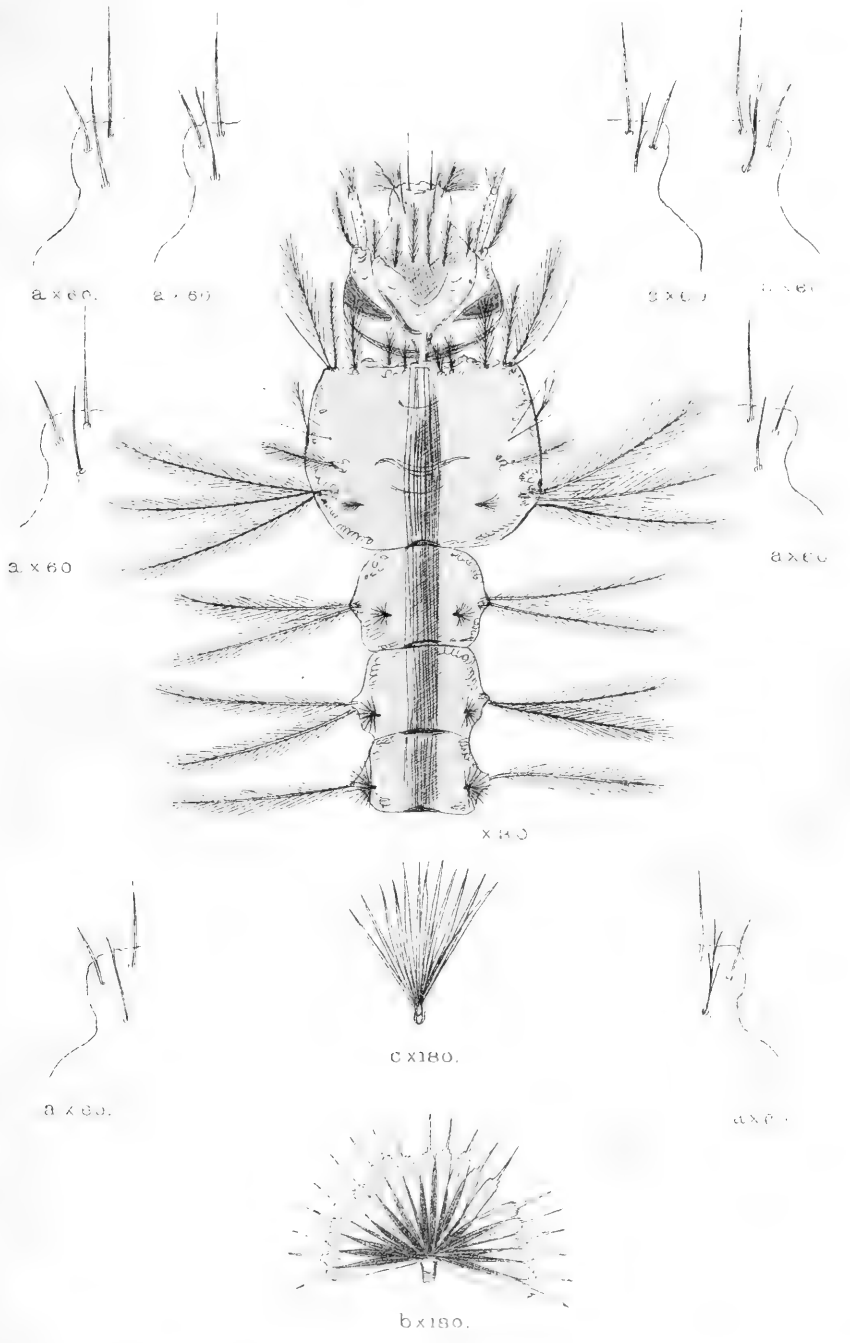
Plates XV—XXIII, main figure × 30. (*a*) × 60. (*b—f*) × 180. Plate XXIV (*a—k*) × 180; (*l*) × 3 (about). Plates XXV and XXVI. all figures × 15.

Drawings from Immature Larvæ.

Plate XVIII.—(*a*) Lower figures; very small larvæ.

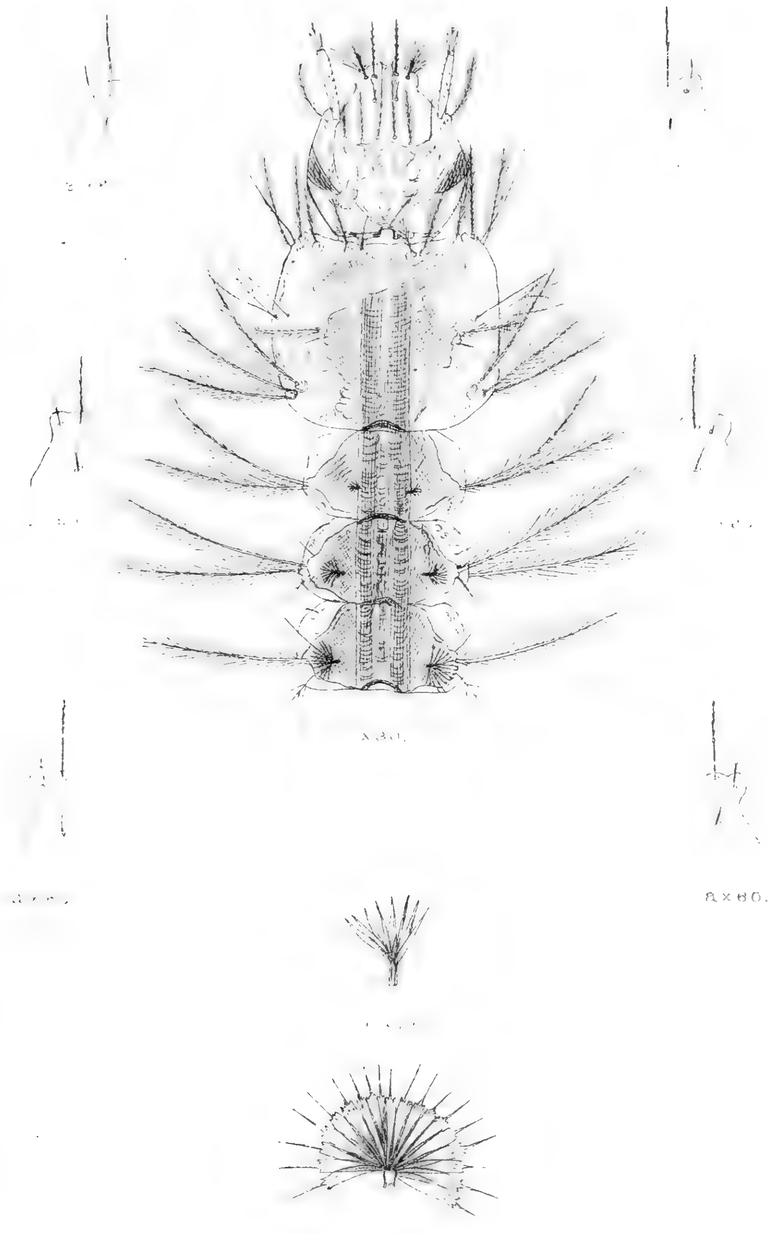
Plate XX.—(*a*) Two lower figures, one half, and three quarters grown.

Plate XXIII.—(*a*) Three lower, two one half, and one three quarters grown.



E Hill, del.   Huth Lith[r] London.

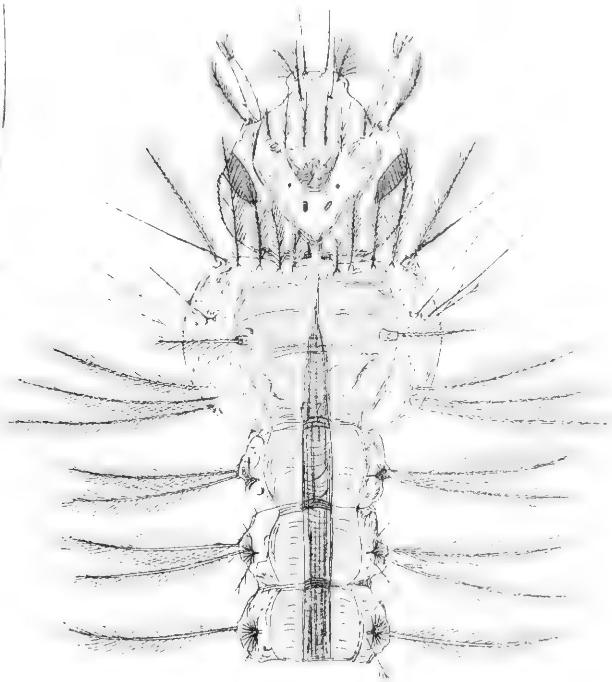
MYZOMYIA FUNESTA *Giles.*



E. Hill, del. Huth Lith.r London

PYRETOPHORUS COSTALIS *Loew.*

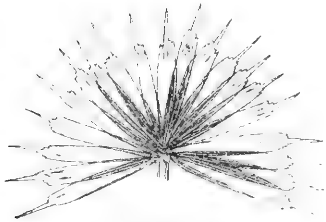
a x



x 30

a x 60

c x 180.

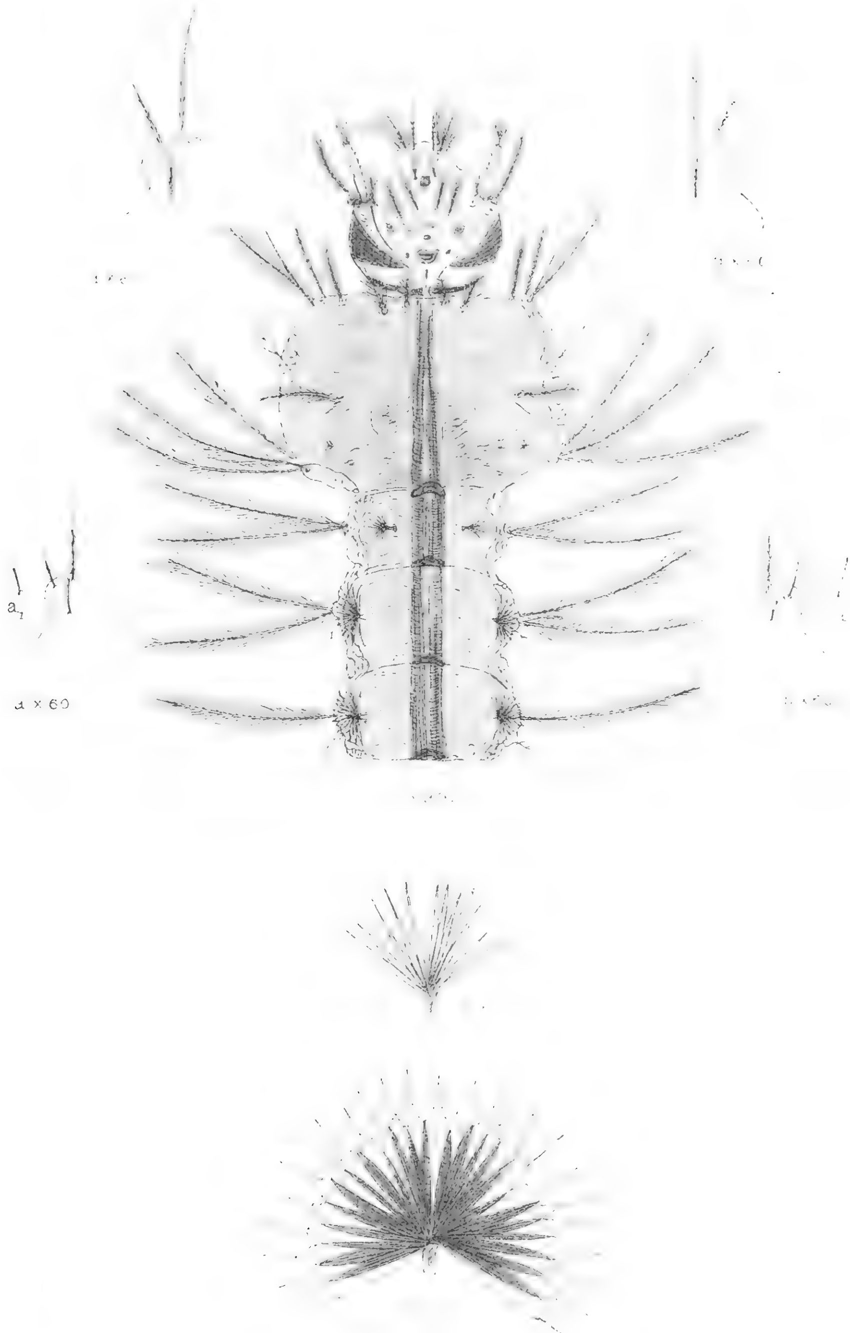


b x 80

E. Hill, del.

Huth Lith

PYRETOPHORUS CINEREUS *Theobald.*

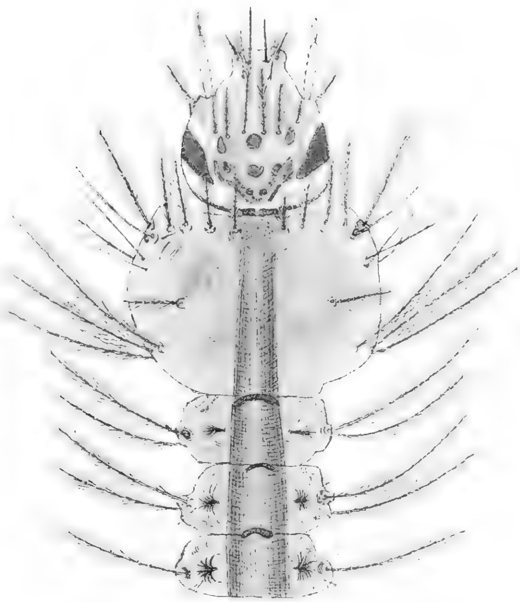


b × 180

E. Hill, del. Huth Lith^r London.

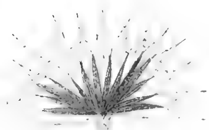
PYRETOPHORUS ARDENSIS *Power.*

a. × 60.



× 30

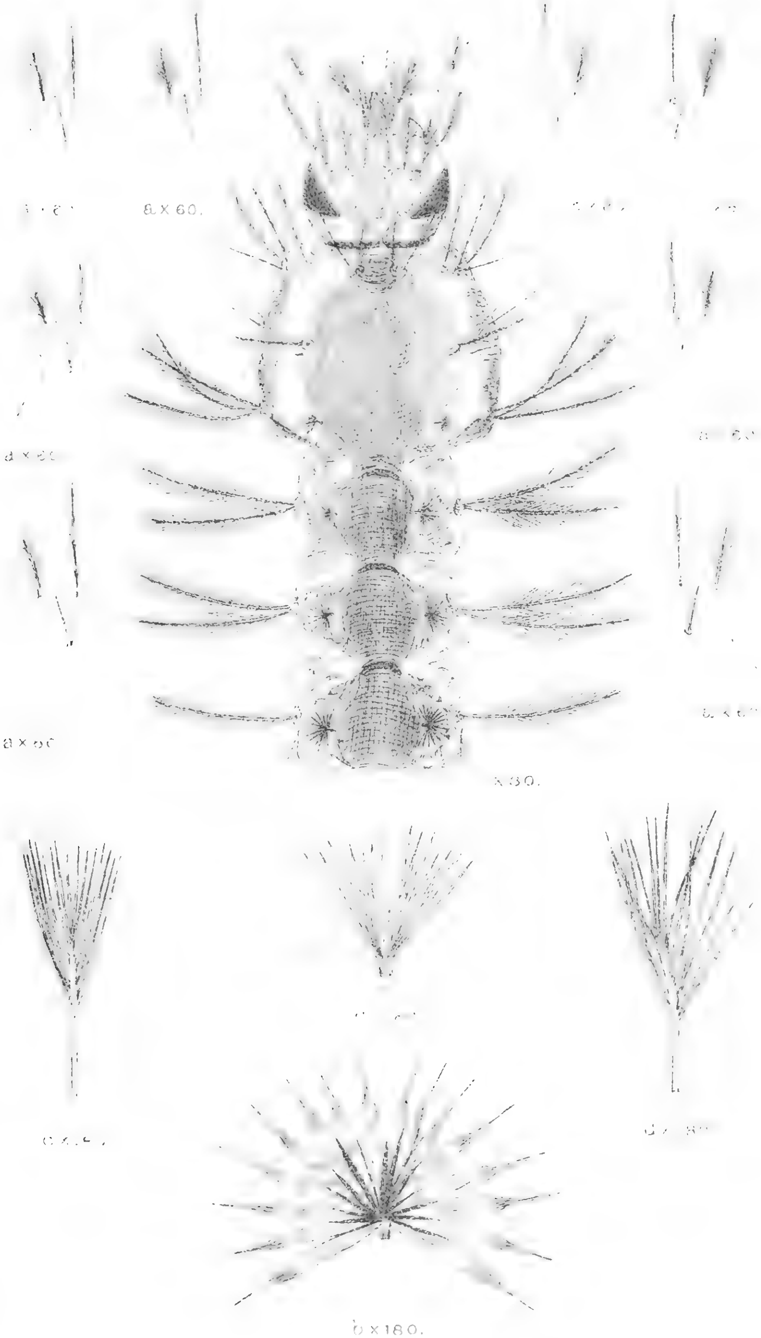
c × 180



b × 180

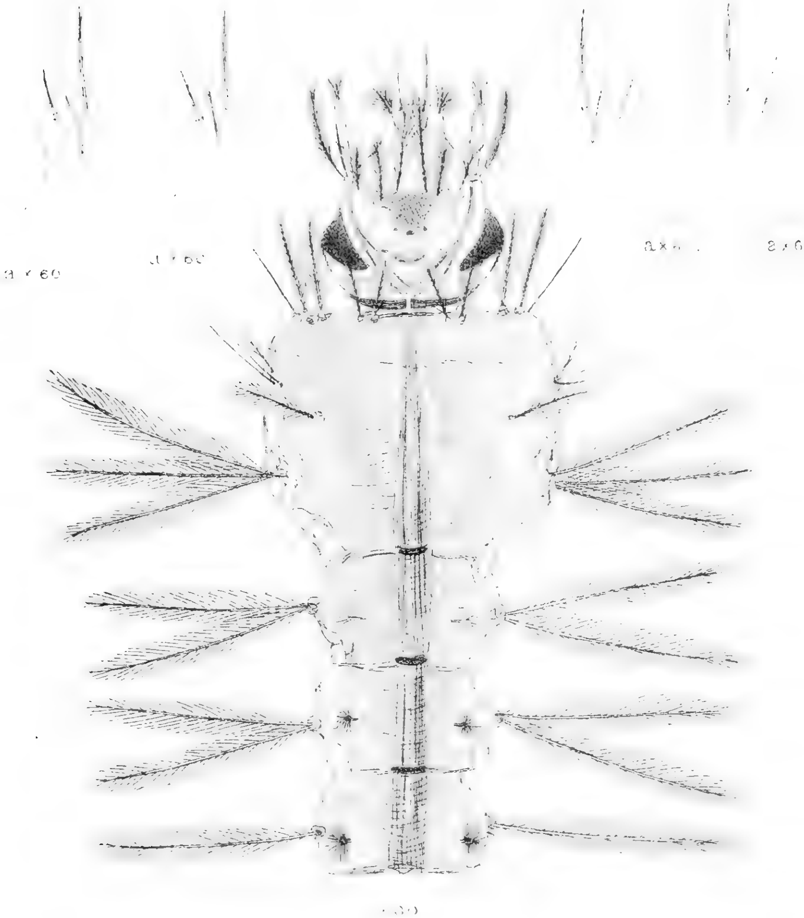
E. Hill del. Huth Lith^r London.

NYSSORHYNCHUS PRETORIENSIS *Theobald.*



E. Hill del. Huth Lith[r] London.

CELLIA SQUAMOSA *Theobald.*

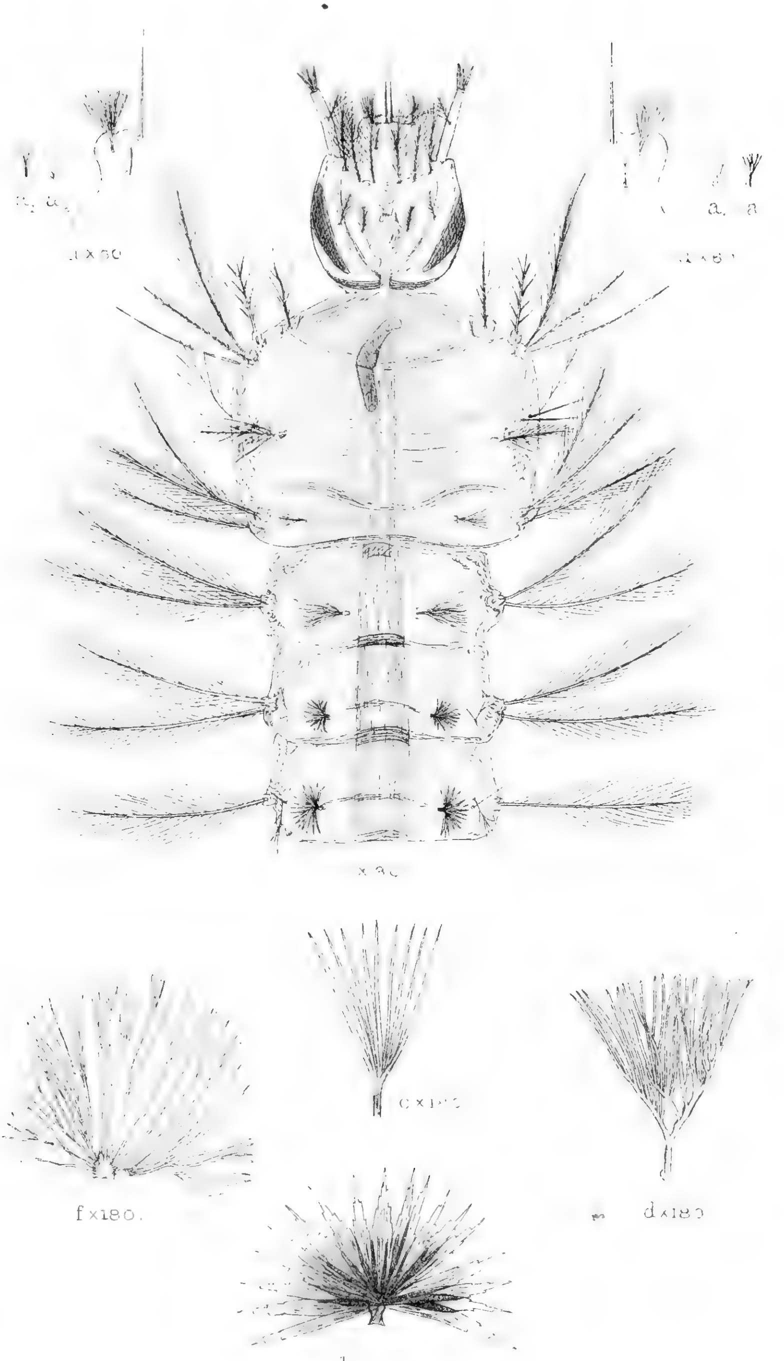


C$_2$ × 180. C$_1$ × 180. b × 180

C$_1$ *on first abdominal* C$_2$ *on second abdominal segment.*

E. Hill, del. Huth Lith^r London.

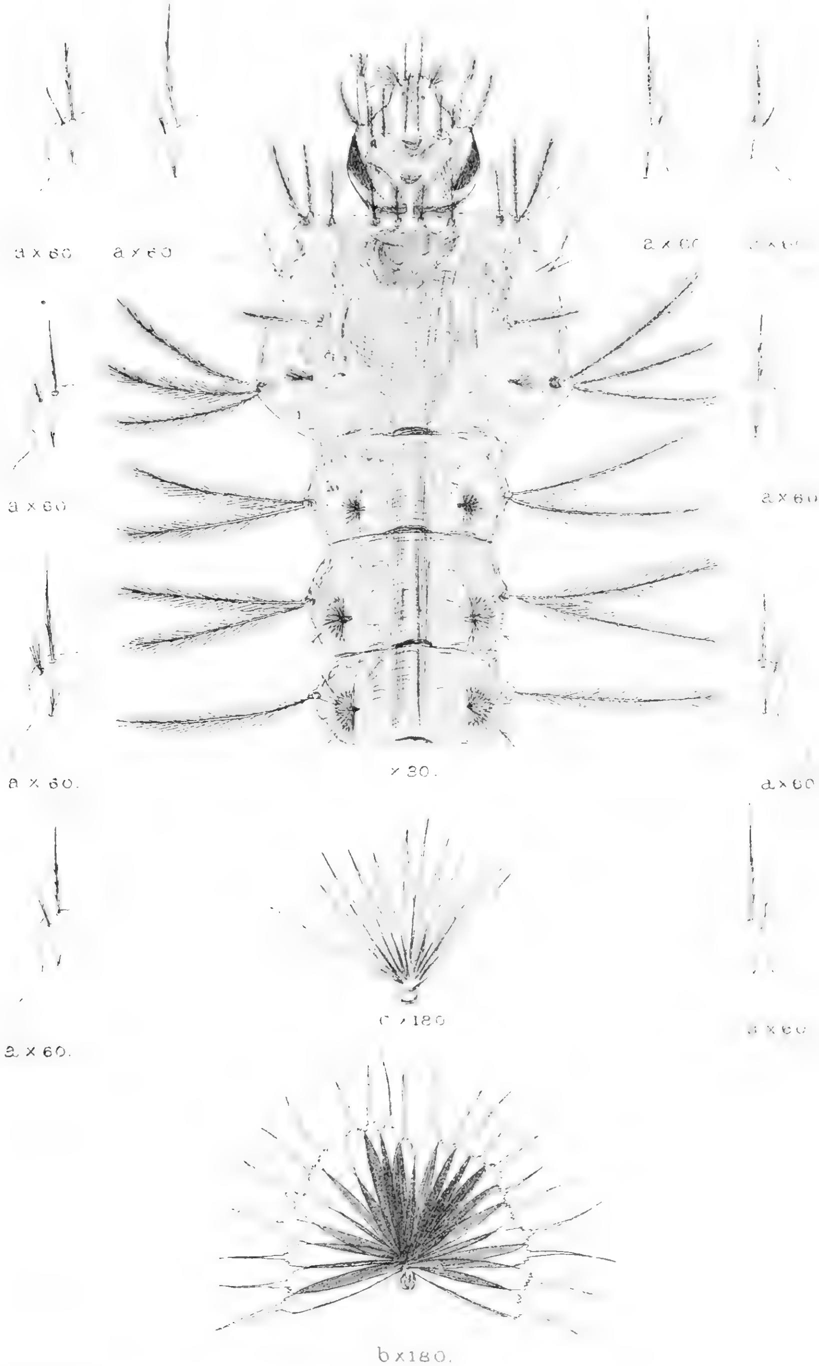
CELLIA JACOBI *n. sp.*



E. Hill, del. Huth Lith. London.

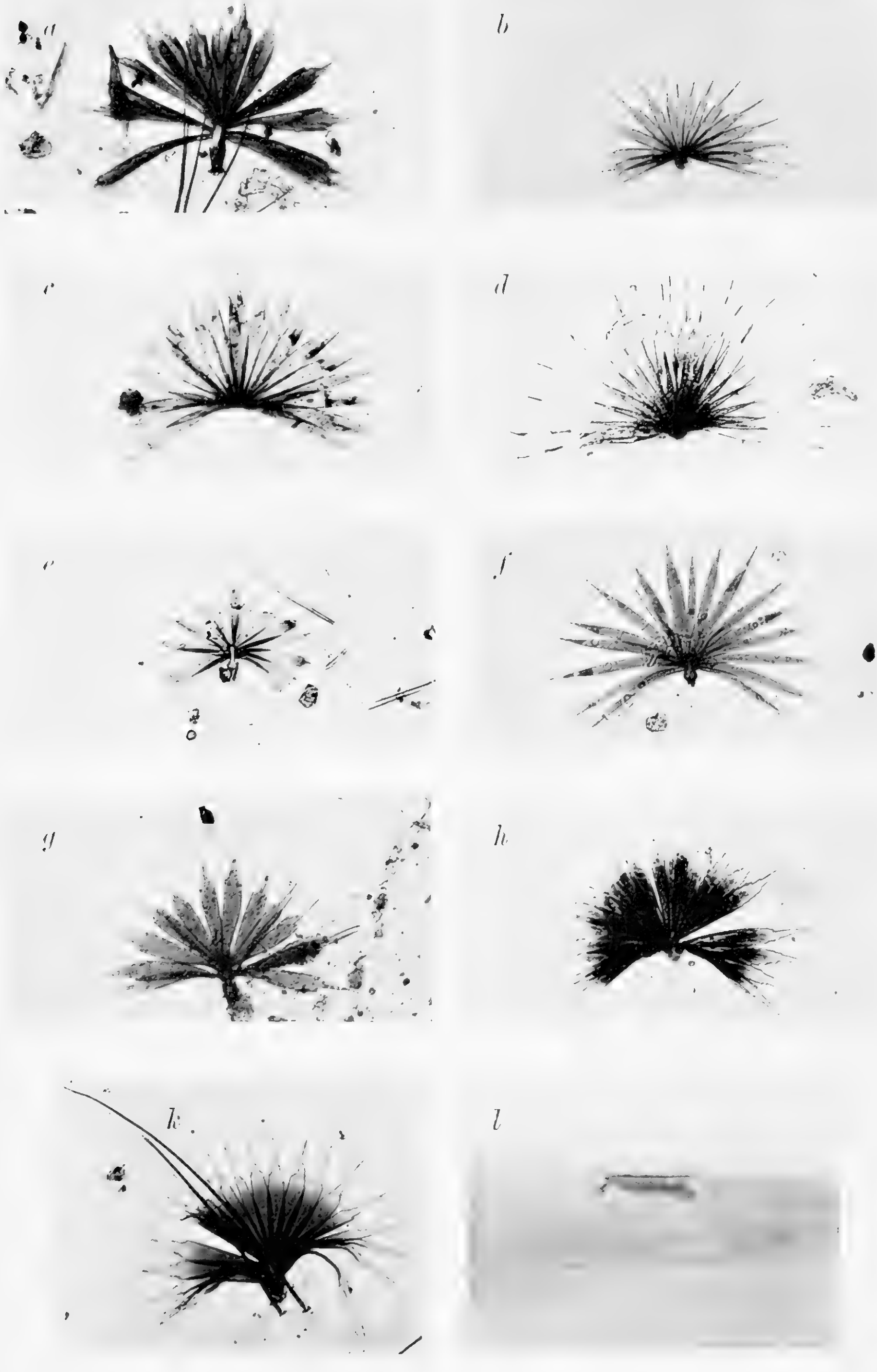
a_1 a_2 *posterior frontal hairs.*

MYZORHYNCHUS PALUDIS *Theobald.*



E. Hill, del. Huth Lith. London.

MYZORHYNCHUS NATALENSIS *n. sp.*

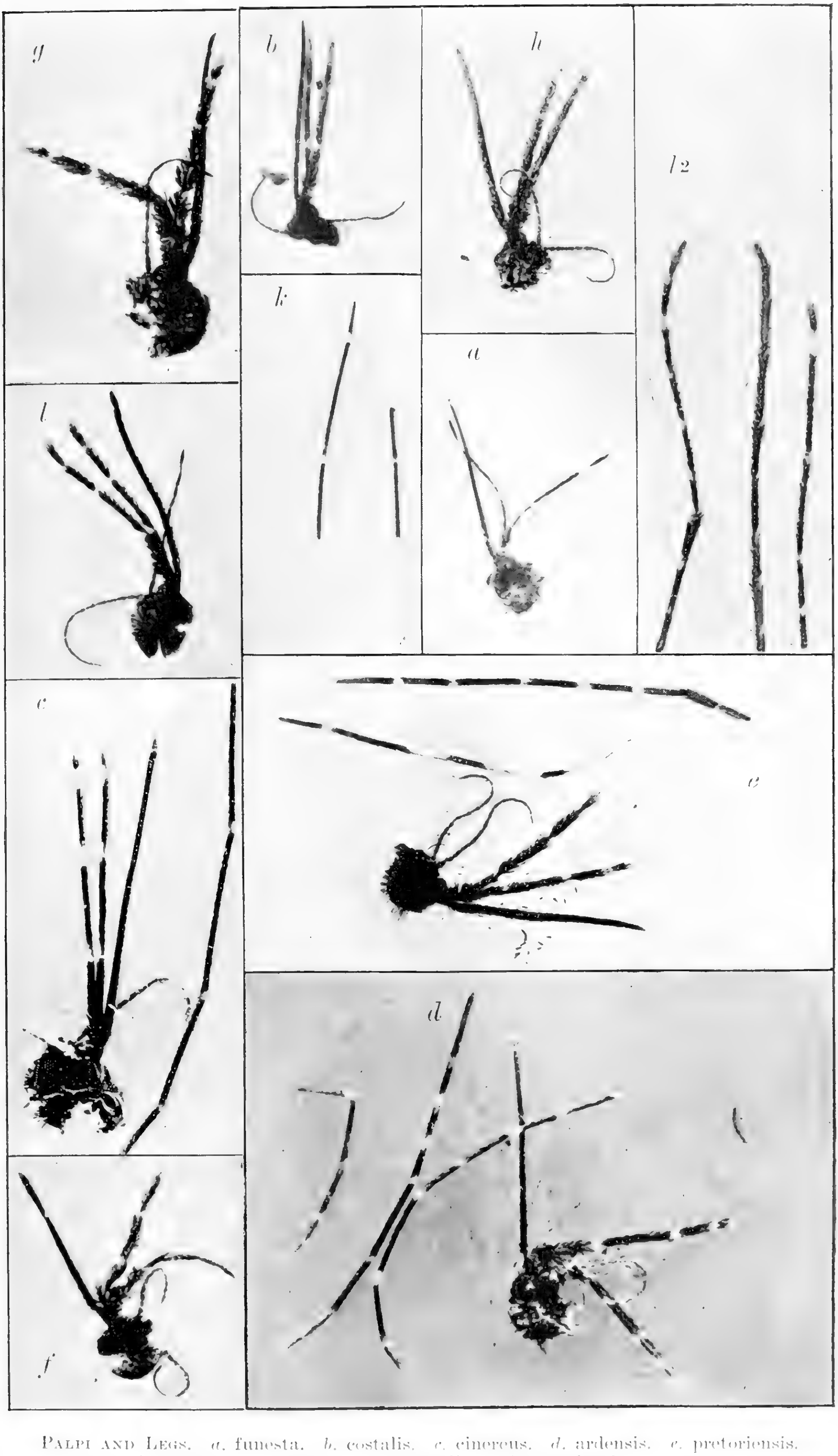


Palmate Hairs. *a*. Myzomyia funesta. *b*. Pyretophorus costalis. *c*. P. cinereus. *d*. P. ardensis. *e*. Nyssorhynchus pretoriensis. *f*. Cellia squamosa. *g*. Cellia jacobi. *h*. Myzorhynchus paludis. *k*. Myzorhynchus natalensis. × 180. *l*. Living larva of Myzorhynchus paludis, showing palmate hairs spread out at the surface of the water. × 3.

Adlard & Son, impr.

Wings. *a.* funesta. *b.* costalis. *c.* cinereus. *d.* ardensis. *e.* pretoriensis. *f.* squamosa. *g.* jacobi. *h, k, l.* paludis. *m.* natalensis. × 15.

Idlard & Son, Impr.



PALPI AND LEGS. *a.* funesta. *b.* costalis. *c.* cinereus. *d.* ardensis. *e.* pretoriensis. *f.* squamosa. *g.* jacobi. *h, k.* paludis. *l, l2.* natalensis. × 15.

Language of Colours amongst the Zulus expressed by their Bead-work Ornaments; and some General Notes on their Personal Adornments and Clothing.

By

Rev. Father Franz Mayr.

With Plate XXVII.

At the suggestion of Dr. Warren, Director of the Natal Government Museum, I propose to place before the reader a few notes on the personal ornaments used by Zulus, especially with reference to the meanings assigned to the variously coloured beads which are so generally used in certain of their adornments.

Before speaking of the bead-work ornaments, now very freely used by the Zulus in adorning their dusky bodies, it will be interesting to indicate the kind of ornaments that were formerly used before the advent of beads.

I.

Previous to the arrival of the white man nature supplied the Zulu with the materials for the following articles of ornament:

(1) For adorning the head the Zulu man uses the well-known head-ring (isicoco). Sewing fibre (uzi), obtained from the bast of the wild fig and certain other trees, is twisted to form a circlet, which is sewn into the woolly hair.

This ring of fibre is then covered with the viscous material (ungiyane) obtained from the sticky secretion of a scale-insect which lives on the thorn bush—Dalbergia obovata (umzungulu). Afterwards it is polished with a pebble until it shines like a well-polished boot.

The man with the head-ring is called ikehla. Formerly it was the sign of attaining manhood, and it gave the young man royal right to look for a wife. The time for putting on the head-ring, known as ukutunga, was announced to the young men by the Zulu king. To touch a man's head-ring disrespectfully was the greatest insult possible; and formerly such a deed was often revenged by putting the offender to death.

Besides the head-ring, men of importance or warriors would wear an ostrich feather; each regiment would have a uniform colour—all white, all black, etc.

Another head ornament which was, and still is, very much sought after is a bunch of tail-feathers of the large Kafir finch or long-tailed widow bird (isakabuli). The bunch of feathers may cover almost the whole of the head, and is called isidhlodhlo.

Headmen wore, and still wear, below the head-ring a circlet of leopard, serval, otter, or other fur.

(2) As neck ornaments the men of the royal family wore circlets of lion or leopard claws. Royal princesses wore stiff collars of heavy, solid, brass rings, made by bending a brass rod into a spiral of two or three turns. It was called umnaka or ubedu. These collars must have been most uncomfortable to wear, as the head could not be turned without moving the whole body.

An ordinary Zulu woman would frequently wear around the neck a fibre string carrying a perforated brass ball (indondo) about an inch in diameter. The ball would hang about at the level of top of the sternum.

Sometimes a number of little sticks of the scented umtomboti tree (Excæcaria africana) would be threaded on a string to form a necklet; or large beads made of scent-powder would be similarly threaded. The powder was prepared from various scented plants, which were dried and pulverised, and kneaded into balls.

The single brass ball (indondo) is no longer seen; but the circlet of scented balls (amaka) and the necklet of little sticks (ubande) of the scented umtomboti tree are still in use.

(3) For adorning the arms and legs the young men used the bushy ends of cattle tails (amatshoba), which were fastened above the elbows and below the knees. As in the case of the ostrich feathers, the various regiments were distinguished by the colour of the tails—white, black, brown, etc. Boys and girls satisfied themselves with grass wristlets and anklets, but princesses were obliged to wear heavy brass rings around the wrists and ankles (umnaka or ubedu), similar to those worn as necklets, only they were simple rings without spiral turns.

(4) Lastly, for covering and adorning the body grass belts (izifociya) were used, besides strips of skin of bucks or domestic animals.

Married women used formerly, as at the present time, the short petticoat (isidwaba) of goat- or ox-skin.

Men wore the loin-dress (umutsha), consisting of bushy tails in front (isinene) and a square or oblong piece of ox- or buck-skin behind (ibetshu). In place of the bushy tails strips of buck-skin were often used.

Grown-up girls clothed themselves with the ubendhle, which was a fringed loin-covering encircling the body. It was made from the veld plant Gazania longiscapa.

Witch-doctors were distinguished by their iminqwambi, which were strips of skin worn over the shoulders, and fastened together at the middle, before and behind, something like a pair of braces.

For the great umkosi, the Zulu king's annual festival, the warriors wore the state dress, consisting of three girdles or kilts of ox-tails. One was worn low down over the buttocks, another above the hips, and the third over the shoulders. In this way the body was entirely covered from neck to knee. This state dress was called imiqubula.

II.

From the brief account given above we see that there has always been a great variety of different dresses and ornaments, distinguishing royalty, warriors, witch-doctors, and common folk; but when the European brought glittering coloured beads the sympathy of the Zulu was at once aroused, and he found a new field for his imagination and skill.

Beads were first brought by the Portugese, then by the Dutch, and now by the English. The natives show very considerable skill and taste in making ornaments and designing patterns. There are established colours and kinds of beads in use among the Zulus, and they will not look at any other kinds, however pretty they may be, which are not established by traditional use. Traders soon discover this peculiarity, and take care to only have in stock the kinds of beads and colours which are liked by the natives.

The natives have given each colour of beads a special name and meaning; and they have invented a kind of language of colour, whereby they can convey their thoughts from one to another without speaking. How this is done will best be explained by reference to the illustrations of bead work given in the plate (Pl. XXVII) attached to this paper; but I will first give a list of the names and literal meanings of the different coloured beads:

White beads . = itambo (lit. bone).

Black beads . = isitimane (name of a regiment formed by Mpande; also, nick-name for a very black person).

Blue beads . = ijuba (lit. dove).

Red beads . = umgazi (from igazi, blood).

Yellow beads . = incombo (lit. young Kafir-corn still yellow) or ipuzi (lit. bright yellow native pumpkin).

Green beads .	= ubuhlalu obuluhlaza (from uluhlaza, new grass).
Striped beads .	= intotoviyane (lit. large striped grasshopper).
Pink beads .	= ubuhlalu obumpofu (from impofu, poor, poverty).
Transparent brown beads .	= umlilwana (lit. a low fire).
Dark blue beads	= inkankane (lit. Common Ibis).
Large-sized beads of any colour .	= amapohlo or amaqanda (amaqanda means eggs).

Anyone uninitiated in the secret meaning of the different beads, and seeing, for example, a number of white beads followed by a few red, green, blue, and black, and then again white, red, green, blue, and black in the same succession and the same number of each kind of bead, might think that the arrangement was simply for the sake of ornament and symmetry. But a kraal-native would say it was a letter, and would call it so, i.e. incwadi, or better, ubala abuyise, which means "one writes in order that the other should reply." In this way an uneducated Zulu girl will present her sweetheart with an ubala abuyise, and will expect his visit in return.

A variety of different bead ornaments are used as letters in this way, the chief of which are illustrated in the accompanying plate.

Fig. 1, ingeje, a single bead string.

Fig. 2, umampapeni, one square of beads with one or more bead strings.

Fig. 3, ulimi (lit. tongue), one long oblong piece of beadwork with one or more bead strings.

Fig. 4, igcagcane, a necklet consisting of a number of connected small squares of bead work.

These illustrations are taken from actual specimens in the Natal Government Museum, and the colours represent, as nearly as possible, the favourite shades established by custom.

The simplest form of *ubala abuyise*, or letter, is an *ingeje*, or single bead string (fig. 1), consisting of only two kinds of beads. In this specimen one half of the string consists of white beads, and the other half of pink. The meaning of this would be, that the girl's heart is full of love (white beads), but she tells her lover by the same number of pink beads that his poverty is as great as her love towards him. This implies, of course, an earnest appeal to him to work hard in order to get the cattle for the *lobola*, or payment, necessary to buy her from her father or guardian.

To express wealth yellow beads are used.

The remaining figures in the plate represent more complicated letters; and a succession of white, red, green, blue and black beads, for example, would be interpreted in the following way:

Inhliziyo yami imhlope ngezinsuku ezikude (expressed by the numerous white beads). *Kodwa sengikubeke, amehlo ami az'abomvu* (red beads). *Nang'-ubala abuyise, kepa sengizacile ngaza nga'luhlaza* (green beads). *Uma bengi l ijuba, bengizaundiza ngiyocotsha emyango kwenn* (blue beads). *Ngivinjelwe ubumnyama ngingeze ngaya kuwe* (black beads). *Kodwa inhliziyo yami imhlope*, etc. (white beads—the same story is repeated again and again).

The Zulu idiom can never be expressed in English, and in a translation the letter loses much of its force; but it would run in some such fashion as the following. My heart is pure and white in the long weary days (white beads). My eyes are sore and red by looking out for you so long (red beads). Nang'ubal'abuyise = here is my letter to you. I have become quite lean and sickly (green beads). If I were a dove I would fly to your home and pick up food at your door (blue beads). Darkness prevents my coming to you (black beads). But my heart is pure, etc., etc., and the whole message would be repeated several times.

The actual pattern does not appear to have any defined significance; it is rather the succession of colour, and the relative amounts of the different colours, that express the tenor of the message.

In reading a letter of the umampapeni (fig. 2) and ulimi (fig. 3) types, the string which passes round the neck, beginning at the fastening, is taken first; and on the whole the string has the greater significance. In the case of the square and oblong piece the letter would be read from without inwards, but the edging or border is for the sake of ornament simply, and, as a rule, has no special meaning. In a string the number of successively placed yellow beads may indicate the number of cattle owned by the recipient of the letter.

Having thus obtained a key to the meanings assigned to the colours, it is an easy matter to interpret any of these epistles; and it may suffice to say that the Zulu lad is very proud of them, and hangs them all round his neck and head in order to show everyone how much he is loved by one or a number of girls.

EXPLANATION OF PLATE XXVII,

Illustrating Rev. Father Mayr's paper, "Language of Colours amongst the Zulus, etc."

The illustrations are reduced to five-eighths of the actual size.

FIG. 1.—Ingeje. The tenor of the letter is that the girl realises that the man is poor (pink), and she asks him to work for cattle, as she is in love (white) with him.

FIG. 2.—Umampapeni. The purport of the letter is that the recipient is well to do (yellow), and the girl is weeping (red) on account of his not going to her.

FIG. 3.—Ulimi. The general tone is that the girl is greatly in love (numerous white beads), and she thinks the man is sufficiently rich (yellow) to marry her. The blue border at the bottom is pure ornamentation, without special significance.

FIG. 4.—Igcagcane. The general tone is somewhat distressing. The girl is fond of the boy (white), yet there is difficulty in going to him (black), as he is poor (pink), and consequently she feels lean and sickly (green).

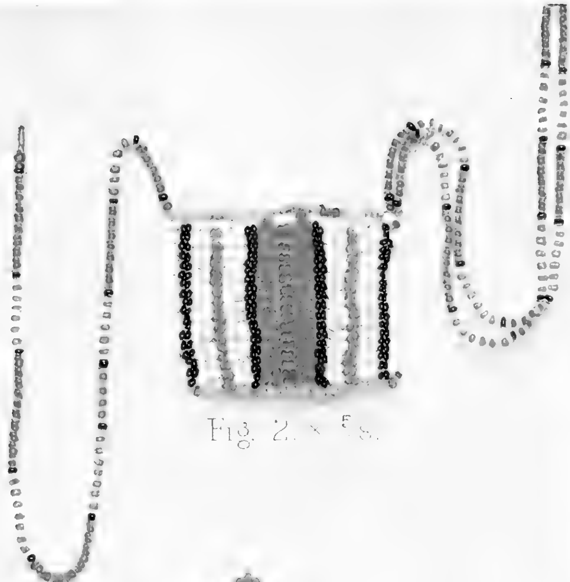


Fig. 2. × 5/8.

Fig. 4. × 5/8

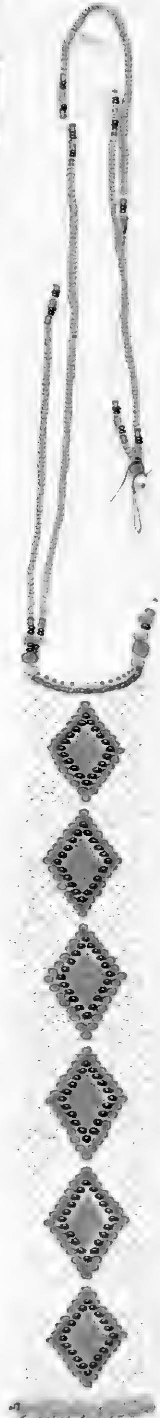


Fig. 1 × 5/8

Fig. 3 × 5/8

On Two New Reptiles from the Karroo Beds of Natal.

By
R. Broom, M.D., D.Sc., C.M.Z.S.
Victoria College, Stellenbosch.

With Plate XXVIII.

Though for many years reptilian bones have been known to occur in the Karroo beds of Natal, until a few months ago nothing definite has been known concerning them. Mr. William Anderson, lately government geologist of Natal, recently submitted to me a small collection of reptilian remains for examination. Though most of the specimens were extremely fragmentary, those that could be identified were all Anomodonts, and for the most part belonged to the genus Lystrosaurus. A second collection has just been sent me for examination by Dr. Warren, and comprises specimens belonging to the Government Museum, Pietermaritzburg. Though the collection is small, and many of the specimens very imperfect, almost all the fragments can be identified, and the collection proves to be of considerable interest. Most of the specimens belong to a large Dicynodon, which proves to be a new species, and there is also a specimen of a new species of Therocephalian. These two new species I have much pleasure in describing. Three Natal species are now known, and though they belong to well-known genera they are all very distinct from the species known in Cape Colony. This is a little remarkable, considering that the forms from the Western Karroo beds are identical with those from similar horizons in the Eastern Province. Very likely the

Natal species may yet be found in Cape Colony when the beds are more fully worked.

Dicynodon ingens n. sp. Pl. XXVIII, figs. 1–4.

This new species of Dicynodon is represented by a considerable portion of the snout of an animal which is perhaps an adult female; by the imperfect front portion of the skull of an immature animal; by four tusks, two probably of adult males and two of females; and by a number of fragments of limb bones. The snout of the supposed adult female is taken as the type. Of species already known only three at all resemble the Natal form. These are D. leoniceps, D. simocephalus, and D. latifrons. Neither D. leoniceps nor D. latifrons have ever been discovered of nearly such large size as D. ingens, and there are marked differences.

The specimen which is taken as the type is the fairly well preserved palatal portion of a large skull, comprising the maxillary bones, the pre-maxillary bones, most of the vomer, and parts of the palatines. The tusks are broken off at their bases. In general appearance the palate resembles that of D. leoniceps in being much longer than broad. Unfortunately the palate of D. leoniceps has not been cleared of matrix, and it is impossible therefore to institute detailed comparisons. The tusks in D. ingens are, however, very much longer than in D. leoniceps. At the point where broken across in the type specimen the tusk measures 40 mm. in diameter, and is as near as may be circular in section. The distance between the tusks is 82 mm., but there is a slight degree of lateral crushing. From the line joining the two tusks to the front of the snout the distance is about 150 mm. At the hollow immediately in front of the great dilatation caused by the tusk the transverse measurement of the snout is 120 mm., and at the tusk region probably 190 mm. The median ridge is very prominent, and extends from about 35 mm. in front of the plane passing along the anterior border of the tusks to near the plane passing along the posterior border. In front the palate has the usual two premaxillary ridges well developed. The front of the snout is unusually straight. It has a low median ridge and a slight lateral one on each side. The nostril is of large size, and probably is within 50 mm. of the edge of the jaw. Antero-posteriorly it measures at least 80 mm., and the lower border is moderately straight.

There are tusks from the same locality, and most probably of the same species, which are very much larger than those of the type specimen. This is probably due to their being tusks of males. One specimen measures at the root 57 mm. × 45 mm. It is considerably crushed. Another specimen, which is also crushed, measures 59 mm. × 43 mm.

The type specimen was discovered at Ennersdale, Natal, by Mr. A. S. Woodgate.

Scymnosaurus warreni n. sp. Pl. XXVIII, figs. 5–7.

The Therocephalian specimen is the snout of a moderate-sized reptile. It is considerably crushed from above downwards, but otherwise is in good preservation. The front part of both mandibles is preserved, and the right one has been detached from the skull and cleared of matrix. The animal has manifestly had a broad, yet deep, snout, while probably the back part of the skull was relatively short.

The nasal bones are broad both in front and behind. Posteriorly the two probably measure 45 mm. across, and in front slightly more. The greatest length of the nasals is 96 mm. apparently, but it is a little difficult to be sure of the posterior suture. Superficially the bones are slightly rugose.

The premaxillaries are well developed, but, as in other Therocephalians, considerably covered over by the maxillaries. The inter-nasal process is relatively short and broad. The extra-nasal process is larger and broader than usual. The nostril measures about 17 mm. across, and the extra-nasal process, so far as it is visible in front of the maxilla, is 15 mm. wide. The depth of the premaxilla below the nostril is about 16 mm. From the median suture to the anterior part of the maxilla is 30 mm. There appear to be five teeth in front of the large canine. On the right side five teeth are visible, but a fairly wide gap is present between the first and second. On the left side three teeth are seen, and wide gaps are present before and behind the third. If we look at the alveolar margins, however, we find reason to believe that there are only five teeth in front of the large canine. All five are, I believe, incisors, though it must be borne in mind that in some Therocephalians the small tooth in front of the large canine is also a maxillary tooth, and therefore a canine. The first incisors of each side are fairly equal in size, both measuring about 9 mm. × 6 mm. The second incisor is much smaller on the left side than on the right, the latter measuring 10 mm. × 6 mm., and the former 6 mm. × 5 mm. The third incisor of the right side measures 10 mm. × 7 mm. The fourth incisor of the right side measures 6 mm. × 5 mm.; that of the left side 9 mm. × 5·5 mm. The fifth incisor measures 6·5 mm. × 5 mm. The differences in the sizes of the teeth on the two sides is probably owing to the fact that in Therocephalians there is apparently a continuous succession of teeth, a new one always replacing an injured or worn one. The measurement in a direct line from the front of the first incisor to the front of the canine is 43 mm. on both sides. In no case is the crown of the tooth preserved.

The maxillary bone has a very convex outer surface and is very rugose, especially at the lower and anterior margins. Its greatest depth is 50 mm. and the greatest length probably 85 mm. The canine tooth measures 16 mm. × 12 mm. on both sides. Behind the canine are three small molars. The first is 8 mm. behind the canine, it measures 5 mm. × 3·5 mm. The other two are smaller. The three together measure 15 mm.

From the back of the nostril to the front of the orbit is 74 mm.

The anterior part of the dentary is strongly developed, and bears four incisors, a large canine, and probably three small molars. Fortunately the incisors and canines have been extracted from the matrix, so that their crowns can be examined. The first incisor is 19 mm. in height, 8 mm. at the base from without in, and 5 mm. from side to side. On passing upwards it curves slightly backwards like a bird's claw, and ends in a somewhat obtuse point. Along each side in the upper two thirds of the tooth runs a low ridge, which curves with the tooth, but passes more to the inner side on approaching the apex. On the front of the upper part of the tooth are four faint ridges, and on the concave side are also four ridges slightly more marked. There is no evidence of any serrations on the tooth. The second, third, and fourth teeth are apparently all similar to the first, but they are all more or less worn, and the ridges less distinct. The teeth decrease in size from the first to the fourth. The fourth measures 8 mm. in height. The four incisors measure together 20 mm. The canine is large and very like the incisors in structure. There is a feeble ridge in front and behind, and on the concave side five faint ridges. No ridges are seen on the outside of the tooth, but this may be due in part to wear. The tooth measures in height probably 30 mm. Antero-posteriorly it measures 11 mm., and in the other direction 10 mm. There are probably three molars, but only two are preserved, the first close against the canine, and the supposed third 16 mm. from the canine. Though the jaw is probably pretty deep in front, it rapidly becomes narrow, and at the third molar it measures only 21 mm.

The dental formula of the species is $i\frac{5}{4}c\frac{1}{1}m\frac{3}{3}$. This is probably identical with the formula of the specimen described from Cape Colony as Scymnosaurus ferox *Broom*, and for this reason I have provisionally placed the Natal specimen in the same genus. The differences in the dentition are sufficiently great to make it a new genus if it were a mammal, but it seems better in the meantime to make the reptilian genera rather comprehensive.

It is unfortunate that the locality of the Cape specimen of Scymnosaurus is unknown, but as it is a rather highly specialised type of Therocephalian, it seems likely that it is from the upper division of the Lower Beaufort beds. The close resemblance of Scymnosaurus to the Russian genus Inostranzewia (*Amalitzky*) is worthy of note. They are apparently distinct, but closely allied.

I have much pleasure in naming the Natal specimen after Dr. E. Warren, of the Government Museum, Pietermaritzburg.

The specimen was discovered at the Little Tugela River by Mr. P. Paterson.

EXPLANATION OF PLATE XXVIII,

Illustrating Dr. R. Broom's paper "On Two New Reptiles from the Karroo Beds of Natal."

FIG. 1.—Plate of Dicynodon ingens. × ·3.

FIG. 2.—Side view of portion of skull of Dicynodon ingens. × ·3.

FIG. 3.—Canine of Dicynodon ingens. × ·28.

FIG. 4.—Canine of Dicynodon ingens. × ·28.

FIG. 5.—Under view of portion of skull of Scymnosaurus warreni. × ·56.

FIG. 6.—Side view of portion of skull of Scymnosaurus warreni, slightly restored. × ·56.

FIG. 7.—Upper view of front of right mandible of Scymnosaurus warreni. Nat. size.

Fig. 1 × 0·30

Fig. 3 × 0·28.

Fig. 4 × 0·28.

Fig. 2 × 0·30.

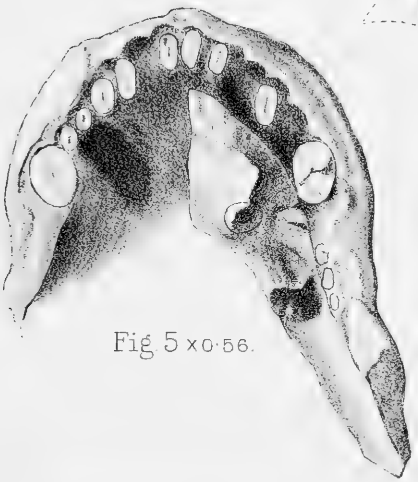


Fig. 5 × 0·56.

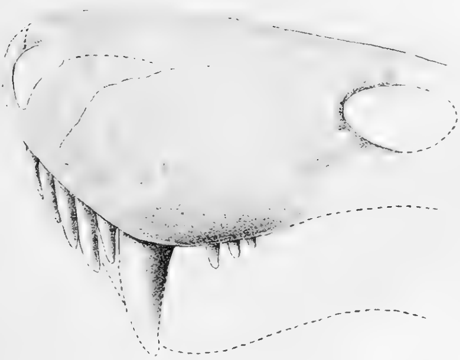


Fig. 6 × 0·56.

Fig. 7 nat. size

Broom del. Huth Lith. London

DICYNODON INGENS *Broom.* Figs 1-4.

SCYMNOSAURUS WARRENI *Broom.* Figs 5-7.

On Entomostraca Collected in Natal by Mr. James Gibson. (Part II.)

By
G. Stewardson Brady, M.D., LL.D., D.Sc., F.R.S., C.M.Z.S.

With Plates XXIX—XXXII.

About two years ago I published in the 'Proceedings of the Zoological Society of London' a short account of some Natal Entomostraca, the material for which was kindly sent to me by Mr. James Gibson. I am now indebted to him for further gatherings from the same district. Many of these have been already described by other authors, notably by Professor G. O. Sars and Dr. G. W. Müller, references to whose papers are given under the heads of the various species; others appear to be new. The new species I here briefly describe and figure; I also figure, sufficiently I think to ensure proper identification, some of the previously known species, as far as my material enables me to do so. Some others, e. g. Cypretta sarsi, Oncocypris voeltzkowi, Broteas lamellatus, and Diaptomus orientalis, have already been abundantly figured.

Ostracoda.

Genus Cypris *Müller.*

Cypris intumescens n. sp. Pl. XXIX, figs. 1–5.

Shell seen laterally subreniform, greatest height in front of the middle, and equal to about two thirds of the length (fig. 1). Anterior extremity broadly rounded, posterior much narrower and rather obliquely rounded, dorsal margin almost gibbous in front of the middle, thence sloping steeply to the front and much more gently backward, ventral margin almost straight. Seen from above (fig. 2) the outline is very broadly ovate, obtusely pointed in front, rather abruptly rounded behind, lateral margins evenly arcuate; greatest width situated behind the middle, and equal to at least two thirds of the length. Surface of the shell perfectly smooth, without any trace of sculpture, the free margins fringed with fine hairs; colour pale green. Length, 1·35 mm.

The swimming setæ of the posterior antennæ reach as far as the apices of the terminal claws; margins of the labial plates (fig. 3) very strongly toothed; principal spines of the first pair of maxillæ quite destitute of marginal processes; caudal rami (fig. 5) extremely slender, having two slender apical setæ, marginal seta very small, and not far removed from the apex; genital plates well developed, the convoluted spermathecal (?) tubes very large and conspicuous (fig. 4).

One example only of this species was seen; it occurred in a gathering from Somkele, Zululand.

Genus Cypretta *Vàvra.*

Cypretta sarsi *G. S. Brady.*

1901. Cypretta sarsi *Brady*, "On new or imperfectly-known Ostracoda, chiefly from a Collection in the Zoological Museum, Copenhagen" ('Trans. Zool. Soc., London,' vol. xvi, pt. iv), p. 195, Pl. XXV, figs. 10–15.

The type specimens were from St. Thomas, West Indies. Those now noted were from Pietermaritzburg, in which gathering it occurred abundantly.

Genus Cypria *Zenker.*

Cypria armata *G. W. Müller.* Pl. XXIX, figs. 6–11.

Cypria armata *Müller* 'Die Ostracoden (Ergebnisse einer Zoologischen Forschungsreise in Madagaskar und Ost-Afrika,' 1889–1895), p. 261, Taf. 13, figs. 1–5, 12.

Shell seen from the side oblong, subovate, nearly twice as long as high (fig. 6), greatest height in the middle, anterior extremity rounded off gently above but somewhat abruptly below, posterior evenly rounded, dorsal margin well and evenly arched, ventral slightly protuberant in the middle, otherwise almost straight. Seen from above, the outline is ovate, more than twice as long as broad, widest in the middle, much compressed, posterior extremities rounded off, anterior scarcely rounded, subacuminate (fig. 7), colour more or less brown, surface smooth. Length, 1·2 mm. Swimming setæ, as usual in this genus, reaching very far beyond the extremity of the antennal claws (fig. 8); caudal rami very stout (fig. 11), their terminal claws stout and moderately curved, marginal seta long, attached a little beyond the middle of the limb.

Hab.—Pietermaritzburg.

These specimens agree in all respects with those described by Dr. G. W. Müller from Madagascar.

Genus Cypridopsis *Brady*.

Cypridopsis punctillata n. sp. Pl. XXXI, figs. 7–15.

Shell seen from the side oblong, reniform, greatest height situated in the middle and equal to rather more than half the length (fig. 7), extremities evenly rounded, the anterior rather the broader of the two, dorsal margin very boldly arched, sloping gently toward the front, steeply arcuate behind, ventral margin distinctly sinuated in the middle; seen dorsally the outline is ovate, about twice as long as broad (fig. 8), tapering toward the front, which is bluntly pointed, wider and almost subtruncated behind. Surface smooth, marked uniformly with very small, impressed punctations (fig. 11). Antero-ventral angle of the left (and in some cases also of the right) valve very minutely denticulated, and fringed with slender hairs (fig. 9), colour greenish. Length 0·57 mm. Swimming setæ of the posterior antennæ reaching much beyond the extremities of the terminal claws, branchial plates of the mandibles bearing only five or six setæ; caudal rami simple, setiform (fig. 10).

Hab.—Pietermaritzburg.

This is a very small species presenting all the characters of a typical Cypridopsis—somewhat like C. newtoni in general character—not nearly so compressed as C. villosa nor so pubescent.

Genus Proteocypris *Brady.*

Proteocypris *Brady.* 'Trans. Northumberland and Durham Nat. Hist. Soc.'

This genus does not differ materially from Cypridopsis except in its bisexual character.

Proteocypris reniformis sp. n. Pl. XXX, figs. 1–9.

Shell seen laterally reniform, highest in the middle, height equal to more than half the length (fig. 1), anterior margin broadly rounded, and produced at the ventral angle so as to form a rather prominent lip; posterior forming a steep curve and rounded off at the ventral angle, dorsal margin boldly and evenly arched, ventral sinuated in the middle; seen dorsally the outline is compressed, ovate, acutely pointed in front, rounded off behind, greatest width situated behind the middle and equal to less than half the length (fig. 2), shell smooth, slightly pubescent, marked with rather coarse, closely-set oblong or angular pittings (fig. 9). Length 0·5 mm. Natatory setæ reaching far beyond the extremities of the terminal claws (fig. 3); mandibular palp rather short and stout (fig. 4); apices of posterior feet simply setiferous, not forcipate; caudal rami (fig. 7) simple, setiform. Ejaculatory duct of male bearing about twelve whorls (fig. 8).

Hab.—Somkele.

Proteocypris (?) globuloides sp. n. Pl. XXX, figs. 10–18.

Shell seen laterally subovate, height equal to two thirds of the length (fig. 10), anterior extremity broadly rounded, posterior somewhat narrower and more flattened, dorsal margin well arched, highest in the middle, ventral slightly sinuated. Seen dorsally the outline is very broadly oval, almost circular, the width only slightly less than the length (fig. 11), natatory setæ of the posterior antennæ not reaching beyond the terminal claws (fig. 12). Caudal rami simple, bearing two apical setæ (fig. 17). In other respects the animal is essentially similar to P. reniformis. Shell quite smooth, with a few marginal hairs, and showing by transmitted light a rather coarsely reticulated structure. Colour, brown. Length 0·43 mm.

Hab.—Richmond.

This is a minute species, easily distinguished from the preceding by its very tumid outline, and on dissection, by the shorter length of the swimming setæ, the character of the caudal rami, and, in the male, by the more robust build of the prehensile second maxillæ.

Genus Stenocypris *G. O. Sars.*

Stenocypris *G. O. Sars.* 'On some Freshwater Ostracoda and Copepoda raised from Dried Australian Mud' (Christiania, 1889).

Shell much compressed and elongated, valves subequal " free edges smooth, inner duplications very large, especially at the anterior part. Natatory setæ of the posterior antennæ not reaching beyond the terminal claws. Palp of the first pair of maxillæ narrow, cylindrical, last joint small, masticatory lobes long and narrow. Caudal rami rather large, more or less lamelliform, dorsal edges sometimes pectinate, claws very unequal, both coarsely denticulate, seta of dorsal edge absent or very small, the apical one rather elongate. Propagation exclusively parthenogenetical."

Apart from the structure of the shell, to which one need not perhaps attach very great importance, the principal distinctive characters of this genus, as described by Sars, are "parthenogenetical" reproduction, the unequal and pectinated claws of the caudal rami, and the rather abnormal build of the first maxillar palps. G. W. Müller, however, adds to these characters the asymmetrical structure of the two caudal rami, though this want of symmetry is not found in the types previously described—S. malcolmsoni and S. chevreuxii. A still more important divergence is the bisexual character of S. sinuata as described by Müller. In this species the two sexes are fully developed, so that the "exclusively parthenogenetical" character ascribed to the genus by Sars cannot here apply. But no males have been found in the case of S. aldabræ, and in this species Müller states that the receptacula seminis are always empty. This accords with my own observation. Still, I find it difficult to believe that these organs should exist, as they do in many true Cypridæ, apart from any possible functional use, and it seems to me not unlikely that some day or other males may be found in species which we are at present constrained to call "parthenogenetical." The present generic allocation of the various species must be looked upon as provisional.

Stenocypris aldabræ *G. W. Müller.* Pl. XXXI, figs. 1–6.

Stenocypris aldabræ *Müller*, loc. cit., p. 275, Pl. VII, figs. 1–8.

Shell seen laterally elongated, siliquose, highest in the middle, height equal to less than half the length; anterior extremity well rounded, posterior sloping steeply and almost in a right line to the ventral angle, which is rounded off; dorsal margin evenly arched, rather flattened, ventral sinuated in the middle, otherwise straight (fig. 1); seen dorsally the outline is much compressed, elongated, fully four times as long as broad, with acutely pointed extremities (fig. 2). Surface of the shell quite smooth; colour, grey. Length,

23. mm. Swimming setæ of the posterior antennæ (fig. 3) reaching to the extremity of the terminal claws ; apices of the last feet forcipate (fig. 4). Caudal rami bearing two strong apical claws and one short seta (figs. 5 and 6), no marginal seta, inner margins of the claws coarsely pectinated, distal portions of the rami spinulose on the dorsal margins, the spines of the left limb small, those of the right side much larger, and arranged in progressively graduated groups of three or four in each.

Hab.—Pietermaritzburg.

Only a few specimens—probably not fully grown—were seen. The measurement given by G. W. Müller is 2·9 mm. to 3·5 mm. of specimens from Madagascar.

Genus Oncocypris *G. W. Müller.*

Oncocypris voeltzkowi *G. W. Müller.*

Oncocypris voeltzkowi *Müller,* 'Die Ostracoden, Voeltzkow Reissergebnisse,' p. 288, Pl. I, figs. 1–18.

Plentiful in gatherings from Richmond and Pietermaritzburg.

Cladocera.

Genus Simocephalus *Schoedler.*

Simocephalus capensis? *G. O. Sars.* Pl. XXXII, fig. 8.

? Simocephalus capensis *Sars.* 'On some South African Entomostraca raised from Dried Mud' (1895), p. 15, Pl. III.

This species occurred plentifully in a gathering from Richmond. I can scarcely doubt that the specimens belong to Sars' species, though they seem to differ slightly in the slightly spinulose character of the hinder margins of the valves, whereas Sars remarks that it is "nearly allied to the European species S. serrulatus *Koch,* but differs in the somewhat different form of the head, and in the circumstance that the hind edges of the valves, below the posterior prominence, are quite smooth, not, as in that species, serrulate." But different stages of growth are accountable for much difference in minor distinctive characters, and it seems very likely that the specimens here noticed are not quite fully grown. The most characteristic form of the Richmond specimens is represented in fig. 8.

Genus Ceriodaphnia *Dana.*

Ceriodaphnia natalis sp. n. Pl. XXXII, figs. 3–7.

Carapace of female seen laterally tumid, rounded, sub-quadrangular, postero-dorsal angle much produced and sharply pointed, both dorsal and ventral margins strongly convex (fig. 5), seen dorsally (fig. 6) the outline is ovate, rather acutely pointed behind, about twice as long as broad; shell marked throughout with minute and closely-set circular punctations; antennules short, club shaped; eye moderately large. Post-abdomen with a small dorsal process, terminal portion rounded and rather wide, anal spinules eight or nine on each side, gradated in size from the middle to each end of the series (fig. 7), terminal claws bearing four short spinules near the base; head much depressed, separated from the body by a deep dorsal depression, rounded and prominent inferiorly. Length, 0·77 mm.

The carapace of the male (fig. 3) seen laterally is much narrower, and almost quadrangular, the dorsal and ventral margins almost straight and sub-parallel; eye rather larger than in the female; antennule large, bi-articulate, projecting beyond the head, bearing a large setiform flagellum and a brush of about four small sensory setæ. Length, 0·66 mm.

This species was found rather plentifully in a netting from Richmond. It seems to be quite distinct from any other described form.

Genus Alona *Baird.*

Alona glabra *G. O. Sars.*

Alona glabra *Sars*, 'Fresh-water Entomostraca of South America,' pt. I "Cladocera," p. 55, Pl. IX, figs. 6, 6a.

Alona guttata *G. O. Sars.* Var. parvula *Kurz.*

Sars loc. cit., p. 51, Pl. IX, figs. 3, 3A.

Both of these Alonæ occurred in the Richmond gatherings.

Genus ALONELLA *G. O. Sars.*

Alonella clathratula *G. O. Sars.*

Alonella clathratula *Sars,* loc. cit., p. 62, Pl. X, figs. 5, 5A.

Taken at Richmond with the two species of Alona.

Alonopsis? sp., Pl. XXXI, figs. 14, 15.

A species probably referable to this genus occurred in the Richmond nettings. Only one specimen was seen.

Genus Leydigia *Kurz.*

Leydigia propinqua *G. O. Sars,* Pl. XXXI, figs. 12, 13.

1893. Leydigia acanthocercoides *Sars* on 'South African Entomostraca raised from Dried Mud,' p. 18, Pl. IV, figs. 1–4.

1903. Leydigia propinqua *Sars,* 'Fresh-water Entomostraca from China and Sumatra,' p. 14 (separate copy), Pl. I, figs. 4, 4A.

1904. Leydigia africana *Gurney,* "Fresh-water Entomostraca from South Africa" ('Proc. Zool. Soc. Lond.'), p. 300, Pl. XVIII, figs. 5, 6.

Professor G. O. Sars remarks respecting this species: "Having now, through the kindness of Professor Lilljeborg, had an opportunity of examining Swedish specimens of the true L. acanthocercoides *Fischer,* I find that the South African form described by me under this name is in reality specifically distinct, for which reason I propose for it the above name. It differs not only in the shape and sculpture of the carapace, but also in the much smaller size of the ocellus, which scarcely exceeds that of the eye, whereas in

L. acanthocercoides it is considerably larger. Moreover, the caudal part is somewhat less broad, and the terminal claws have each at the base a very small denticle, omitted in my previous figure.

Two specimes of L. propinqua were seen in the nettings from Richmond. These are undoubtedly identical with Sars' species, and are here figured (Pl. XXXI, figs. 12, 13). I think that Mr. Gurney's L. africana also is referable to the same species.

Genus Pleuroxus *Baird.*

Pleuroxus assimilis sp. n. Pl. XXXII, figs. 9, 10.

Body of the female seen laterally broadly subovate, broadly rounded in front, abruptly narrowed and truncated behind, height equal to nearly three fourths of the length (fig. 9); anterior extremity produced below the middle into a long, slender, acutely-pointed rostrum, posterior very narrow, almost rectilinear, notched twice or thrice near the ventral angle, dorsal margin very strongly arched, slightly sinuated behind, where it forms a sharp postero-dorsal angle; ventral margin boldly convex in front, where it turns abruptly upwards, forming a deep sub-rostral sinus. Surface of the valves faintly marked behind the middle with flexuous longitudinal striæ, plain in front. Ocellus smaller than the eye, and situated nearly half way between that organ and the point of the rostrum. Post-abdominal lamina with a produced and rather broadly rounded post-anal angle, of nearly uniform width throughout (fig. 10), marginal spines numerous, about twenty on each lamina, those of the distal angle long and curved, the rest short and nearly equal; terminal claw strong and deeply coloured, with two spinules at the base, one long and one short. Length, 0·5 mm.

Hab.—Richmond. Only two specimens seen.

Genus Chydorus *Leach.*

Chydorus gibsoni sp. n. Pl. XXXII, figs. 1, 2.

Carapace seen from the side subglobose, broadly rounded in front (fig. 1), narrower behind, dorsal and ventral margins both strongly arcuate, no posterior marginal denticle, width equal to more than three fourths of the length, rostrum curved and acutely pointed, lip-plate rather prominent (fig. 1A), smooth, without any trace of serration; ocellus considerably smaller than the eye; post-abdominal lamina narrowed and deeply sinuated distally (fig. 2), bearing about ten small, sharp, rather distantly-placed denticles; terminal claw smooth, with two basal spinules, one long and one short. Length, 0·5 mm.

Several specimens of this form occurred in the Richmond gatherings. Its nearest allies appear to be Chydorus barroisi *Richard* and C. poppei *Richard*. It may, however, be distinguished from the former by the absence of any posterior marginal denticle, by the perfectly smooth "lip-plate," and by the unsculptured carapace—from the latter by the number and character of the caudal spinules and the want of shell sculpture.

Copepoda.

Genus Broteas *Lovén.*

Broteas lamellatus (*G. O. Sars*).

1895. Paradiaptomus lamellatus *Sars.* 'On some South African Entomostraca raised from Dried Mud,' p. 46 (separate copy), Pls. VII and VIII.

Hab.—Richmond.

Professor Sars, in his paper "On the genus Broteas of Lovén," rejects his previously described genus "Paradiaptomus" in favour of Lovén's Broteas, which claims priority of date. The type species B. falcifer, as well as B. lamellatus, is native to South Africa.

Genus Diaptomus *Westwood.*

Diaptomus orientalis *G. S. Brady.*

Frequent in gatherings from Somkele and Richmond. This species was described many years ago from specimens taken in Ceylon,[1] and has been since seen by other observers in various places. Professor G. O. Sars has noticed it among species raised from dried Australian mud.

EXPLANATION OF PLATES XXIX—XXXII,

Illustrating Dr. G. S. Brady's paper "On Entomostraca Collected in Natal by Mr. James Gibson."

PLATE XXIX.

Cypris intumescens n. sp.

Fig. 1.—Shell seen from right side. × 40.
Fig. 2.—Shell seen from above. × 40.
Fig. 3.—Labrum. × 240.
Fig. 4.—Genital plate. × 240.
Fig. 5.—Caudal ramus. × 100.

Cypria armata *G. W. Müller.*

Fig. 6.—Shell seen from right side. × 84.
Fig. 7.—Shell seen from above. × 84.
Fig. 8.—Posterior antenna. × 200.
Fig. 9.—Extremity of foot of second pair. × 240.
Fig. 10.—Right copulative organ of male. × 350.
Fig. 11.—Caudal ramus. × 240.

PLATE XXX.

Proteocypris reniformis n. sp.

Fig. 1.—Shell seen from left side. × 84.
Fig. 2.—Shell seen from above. × 84.
Fig. 3.—Posterior antenna. × 300.
Fig. 4.—Mandible and palp. × 300.
Fig. 5.—Maxilla of first pair. × 300.
Fig. 6.—Claw of second maxilla, ♂. × 300.
Fig. 7.—Caudal ramus. × 440.
Fig. 8.—Ejaculatory duct and copulative organ, ♂. × 240.
Fig. 9.—Shell structure. × 240.

[1] Linnean Society's Journal, 'Zoology,' vol. xix (1885).

Proteocypris globuloides n. sp.

FIG. 10.—Shell seen from left side. × 84.
FIG. 11.—Shell seen from above. × 84.
FIG. 12.—Posterior antenna. × 240.
FIG. 13.—Claw of second maxilla, right side, ♂. × 300.
FIG. 14.—Second maxilla of left side, ♂. × 300.
FIG. 15.—Foot of first pair. × 240.
FIG. 16.—Foot of second pair. × 300.
FIG. 17.—Caudal ramus. × 350.
FIG. 18.—Copulative organ of right side. × 240.

PLATE XXXI.

Stenocypris aldabræ *G. W. Müller.*

FIG. 1.—Shell seen from left side. × 31.
FIG. 2.—Shell seen from above. × 31.
FIG. 3.—Posterior antenna. × 84.
FIG. 4.—Extremity of second foot. × 240.
FIG. 5.—Caudal rami. × 84.
FIG. 6.—End of right ramus, enlarged. × 240.

Cypridopsis punctillata n. sp.

FIG. 7.—Shell seen from right side. × 80.
FIG. 8.—Shell seen from above. × 80.
FIG. 9.—Anterior border of left valve. × 80.
FIG. 10.—Caudal ramus. × 440.
FIG. 11.—Shell sculpture. × 240.

Leydigia propinqua *G. O. Sars.*

FIG. 12.—Female seen from left side. × 100.
FIG. 13.—Caudal lamina. × 240.

Alonopsis sp?

FIG. 14.—Female seen from left side. × 130.
FIG. 15.—Caudal lamina. × 250.

PLATE XXXII.

Chydorus gibsoni n. sp.

FIG. 1.—Female seen from left side. × 90.
1A.—Lip-plate.
FIG. 2.—Caudal lamina. × 250.

Ceriodaphnia natalis n. sp.

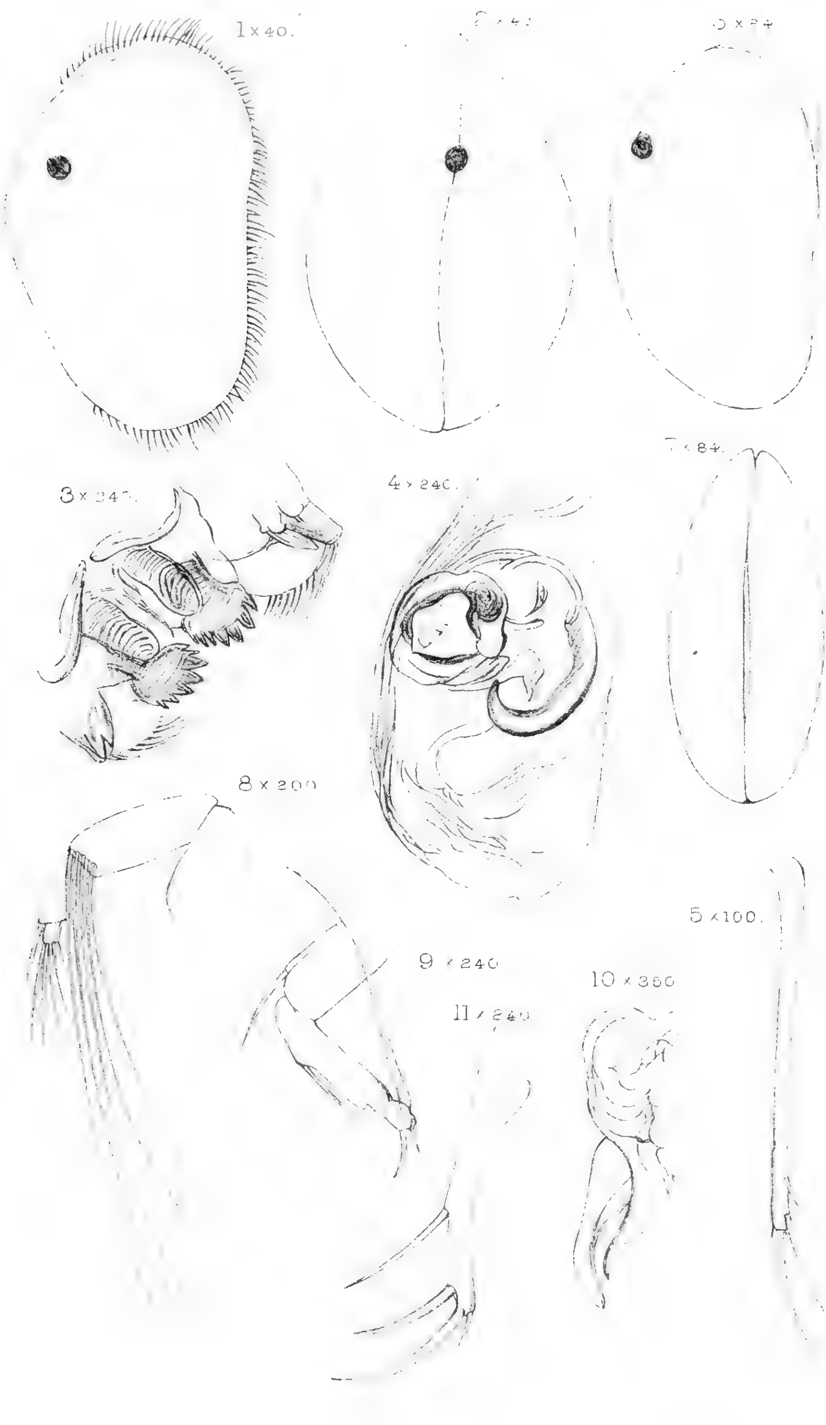
Fig. 3.—Male seen from left side. × 84.
Fig. 4.—Antennule of same. × 100.
Fig. 5.—Female seen from left side. × 84.
Fig. 6.—Female seen dorsally. × 84.
Fig. 7.—End of caudal lamina. × 240.

Simocephalus capensis? *G. O. Sars.*

Fig. 8.—Female seen from right side. × 31.

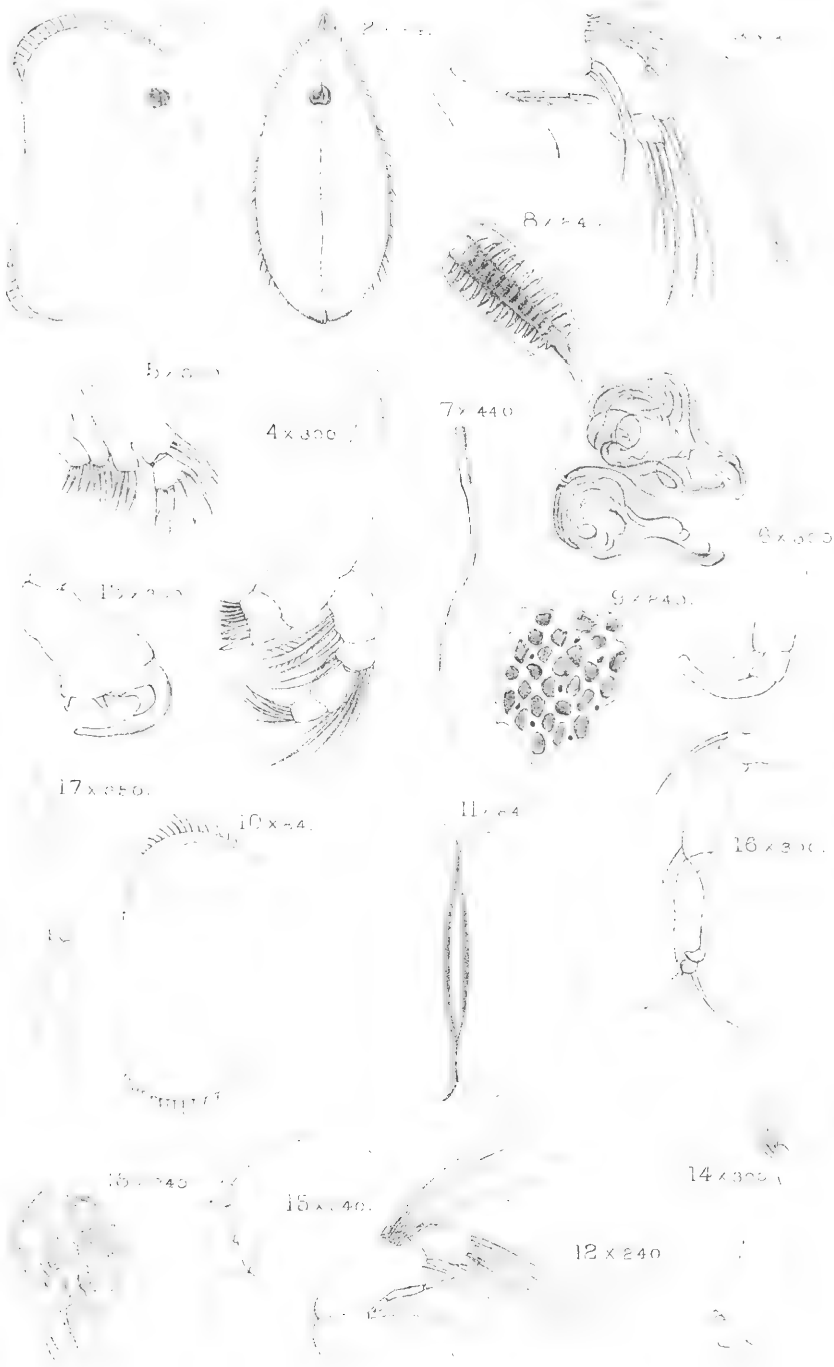
Pleuroxus assimilis n. sp.

Fig. 9.—Female seen from left side. × 110.
Fig. 10.—Caudal lamina. × 320.



Brady del. Huth Lith. London.

CYPRIS INTUMESCENS nov. sp. Figs. 1-5. CYPRIA ARMATA G. W. Müller Figs. 6-11.



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PROTEOCYPRIS RENIFORMIS nov. sp. Fig.s 1-9. PROTEOCYPRIS GLOBULOIDES nov. sp. Fig.s 10-18.

Brady del. Huth Lith[rs] London.

STENOCYPRIS ALDABRÆ *G.W.Müller* Figs 1–6 CYPRIDOPSIS PUNCTILLATA nov sp Figs 7–11.

LEYDIGIA PROPINQUA *G.O.Sars* Figs 12–13 ALONOPSIS? sp. Figs 14–15.

Brady del. Huth, lith. London.

CHYDORUS GIBSONI nov. sp. Figs 1–2. CERIODAPHNIA NATALIS nov. sp. Figs 3–7.
SIMOCEPHALUS CAPENSIS? *G.O.Sars* Fig 8. PLEUROXUS ASSIMILIS nov. sp. Figs 9–10.

On Parawrightia robusta gen. et sp. nov., a Hydroid from the Natal Coast; and also an Account of a Supposed Schizophyte occurring in the Gonophores.

By

Ernest Warren, D.Sc.Lond.
Director of the Natal Government Museum.

With Plates XXXIII and XXXIV.

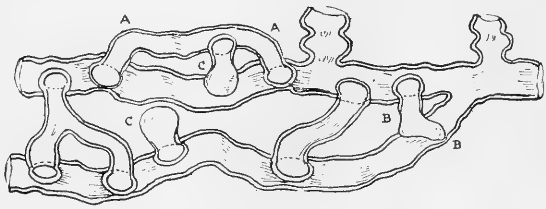
I.

This hydroid has been found at several places on the Natal coast. It was first collected at Park Rynie, and subsequently at Isipingo and Scottsburg. These places are situated thirty to forty miles south of Durban. The hydroid is not very common; it occurs attached to sea-weeds and sponges in the rock-pools near the low-water line.

(1) Trophosome.—It consists of a creeping stolon, about 0·25 mm. in diameter, forming an irregular reticulum on the surface of the foreign body to which it is attached (Pl. XXXIII, figs. 1, 2). From the reticulum there spring upright stems 5—12 mm. in height, which usually bear a single terminal polyp. Occasionally the stem may produce one or even two short lateral branches, each carrying a hydranth.

The growth of the stolon or reticulum is not by any means limited to apical growth. Almost any part of the stolon appears to have the power of sending out bud-like swellings. The ectoderm under the thick perisarc proliferates, forces its way through the perisarc, and is at first only covered by the thinnest cuticle-like layer (text-fig. 3, A, *c.*). An examination of a reticulum and its growing apices clearly shows that the lateral off-shoots are capable of fusing with neighbouring stolons, the perisarc ultimately disappearing at the place of contact, and the lumen of the lateral shoot becoming continuous with that of the stolon to which it has joined. In the annexed figure a piece of the stolon reticulum is shown. In the case of the shoot A, the outgrowth has bent round and fused with the parent stolon. In B, a cross-filament is flattening itself over a neighbouring stolon, preparatory to complete fusion and the disappearance of the intervening layer of perisarc. C and C are young buds

TEXT-FIG. 1.



AA. Branch uniting to parent stolon. C. Young buds covered by thin membrane. B. Young bud fastening itself to neighbouring stolon. × 20.

which have recently appeared. It is doubtful whether the substance of the perisarc is the same as that of the chitin of Arthropods; but in any case it is a peculiarly insoluble substance, and it might be of interest to endeavour to trace the mode of absorption of the perisarc in the formation of buds, and the fusion of lateral shoots, since it is clearly not merely a mechanical rupture. I have not, however, had an opportunity to investigate the matter with any thoroughness.

The stolons may be knarled in places, and the general contour tends to be somewhat irregular (Pl. XXXIII, fig. 2, *k*). The stems bearing the hydranths are irregularly ringed or spirally ridged to a variable extent. The ridging (*r.*) may extend throughout the whole length; but it is generally confined to the basal region, where the hydrocaulus springs from the stolon, and the greatest strain has to be borne. The older portions of the stolon tend to be dark brown, while the younger portions are pale brown or whitish. The whole surface of the perisarc is generally clothed with particles of mud and very fine sand (Pl. XXXIII, fig. 3, *ex. l.*, and XXXIV, fig. 6, *o. l.*).

The base of the hydranth is cup-shaped, and the perisarc extends over it forming a kind of calyx (Pl. XXXIII, fig. 3); but the crown of the hydranth is not perceptibly retractile into it, as in the case of Hinck's genus Atractylis. There are thirteen to eighteen tentacles which spring in a single whorl around the edge of the cup-shaped base. The tentacles are sometimes held alternately elevated and depressed (Pl. XXXIII, fig. 2, *p. el.*), as in the genera Perigonimus, Bimeria, etc. The hypostome can scarcely be described as conical, it is intermediate in shape between the conical hypostome of a Perigonimus and the widely expanded, trumpet-shaped hypostome of an Eudendrium.

The hydranth can be found in three conditions (Pl. XXXIII, fig. 2): (1) the ordinary contracted condition (*c. p.*) with tentacles placed more or less vertically, covering the hypostome; height about 0·90 mm.; (2) hypostome and cup elongated (*p. el.*) and tentacles alternately elevated and depressed; height about 1·10 mm.; (3) flattened condition (*ex. p.*) forming a star, where the hypostome and cup constitute the disc, about 0·90 mm. in diameter, and the tentacles form the rays. The thick perisarc of the cup must be highly elastic in order to allow such very complete lateral expansion.

The endoderm of the hydranth is red, the other parts of the hydroid are translucent and white.

The sexes are separate, and fixed gonophores are formed. Both male and female gonophores have only been found springing singly from the stems carrying the hydranths (Pl. XXXIII, fig. 2., *g*, *y.g.*), they have not been seen originating from the stolon.

(2) Histology.—Perisarc.—The perisarc of the stolon is

about 18·7 μ in thickness, and is obviously laminated in structure. The stem carrying the hydranth has a perisarc consisting of two layers: (1) An inner laminated layer continuous with the perisarc of the stolon (Pl. XXXIII, fig. 3, *ch.*[2]), and (2), an outer vertically striated layer (*ch.*[1]). This layer alone forms the cup of the hydranth, and its upper edge is inserted in the shallow perisarc-groove just below the verticil of tentacles. The outer layer gradually thins out towards the base of the hydranth-bearing stem, while the laminated layer thins out and disappears at the base of the hydranth. The thick perisarc around the gonophore consists of the laminated layer only (Pl. XXXIII, figs. 3 and 5, *ch.* 2; text-fig. 3, B, *ch.*[2]). The whole of the perisarc is apparently covered with a gelatinous or sticky substance, as there is normally a very conspicuous coating of small particles of mud and sand.

In the developing hydranth the whole of the ectoderm of the cup-like base appears to take part in the secretion of perisarc. The perisarc-groove, where the perisarc terminates, is a more obvious structure than in the mature hydranth (text-fig. 2, B, *p. g*). It would appear that the outer vertically striated layer (*ch.*[1]) is only secreted by the hydranth, and that as the hydranth elongates and forms a stalk, this layer of perisarc is, so to speak, left behind, and is then strengthened by the secretion of the inner laminated layer by the general ectoderm of the stem. It may be noticed that in the majority of the gymnoblastic hydroids the groove or "collar" occurs at the top of the stem bearing the polyp, where the perisarc terminates; while in the present species it occurs just below the verticil of tentacles of the hydranth.

Ectoderm.—The histology of the ectoderm is typical. The nematocysts are of one kind only in the hydranth, and are somewhat small, measuring about 5·0 μ in length and 2·9 μ in breadth. I have not found them occurring in the endoderm. They are scattered somewhat sparsely throughout the ectoderm of the tentacles and general cœnosarc. In the gonophores, nematocysts are abundant, and they tend to be somewhat larger than those on the tentacles (5·6 μ in length);

they occur in the thickening of the umbrella ectoderm around the opening of the umbrella (Pl. XXXIII, figs. 3 and 5, *n*; text-fig. 6, *n*.). They also occur plentifully in the midst of the spermatic mass (Pl. XXXIV, fig. 6, *n*).

It seems fairly clear that nematocysts can have no function imbedded in the spermatic mass, or even in the general cœnosarc, since they are shut off from the exterior by a thick perisarc. It would appear that the ectoderm, being endowed with the power of forming nematocysts, produces these structures whether or not they can become functionally active. It is conceivable that the presence of nematocysts throughout the entire substance of the ectoderm would render the hydroid distasteful to be eaten as a whole; but I do not consider that this is the correct view. The abundance of nematocysts around what would be the margin of the umbrella is an interesting case of the persistence of a structure after the loss of its function. The fact that the nematocysts are somewhat larger in the gonophore than in the hydranth is also of some interest.

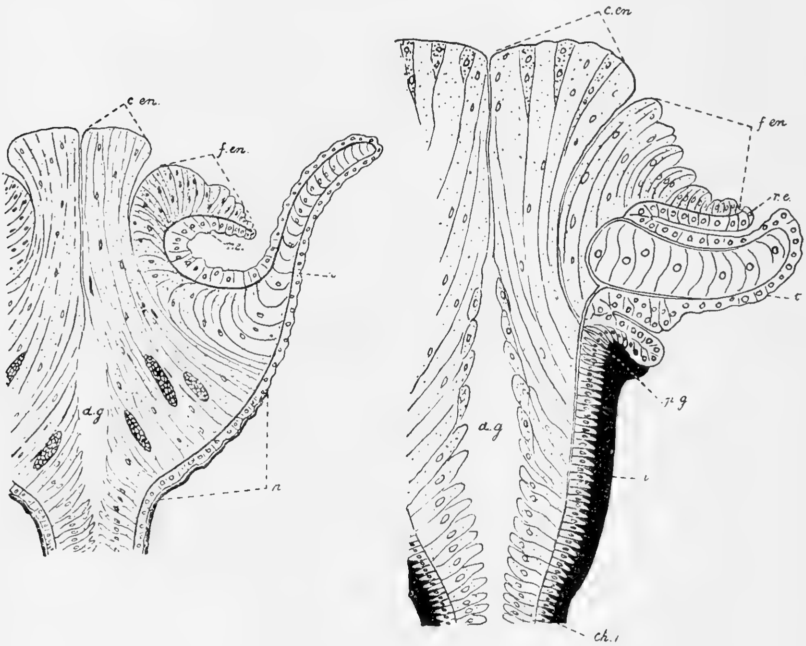
Endoderm.—The endoderm of the hypostome consists of narrow columnar cells, with small deeply-staining nuclei (Pl. XXXIII, fig. 4, *en.h.*). The small vacuolated cells, which stain intensely, and are frequently seen in the endoderm of the hypostome of various hydroids, do not appear to occur in this species. In transverse section the endoderm of the hypostome is seen to be raised into six to eight prominent ridges.

At the base of the hypostome the endoderm abruptly changes its character, and the cells are large, vacuolated, and richly granular. These endoderm cells frequently contain globules of yolk (Pl. XXXIII, fig. 3, *y. gl.*), more especially towards the base of the polyp. Special glandular cells (*gl. c.*) with large granules occur in the upper portion of the digestive cavity of the hydranth, and they are also found irregularly scattered in the endoderm of the stem and stolon.

(3) The development of the hydranth.—A lateral branch of the stolon, a hydranth, or a gonophore, originate

from the parent cœnosarc in a closely similar manner. A bud is formed by an outgrowth of the cœnosarc, which pushes its way through the perisarc, partly by mechanical pressure, and partly, I think, by absorption (text-fig. 3, A). The bud is at first covered merely by a very thin membrane (*c.*). In

TEXT-FIG. 2.



A. B.

A. Adult hydranth of Eudendrium sp. B. Developing hydranth of Parawrightia robusta.

c.en. Central endoderm. *f.en.* Fan-shaped endoderm. *r.e.* Reflexed ectoderm. *t.* Tentacle. *p.* Perisarc, consisting of the vertically striated layer chiefly. *p.g.* Perisarc groove. *d.g.* Digestive cavity. × 140.

the case of a lateral branch of the stolon the bud can readily mould itself so as to fit into any irregularities of surface of the foreign body which supports the hydroid. In this way the colony becomes very firmly attached (Pl. XXXIII, fig. 2, *cl. r.*).

The developing hydranth shows a very marked resemblance to the adult structure of an undescribed Eudendrium-like species, which was dredged off Bird Island last year by the museum collector.

In the annexed illustration are shown, side by side, vertical sections of the adult polyp of the Eudendrium (A) and of the developing polyp of Parawrightia (B).

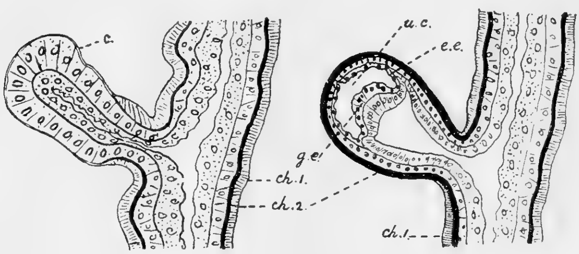
The striking similarity in structure in the two cases is remarkable. At this stage in the development there is no hypostome, and the elongated endoderm is spread out in a fan-shaped manner so as to be widely exposed to the exterior. The reflexed ectoderm (*r. e.*), the arrangement of the endoderm over it (*f. en.*), and the origin of the tentacles (*t.*) may be directly compared with the condition seen in the adult polyp of the supposed Eudendrium. The central portion of endoderm (*c. en.*), consisting of very elongated cells, is essentially alike in the two cases. The digestive cavities (*d. g.*) are both exceptionally narrow. In the Eudendrium the perisarc is less strongly developed; but it does extend over the base of the polyp (*p.*) to form a kind of calyx, as in Parawrightia.

It is, of course, debatable how far such a resemblance is to be regarded as arising through genetic relationships; but the similarity of structure in the two cases is so close that the matter appeared worthy of record; and it is not unreasonable to assume the possibility that the mode of development of the hydranth may give some hints of phylogenetic significance.

(4) Gonosome.—The sexes are separate, male and female gonophores being formed on different colonies. The gonophores, whether male or female, arise on the stems carrying the hydranths. As a rule only one gonophore is produced on a stem, and it is generally situated not far from the polyp. The gonophore, like a lateral polyp, arises by proliferation of a patch of ectoderm and endoderm, which grows through the perisarc in the form of a swelling, and is at first only covered by a very thin membrane.

Ultimately the gonophore becomes surrounded by a uniform layer of perisarc continuous with the inner laminated layer of the stem (text-fig. 3, B). An umbrella-cavity (*u. c.*) appears at an early stage with ectoderm on ectotheca (*e. e.*) and endotheca (*g. e.*) Later on the umbrella-cavity becomes relatively small and is mostly confined to the apical region of the gonophore (text-fig. 4, A and B). Below the apically-situated cavity the endotheca, consisting of the generative epithelium, is continuous with the ectotheca; but there are gradually developed four canals (Pl. XXXIII, fig. 4, *sp.*, and text-fig. 4, *sp.*) which are continuous with the umbrella-cavity in the apical region, and are situated in such a manner

TEXT-FIG. 3.



A. Polyp-bud. × 100. B. Young gonophore. × 70.

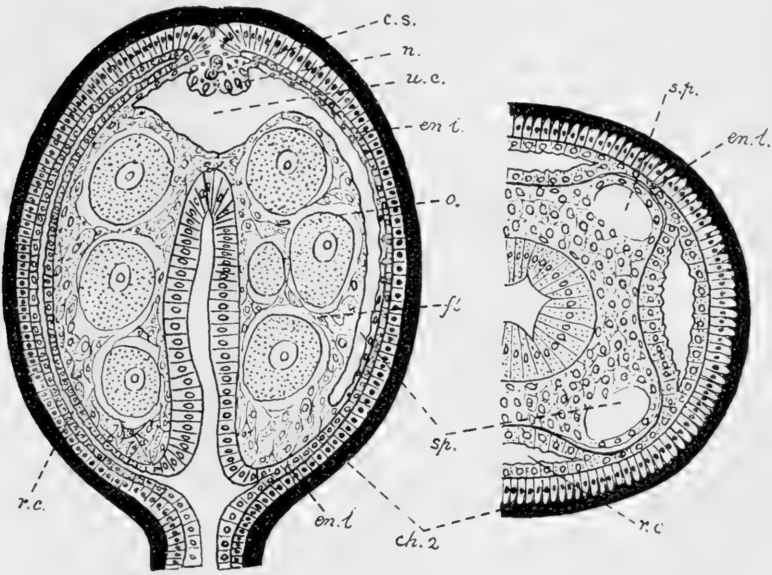
c. Thin membrane covering bud. *ch*[1]. Outer striated layer of perisarc. *ch*[2]. Inner laminated layer of perisarc. *g.e.* Germinal epithelium. *u.c.* Umbrella cavity. *e.c.* Ectoderm of Ectotheca.

as to alternate with the endodermal radial canals (*r. c.*) An endodermal lamella (*en. l.*) is present, connecting together the radial canals.

The male and female gonophores differ in shape. The male is a somewhat elongated ovoid, about 1·20 mm. in length, and 0·70 mm. in breadth, and is so placed that it lies almost parallel to the parent stem. The female gonophore is more nearly spherical, about 1·10 mm. in length, and 0·99 mm. in breadth, and it tends to stand out nearly at right angles to the stem (Pl. XXXIII, figs. 3 and 5).

The umbrella-cavity (*u. c.*) of the mature female gonophore has an apical opening (*o. u.*) surrounded by nematocysts (*n.*); but it does not communicate with the exterior on account of the presence of the thick perisarc (about 25 μ thick). In the case of the male gonophore I have not actually seen such an opening developed, but its position is clearly indicated by the dipping in of the ectoderm and the cluster of nematocysts (Pl. XXXIII, fig. 5; text-fig. 4, A.) The ectodermal epithelium of the ectotheca lining the umbrella-cavity is seen in

TEXT-FIG. 4.



A. Female gonophore, longitudinal section. B. Male gonophore, transverse section.

c.s. Capsule of Schizophyte. *n.* Nematocysts. *u.c.* Umbrella-cavity. *en.l.* Endodermal lamella. *o.* Ovum. *fl.* Follicle cells. *r.c.* Radial canal. ch^2. Laminated perisarc. *sp.* Canals opening into umbrella-cavity. × 140.

Pl. XXXIV, fig. 6, *n. o. e.*, and of the endotheca, as distinct from the spermatic tissue, at *e. c.* The space marked *u. s.* is one of the channels which opens into the umbrella-cavity at the apical region of the gonophore. The spaces marked *ch.* occur irregularly through the spermatic mass. A distinct circular canal is not formed.

It is far from clear how fertilisation takes place, since the gonophore is surrounded by a thick perisarc, and the eggs, after they have become charged with yolk-globules, segment and ultimately form planulæ while still inside the parent gonophore (Pl. XXXIII, fig. 3, *Pl.*). The planulæ are solid, and consist of an outer columnar epithelium, within which is a granular mass densely crowded with yolk. During maturation the eggs are surrounded by follicle cells (Pl. XXXIII, fig. 4, *fl.*; and text-fig. 4, A, *fl.*). On the formation of the planulæ the follicle cells disappear, but a layer of ectoderm cells persists on the ectotheca and also covering the spadix (Pl. XXXIII, fig. 3, *ect.*).

(5) Systematic position.—As it has been seen, the reproductive bodies are fixed gonophores, and consequently the present species is at once marked off from Perigonimus, where free medusæ are produced. It agrees with Bimeria and Garveia in having fixed gonophores. It differs, however, from Bimeria in habit, in not having the perisarc continued over the base of the hypostome and tentacles, and in having the spadix unbranched. It also differs from Garveia in habit and in the structure of the gonophore.

In the gonosome the species agrees with Hinck's definition of Atractylis arenosa (Allman's Wrightia arenosa), in which a special point is made that although closely allied to Perigonimus it differs in having fixed gonophores.

The polyp of this species is, however, very little like that of Wrightia arenosa. The average number of tentacles is about fifteen instead of about nine; the tentacles are not muricated, and the polyp is scarcely at all retractile into the upper cup-like portion of the stem. Also, the extrusion of the eggs from the gonophore into a gelatinous sac, which Hinck's describes in Atractylis, has not been observed in the present species; and in fact it probably does not occur, since fully-developed planulæ are found in the unruptured gonophore. The mode of fertilisation is problematical.

The general appearance of a colony is like that of Perigonimus; the endoderm of the hydranth is red, as in several species of Perigonimus, while in Wrightia it is white. On the whole it appears advisable to separate it from Wrightia; and the name Parawrightia robusta is proposed to indicate the relationship.

II.

The structures about to be described, and shown in situ in Pl. XXXIII, fig. 3, *p.b.*, Pl. XXXIV, fig. 6, *y.s.*, have only been found in the male and female gonophores. I have searched carefully in the substance of the general tissues of the hydroid, both in the ectoderm and endoderm of the polyp, stem, and stolon. Also, they have not been seen in any cavities, such as the digestive cavities of the polyp or cœnosarc, or in the irregular cavities between the cœnosarc and the perisarc. The structures occur in the umbrella-cavity, in the generative epithelium, and in one case embedded in the ectoderm filling up the opening of the umbrella-cavity. They have not been seen in the endodermal radial canals of the gonophore. It will be noticed that the structures develop in temporary spaces, and that they must ultimately pass out to the exterior by the dehiscence of the gonophore.

In no sense do the bodies appear to exercise a malignant effect on the host; they may increase in numbers in the gonophore to a considerable extent, but the development of the planulæ and sperm continues, to all appearance, in a perfectly normal manner.

From the amount of material available it is difficult to obtain much idea of their frequency of occurrence. I have collected six colonies; three of these possessed no gonophores; of the remaining three, two from one locality (Park Rynie) were female, and one from another locality (Isipingo) was male. About fifteen male and female gonophores in various stages of development were present on these three colonies, and the structures were present in ten. They occurred in all three colonies, but not in every gonophore. The evidence, as far as it goes, indicates a general occurrence of the structures in the gonophores. The organisms have not been found outside the hydroid, either adhering to the surface of the perisarc, or to the sea weed or other foreign body to which it is attached. The structures occur especially in the four canals of the umbrella cavity left between the ectotheca and endotheca, and alternating in position with the radial endodermal canals (text-fig. 4, A and B). They may also be found in cavities that occur in the spermatic mass (Pl. XXXIV, fig. 6, *ch.*), and between the ova or developing planulæ of a female gonophore.

The youngest stage observed is seen in Pl. XXXIV, fig. 7 (*1*). It is a rounded body, about 2·2 μ in diameter, and staining with hæmatoxylin or aniline dyes with great difficulty. The body is refringent, and appears homogeneous with Zeiss's DD objective, but with Zeiss's apochromatic $\frac{1}{18}$ it is seen to be slightly granular with one or two minute globules. In this stage it is capable of division. I have found such bodies embedded in the spermatic tissue, and in one case in the ectoderm of the ectotheca. The bodies apparently work their way out into any spaces, such as the umbrella-cavity and channels, and any cavities in the spermatic mass (Pl. XXXIV, fig. 6, *b*) or between the ova. No distinct, separable cell-wall can be observed.

When in a cavity the body soon secretes a transparent and refringent envelope of one or two layers (fig. 7 (*2*, *3*, *4*, and *5*)). This envelope, especially the outermost and older layer, is capable of staining deeply with hæmatoxylin (Pl. XXXIV, fig. 8 (*4*), *o.en.*).

In this condition (fig. 7 (*4*)) it is capable of fission, both the central body (*c. b.*) and the envelope dividing.

The envelope, forming a definite capsule, increases in size and in the number of laminations, and the central body becomes smaller and more refringent. The central body, which in the young stage is rounded and about 2·2 μ in diameter, varies in size in the fully-grown capsule from about 1·10 μ to 0·48 μ (figs. 9 and 10, *c.b.* and *d.b.*). The central body can divide by fission (*d.b.*) inside the capsule. Previous to fission the body becomes rod-shaped, and is about 1·10 μ. in length, and 0·50 μ in width (fig. 10, *c.b.*) On the division of the central body, one of three events may take place:

(1) The envelope divides, and fission or budding takes place as mentioned above. This may continue a number of times until a cluster of individuals is produced (fig. 8 (*2*, *4*, *5*)). Such occurs only when the capsules are small and consist of but few layers.

(2) The division products of the central body may each form a centre from which fresh laminated layers originate. In this way a number of separate centres of lamination may be formed inside the original system (fig. 8 (*7*) and fig. 11).

(3) The division-products of the central bodies may not start fresh centres of lamination, but may remain stranded, so to speak, in the laminated system of the parent body (figs. 9, 10, 11, *s.b.*, and text-fig. 5 (*7*) *s.b.*). In an old capsule such bodies are seen irregularly scattered through the laminations.

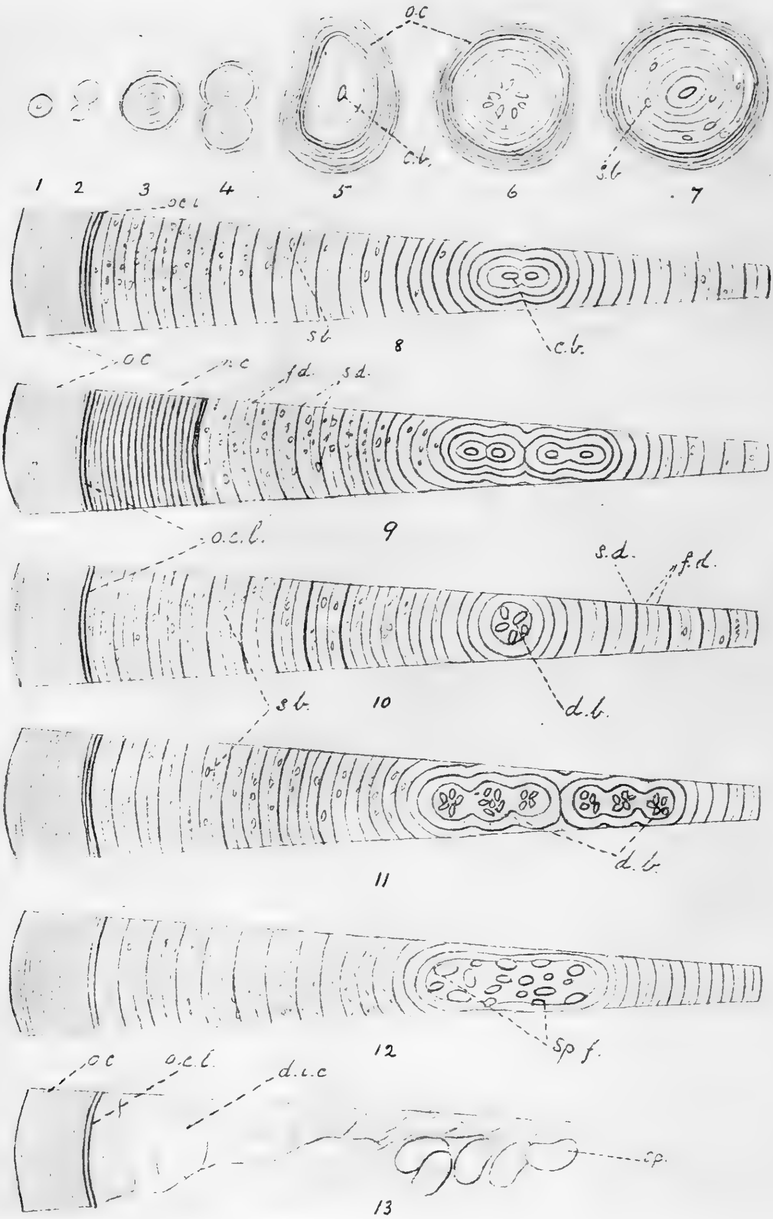
In the case of the female gonophore the capsules may grow to a very considerable size, and may reach a length of 70 μ or more. The appearance of these structures varies according to the number of centres of lamination. The central bodies, and the bodies stranded in the substance of the capsule, are highly refringent, while the substance of the capsule is perfectly clear like spun glass, and is considerably refringent.

The structures may be spherical with a single central body, or they may be elongated with a row of central bodies along the long axis (Pl. XXXIV, fig 10), or they may be lobed with various centres of lamination (fig. 11). In the case of fig. 9 the structure was bilobed with two centres of lamination.

In the accompanying illustration (text-fig. 5), the arrangement of the laminations and the bodies is shown on a large scale, and consequently more clearly than is possible in the plate. The cone-shaped figures are wedges taken from various capsules; the centre of the capsule being situated towards the right hand side of the page.

Figures 1 to 5 and 7 show the early stages of development,

Text-fig. 5.



c.b. Central body or supposed Schizophyte. *d.b.* Dividing body. *d.i.c.* Disintegrating inner capsule. *f.d.* Faintly defined layer of capsule. *o.c.* Outer capsule. *o.c.l.* Outer layer of inner capsule. *s.b.* Stranded body. *s.d.* Sharply defined layer. *sp.* Spore. *sp.f.* Spore formation. × 2000.

and have already been sufficiently explained. Fig. 6, and Plate XXXIV, fig. 8 (*8, 9, 10*), represent capsules which frequently occur in the male gonophore, and they will be mentioned below.

In text-fig. 5 (*8*) are seen two central bodies, 1·3 μ and 0·6 μ in length, which have clearly been formed by fission. The outermost layer (*o. c.*) of the capsule is about 3·9 μ in thickness, it is apparently very compact and dense, and the lamination, if visible at all, is very close. On the inner side of this dense envelope are two thin layers separated by a narrow clear space (*o. c. l.*). The outer capsule and these two thin layers stain more intensely than any other part of the capsule. Passing inwards we find concentric layers arranged with great regularity, often there are alternating layers of sharply and less sharply defined strata. In these layers and between them can be seen refringent bodies irregularly placed. They may be clustered on one side of the capsule only (Pl. XXXIV, figs. 9, 10, 11, *s. b.*). They vary in size from about 1·1 μ to about 0·4 μ, and were presumably formed by the division of the central body. The layers of capsule immediately surrounding the central body or bodies are less pellucid than the others (Pl. XXXIV, figs. 10 and 11, *i. l.*).

In fig. *9* there are four central bodies, obviously formed by the division of two. The capsule shows the usual outer compact layer with little trace of lamination, then the sharply defined double line. Within this there are twelve or thirteen closely applied layers (*m. c.*), following which are two sharply defined layers, and then a considerable number of thick layers (*s. d.*), each consisting of two or three faintly defined layers (*f. d.*).

In fig. *10* the central body has broken up into a cluster of smaller bodies, and it is supposed that it is in such a way that the bodies (*s. b.*) scattered through the substance of the capsule originate. Most of the bodies of the cluster appear to become included in the new laminations, while one or more remain as central bodies producing fresh laminations.

In fig. *11* the central bodies, of which there were clearly six, have each broken up into clusters of small bodies.

When the life of the gonophore is drawing to a close, and the generative products are nearly ripe, a change takes place in the central bodies. These divide rapidly and form an irregular collection in the central region of the laminated system; at the same time the innermost layers of lamination become indistinct, and then disappear. The bodies, derived from the splitting up of the central bodies, increase considerably in size; they are rounded in shape, and some of them become conspicuously large (Pl. XXXIV, figs. 11 and 12, *d. b.*; and text-fig. 5 (*12*), *sp. f.*).

Ultimately the whole of the laminated layers of the capsule, except the outer dense layer, and the double sharply defined layer immediately on the inside, disintegrate, and more or less completely disappear (text-fig. 5 (*13*), *d. i. c.*). Most of the bodies derived from the splitting up of the central body or bodies also disappear; but a few persist, ten to twelve for a good-sized capsule, having grown into oval bodies of very fairly constant size and shape. The average size is 3·4 μ in length and 2·5 μ in breadth. These bodies may probably be regarded as "spores;" they are characterised by readily becoming intensely stained with hæmatoxylin, while the ordinary central bodies of the capsules do not stain very readily. The "spore" is surrounded by a membrane which appears to be firm, since a constant shape is maintained.

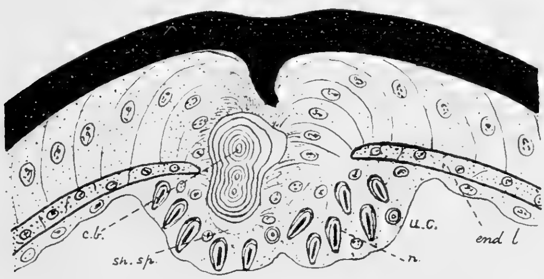
In Pl. XXXIV, fig. 12, the process of "spore-formation" is in progress, and the inner layers are shrinking (see also text-fig. 5 (*13*)). Ultimately the capsules become hollow, and include nothing but a few oval "spores" and perhaps the shrunken residue of some of the inner layers (Pl. XXXIV, figs. 13 and 14).

Under the highest magnification I could detect no obvious structure in the "spore" except an outer membrane and a very finely granular interior.

It may be noticed that in Pl. XXXIV, fig. 11, a number of different systems are enclosed in the compact outer envelope. In two of these spore-formation is beginning (*d. b.*), while in the other two centres vegetative growth is still continuing.

In the case of the male gonophores, I have never found such large capsules as occur in the female gonophores. Their final growth appears to be much reduced, and they do not as a rule exceed 10 to 12 μ in diameter. In some of these smaller forms the concentric lamination, especially towards the centre, is replaced by a radial striation (Pl. XXXIV, fig. 8 (*8*, *9*, *10*), and text-fig. 5 (*6*)). In figs. *9* and *10* of the plate the central body has split up (*d. b.*) preparatory to the formation of spore-like bodies. In correlation with the small size of the capsules in the male gonophore it may be noticed that there is but little space for development, as the umbrella-

TEXT-FIG. 6.



u.c. Umbrella-cavity. *c.b.* Central body, supposed Schizophyte. *end.l.* Endodermal lamella. *n.* Nematocysts. *sh.sp.* Shrinkage space between capsule and hydroid. × 750.

cavity is very restricted. It is interesting to note this adaptation to the environment.

In one female gonophore a capsule was found embedded in the ectoderm at the future opening of the umbrella-cavity. It differed from the capsules growing free in the umbrella-cavity in the almost complete absence of the outer compact layer, and in the layers of the capsule being apparently more separable from one another.

The real nature of the central bodies and capsules is problematical. The central bodies are, as we have seen, highly refringent, and stain in section only with difficulty. The structures in a young condition can be embedded and cut with a microtome fairly well, but in an older condition, when the capsule is fully formed, it has not been found possible to cut satisfactory sections. The circumstance is, however, of less importance as the capsules are exceedingly transparent. It is probable that the difficulty in cutting is due to the impermeability of the capsule to the paraffin-wax.

The capsule itself is refringent, but it stains readily with Delafield's hæmatoxylin.

I have treated some fragmentary sections with a series of reagents in order to endeavour to test the nature of the capsule. I have had no opportunity of testing fresh material[1] in a similar manner.

Cellulose tests.—It is coloured faintly yellow by liquor iodi; it is slightly disorganised by concentrated sulphuric acid; it is not coloured blue with iodine and sulphuric acid; it is not appreciably swollen or dissolved by an ammoniacal solution of cupric hydrate.

The capsule accordingly does not give a characteristic cellulose reaction.

Proteid tests.—Concentrated nitric acid causes a faint yellow tinge both in the capsule (especially in the outermost layer) and in the perisarc and mesoglea of the hydroid. On the addition of 50 per cent. caustic potash or ammonia the yellow tinge becomes somewhat intensified. There would thus appear from this test, the xanthoproteic reaction, that there is some proteid matter both in the capsule and in the perisarc.

Neither 50 per cent. caustic potash nor concentrated ammonia have any appreciable swelling action on the capsule.

Concentrated hydrochloric acid and aqua regia do not obviously affect the capsule.

Picric acid has no marked staining effect.

Delafield's hæmatoxylin stains the capsule and the mesoglea intensely, while the perisarc is somewhat less strongly acted upon.

Methyl blue stains the capsule deep blue.

Methylene blue is an excellent stain for the capsule and

[1] The hydroid had been fixed with a half-saturated solution of corrosive sublimate in 30 per cent. spirit with 1½ per cent. acetic acid.

also for the central bodies. By means of this stain the outer envelope of the capsule, which generally appears homogeneous, is shown to be finely laminated.

Methyl eosin does not stain the capsule or the perisarc of the hydroid to any extent.

Congo red tends to stain the inner envelopes of the capsule more than the outer sheath. All the tissues of the hydroid, including the perisarc, are stained. On faintly acidulating the preparation the perisarc becomes blue, while the capsules, the mesoglea, and the rest of the tissues of the hydroid remain red.

Mr. Arnold Cooper has kindly tested for me the effect of the capsules on polarised light. He finds that they sometimes possess slight depolarising power. The innermost layer of the capsule immediately surrounding the central bodies appears generally to possess this power to the greatest extent. The central bodies themselves remain dark. In some capsules areas of light of different sizes appear in various parts of the laminations. Perhaps this is due to stresses and strains set up in the substance of the capsule during its growth. The perisarc, especially the innermost layer, and also the mesoglea may at times possess a certain amount of depolarising power.

In all the tests that have been applied, the capsules, the mesoglea, and the perisarc react very similarly, and it is possible that they may all consist of somewhat analogous substances; but the capsules are certainly harder and more brittle than either the mesoglea or the perisarc.

It would appear probable that the organism gains entrance into the gonophore when the latter is in the form of a bud, for at this stage the young gonophore is practically naked, as the covering membrane is excessively thin.

The central body is possibly a Schizophyte, and the laminated capsules recall Leuconostc; but in the present case the capsules are hard and not gelatinous.

The formation of a limited number of somewhat large spore-like bodies, with the disappearance of the middle portion of the capsule and the greater number of the cocci, are also somewhat analogous to the phenomena which occur in Leuconostc.

The central bodies are too small, and apparently structureless to be regarded as unicellular algæ of the nature of Gleocapsa, and besides the character of the capsule is not the same.

Certain bacteria form capsules, and perhaps in the present case in extracting their nourishment from the fluids of the hydroid the central bodies form the capsules as a by-product, which is not very dissimilar in nature from the mesoglea.

On the other hand, it should be noticed that in the formation of the so-called spores the whole of the inside of the capsule is dissolved, and only the outer compact envelopes remain. It would, therefore, be more reasonable to regard the inner substance of the capsule as reserve food-material which is utilised in the reproductive stage when the spores are formed. It is scarcely conceivable that the relatively huge capsule should be formed merely in connection with the vegetative growth of the minute central bodies. This hypothesis is rendered somewhat more probable in that the reproductive processes take place when the gonophores are dehiscing and losing their vital activity.

EXPLANATION OF PLATES XXXIII AND XXXIV,

Illustrating Dr. Ernest Warren's paper "On Parawrightia robusta gen. et sp. nov., a Hydroid from the Natal Coast; and also an Account of a supposed Schizophyte occurring in the Gonophores."

Fig. 1.—Natural size. Colony growing over sponge and sea-weed.

Fig. 2.—× 15 diameters. A small piece of a female colony attached to sea-weed. The hydranths are shown in different conditions of expansion and contraction (*ex. p.*; *p. el.*; *c. p.*). The attachment of the stolon to its support is assisted by clinging branches (*cl. r.*). The planulæ have escaped from the empty gonophore (*em. g.*).

Fig. 3.—× 60. Longitudinal section through hydranth and female

gonophore. The umbrella cavity (*u. c.*) of the gonophore has an opening (*o. u.*). Two planulæ nearly ready to escape are shown (*Pl.*). *ect.* Ectodermal epithelium lining spadix and ectotheca.

Fig. 4.—× 60. Transverse section of a young female gonophore. Alternating with the endodermal canals are seen four spaces (*sp.*), which are ectodermal canals opening into umbrella-cavity.

Fig. 5.—× 60. Longitudinal section through a male gonophore. The umbrella-cavity (*u. c.*) is closed, although the position of an opening is indicated at *n.* *e. ep.* is the ectodermal epithelium lining spadix and ectotheca.

Fig. 6.—× 750 diameters. Small piece of transverse section of male gonophore with capsuled Schizophyte in ectodermal canal and in channels (*ch.*) in the generative epithelium.

Fig. 7.—× 1300 diameters. (*1*) Youngest stage; (*2*) and (*3*) show the beginning of the formation of a capsule; (*4*) shows the fission of central body and of capsule.

Fig. 8.—× 1300 diameters. Older stages. (*2*) (*4*) and (*5*) are examples of budding; (*6*) central body (*d. b.*) dividing; (*7*) several central bodies are present, and dense outer capsular layer; in (*8*) (*9*) (*10*) the laminated structure is replaced by a radiating structure, except for the outer layer (*o. en.*). Specimens were taken from a male gonophore. In (*9*) and (*10*) the central body has divided considerably (*d. b.*).

Fig. 9.—× 1000 diameters. Specimen taken from a female gonophore, showing central bodies (*c. b.*); capsule with outer compact envelope, and bodies (*s. b.*) embedded in the substance of the capsule.

Fig. 10.—× 1000. Specimen from female gonophore with central bodies (*c. b.*), and dividing bodies (*d. b.*). Two outer envelopes or sheaths to the capsule are seen. The innermost layer (*i. l.*) is less pellucid than the other layers of the capsule.

Fig. 11.—× 1000 diameters. Lobed specimen with several centres of lamination. At *d. b.* the central bodies are splitting up preparatory to the formation of spores.

Fig. 12.—× 1000. Older stage with dividing bodies (*d. b.*) and the contracting inner capsule (*I. sh.*) with cavity (*e. cy.*). The two outer envelopes, en_1. and en_2. are shown.

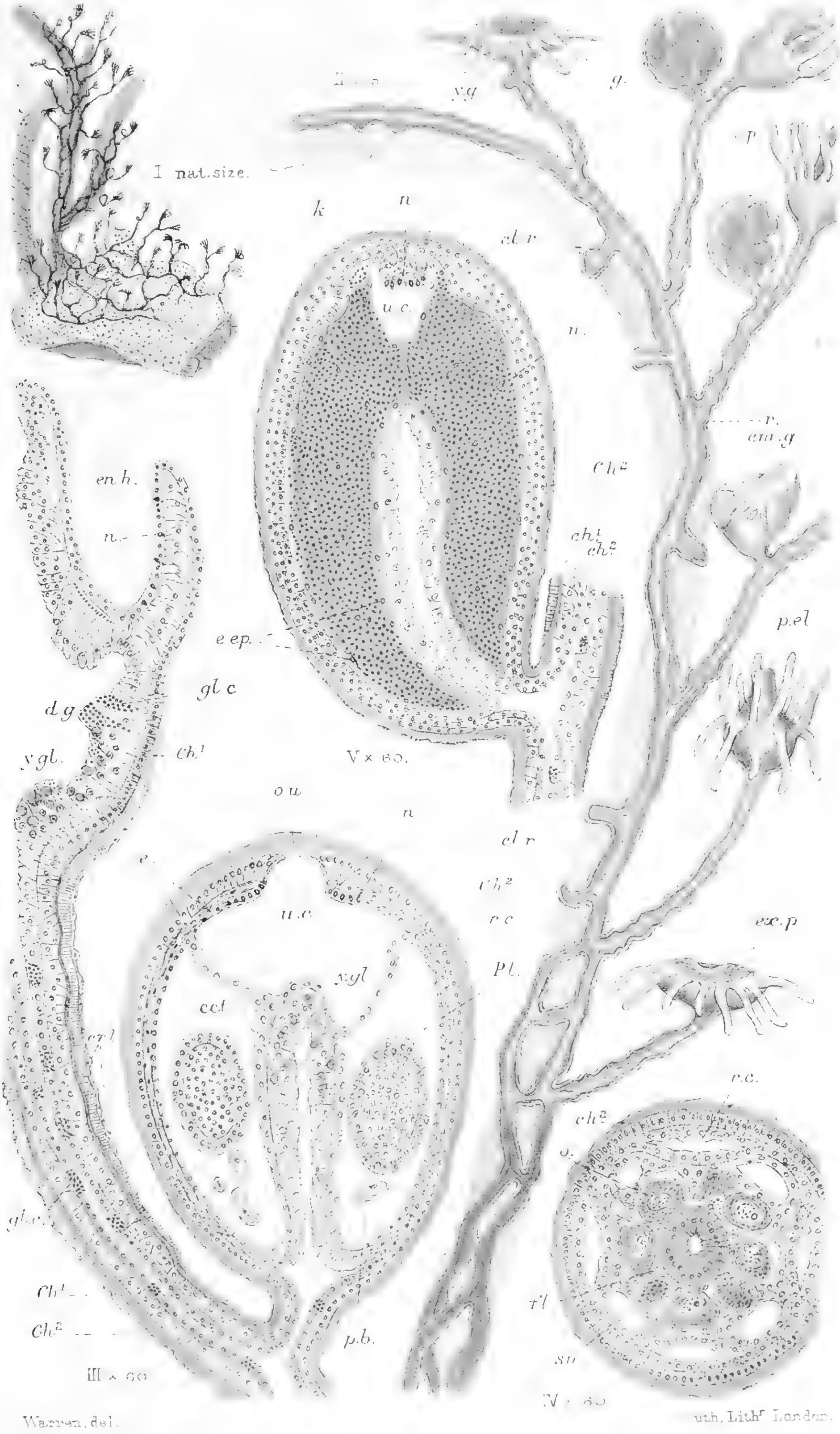
Fig. 13.—× 600. Capsule showing spores (*spo.*) and cavity (*e. cy.*).

Fig. 14.—× 1500. Specimen with disintegrating inner capsule (*In. sh.*) and spores (*spo.*).

Fig. 15.—× 2000. Spores.

Explanatory References.

b. Youngest stage of Schizophyte. *c. b.* Central body. *c. p.* Contracted polyp. ch_1. Outer vertically striated layer of perisarc. ch_2. Inner laminated layer of perisarc. *ch.* Channel in spermatic tissue. *cl. r.* Clasping branch of stolon. *d. b.* Dividing body. *d. g.* Digestive cavity. *e.* Ectoderm of umbrella. *ect.* Ectoderm lining spadix and ectotheca. *e. cy.* Empty cavity of capsule. *e. c.* Ectodermal nuclei in generative epithelium. *e. l.* Endodermal lamella. *e. ep.* Ectodermal epithelium of umbrella cavity. en_1. Outer envelope of capsule. en_2. Outermost envelope of inner capsule. *en. h.* Endoderm of hypostome. *em. g.* Empty gonophore. *ex. l.* Outer layer of perisarc with adhering débris. *ex. p.* Expanded polyp. *fl.* Follicle cells. *g.* Female gonophore. *gl. c.* Glandular cell of endoderm. *i. l.* Innermost layer of capsule, less pellucid than the other layers. *I. sh.* and *In. sh.* Inner sheath or capsule. *k.* Knarled stolon. *l. s.* Laminated structure. *n.* Nematocyst. *n. o. e.* Nuclei of ectodermal epithelium of ectotheca lining umbrella cavity. *o.* Ovum. *o. l.* Outer coating of mud and sand. *o. en.* Outer envelope of capsule. *o. u.* Opening of umbrella cavity. *Pl.* Planula. *p. b.* Capsules of supposed Schizophyte. *p. el.* Polyp elongated, with tentacles alternately elevated and depressed. *r.* Ringed portion of stem. *r. c.* Radial endodermal canal. *s. b.* Stranded bodies in the substance of the capsule. *s. l.* Laminated perisarc layer. *s. p.* Ectodermal canals continuous with umbrella cavity. *spo.* Spore. *u. c.* Umbrella-cavity. *u. s.* Umbrella space. *y. g.* Young gonophore appearing as a bud on the stem. *y. s.* Young stages of Schizophyte. *y. gl.* Yolk-globules.



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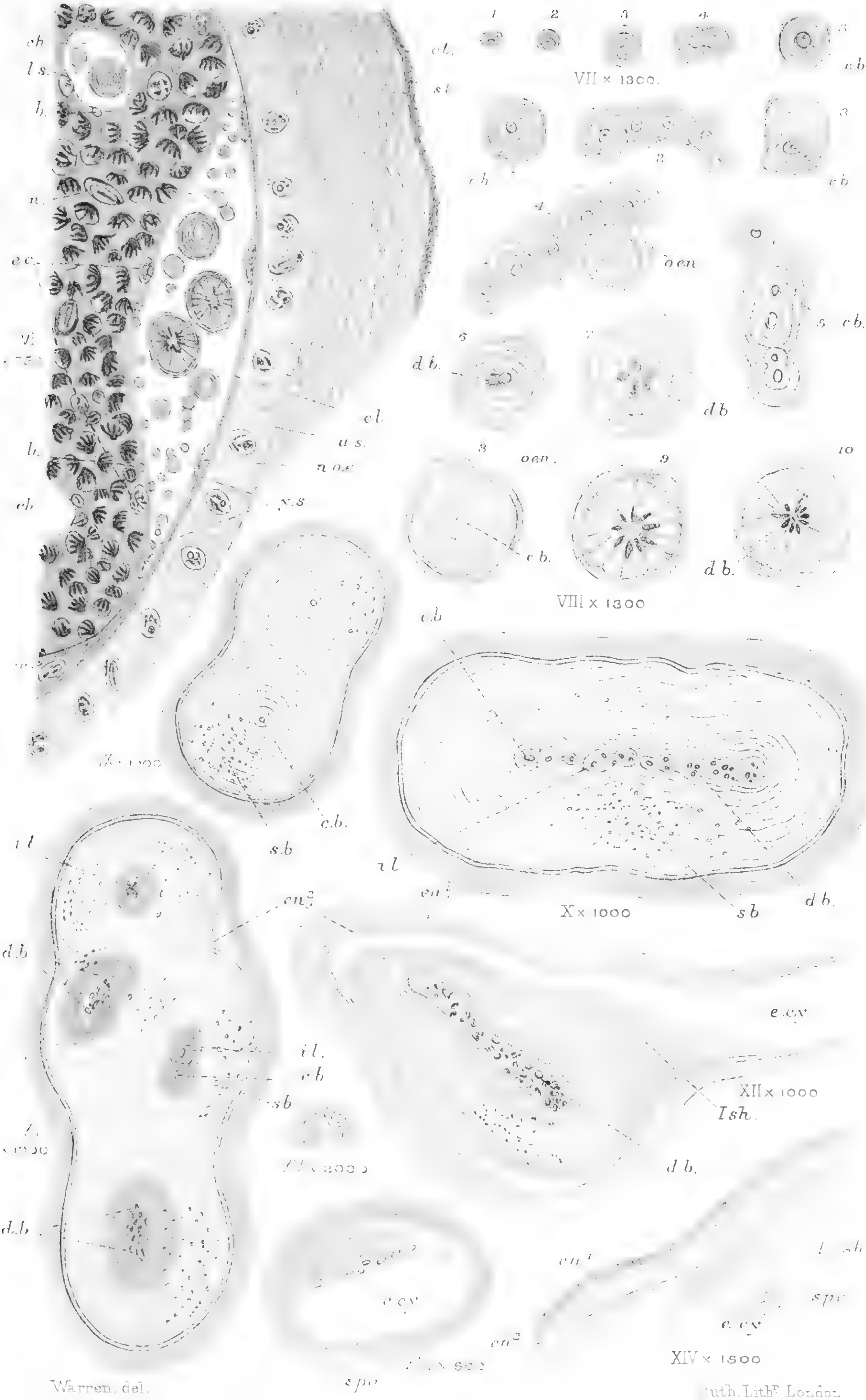

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Note on the Variation in the Arrangement of the Capitate Tentacles in the Hydroid, Halocordyle cooperi *Warren.*

By

Ernest Warren, D.Sc.Lond.,
Director of the Natal Government Museum.

In the description of this new species in the 'Annals of the Natal Government Museum,' vol. i, part 1, it was pointed out that the arrangement of the capitate tentacles exhibited considerable variation.

According to Allman,[1] the genus Pennaria is characterised by the hydranth having twenty to thirty capitate tentacles scattered irregularly over the sides of the body, while the genus Halocordyle has about twelve capitate tentacles arranged in two verticils of about six in each. Typically H. cooperi possesses two alternating verticils of four tentacles, but the species exhibits marked variations in the arrangement, and it was thought that a statistical investigation into the matter might prove of interest.

It is unfortunate that the hydroid is comparatively rare. The coast of Natal has been searched diligently at different places on a number of occasions, but only forty-two colonies, and some of these were in poor condition, have been found altogether. As it is improbable that any considerable number will now be obtained, I will give the results, although the amount of material is not sufficient for a strict analysis.

[1] 'A Monograph of the Gymnoblastic or Tubularian Hydroids,' Part II, pp. 364, 367.

Store No. of colony.	Locality.	Sex.	No. of oral capitate tentacles.	No. of basal capitate tentacles.	Total number of capitate tentacles.	Remarks.
2	Scottsburg	♀	4	4	8	Regularly alternating.
3	,,	?	4	6—7	10—11	—
4	,,	♀	4	5	9	—
7	,,	♀	—	—	12—13	Irregularly scattered.
8	,,	?	4	5	9	—
10	,,	?	4	4	8	Regularly alternating.
11	,,	?	4	4	8	,, ,,
12	,,	?	4	4	8	,, ,,
13	,,	?	4	4	8	,, ,,
14	,,	?	4	4	8	,, ,,
15	,,	?	4	6	10	—
16	,,	?	4	6	10	—
17	,,	?	4	4	8	Regularly alternating.
19	,,	?	4	4	8	,, ,,
20	,,	?	4	4	8	,, ,,
21	,,	?	4	4	8	,, ,,
26	,,	♀	4	4	8	,, ,,
28	,,	?	4	4	8	,, ,,
29	,,	?	4	5	9	—
30	,,	?	4	4	8	Regularly alternating.
31	,,	?	4	4	8	,, ,,
41	,,	?	—	—	9—10	Irregularly scattered.
5	Park Rynie	?	4	6	10	—
6	,,	?	4	5	9	—
9	,,	?	4	5	9	—
32	,,	♀	4	5	9	—
33	,,	♀	4	4	8	Regularly alternating.
35	,,	?	4	4	8	,, ,,
36	,,	?	4	4	8	,, ,,
37	,,	?	4	4	8	,, ,,
38	,,	?	4	4	8	,, ,,
40	,,	?	—	—	10—11	Irregularly scattered.
42	,,	?	4	4	8	Regularly alternating.
43	,,	?	4	4	8	,, ,,
1	Isipingo	?	4	4	8	,, ,,
22	,,	♂	4	4	8	,, ,,
23	,,	♂	4	4	8	,, ,,
25	,,	?	4	4	8	,, ,,
44	,,	♂	4	4	8	,, ,,
45	,,	?	4	4	8	,, ,,
45	Kosi Bay	?	4	4	8	,, ,,
46	,,	?	4	4	8	,, ,,

In the accompanying table is given the average arrangement of the capitate tentacles in the hydranths of the forty-two colonies. It should be mentioned that the arrangement of the tentacles in the hydranths of one and the same colony is not absolutely invariable, although the greater number of the polyps conform to the same plan; but aberrations do occasionally occur. The variability of the polyps in this respect in the same colony has not been investigated, but only the general average arrangement in the colony has been recorded.

Thus the average arrangement of the tentacles in colony "2," Scottsburg, is for four capitate tentacles around the mouth to alternate with four at a lower level; in colony "3" the lower verticil in the majority of the polyps consisted of six or seven tentacles.

The sex of the colonies could only be determined when gonophores were present. When a distinct oral verticil could be distinguished, it will be noticed that in no case did it normally consist of more or less than four tentacles. The lower or basal whorl is the variable one; typically it is composed of four tentacles alternating with the four of the oral verticil; but it may consist of five, six, or even seven tentacles. In three cases out of the forty-two no definite verticils could be distinguished, and the average numbers of the tentacles in these three colonies, "7," "41," "40," were twelve to thirteen, nine to ten, and ten to eleven respectively.

To show in the form of a diagram the distribution of the symmetry of the arrangement of the tentacles in the population it will be necessary to arrange a scale of symmetry which, of course, must be empirical.

Let ("0") be the condition of having thirty-two to twenty capitate tentacles irregularly scattered. This has not been observed in H. cooperi, but it occurs in Pennaria and H. tiarella.

Let ("1") be the reduced number of thirteen to nine tentacles irregularly scattered. Observed in three colonies (about 7 per cent.).

("2") Colonies with the average arrangement of four in an oral verticil, and six to seven tentacles below, which may be arranged in more or less of a verticil. Observed four times (about 9·5 per cent.).

("3") Colonies with the average arrangement of four in an oral verticil, and five in a basal whorl. Observed six times (about 14 per cent.).

("4") Colonies with a vertical of four oral tentacles alternating with a basal whorl of four tentacles. This is the perfectly symmetrical condition. Observed twenty-nine times (about 69 per cent.).

TEXT-FIG. 7.

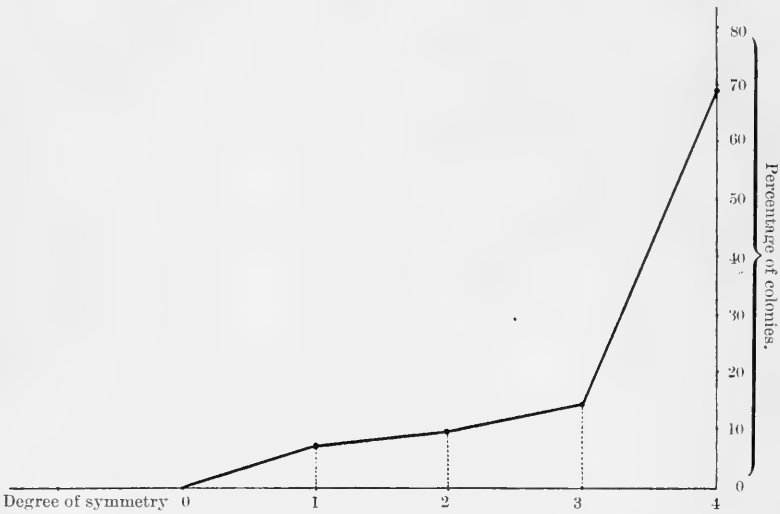


Diagram showing distribution of symmetry in forty-two colonies.

It must be remembered that these degrees of symmetry may not be of equal value, although they are thus represented in the diagram. For example, there may be a step where the basal verticil has been reduced to four tentacles, but these have not acquired the regular alternating position with the oral tentacles. This cannot be observed with any great certainty under the microscope.

The results of this investigation may be summed up in the following paragraphs:

(1) The amount of material available is not sufficient to be certain as to whether locality or sex have any effect on the arrangement of the tentacles.

(2) The oral verticil of four capitate tentacles tends to be constant, except in the few cases where all the tentacles were irregularly scattered.

(3) The variations in symmetry show how easily H. cooperi could have descended from a Pennarian ancestor, where the capitate tentacles are present in a considerable number, and are quite irregularly scattered.

(4) An important point to consider is whether the distribution of symmetry in a population throws any light on the steps by means of which this symmetry was acquired.

It may be assumed that symmetry of this nature could not easily be acquired by imperceptible steps, it would more readily be acquired by larger steps, or in other words by "discontinuous" variations.

On account of the tendency which the observations have to form a symmetrical curve, it may be considered possible that the scale of symmetry suggested has a natural meaning, and that the steps by which the symmetrical arrangement has been acquired correspond to the degrees of symmetry detailed above. For, it may be observed, that in no case did I find other combinations, such as three tentacles in the upper whorl and six in the lower, or three in the upper and five in the lower, or five in the upper and three in the lower, etc.

The variations appear to be sharp and definite, so that an unit amount of variation, so to speak, is a discrete and quite perceptible quantity.

It is unfortunate that the scarcity of material prevents a more thorough and exhaustive enquiry.

Note on the Larva of a Fly (Sarcophaga sp.) occurring in the Human Intestine.

By

Ernest Warren, D.Sc.Lond.,
Director of the Natal Government Museum.

In June of 1903 the Rev. A. T. Bryant, of Natal, sent to me for identification some larvæ in spirit expelled from the intestine of a Kafir girl. This gentleman informed me that such larvæ frequently occur among the Kafirs.

An examination of the larvæ showed that they were the grubs of a fly.

In January of 1904 Dr. Campbell Watt, of Maritzburg, brought to me two living larvæ, about ½ in. in length, which had been passed by a female patient (European) having the ordinary symptoms of worms. I was informed that dozens of these larvæ had been passed from time to time. The diet of the patient had been extremely abstemious, and included but little flesh food of any kind. The grubs were passed more or less intermittingly in batches.

The larvæ were obviously fly larvæ, and resembled in every way, except in their small size, those sent to me by Mr. Bryant.

The two grubs were placed in an incubator at 90° F. in a glass-capsule and supplied with excrement. One of the specimens, unfortunately, escaped from the capsule and died. In four days the second specimen was full grown, and had increased in length from ½ in. to about ¾ in. The larva now became extremely restless, crawling round and round the capsule with the greatest uneasiness. It was therefore removed from the incubator, and on the following day it pupated. After twelve days the fly emerged, the pupa having been kept on slightly damp mould at the ordinary temperature of the laboratory.

The fly closely resembles the common flesh-fly of the genus Sarcophaga.

In February of the same year Dr. Watt sent to me in spirit a similar grub passed by a white male patient.

A few months ago I forwarded the bred fly to Mr. Ernest E. Austen, of the British Museum, and he has very kindly sent to me a technical description of it, and also some interesting observations on the parasitic habits of Sarcophaga.

Unfortunately the specimen is a female, and it appears that it is not possible to determine the species with any certainty from a solitary specimen of the female of a Sarcophaga.

The following is Mr. Austen's description of the specimen:

"Sarcophaga sp., bred from larva from human intestine. ♀. Length, about 12 mm. Grey, with dark markings. Head: face and sides of anterior portion of front silvery; frontal stripe deep black; palpi black, with paler tips. Thorax with three sharply-defined black longitudinal stripes, of which the median one extends nearly to the posterior margin of the scutellum. Abdomen marked with shimmering patches, which appear lighter or darker according to the direction from which the light falls on the insect, and marked with a median black longitudinal stripe and a stripe on each side of this midway between the median stripe and the lateral margin; the admedian stripes are interrupted on the hind margins of the segments, and do not reach the tip of the abdomen. Apical segment orange."

Mr. Austen further writes that he has "two species of Sarcophaga bred from larvæ from a sore on a girl's foot in British Guiana. In Russia an allied species frequently infests the nasal sinuses of human beings and domestic animals. There are cases on record in which larvæ of species of Sarcophaga have been expelled from the human intestine in Europe, and it has been stated that they are introduced into the stomach with raw meat. In the case of Kafirs the eating of raw meat may well afford the explanation."

The common Sarcophaga is viviparous, and the newly-born larvæ on being placed on animal matter instantly penetrate beneath the surface, and so disappear from sight. It is probable in the present case that a number of minute newly-born larvæ were swallowed with food, and that they lived in the stomach or intestine. It is clearly impossible that dozens of large ($\frac{1}{2}$ in. long) larvæ should have been inadvertently swallowed.

The great restlessness of the larvæ when fully grown would probably assist them in being expelled from the body, so that pupation could occur outside of the host.

In the present case it is certain that raw meat was not eaten; but I have found that a female of a Sarcophaga, enclosed in a box without food of any kind, nevertheless produced large numbers of larvæ, which could be observed escaping from the body of the parent without any apparent violition on the part of the fly.

From this observation it is seen that a female, enclosed in a receptacle containing bread or any other food, would readily let fall considerable numbers of minute white grubs, which on adhering to bread or many other articles of food would be practically invisible.

These observations are of value in showing the importance of keeping flies away from all food and kitchen utensils.

It is interesting to observe that the fly belongs to the family Muscidæ, and not to the modified parasitic family the Oestridæ or Bot flies. It is a quite typical flesh-fly, identical or closely similar to a species very common in this district.

The larva possesses no special organs for adhering to the mucous membrane of the alimentary canal, and it is very possible that the parasitic habit is purely accidental.

It is to be surmised, either that the species in question has a general tendency to become parasitic, and it would then be a matter for conjecture as to the modifications which would thereby be ultimately induced in the species, or that the larvæ have an extraordinary power of adapting themselves to various environments, so that they are indifferent whether they live in the alimentary canal of a mammal or on ordinary decomposing animal matter.

Vol. I, part 3, issued May 15th, 1908.

On a Collection of Fresh-water Fishes, Batrachians, and Reptiles from Natal and Zululand, with descriptions of New Species.

By
G. A. Boulenger, F.R.S.

With Plates XXXV and XXXVI.

The collection dealt with was forwarded to me from the Natal Museum for identification, and the following faunistic lists possess considerable interest.

Descriptions of the new species are given after the lists. The types of the new species are being preserved in the British Museum.

Fresh-water Fishes.

Characinidæ.

Alestes natalensis *Blgr.*

Pools at Elcheleselwane, Zululand.

Cyprinidæ.

Labeo darlingi *Blgr.*

Mkusi River, Zululand.

Barbus gibbosus *Peters.*

Pools at Indukuduku, Zululand.

Barbus decipiens *Blgr.*

Pools at Elcheleselwane, Zululand; Mkusi R., Zululand.

Neobola brevianalis *sp. n.*

Mkusi River, Zululand.

Siluridæ.

Clarias capensis *C. & V.*

Pietermaritzburg, Natal.

Clarias gariepinus (*Burch.*).

Richmond, Natal.

Anguillidæ.

Anguilla mossambica *Peters.*
= A. bengalensis *Ham.-Buch.*

Dorp Spruit, Pietermaritzburg, Natal.

Anguilla virescens *Peters.*

Usilonda Lake, near Kosi Bay, Zululand.

Cyprinodontidæ.

Haplochilus johnstoni *Gthr.*

Pools at Indukuduku, Zululand.

Haplochilus myaposæ *sp. n.*

Myaposa River, Zululand.

Cichlidæ.

Haplochromis moffatti (*Casteln.*).

The dentition varies as in the closely allied H. desfontainesi (*Lacep.*) and specimens have in consequence been referred to two genera, Paratilapia (P. moffatti *Casteln.*) and Tilapia (T. philander *M. Weber*). As a rule the outer teeth are conical in the males, and bicuspid in the females.

Pools at Indukuduku, Zululand, Lake Sibayi, Zululund.

Tilapia sparrmani *A. Smith.*

Indukuduku, Zululand.

Tilapia melanopleura *A. Dum.*

Lake Sibayi and Mkusi River, Zululand.

Tilapia natalensis (*M. Weber*).

Mkusi R., Indukuduku and Lake Sibayi, Zululand.

Tilapia mossambica (*Peters*).

Lake Sibayi, Zululand.

Gobiidæ.

Gobius æneo-fuscus *Peters.*

Mseleni River, Zululand; Umsindusi, Pietermaritzburg.

Batrachia.

Dactylethridæ.

Xenopus lævis (*Daud.*).

Mseluzi R. and Myaposa R., Zululand; Impendhla, Natal.

Bufonidæ.

Bufo regularis *Reuss.*

Mseleni, pools at Indukuduku, Zululand.

Bufo carens (*A. Smith*).

Botanic Gardens, Pietermaritzburg.

Engystomatidæ.

Cacosternum boettgeri (*Blgr.*).

Natal.

Breviceps verrucosus *Rapp.*

Natal.

Breviceps mossambicus *Peters.*

Mseleni, Hlabisa, Zululand.

Hemisus guttatum (*Rapp.*).

Indukuduku, Zululand.

Ranidæ.

Rana adspersa (*D. & B.*).

Mseleni, Zululand.

Rana natalensis (*A. Smith*).

Pietermaritzburg, Natal.

Rana mascareniensis *D. & B.*

Mseleni, Zululand.

Rana queketti *Blgr.*

Natal.

Rana oxyrhynchus *A. Smith.*

Kosi Bay, Zululand; Natal.

Rana fasciata *A. Smith.*

Natal.

Phrynobatrachus natalensis *A. Smith.*

Mseleni, Black Umfolosi and Hlabisa, Zululand; Natal.

Arthroleptis wahlbergii *A. Smith.*

Hlabisa, Zululand; Richmond, Natal.

Rappia concolor (*Hallow.*).

Lower Umluluzi, Zululand.

Rappia undulata *Blgr.*

Pietermaritzburg, Natal.

Rappia cinctiventris (*Cope*).

Elcheleselwane and Indukuduku, Zululand; Pietermaritzburg, Natal.

Lacertilia.

Geckonidæ.

Lygodactylus capensis (*A. Smith*).

Indukuduku, Zululand; Natal.

Hemidactylus mabouia (*Mor.*).

Mseleni, Zululand.

Homopholis wahlbergii (*A. Smith*).

Mseleni, Zululand.

Pachydactylus capensis (*A. Smith*).

Junction of the two Umfolosi Rivers, Kosi Bay, Zululand; Bergville, Natal.

Pachydactylus maculatus *Gray.*

Junction of the two Umfolosi Rivers, Entendweni, Zululand; Thornybush, Natal.

Agamidæ.

Agama armata *Peters.*

Eshowe, Entendwene, Kwambonambi and Indukuduku, Zululand; Natal.

Agama atricollis *A. Smith.*

Indukuduku and Mseleni, Zululand; Natal.

Zonuridæ.

Zonurus warreni *sp. n.*

Ubombo, Zululand.

Zonurus vittifer *Reichen.*

Junction of the two Umfolosi Rivers and Ubombo, Zululand.

Pseudocordylus microlepidotus (*A. Smith*).

Balgowan, Natal.

Platysaurus guttatus *A. Smith.*

Ubombo, Zululand.

Agrees with the specimen from Mashonaland, noticed in 'Proc. Zool. Soc.,' 1902, ii, p. 16.

Chamæsaura ænea (*Wiegm.*).

Natal.

Chamæsaura anguina (*L.*).

Natal.

Chamæsaura macrolepis (*Cope*).

Indukuduku and Mseleni, Zululand; Pietermaritzburg, Natal.

Varanidæ.

Varanus albigularis (*Daud.*).

Isitasa and Ubombo, Zululand.

Varanus niloticus (*L.*).

Pietermaritzburg, Natal.

Amphisbænidæ.

Amphisbæna violacea *Peters.*

Kosi Bay, Zululand.

Lacertidæ.

Nucras tessellata (*A. Smith*).

Junction of the two Umfolosi Rivers, Zululand.

Two specimens agreeing with the variety ornata *Gray* (holubi *Stdr.*, camerani *Bedr.*) in the short foot, not longer than the skull in the adult, and in the colouration; but with smaller scales, 58–60 across the middle of the body. The larger specimen measures 95 mm. from snout to vent.

Nucras delalandii (*M.-Edw.*).

Zwaartkop, Natal; Drakensberg at altitude of 6000 ft., Natal.

Ichnotropis capensis (*A. Smith*).

Mseleni, Zululand.

Ichnotropis squamulosa *Peters.*

Kosi Bay, Zululand.

Gerrhosauridæ.

Gerrhosaurus grandis *sp. n.*

Ubombo, Zululand.

Gerrhosaurus flavigularis *Wiegm.*

Mseleni, Zululand; Pietermaritzburg, Natal.

Tetradactylus africanus (*Gray*).

Melmoth, Zululand.

Scincidæ.

Mabuia homalocephala (*Wiegm.*).

Indukuduku and Mseleni, Zululand.

Mabuia quinquetæniata (*Licht.*).

Ubombo, Zululand.

Mabuia varia (*Peters*).

Junction of the two Umfolosi Rivers, Zululand; Thornybush, Natal.

Mabuia striata (*Peters*).

Indukuduku, Mseleni, and Ubombo, Zululand; Town Bush, Pietermaritzburg, and Estcourt, Natal.

Ablepharus wahlbergii (*A. Smith*).

Umfolosi Drift, Kosi Bay, and Ubombo, Zululand.

A specimen from Ubombo is abnormal in having the prefrontals in contact in the middle line, separating the frontonasal from the frontal.

Scelotes bipes (*L.*).

Indukuduku, Zululand.

Scelotes guentheri *Blgr.*

Junction of the two Umfolosi Rivers and Ubombo, Zuluand; Drakensberg at altitude of 6000 ft., Natal.

Scelotes inornatus (*A. Smith*).

Kosi Bay, Zululand.

Herpetosaura arenicola *Peters.*

Mseleni, Zululand.

Acontias plumbeus *Bianc.*

Kosi Bay, Zululand.

Anelytropidæ.

Typhlosaurus aurantiacus *Peters.*

Mseleni, Zululand.

RHIPTOGLOSSA.

Chamæleontidæ.

Chamæleon dilepis *Leach.*

Indukuduku, Zululand.

Chamæleon tæniobronchus *A. Smith.*

Town Hill, Pietermaritzburg, Natal.

Chamæleon damaranus *Blgr.*

South Africa.

OPHIDIA.

Typhlopidæ.

Typhlops mossambicus (*Peters*).

Mseleni, Zululand.

Typhlops bibronii (*A. Smith*).

Bulwer, Pietermaritzburg, Hilton Road, Natal.

Glauconiidæ.

Glauconia distanti *Blgr.*

Junction of the two Umfolosi Rivers, Kosi Bay, Zululand; Natal.

Glauconia conjuncta (*Jan.*).

Mseleni, Zululand; Natal.

Colubridæ.

Tropidonotus lævissimus (*Gthr.*).

Natal.

The habitat of this rare snake was previously unknown.

Ablabophis rufulus (*Licht.*).

Natal.

Boodon infernalis *Gthr.*

Zwaartkop, Natal.

Boodon lineatus *D. & B.*

Mseleni, Zululand; Natal.

Lycophidium semiannulus *Peters.*

Kosi Bay, Zululand.

Differs from the type in the absence of dark cross-bars on the body.

Lycophidium capense (*A. Smith*).

Mseleni, Zululand; Pietermaritzburg, Natal.

Simocephalus capensis (*A. Smith*).

Durban, Natal.

Pseudaspis cana (*L.*).

Springvale, Pietermaritzburg, Natal.

Chlorophis hoplogaster (*Gthr.*).

Mseleni, Ubombo, Zululand; Natal.

Chlorophis natalensis (*A. Smith*).

Dargle Road, Natal.

Philothamnus semivariegatus *A. Smith.*

Umfolosi Drift, Zululand.

Prosymna ambigua *Bocage.*

Ubombo, Kosi Bay, Zululand.

Prosymna jani *Bianc.*

Kosi Bay, Zululand.

Homalosoma lutrix (*L.*).

Melmoth, Zululand; Hilton Road, Natal.

Homalosoma variegatum *Peters.*

Mseleni, Zululand.

Dasypeltis scabra (*L.*).

Mseleni, Ubombo, Zululand; Pietermaritzburg, Natal.

Leptodira hotambœia (*Laur.*).

Mseleni, Zululand; Natal.

Trimerorhinus rhombeatus (*L.*).

Pietermaritzburg, Natal.

Trimerorhinus tritæniatus (*Gthr.*).

Cedara, Natal.

Psammophis sibilans (*L.*).

Kosi Bay, Mseleni, Zululand; Greenwood Park, Pietermaritzburg, Natal.

Psammophis crucifer (*Daud.*).

Hilton Road, Natal.

Thelotornis kirtlandii (*Hallow.*).

Kosi Bay, Ubombo, Mseleni and Hlabisa, Zululand.

Dispholidus typus (*A. Smith*).

Kosi Bay, Zululand; Pietermaritzburg, Natal.

Amblyodipsas microphthalma (*Bianc.*).

Kosi Bay, Zululand.

Calamelaps warreni *sp. n.*

Kosi Bay, Zululand.

Macrelaps microlepidotus (*Gthr.*).

Natal.

Aparallactus capensis *A. Smith.*

Junction of the two Umfolosi Rivers, Kosi Bay, Zululand.

Elapechis decosteri (*Blgr.*).

Kosi Bay, Zululand.

Elapechis sundevallii (*A. Smith*).

Natal.

Naia haie (*L.*).

Mseleni, Zululand.

Naia nigricollis *Reinh.*

Pietermaritzburg, Natal.

Sepedon hæmachates (*Lacep.*).

Natal.

Homorelaps lacteus (*L.*).

Natal.

Dendraspis angusticeps (*A. Smith*).

Mount Edgecombe, Natal.

Viperidæ.

Bitis arietans (*Gray*).

Zululand; Natal.

Atractaspis bibronii *A. Smith.*

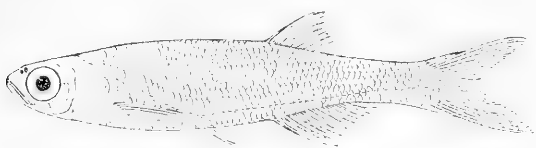
Junction of the two Umfolosi Rivers, Entendweni, Zululand.

Descriptions of the two new fresh-water Fishes.

Neobola brevianalis *sp. n.* (Text-fig. 1.)

Depth of body $4\frac{1}{2}$ times in total length, length of head $3\frac{1}{2}$ times. Snout obtuse, not projecting beyond the mouth, shorter than the diameter of the eye, which is $3\frac{1}{4}$ times in length of

TEXT-FIG. 1.



head; mouth extending to below anterior third of eye. Dorsal with II 7 rays, its origin slightly in advance of that of the anal; its distance from the end of the snout twice and $\frac{1}{4}$ its distance from the caudal; first branched ray longest, about $\frac{2}{3}$ length of head. Anal II 12. Pectoral acutely pointed, as long as head, reaching root of ventral. Caudal peduncle once and $\frac{2}{3}$ as long as deep. Caudal deeply forked. Scales $52\,\frac{10\frac{1}{2}}{3\frac{1}{2}}$, 1 between lateral line and root of ventral, 16 round caudal peduncle. Yellowish, with a silvery lateral band; fins white.

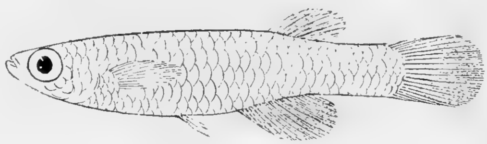
Total length 37 millm.

A single specimen from the Mkuzi River, Zululand. Three species of Neobola were known: N. bottegi *Vincig.* (Lake Rudolf, Gallaland, Somaliland), N. argentea *Pellegr.* (Lake Victoria), and N. minuta *Blgr.* (Lake Tanganyika). N. brevianalis differs from its congeners in the lower number of anal rays (14 instead of 18 to 20).

Haplochilus myaposæ sp. n. (Text-fig. 2.)

Depth of body 4 to $4\frac{1}{2}$ times in total length, length of head $3\frac{2}{3}$ to 4 times. Snout very short, truncate, with the lower jaw projecting; eye longer than the snout, as long as or a little shorter than postocular part of head; interorbital space about half length of head. Dorsal with 10 rays, originating above anterior third of anal, nearer to root of caudal than to occiput; median rays longest, about half length of head. Anal with 14 or 15 rays, median longest, the fin rounded, like the dorsal. Pectoral reaching a little beyond base of ventral. Caudal rounded, as long as head. Caudal peduncle once and $\frac{1}{3}$ as long as deep. Scales 27–28 in a longitudinal series, 16 round body in

Text-fig. 2.



front of ventrals. No lateral line pits. Pale olive, with darker edges to the scales; fins greyish.

Total length 28 millim.

Four specimens from the Myaposa River, Zululand.

This little Cyprinodontis is so closely allied to *H. pumilus*, from Lakes Tanganyika and Victoria, that I have hesitated before describing it as distinct. It differs, however, in having the eye as long as, or but little shorter, than the postocular part of the head and in having the dorsal and anal fins more rounded, the median rays being the longest.

Description of the three new Reptiles.

Zonurus warreni sp. n. (Pl. XXXV.)

Head longer than broad, strongly depressed. Head-shields rugose; frontonasal as long as broad, forming a narrow suture with the rostral, separating the nasals; latter scarcely swollen; nostrils in the posterior part of the nasal; prefrontals in contact with their inner angles, or forming a short suture; frontal hexagonal, slightly widened anteriorly; frontoparietals broader than long; four equal parietals with a small hexagonal interparietal between them; a row of six short occipital spines; temporals large, keeled; four or five small temporal spines; four supraoculars; three or four supraciliaries; lower eyelid opaque; loreal and præocular large; three suborbitals; rostral nearly three times as broad as deep; seven upper labials. Symphysial forming a very open angle posteriorly; six lower labials, bordered below by five large shields; small irregular chin-shields; gular scales small, obtusely keeled; larger keeled scales under the neck; sides of neck with small erect spines. Dorsal scales forming regular transverse series, obtusely keeled on the back, spinose on the sides; about 40 transverse series of about 20 shields between the well-marked lateral folds. Ventrals quadrangular, mostly broader than long, outer keeled, others smooth; 14 longitudinal series. A pair of feebly enlarged preanal plates, with smaller ones in front and on the sides. Limbs above with large spinose imbricate keeled scales; 12 femoral pores on each side, with 3 or 4 rows of callose scales in front of them. Tail with whorls of large, strongly keeled, spinose scales, separated from each other by whorls of smaller scales. Dark brown above, with small yellow black-edged spots forming more or less regular transverse series on the body; lower parts pale brown, lower lip and throat spotted or marbled with darker.

Total length	270	millim.
Head	33	„
Width of head	27	„
Body	77	„
Fore limb	43	„
Hind limb	60	„
Tail	160	„

Two male specimens from Ubombo, Zululand.

Gerrhosaurus grandis *sp. n.* (Pl. XXXVI.)

Form stout, head and body much depressed. Head a little longer than broad. Head-shields rugose; frontonasal as long as broad, narrowly in contact with the rostral; prefrontals forming a long median suture; frontal as long as its distance from the rostral or the frontoparietals and interparietal together; a narrow, band-like shield on the anterior border of the ear-opening; three or four upper labials anterior to the subocular. Dorsal shields rugose, strongly keeled, in 14 longitudinal and 32 transverse series; ventrals in 10 longitudinal series. 12 or 13 femoral pores on each side. Tail once and a half the length of head and body, cylindrical. Head and body pale brown with black spots, which become confluent posteriorly, the upper surface of the body being black with elongate yellowish spots corresponding with the shields; a yellowish lateral band from above the ear, becoming gradually indistinct by being broken up into spots on the posterior part of the body; chin and throat white; belly and lower surface of limbs and tail brown.

Total length	. 475	millim.
Head	. 40	,,
Width of head	. 33	,,
Body	. 150	,,
Fore limb	. 50	,,
Hind limb	. 70	,,
Tail	. 285	,,

A single specimen from Ubombo, Zululand.

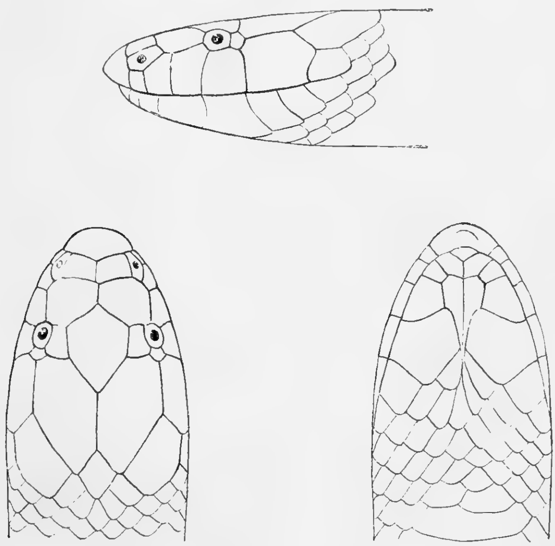
This fine lizard agrees in size with G. validus *A. Smith*, or G. major *A. Dum.* It differs from both in the number of longitudinal series of dorsal shields, and from the former by the number of longitudinal series of ventral shields, the separation of the nasal shields by the rostral and frontonasal, and the low number of femoral pores. In coloration it resembles the former.

Calamelaps warreni *sp. n.* (Text-fig. 3.)

Rostral large, a little broader than deep, the portion visible from above as long as its distance from the frontal; internasals much broader than long, half as long as the prefrontals;

frontal hexagonal, once and a half as long as broad, longer than its distance from the end of the snout, shorter than the parietals; nasal entire; supraocular small; a very small post-ocular; a single temporal; six upper labials, second and third in contact with the prefrontal, third and fourth entering the eye, fifth very large and forming a long suture with the parietal; four lower labials in contact with the anterior chin-shields, fourth very large and narrowly separated from its

TEXT-FIG. 3.

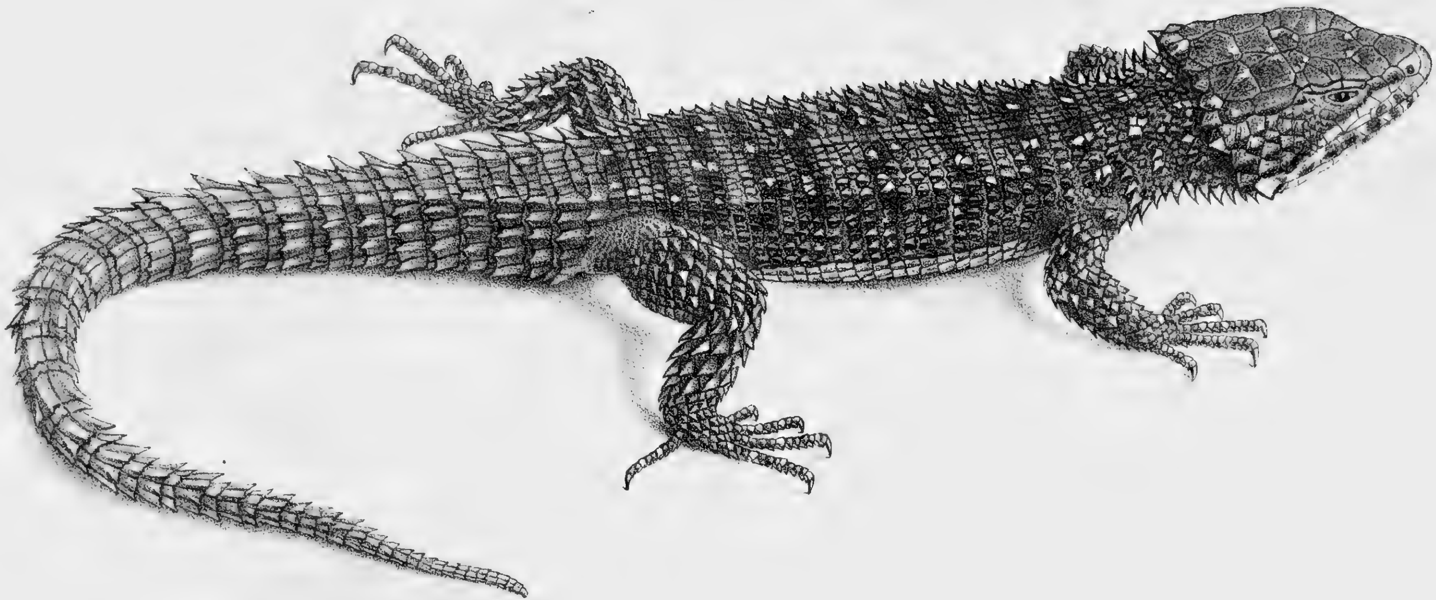


fellow by the chin-shields. Scales in 19 rows. Ventrals 161; anal divided; sub-caudals 26. Uniform plumbeous grey.

Total length 235 millim.; tail 25.

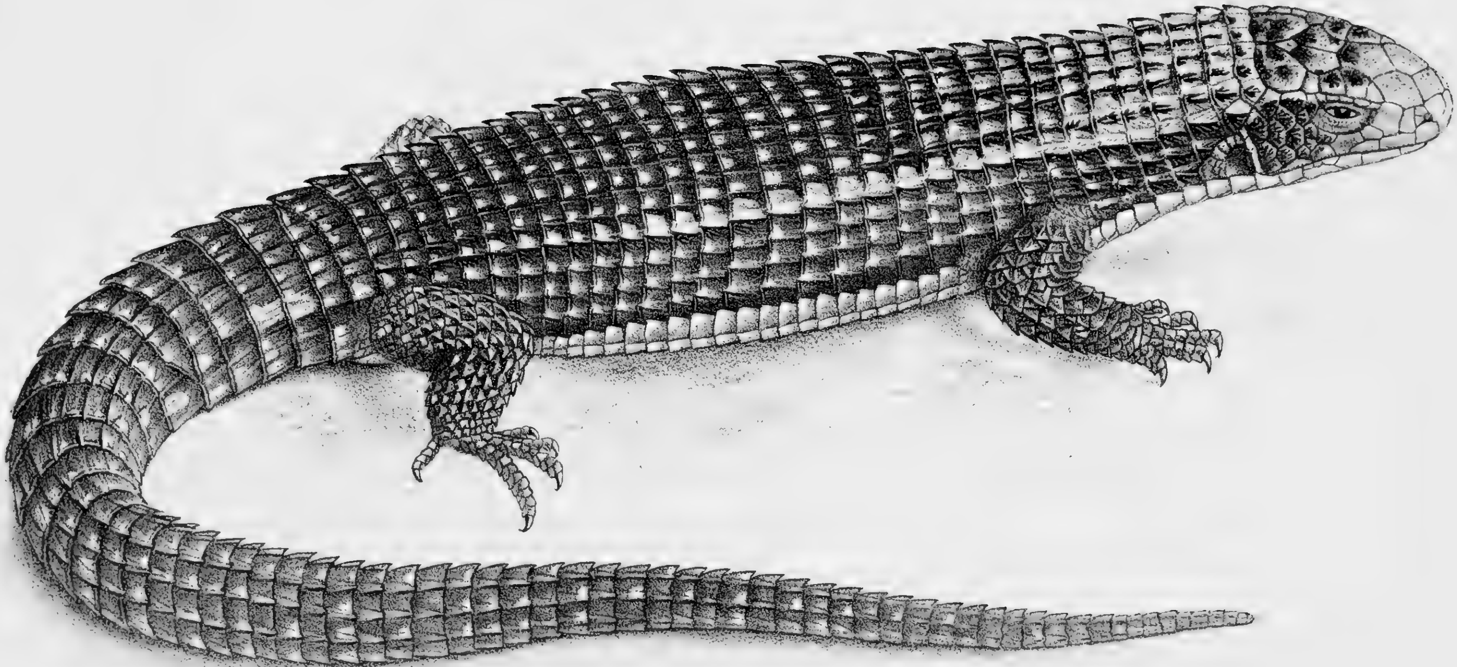
A single female specimen from Kosi Bay, Zululand.

In the number of rows of scales this species is intermediate between C. unicolor *Reinh.* and C. polylepis *Bocage*; it differs from both in having the nasal shield entire. C. mironi *Mocquard*, recently described from Natal, is stated to have the nasal divided, the scales in 17 rows, and only 133 ventral shields.



J. Green imp.

ZONURUS WARRENI.



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GERRHOSAURUS GRANDIS.

Note on Clarias capensis *C. & V.*

By

G. A. Boulenger, F.R.S.

Although 'Barbels,' as the Clarias are called by the colonists, are common over a considerable portion of South Africa, little attention has been paid to their characters. A species described in 1840 in Cuvier and Valenciennes's great work, Histoire des Poissons, vol. xv, p. 377, from a single stuffed specimen labelled as from the 'Cape of Good Hope,' a term which in those days was often taken to mean South Africa, has until lately been a puzzle to ichthyologists. This Clarias capensis was regarded by Günther as a doubtful synonym of Clarias gariepinus (*Burchell*), 1822, a specimen of which had been described and figured by Andrew Smith under the former name. Some years ago, I had an opportunity of taking notes on the type specimen of Cl. capensis, preserved in the Paris Museum, and I expressed the opinion (Poiss. Bass. Congo, p. 255, 1901) that it constitutes a species distinct from Cl. gariepinus, the common 'Barbel,' the range of which extends from Angola and the Zambesi to the Orange River and Natal.

The specimen of Clarias capensis remained unique until a few months ago I received from Dr. Warren another 550 millim. (about 21 in.) long, procured from the pond in the Botanic Gardens at Pietermaritzburg, which answers in every important point to the long-sought-for Clarias capensis. It is distinguished at a glance from Cl. gariepinus, of which I have also received specimens from Dr. Warren, in having the caudal part of the body (behind the ventral fins) more elongate,[1] and the space between the pointed occipital process and the origin of the dorsal fin greater (more than one fourth of the length of the head measured to the extremity of the occipital process). These two characters ought I think to enable anyone to identify further examples, which I hope may soon turn up. In the meantime I here give a description of the specimen for which the British Museum is indebted to Dr. Warren:

Depth of body $7\frac{1}{3}$ times in the total length, length of head 4 times. Head once and $\frac{1}{2}$ as long as broad, its upper surface coarsely granulate; occipital process angular; frontal fontanelle nearly 4 times as long as broad, $\frac{1}{3}$ the length of the head; occipital fontanelle very small, well in advance of the occipital process; eye very small, its diameter 4 times in the length of the snout, 7 times in the interorbital width, which equals the width of the mouth and $\frac{2}{5}$ the length of the head; band of premaxillary teeth 6 times as long as broad; band of vomerine teeth a little narrower than the premaxillary band, rather widely interrupted in the middle, composed of small partly pointed, partly granular teeth. Nasal barbel $\frac{1}{3}$ the length of the head; maxillary barbel as long as the head, reaching middle of pectoral spine; outer mandibular barbel $\frac{3}{4}$ the length of the head, inner about $\frac{1}{2}$. Gill-rakers on first arch long and closely set, 55 in number. Clavicles hidden under the skin. Dorsal fin with 63 rays, its distance from the occipital process $\frac{2}{7}$ the length of the head, its distance from the caudal fin 4 times the diameter of the eye. Anal fin with 50 rays, narrowly separated from the caudal. Pectoral fin $\frac{1}{2}$ the length of the head, the spine feebly serrated on the outer border, $\frac{4}{5}$ the length of the fin. Ventral fins once and $\frac{1}{4}$ as distant from the root of the caudal fin as from the end of the snout. Caudal fin $\frac{1}{2}$ the length of the head. Dark olive brown above, whitish beneath.

The type specimen, which measures only 480 millim., has a rather larger eye,—its diameter 3 times in the length of

[1] In Cl. gariepinus the ventral fins are nearly equally distant from the end of the snout and from the root of the caudal fin.

the snout, 5 times in the interorbital width; the frontal fontanelle is $3\frac{1}{2}$ times as long as broad and 4 times in the length of the head. Dorsal fin with 72 rays, anal with 52; the distance between the occipital process and the dorsal is $\frac{1}{3}$ the length of the head; the distance between the dorsal and the caudal equals the diameter of the eye. The pectoral spine measures only $\frac{2}{3}$ the length of the fin.

Perhaps Cl. capensis grows to the same large size as Cl. gariepinus, of which I have seen a skull measuring 260 millimetres, brought home from the Tugela by Capt. J. W. H. Seppings, R. Dublin Fusiliers.

A Collection of Fishes from the Coasts of Natal, Zululand, and Cape Colony.

By
C. Tate Regan, M.A.

With Plates XXXVII—XLII.

A collection of marine fishes from Natal, Zululand, and Cape Colony, received from Dr. Warren, is of considerable interest. The specimens were obtained at five localities, viz. Kosi Bay, Zululand; Scottburgh, Durban Bay, and Congella, near Durban, Natal; and sixteen miles N.E. of Bird Island, Algoa Bay.

A complete list of the collection is first given, and afterwards the new species are described.

I.—SELACHII.

Fam. Carchariidæ.

Mustelus vulgaris *M. & H.* . . Bird Island.

Fam. Scyliorhinidæ.

Scyliorhinus africanus (*L.*) . . Bird Island.
" edwardsii (*Cuv.*) . . "
" variegatus (*A. Smith*) . "
" natalensis (*Rgn.*) . . "

Fam. Squalidæ.

Squalus acutipinnis *sp. n.* . . . Bird Island.
Pliotrema warreni *Rgn.* . . . "

Fam. SQUATINIDÆ.

Squatina africana *sp. n.* . . . Durban Bay.

Fam. TORPEDINIDÆ.

Torpedo marmorata *Risso.* . Bird Island, Congella, and Algoa Bay.
Astrape capensis (*L.*) . . . Bird Island.

Fam. RHINOBATIDÆ.

Rhinobatus columnæ *M. & H.* . . Bird Island.
" blochii *M. & H.* Bird Island and Durban Bay.

Fam. RAIIDÆ.

Raia marginata *Lacep.* . . . Bird Island.
" ocellifera *Rgn.* . . . "
" rhizacanthus *Rgn.* . . . "

Fam. DASYBATIDÆ.

Dasybatis uarnak (*Forsk.*) . . . Durban Bay.
Myliobatis aquila (*L.*) . . . Bird Island.

Fam. CHIMÆRIDÆ.

Callorhynchus antarcticus (*Lacep.*) . Bird Island.

II.—TELEOSTOMI.

Fam. CLUPEIDÆ.

Clupea durbanensis *Rgn.* . . . Durban Bay.
Spratelloides delicatulus (*Benn.*) . Kosi Bay.

Fam. SILURIDÆ.

Galeichthys feliceps *C. & V.* . . Bird Island.

Fam. ANGUILLIDÆ.

Muræenesox cinereus (*Forsk.*) . .	Durban Bay.
Ophichthys unicolor *sp. n.* . .	Bird Island.
" kirkii *Gthr.* . . .	Kosi Bay.

Fam. MURÆNIDÆ.

Muræna polyophthalmus *Blkr.* . .	Durban Bay.
" macrurus *Blkr.* . . .	Kosi Bay.

Fam. SCOMBRESOCIDÆ.

Hemirhamphus dussumieri *C. & V.* .	Kosi Bay.
Belone robusta *Gthr.* . . .	"

Fam. MUGILIDÆ.

Mugil robustus *Gthr.* . . .	Kosi Bay.
" ceylonensis *Gthr.* . . .	"
" smithii *Gthr.* . . .	"
" constantiæ *C. & V.* . . .	Durban Bay.

Fam. ATHERINIDÆ.

Atherina pinguis *Lacep.* . . .	Kosi Bay.

Fam. GADIDÆ.

Merluccius capensis *Casteln.* . .	Bird Island.

Fam. PLEURONECTIDÆ.

Platophrys pantherinus (*Rüpp.*) . .	Kosi Bay.
Pseudorhombus russellii (*Gray*) . .	Durban Bay.
Paralichthodes algœnsis *Gilchr.* . .	"
Synaptura ciliata *Gilchr.* . . .	"
" pectoralis *Kaup.* . .	Bird Island.
Plagusia marmorata *Blkr.* . .	Kosi Bay.

Fam. Serranidæ.

Epinephelus sonnerati (*C. & V.*) . .	Durban Bay.
„ andersoni *Blgr.* . .	„
„ tauvina (*Forsk.*) . .	Congella.
„ hemistictus (*Rüpp.*). .	Kosi Bay.
„ maculatus (*Bl.*) . .	„
Therapon servus (*Bl.*) . . .	Durban Bay.
Parascorpis typus *Blkr.* . . .	Bird Island.
Apogon warreni *sp. n.* . . .	Durban Bay.
Cirrhitichthys maculatus (*Lacep.*) .	„
Pomatomus saltator (*L.*) . . .	Bird Island.
Lutianus gembra (*C. & V.*) . . .	Durban Bay.
„ johnii (*Bl.*) . . .	„
„ marginatus (*C. & V.*) . .	„

Fam. Pomadasidæ.

Pomadasys tæniophorus *sp. n.* . .	Kosi Bay.
„ multimaculatus (*Playf.*) .	Durban Bay.
„ hasta (*Bl.*) . . .	„
„ opercularis (*Gthr. & Playf.*) .	„
Diagramma griseum *C. & V.* . .	Kosi Bay.
„ affine *Gthr.* . . .	Durban Bay.
„ crassispinum *Rüpp.* . .	Kosi Bay.

Fam. Sparidæ.

Cantharus emarginatus *C. & V.* . .	Bird Island.
Dentex argyrozona *C. & V.* . .	„
„ undulosus *sp. n.* . . .	„
Lethrinus nebulosus (*Forsk.*) . .	Kosi Ray.
Sargus cervinus (*Lowe*) . . .	„
„ capensis *A. Smith* .	Kosi Bay and Durban Bay.
„ holubi *Stdr.* . .	„ „ „
„ nigrofasciatus *sp. n.* . .	Bird Island.
Pagrus laniarius *C. & V.* . . .	„

Chrysophrys gibbiceps *C. & V.* . .	Bird Island.
,, hasta (*Bl. Schn.*) . .	Kosi Bay.
,, bifasciatus (*Forsk.*) . .	,,
,, sarba (*Forsk.*) . .	Durban Bay.
Pagellus lithognathus *C. & V.* . .	Bird Island.
,, mormyrus (*L.*) . . .	Kosi Bay.

Fam. Mullidæ.

Mulloides flavolineatus (*Lacep.*) . .	Kosi Bay.

Fam. Liognathidæ.

Gerres longirostris *Rüpp.* .	Durban Bay and Kosi Bay.
,, lineolatus *Gthr.* . . .	Kosi Bay.
Equula edentula (*Bl.*) . . .	Durban Bay.

Fam. Sciænidæ.

Otolithus æquidens *C. & V.* . .	Bird Island.
Umbrina capensis *Pappé.* . . .	,,
Sciæna aquila *Lacep.* . . .	,,
,, margaritifera *Haly.* . .	Durban Bay

Fam. Sillaginidæ.

Sillago sihama (*Forsk.*) . . .	Kosi Bay.
,, chondropus *Blkr.* . . .	Durban Bay.

Fam. Pempheridæ.

Pempheris molucca *C. & V.* . .	Kosi Bay.

Fam. Scorpididæ.

Psettus falciformis (*Lacep.*) . .	Kosi Bay.

Fam. Cyphosidæ.

Cyphosus fuscus (*Lacep.*) . . .	Kosi Bay.

Fam. Chætodontidæ.

Chætodon vagabundus *L.* . . .	Kosi Bay.
,, setifer *Bl.* . . .	,,

Fam. Drepanidæ.

Drepane punctata (*L.*) . . . Durban Bay.

Fam. Teuthididæ.

Teuthis oramin (*Bl. Schn.*) . . . Kosi Bay.

Fam. Acanthuridæ.

Acanthurus triostegus (*L.*) . . Kosi Bay.
„ strigosus *Benn.* . . „

Fam. Pomacentridæ.

Glyphidodon sordidus (*Forsk.*) . . Kosi Bay.
„ cœlestinus *C. & V.* . . „

Fam. Labridæ.

Julis umbrostigma *Rüpp.* . . . Kosi Bay.
„ lunaris (*L.*) . . . . „
Platyglossus scapularis (*Benn.*) . . „

Fam. Scaridæ.

Pseudoscarus maculosus (*Lacep.*) . Kosi Bay.

Fam. Carangidæ.

Trachurus trachurus (*L.*) . . . Bird Island.
Caranx carangus (*Bl.*) . . . Durban Bay.
„ rottleri (*Bl.*) . . . „
„ ciliaris (*Bl.*) . . . „
„ melampygus *C. & V.* . . . Kosi Bay.
„ speciosus (*Forsk.*) . . . „
„ hippos (*L.*) . . . . „
Trachynotus ovatus (*L.*) . Kosi Bay and Durban Bay.
Chorinemus sancti-petri *C. & V.* . Durban Bay.

Fam. Trichiuridæ.

Lepidopus caudatus (*Euphras.*) . . Bird Island.

Fam. Gobiidæ.

Eleotris ophiocephalus *C. & V.* . .	Kosi Bay.

Fam. Blenniidæ.

Blennius bifilum *Gthr.* . . .	Kosi Bay.
,, punctifer *sp. n.* . . .	,,
Salarias quadricornis *C. & V.* . .	,,
,, rivulatus *Rüpp.* . . .	,,
,, kosiensis *sp. n.* . . .	,,

Fam. Ophidiidæ.

Genypterus capensis (*A. Smith*) . .	Bird Island.

Fam. Scorpænidæ.

Scorpæna natalensis *Rgn.* . .	Bird Island.
,, rosea *Day.* . . .	Durban Bay.
,, haplodactylus *Blkr.* . .	Kosi Bay.
Pterois miles (*Benn.*) . . .	Scottburgh.
,, volitans (*L.*) . . .	Kosi Bay.
Agriopus spinifer *A. Smith* . .	,,

Fam. Triglidæ.

Trigla capensis *C. & V.* . . .	Bird Island.

Fam. Platycephalidæ.

Platycephalus tentaculatus *Rüpp.* .	Kosi Bay.
,, insidiator (*Forsk.*) .	,,

Fam. Balistidæ.

Balistes aculeatus *L.* . . .	Kosi Bay.

Fam. Ostraciontidæ.

Ostracion cubicus *L.* . . .	Kosi Bay.

Fam. Tetrodontidæ.

Tetrodon honckenii *Bl.* . . .	Kosi Bay.
,, immaculatus *Bl. Schn.* . .	Durban Bay.

Descriptions of the Nine New Species.

Squalus acutipinnis *sp. n.* (Pl. XXXVII.)

Acanthias blainvillii (part.) *Günth.* Cat. Fish. viii, p. 419 (1870).

Snout pointed; nasal flaps bilobed; distance from nostrils to end of snout $\frac{2}{3}$—$\frac{3}{4}$ that from mouth to nostrils. Base of second dorsal (without the spine) $\frac{1}{4}$ of its distance from the upper caudal lobe and $\frac{1}{2}$ that of the first (without the spine), which is less than its height and about $\frac{2}{9}$ of its distance from the second dorsal; spines without ridges or grooves, that of the second dorsal not quite so high as the fin, in great part exposed. Pectoral extending well beyond the end of the base of first dorsal and at least $\frac{2}{3}$ of the distance from last gill-opening to origin of ventral, with the free edge nearly straight, the posterior angle nearly a right angle and the anterior angle much more acute than in S. blainvillii; ventrals not nearly reaching the second dorsal. Lower caudal lobe without posterior notch, its lower edge continuous with the posterior edge of the upper lobe. Grayish or brownish above, pale below.

South Africa; Mauritius.

Four specimens, a stuffed one from Mauritius (Robillard), one of 560 mm. from Natal, presented by Dr. E. Warren, one of 540 mm. from Table Bay, presented by Dr. J. D. F. Gilchrist, and one of 190 mm. from the Cape of Good Hope, from Sir Andrew Smith's collection.

Squatina africana *sp. n.* (Pl. XXXVIII.)

Folds at sides of head not produced into lobes. Outer nasal flap with entire edges; inner flap with two nearly simple prolongations, the outer of which has a fringed lobe at its base. Distance between the spiracles a little less than the interocular width. Outer angle of pectoral nearly a right angle;

distance from anterior angle to posterior end of base of pectoral $\frac{3}{5}$ the extreme length of the fin. Ventral not reaching the vertical from origin of first dorsal. Width of tail (at the base) about $\frac{1}{4}$ of its length. Base of first dorsal a little more than $\frac{1}{2}$ its height, which is a little more than its distance from the second; second dorsal a little shorter, but scarcely lower than the first; interspace between the dorsals a little less than the distance from second dorsal to caudal, much less than the distance from base of tail to origin of first dorsal. Posterior edge of caudal fin notched, the upper lobe vertically truncate above, the edge becoming oblique before its junction with the lower lobe, which is obliquely truncate. Upper surface with small pointed denticles, each with 3 keels; no median series of enlarged denticles; small imbricated denticles at outer edges of paired fins, extending on to their lower surface and, on the pectoral, forming an inferior marginal strip about $\frac{1}{4}$ as wide as the fin; denticles on lower surface of tail not extending forward to its base; lower surface of head and abdomen naked. Brownish, with numerous pale spots covered with brown reticulations.

A single specimen (♂), 800 mm. in total length, from Durban Bay, Natal.

This species is nearest to Sq. californica *Ayres*, which differs in markings and in having the greater part of the abdomen and of the lower surface of the paired fins covered with denticles in the adult. From the Japanese Sq. nebulosa *Regan* it differs especially in coloration, in having the folds at the sides of the head not produced into lobes and in the form and dimensions of the fins.

The species of Squatina may be arranged thus:

I. A mid-dorsal series of enlarged denticles present in the adult.

(A) Distance between the spiracles greater than the interocular width. 1. japonica *Bleek.*

(B) Distance between the spiracles not greater than the interocular width.

Distance from anterior angle to posterior end of base of pectoral much more than ½ the extreme length of the fin.
2. armata *Philippi.*

Distance from anterior angle to posterior end of base of pectoral a little more than ½ the extreme length of the fin.
3. aculeata *Cuv.*

II. No mid-dorsal series of enlarged denticles in the adult.

(A) Dermal denticles not carinate.

Folds at sides of head produced into an angular lobe on each side. 4. angelus *Dum.*

Folds at sides of head not produced into lobes.
5. australis *Regan.*

(B) Dermal denticles tricarinate.

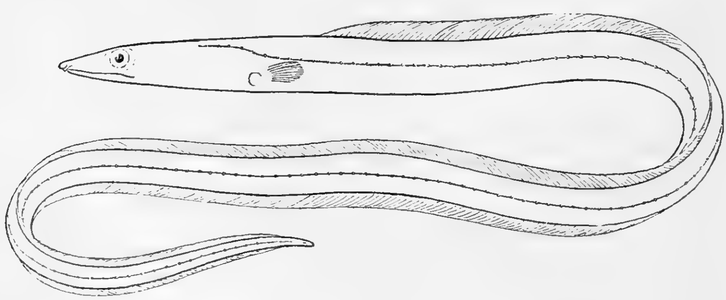
1. Folds at sides of head not produced into lobes.

Abdomen and lower surface of paired fins, in the adult, in great part covered by dermal denticles.
6. californica *Ayres.*

Abdomen naked; lower surface of paired fins with marginal strips of denticles. 7. africana *Regan.*

2. Folds at sides of head produced into two convex lobes on each side. 8. nebulosa *Regan.*

TEXT-FIG. 1.



Ophichthys unicolor *sp. n.* (Text-fig. 1.)

Teeth pointed, subequal, in a double series in both jaws and on the vomer. Length of head $\frac{2}{5}$ the distance from gill-opening to vent; tail nearly twice as long as the rest of the fish. Snout nearly twice as long as eye, projecting beyond the mouth; cleft of mouth about $\frac{1}{3}$ the length of head, extending to below the posterior edge of eye. Origin of dorsal a little behind the end of the pectoral, which is $\frac{2}{9}$ as long as the head. Uniformly brownish.

Sixteen miles N.E. of Bird Island at a depth of 40 fathoms; bottom mud.

A single specimen, 260 mm. in total length.

Apogon warreni *sp. n.* (Pl. XLII.)

Depth of body equal to the length of head, $2\frac{3}{4}$ in the length of the fish. Snout $\frac{3}{5}$ as long as eye, the diameter of which is $3\frac{1}{5}$ in the length of head; interorbital width 5 in the length of head. Maxillary extending slightly beyond the vertical from posterior edge of eye; lower jaw shorter than the upper. Scales $25\frac{2\frac{1}{2}}{8}$. Dorsal VI, I 9; second spine much stronger and a little longer than the third, nearly $\frac{1}{2}$ the length of head; first branched ray the highest, $\frac{3}{5}$ the length of head; free edge of soft dorsal straight. Anal II 8. Caudal notched. Pectoral $\frac{2}{3}$ the length of head; ventrals extending to the anal. A dark band from eye to base of pectoral; a large dark longitudinally expanded spot on the caudal peduncle.

Kosi Bay, Zululand.

A single specimen, 50 mm. in total length.

Pomadasys tæniophorus *sp. n.* (Pl. XXXIX.)

Depth of body $2\frac{1}{4}$ to $2\frac{1}{3}$ in the length, length of head $3\frac{1}{3}$ to $3\frac{1}{2}$. Snout shorter than eye, the diameter of which is $3\frac{1}{2}$ in the length of head and nearly equal to the interorbital width. Maxillary extending to below anterior $\frac{1}{2}$ of eye; depth of præorbital nearly equal to the diameter of eye; 12 gill-rakers on the lower part of the anterior arch. Scales 51–54 $\frac{7}{16}$. Dorsal XII 14–15, commencing above the opercular cleft; fourth spine the longest, a little more than $\frac{1}{2}$ the length of head; soft dorsal highest anteriorly, with straight or slightly convex free edge, scaly at the base and with a series of scales behind each ray; longest rays less than $\frac{1}{2}$ the length of head. Anal III 7; second spine the longest, $\frac{3}{5}$ to $\frac{2}{3}$ the length of head. Caudal truncate or slightly notched. Pectoral longer than the head, extending to above the origin of anal; ventrals reaching the vent. Five or six pairs of dark longitudinal stripes on each side of the body, the stripes of each pair confluent posteriorly; vertical fins dusky.

Kosi Bay, Zululand.

Two specimens, 260 mm. in total length.

Allied to P. furcatus *Bl. Schn.*, which has III 8–10 anal rays, and still more closely to P. anas *Val.*, described and figured by Sauvage in his work on the fishes of Madagascar. The latter has the snout more produced, the maxillary not extending beyond the vertical from the anterior edge of the eye, and the dorsal commencing above the axil of the pectoral, which is shorter than the head.

Dentex undulosus *sp. n.* (Pl. XL.)

Dentex rupestris (non *Cuv. & Val.*) *Casteln.* Poiss. Afr. Austral., p. 28 (1861).

Depth of body $2\frac{3}{4}$ to 3 in the length, length of head $3\frac{1}{3}$ to $3\frac{2}{3}$. Snout $1\frac{1}{4}$ to 2 as long as eye, the diameter of which is $3\frac{1}{2}$ to $5\frac{1}{2}$ in the length of head; interorbital width 3 to $3\frac{1}{2}$ in the length of head. Jaws equal anteriorly; maxillary nearly reaching the vertical from the anterior edge of eye; 4 canines in the upper jaw, moderately strong, the inner pair scarcely smaller than the outer; 6 canines in the lower jaw, the innermost pair small. Depth of præorbital equal to the diameter of eye (adult) or less (young); cheek with 9 or 10 series of scales; præoperculum scaly; 14 to 16 gill-rakers on the lower part of the anterior arch. Scales 57–60 $\frac{9-10}{18-20}$. Dorsal XII 10; origin above axil of pectoral; spines of moderate strength, the third to the fifth the longest, $\frac{2}{5}$ or a little more than $\frac{2}{5}$ the length of head; soft rays $\frac{1}{3}$ or nearly $\frac{1}{3}$ the length of head. Anal III 9; second and third spines subequal, $\frac{1}{3}$ or nearly $\frac{1}{3}$ the length of head. Caudal forked. Pectoral longer than the head, extending to above the origin of anal. Upper half of body with from 3 to 6 undulating longitudinal dark stripes with pale edges; a large blackish spot on the side above the middle of the pectoral.

Sixteen miles N.E. of Bird Island, Natal, and Table Bay, Cape Colony (Gilchrist).

Dentex argyrozona *Cuv. & Val.* is nearest to this species, but has a larger mouth, stronger lateral canines, 6 to 8 scales in a transverse series above the lateral line, III 8 anal rays and a different system of coloration.

Sargus nigrofasciatus *sp. n.* (Pl. XLI.)

Depth of body 2 to $2\frac{1}{3}$ in the length, length of head 3 to $3\frac{1}{4}$. Snout with nearly vertical profile, longer than eye, the diameter of which is $4\frac{1}{2}$ in the length of head; interorbital region very convex, its width $2\frac{2}{3}$ in the length of head. Maxillary extending to below anterior $\frac{1}{5}$ of eye; depth of præorbital equal to diameter of eye; cheek with 5 series of scales; 10 short gill-rakers on the lower part of the anterior arch. Incisors moderately broad, implanted vertically in the upper jaw, obliquely in the lower; 4 or 5 series of molars in the upper jaw, 3 in the lower. Scales 55–57 $\frac{6\text{–}7}{13\text{–}14}$. Dorsal XI 12, commencing above the axil of pectoral; fourth spine the longest, $\frac{1}{2}$ to $\frac{3}{5}$ the length of head; last spine $\frac{2}{7}$ to $\frac{1}{3}$ the length of head and as long as the soft rays. Anal III 11; second and third spines subequal, as long as the last of the dorsal. Caudal forked. Pectoral longer than the head, extending beyond the origin of anal; ventrals reaching the vent. Body with 6 or 7 blackish vertical bars; thoracic region and upper part and sides of head blackish.

Sixteen miles N.E. of Bird Island, Natal, at a depth of 40 fathoms.

Two specimens, 360 mm. in total length.

Allied to S. holubi *Stdr.* which has the præorbital deeper, the spinous dorsal lower, the soft dorsal usually of thirteen rays, and the coloration uniform except for a small dark spot at the root of the pectoral.

Blennius punctifer, *sp. n.* (Pl. XLII.)

Depth of body $3\frac{2}{3}$ to 4 in the length, length of head $4\frac{1}{5}$–$4\frac{2}{5}$. Snout obtuse, with nearly vertical anterior profile. Diameter of eye $3\frac{1}{2}$ to 4 in the length of head and twice the width of the flat interorbital region. Maxillary extending to below posterior edge of eye; very small canines in the lower jaw. On each side a short fringed nasal tentacle and a similar supra-orbital tentacle; occiput with a median series of simple filaments. Dorsal XII 14–15, with a very slight notch, commencing above the edge of præoperculum, ending just before the caudal; spinous part as high as or a little lower than the moderately elevated soft-rayed part. Anal 17–19. Caudal subtruncate. Pectoral extending to above origin of anal. Back with 6 more or less distinct dark cross-bars; numerous very small dark spots on head, body, dorsal fin and base of pectoral fin; series of larger spots on caudal, anal and distal part of pectoral; a more or less distinct dark spot or ocellus behind the first dorsal spine.

Kosi Bay, Zululand and Port Natal (Ayres).

Three specimens, measuring up to 100 mm. in total length.

Blennius cristatus *Linn.* is described by Cuvier & Valenciennes from the Island of Ascension as having the supra-orbital tentacles very small and simple, the anal fin with 16 rays, and the markings somewhat different.

Salarias kosiensis *sp. n.* (Pl. XLII.)

Depth of body equal to length of head, $3\frac{2}{3}$ in the length of the fish. Snout obtuse, with nearly vertical anterior profile. Diameter of eye 5 in the length of head and equal to the width of the somewhat concave interorbital region. Maxillary extending to below posterior edge of eye; canines present in the lower jaw. On each side a short fringed nasal tentacle and a long simple supra-orbital tentacle; a transverse series of short filaments across the nape. Dorsal XI 12, deeply notched, ending just before the caudal; spinous part lower than the rather elevated soft-rayed part. Anal 15. Caudal rounded. Pectoral extending beyond the origin of anal. Blackish-grey, with some white spots and markings.

Kosi Bay, Zululand.

A single specimen, 185 mm. in total length.

This species is very close to S. variolosus *C. & V.*, which has the supra-orbital tentacles small and fringed.

G. M. Woodward del. et lith.

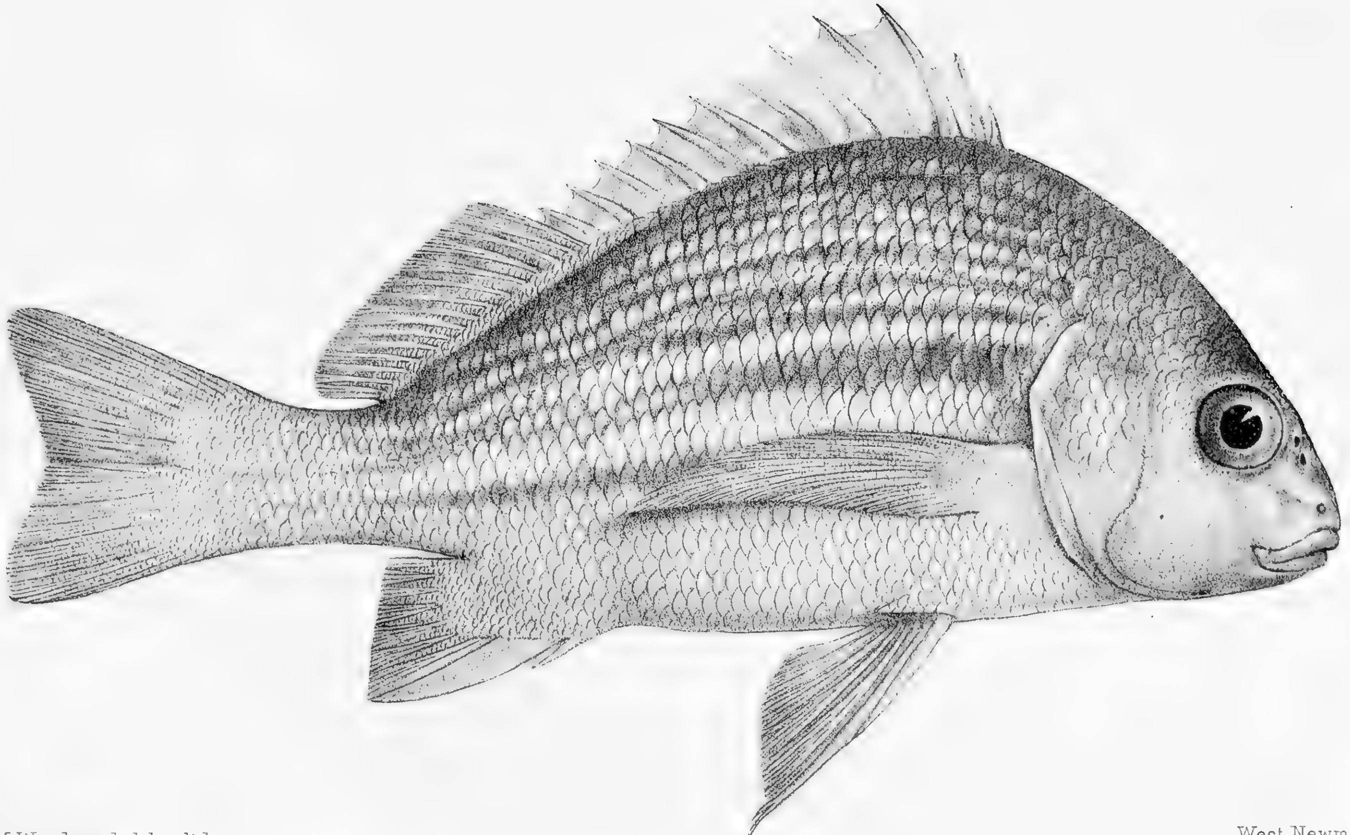
West, Newman imp.

SQUALUS ACUTIPINNIS.

G. M. Woodward del. et lith.

West, Newman imp.

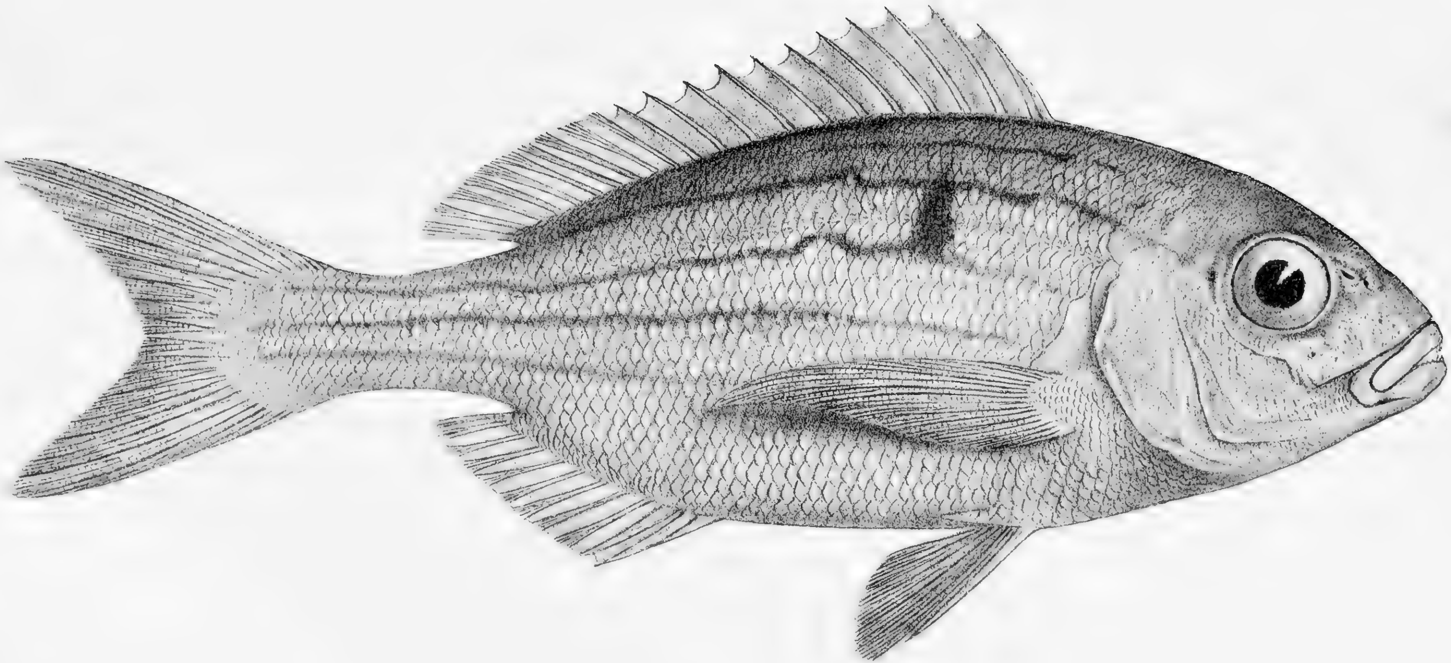
SQUATINA AFRICANA.



G. M. Woodward del. et lith.

West, Newman imp.

POMADASYS TÆNIOPHORUS.



G. M. Woodward del. et lith.

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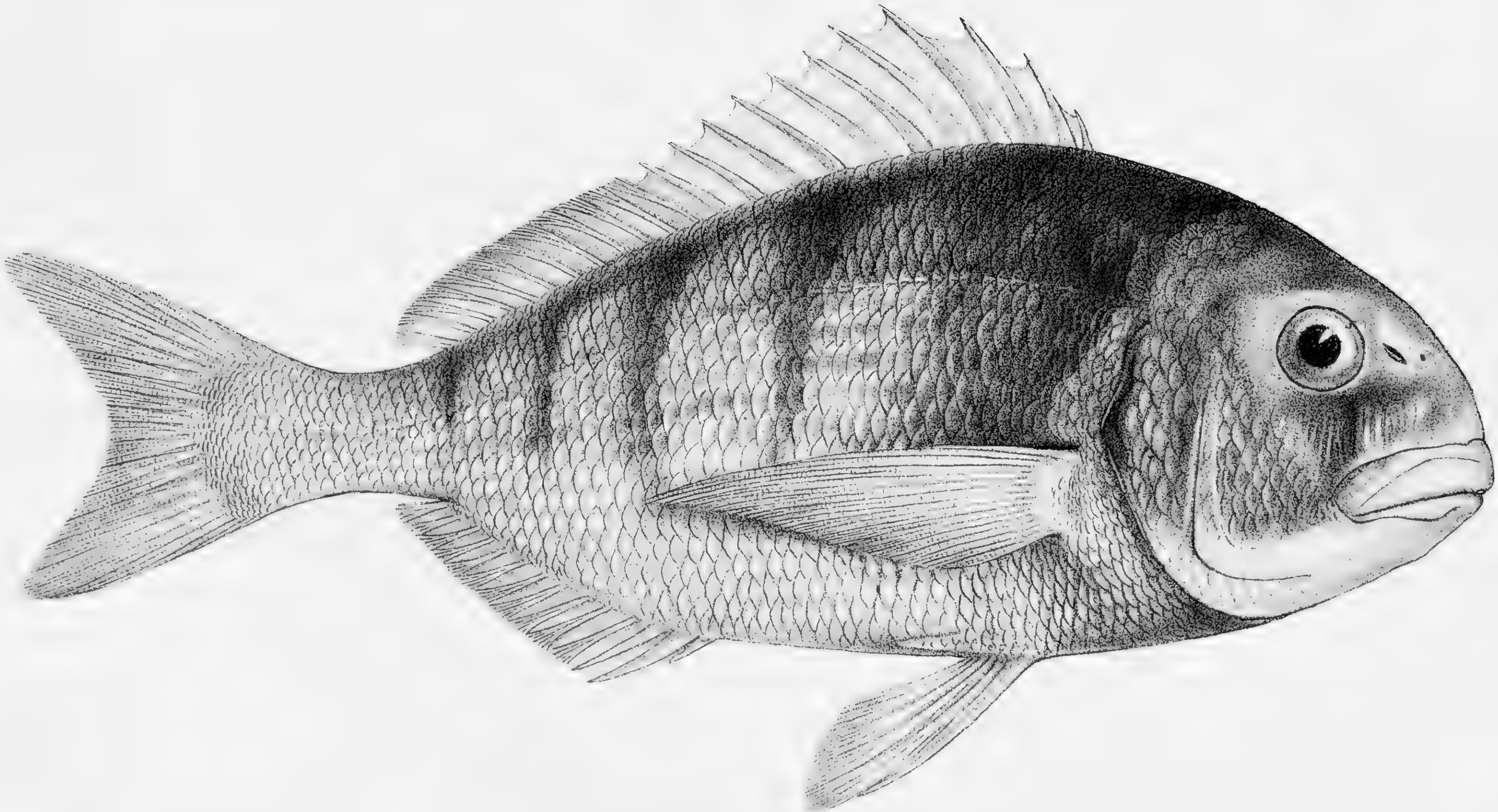
DENTEX UNDULOSUS.

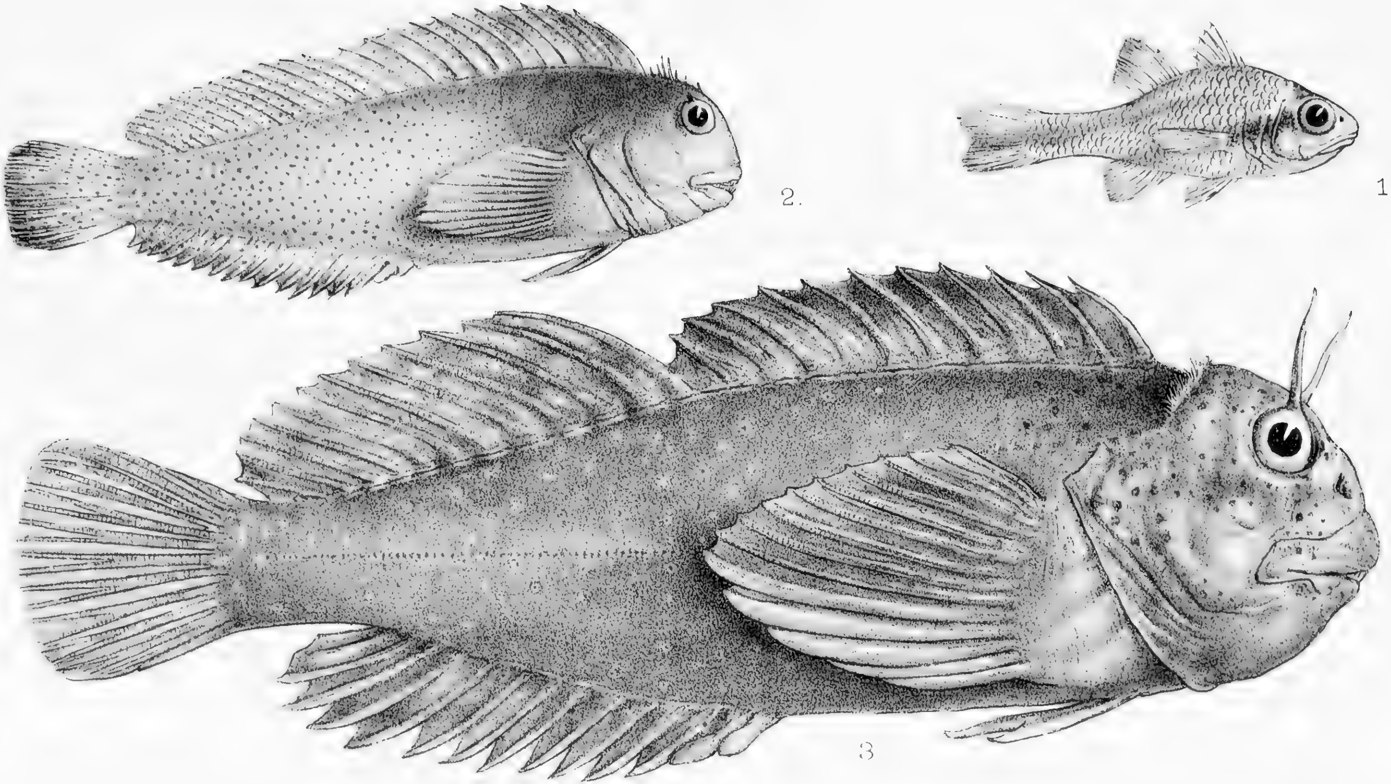
Pl. XLI.



G. M. Woodward del. et lith.

West, Newman imp.

SARGUS NIGROFASCIATUS.



G. M. Woodward del. et lith.

West, Newman imp.

1. APOGON WARRENI. 2. BLENNIUS PUNCTIFER.
3. SALARIAS KOSIENSIS.

A Short Study on Zulu Music.

By

Rev. Father Franz Mayr.

With Plates XLIII and XLIV.

The Zulus have a great liking and a certain natural ability for music, which rejoices the hearts of old and young alike of both sexes.

In spite, however, of the good musical ear which most Zulus possess, and their great fondness for playing musical instruments and for singing, it cannot be said that they have reached any proficiency in either instrumental or vocal music.

At the end of this article there will be given some eight examples of Zulu songs. These have been taken down with care, and may be regarded as fairly accurate transcriptions; they will clearly show the absence of art, or at least what Europeans would call art. Nevertheless, the study of native music should prove of interest, and it discloses a considerable variety of strange airs and rhythms, especially in the direction of dances. It is certainly high time for such a study, as European music is rapidly penetrating into every part of the country, and harmonicas, concertinas, etc., are taking the place of the original primitive instruments.

I. Instrumental Music.

The native musical instruments will now be described.

(1) Umqangala, or stringed bow (Pl. XLIII, figs. 1–3). It is made of a bent stick or reed with a string of ox-tendon stretched tightly across. The bows vary considerably in size,

and sometimes they may be ornamented; in the specimen shown in fig. 3 the surface of the reed is covered with engravings. In using the instrument, one end of the bow is held by the lips of the player, and the other end with the left hand. The string is twanged with the thumb of the right hand, and notes of different pitch are produced by means of the fingers of the left hand pressing on the string. It would appear that the mouth of the performer acts as a resonator (*vide* Pl. XLIV).

(2) *Ugubu*, or *ugumbu*, is a stringed bow with a calabash attached towards one end (fig. 10). A small portion of the calabash is cut off square at the free end. The bow is held vertically, and the opening of the calabash is pressed against the chest with the left hand, while with the right hand the string is struck with a small stick. The pitch is altered by the fingers of the left hand pressing on the string, while the tone is varied by the varying pressure of the calabash against the chest.

(3) *Uqwabe* is a stringed bow with the string tied down at the middle towards the bow, and at this place a large calabash is fixed (fig. 11). The opening of the calabash is slightly pressed against the chest of the player as in the *ugubu*, but the bow is sometimes held horizontally instead of upright. With a small stick the player strikes the string alternately on each side of the calabash, and the pitch is changed by pressing the string with the first finger of the left hand.

(4) *Ugwala* is in form and size like the *umqangala*, except that at one end the string of ox-tendon is attached to the split quill of a feather. The other end of the quill is either bound down to the end of the bow by a thin strip of skin, with a piece of quill projecting freely beyond, or it is passed through a hole in the wood, in which it is tightly wedged by a peg of wood. Figs. 4 and 5 give side and front view of this instrument; the split quill is seen at the bottom of the string.

The instrument appears to be a difficult one to use, and women are the chief performers. The mouth is placed over the split quill and a whistling sound is produced by the breath; the pitch is varied by pressing the string at the opposite end with the fingers of the left hand.

(5) Isitontolo. This instrument has been adopted from the Basutos. It is illustrated in figs. 6 and 7. It often consists of a reed (fig. 7) through which a flexible stick is passed, and a string of ox-tendon is stretched tightly across. The string is tied down in the middle towards the bow. The reed may be replaced by a curved stick, into the ends of which are fixed short flexible sticks (fig. 6). In playing the instrument one end of the middle thicker portion is placed against the mouth, as in the case of the umqangala, while the string is twanged with the right hand. The mouth acts as a resonator, while the pitch can be altered by the fingers of the left hand pressing on the string.

(6) Umtshingo, or reed-pipe whistle. The end placed to the mouth is cut obliquely (fig. 9), the other end is cut transversely. The lower end is more or less closed with a finger, and the pitch can be regulated. As a rule, two whistles are played together by two players, one taking the lead and the other responding.

(7) Igemfe is another form of whistle. It is made of a large reed fitting over one of smaller diameter (fig. 8). It is played like the umtshingo.

(8) Isigubu, or drum (fig. 12). A piece of the trunk of a tree, about eighteen inches long and one to two feet in diameter, is hollowed out into a cylinder. The Umsenge, or Cabbage Tree (Cussonia spicata), or the Umhlonhlo (Euphorbia grandidens) are often selected on account of the softness of the wood. Calf or goat skin is stretched across the two ends and tied tightly together by strips of skin or tendon. The drum is beaten with small drumsticks.

These eight instruments are still in use to a small extent; but the music elicited from them by the untutored Zulu could seldom please a European, for in most cases Zulu instrumental music is extremely monotonous, and with very little value in melody or rhythm. Except in the case of the drum, the volume of sound produced is very small, and practically the performer himself is the only person who derives any enjoyment from the music.

II. Vocal Music.

Zulu songs may be either of a public or private character. Among the natives anyone may invent a song, text and air; and most of them have their own private songs, made at some important moment of their lives, or after some event. Children when playing invent nursery rhymes and songs; so also do boys when herding their father's goats or cattle, and girls when occupied in their homes or at field work, or when sitting round the fire in the evening hours.

Special songs are composed when young people reach puberty, and particularly when marriage arrangements begin.

A Zulu will invent a mournful song in remembrance of the death of a near relative. A witch-doctor has his or her own lamentations to the spirits of the dead—amadhlozi.

The arrival of a European neighbour, the opening of a railway, a war, famine, a plague of locusts, a disease, etc., etc., may become subjects for semi-public songs, which may attain a circulation, more or less wide, among the people.

Songs of a specific public character are those which are used at the public functions of chiefs (e. g. at the feast of the first fruits—ukwetshwama, or at royal marriages), war songs and the tribal songs which are possessed by every chief and tribe.

At marriages and other public ceremonies it is a Zulu custom for not only the songs of the living chief to be rendered, but also those of his father and grandfather. It is for this reason that songs used at the time of Tshaka and Dingane are known by the present generation.

Songs among the Zulus are composed more or less in the following manner: Anyone who feels able and inclined to compose a song invents one or more sentences appropriate to some event or feeling which occupies his mind and heart. He continually hums the sentences to himself, and changes and improves the air until it pleases him. Soon after, on meeting a friend, he may inform him as to his composition, who in his turn may suggest some alteration in the air, or he may add another sentence. In this way the song travels from one to another, and is passed on at beer-drinks or dances, and ultimately it may become the property of the tribe, while the originator is in most cases forgotten.

Their method of rendering their songs is very lax. One and the same song may be rendered in quite different ways, both as regards the repetition of words and the sequence of the musical sentences. Great freedom is allowed, and thus scope is given for the individual feeling or the genius of the singer. Even the same person will make considerable alterations in singing the same song at different times; but the general meaning of the text and the main notes of the air are retained.

The time is very much "tempo rubato." When there is only one singer the text is sung with or without action, and in a feigned or loud voice. If there are several singers, one will take the lead, and the others will accompany in different parts, or the text may be divided among the singers and sung in turn.

The Zulu chants are endless, with a constant repetition of the same text and air.

Rhythm is marked by action, such as stamping the feet, clapping hands, brandishing a dancing-stick, or by other movements of the body.

In singing a war-song—igama lempi—the men stand in a single row, or, if numerous, in many rows, one behind the other, and the chief stands in the centre of the front row. On both sides stand the women and children, who keep time to the chant by clapping their hands. The strong, deep voices of the men cause a roar like distant thunder, and the stamping of the feet makes the earth to resound. All enter thoroughly into the spirit of the song, and the whole is grand on account of the great noise and the weird gesticulations of the performers.

At marriages the grown-up girls, with the bride hidden among them, sing the first songs on their arrival at the kraal of the bridegroom. These introductory songs and dances, performed by the bride's party, are called isingeniso, umcanguzo, and inkondhlo. The action in these dances consists of gradual slow movements forward and backward without clapping the hands. Then the bridegroom's party (iketo) follows, and the dances become more and more excited, and after a time complete confusion reigns, and everyone, both male and female, is trying to make the greatest possible noise.

The regulation time for Zulu marriages is from about 1 or 2 p.m. to sunset, when the eating and drinking begins. Late in the evening another noisy dance—umkahlelo—is performed by the young people, accompanied by the beating of a drum—isigubu. The personal friends of the bride and bridegroom are not satisfied with one day's feasting, and they may remain for a second or even third day. The dances on these days are more private in character, and the bride mostly takes the lead—isimekezo. By the way of taking leave from her parting friends, the bride distributes small presents of bead-work among those of her own age.

Returning to our subject, Music, it must be said that the texts of Zulu songs are mostly without much meaning, and of no poetical value. Like the official court-praisers—izimbongi—the Zulu poets are fond of exaggeration; thus they may speak of a small chief as the conqueror of heaven and earth, who has destroyed great tribes, he is like heaven itself, he is king of kings.

The melodies have, as a rule, a descending tendency, each musical sentence beginning at a high pitch and descending towards its end. Fourths are intervals very frequently used, also minor keys and mournful cadences, which are strange, difficult and barbarous to ears accustomed to modern music. The harmony of the native tunes, in correspondence with the melody, is equally mournful. Without effort the Zulus fall into a second or third vocal part for accompanying the tune, and the absence of discords is notable.

I will now give some specimens of Zulu songs; and in adapting them to modern musical notation I had to resist the temptation of doctoring the native music, lest it should appear more artistic than it really is. Dr. Alan Miller has very kindly rendered me much assistance in this matter, and my hearty thanks are due to him for his valuable aid.

1. Hayiza ma Pondo,	Shout ye Pondos!
Helele ma Pondo,	Alas, Pondos!
Vumani ma Pondo,	Reply Pondos!
Ayeza ma Pondo,	They come the Pondos,
Vumani ma Pondo.	Reply Pondos!

This song was sung by two native girls in a spirited manner. It is a children's ditty—indhlamu—and was probably composed by a young Zulu man. It has been taken up by children in their play, and refers to fights with the Pondos.

2. Anongilondolozani,	Keep me safe ye, [heroes,
Uye watint'a-o-Nqakamatshe,*	He went and attacked the
Anongilondolozani,	Will you protect me,
Zinyane lendhlovu,	Young one of the elephant,
Zinyane lendhlangamandhla.†	Young of the great heroes.

* Name of one of Cetshwayo's regiments.
† Praise-name for chiefs.

This song comes from Cetshwayo's time, and is widely used as the isingeniso, or first song at a marriage, when the bride makes her first appearance with her friends at the place for dancing—isicawu. The bride takes the lead, and the whole song and dance are rendered slowly.

3. Yek uMajozi katandwa ndawo,
Wayiwa le,
Uyimbule,
Wayiwa le,
Sigudhl'unde lolo,
Wayiwa le.

Poor Majozi is not loved,
He was rejected far away,
He is a lion,
He was rejected far away,
We pass this long range,*
He was rejected far away.

Majozi is the surname of chief Ngoza, and the song may be called iketo lenkosi, chief's song. It is sung by men

* Drakensberg Mountains.

only, and sounds impressive on account of the rude, powerful rendering and the strange action.

The composers of chiefs' songs are invariably men, not women; in fact, very few songs originate from women.

4. Aihlom' Imidhleke,*	Let the Imidhleke prepare for war,
He lidume,	Let the thunder of war roll,
Ladhl'amadina,	The dinner has been eaten,
Lidume.	Let the thunder of war roll.

This is an ihubo lempi, war-song, of Hennhemu, father of Mveli, the present chief of the Mafunzi tribe, in the Zwaartkop location, near Pietermaritzburg.

5. Inqa buqili	See the crafty hiding themselves,
Siyausilanda,	We will fetch their cattle,
Nang'u Zulu.	Here we are (we Zulus).

War song used in some parts of Zululand, which was composed after a fight with the Swazis at the beginning of Pande's reign.

6. Hlasela le,	Prepare for war,
Wayiwa le,	Far, far away,
Ikon'inkosi yezwe,	There is the chief of the land,
Sibuz'inkosi ezaukufa.	We ask which chief is going to die.

* The name of a regiment.

Chief Mveli's song—ihubo lenkosi. Note the transition from one key to another without the least warning. Absence of modulation is very marked, and this is the main reason why native songs sound so barbarous, strange, and harsh to our ears.

7. Badabula kwa Hlongwa,	They went through the Hlongwa [district,
Yi-ya yi-yo ye maye,	Alas, alas!
Badabula ezizweni,	They went through many tribes,
Yi-ya yi-yo, ye maye.	Alas, alas!

Hlongwa was the name of an Ama Lala tribe in Alexandra county at Dingane's time. The name of the chief was Joli. The above song is used at marriages in Zululand.

8. Ye he ubaba wangikolisa,	Well my father gave me satisfaction,
Kodwa au yek'amadhlozi	But, alas, the spirits (of the
Angibulala.	Kill me. [dead)
O, kodwa ngiyazisa,	And yet I praise them,
Amadhlozi angilaya,	The spirits inform me,
Yek ubaba epansi,	Oh! my father is dead,

Wo zintandane zakwetu,	Poor orphan children,
Ning'azise ukuti nakolwa.	Tell me do you believe (that the spirits inform me).

This is an isililo, or lamentation of a witch-doctor. It is sung without rhythm or action.

The literal translation gives some idea of the general significance of the text; but a great deal of explanation would be required to make the meaning clearer, and this would carry us beyond the limits of the present article. My intention was to give a few samples of Zulu songs of different kinds, in order to illustrate the general character of native music. It may be added that with the kind assistance of Dr. Alan Miller the songs were carefully taken down, partly from the lips of the singers, and partly from phonograph records.

A study of the specimens given will show that the Zulu is not able to attain to much art without outside assistance, although he has great natural ability for music, and can very readily be trained in this direction.

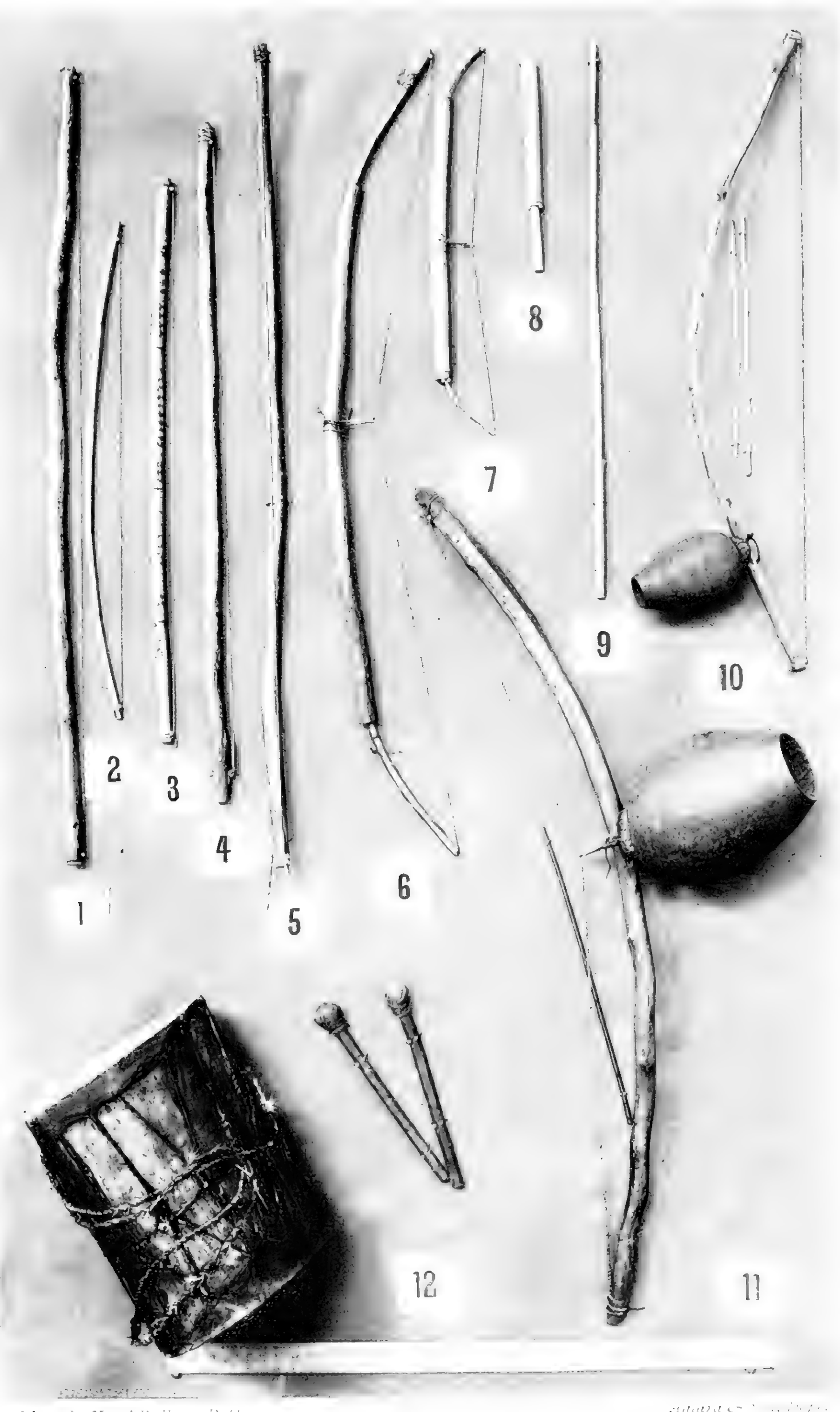


Photo. by Natal Railway Dept.

ZULU MUSICAL INSTRUMENTS

1—3. Umqangala. 4. Side view of Ugwala, with split quill at the bottom. 5. Front view of Ugwala. 6—7. Isitontolo. 8. Igemfe. 9. Umtshingo. 10. Ugubu or Ugumbu. 11. Uqwabe. 12. Isigubu.

(A yard-measure was placed below to indicate size

Adlard & Son, Impr.

Native Musicians.

Names of instruments: back row, beginning on the left, Uqwabe, Umqangala, Igemfe; front row, Ungub, Isitontolo, Ugwala.

On a Collection of Hydroids, mostly from the Natal Coast.

By

Ernest Warren, D.Sc.Lond.

With Plates XLV—XLVIII.

I.

During the last few years a collection of thirty-one species of hydroids has been made while shore-collecting on the Natal and Zululand coasts. In addition, some four species have been dredged from a depth of 40 fathoms in the neighbourhood of Bird Island, near Algoa Bay.

In the following list the species are enumerated under their various families, and the localities are also given.

Except when otherwise stated, the specimens were obtained from the rock-pools at low-tide. They were generally fixed with a half-saturated solution of corrosive sublimate in 30 per cent. spirit, with 1½ per cent. acetic acid. The best results were obtained when the solution was applied fairly hot.

For staining the hydroids whole, Mayer's paracarmine was found satisfactory, and for sections, Delafield's hæmatoxylin, or iron-hæmatoxylin followed by orange, were employed.

Fam. Bimeriidæ.

(1) Parawrightia robusta *Warren.*
Loc.: Isipingo, Scottburgh, Park Rynie.

Fam. Eudendriidæ.

(2) Eudendrium parvum *sp. n.*
Loc.: Park Rynie.

(3) Eudendrium angustum *sp. n.*
Loc.: At a depth of 40 fathoms, sixteen miles N.E. Bird Island, near Algoa Bay.

Fam. Clavatellidæ.

(4) Clavatella multitentaculata *sp. n.*
Loc.: Isipingo.

Fam. Tubulariidæ.

(5) Tubularia solitaria *Warren.*
Loc.: Tongaat, Isipingo, Park Rynie.

(6) Tubularia betheris *sp. n.*
Loc.: Coast Quarry, between Alexandra Junction and Park Rynie.

Fam. Pennariidæ.

(7) Pennaria australis *Bale*, var. cooperi *Warren.*
Loc.: Kosi Bay, Zululand; Isipingo, Scottburgh, Park Rynie.

Fam. Cladocorynidæ.

(8) Cladocoryne floccosa *Rotch.*
Loc.: Isipingo, Scottburgh.

Fam. Syncorynidæ.

(9) Asyncoryne ryniensis *g. e. sp. n.*
Loc.: Park Rynie.

Fam. Corynidæ.

(10) Coryne pusilla *Gärtner.*
Loc.: Isipingo, Park Rynie.

Fam. Sertulariidæ.

(11) Sertularella polyzonias (*Lin.*).
Loc.: Isipingo, Scottburgh, Park Rynie.

(12) Sertularella fusiformis *Hincks.*
Loc.: Park Rynie.

(13) Sertularella tumida *sp. n.*
Loc.: At a depth of 40 fathoms, sixteen miles N.E. Bird Island, near Algoa Bay.

(14) Sertularella campanulata *sp. n.*
Loc.: Scottburgh, Park Rynie.

(15) Sertularia acanthostoma *Bale.*
Loc.: Park Rynie.

(16) Sertularia operculata *Lin.*
Loc.: Isipingo, Alexandra Junction.

(17) Sertularia loculosa *Busk.*
Loc.: Isipingo, Scottburgh, Park Rynie.

(18) Sertularia linealis *sp. n.*
Loc.: Kosi Bay, Zululand.

(19) Sertularia bidens *Bale.*
Loc.: Park Rynie.

(20) Pasythea quadridentata (*Ellis & Sol.*).
Loc.: Scottburgh, Park Rynie.

(21) Thuiaria tubuliformis (*M.— Turneretscher*).
Loc.: Isipingo, Scottburgh, Park Rynie.

Fam. Plumulariidæ.

(22) Plumularia tenuis *sp. n.*
Loc.: Kosi Bay, Zululand; Durban, Park Rynie.

(23) Antennella natalensis *sp. n.*
Loc.: Isipingo.

(24) Plumularia spinulosa *Bale.*
Loc.: Park Rynie.

(25) Kirchenpaueria mirabilis (*Allman*).
Loc.: Scottburgh.

(26) Paragattya intermedia *g. e. sp. n.*
Loc.: Park Rynie.

(27) Halicornaria segmentata *sp. n.*
Loc.: Coast Quarry, between Park Rynie and Alexandra Junction.

(28) Aglaophenia chalarocarpa *Allman.*
Loc.: Kosi Bay, Zululand; Durban, Isipingo, Scottburgh.

(29) Aglaophenia parasitica *sp. n.*
Loc.: Scottburgh.

Fam. Campanulariidæ.

(30) Campanularia tincta *Hincks.*
Loc.: Park Rynie.

(31) Campanularia caliculata *Hincks.*
Loc.: Isipingo.

(32) Clytia elongata *sp. n.*
Loc.: At a depth of 40 fathoms, sixteen miles N.E. Bird Island, Algoa Bay.

(33) Lafœa scandens *Bale.*
Loc.: Isipingo.

(34) Lafœa magna *sp. n.*
Loc.: Scottburgh, Park Rynie, Natal; Bird Island, Algoa Bay.

(35) Thyroscyphus æqualis *sp. n.*
Loc.: At a depth of 40 fathoms, sixteen miles N.E. Bird Island, Algoa Bay.

The species will now be described in order.

(1) Parawrightia robusta *Warren.*

PARAWRIGHTIA ROBUSTA *Warren*, 'Ann. Nat. Gov. Mus.,' vol. i, 1907, p. 187.

This species has a certain affinity with Wrightia arenosa[1] (*Alder*), of the British Coasts; both hydroids possess fixed gonophores.

(2) Eudendrium parvum *sp. n.* (Pl. XLV, figs. 1–4.)

At first this hydroid was considered to be a diminutive form of E. capillare *Alder*; but without a more detailed

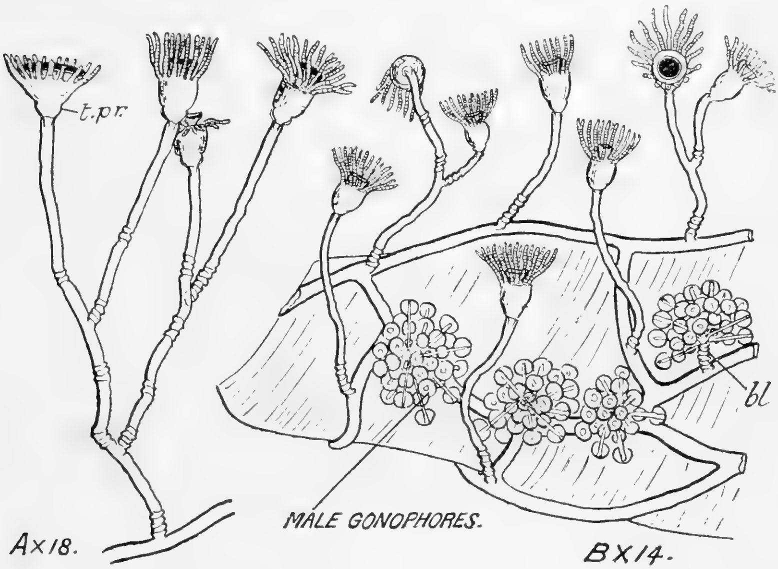
[1] Hincks, T., 'A History of the British Hydroid Zoophytes,' 1868, p. 88.

account of the structure and variability of Alder's hydroid, it is not possible to refer it to this species with any certainty.

The hydroid grows on the surface of sea-weed, and may extend over a very considerable area. In all the specimens obtained the hydrocaulus has exhibited very little branching, and the total height has not exceeded about ¼ in.

The polyps are of a very pale horn colour.

TEXT-FIG. 1.



Eudendrium parvum, *sp. n.*

TROPHOSOME.—The hydrorhiza or creeping stolon branches in an irregular manner, and may form a more or less complicated network. The diameter is about 0·15 mm., and the thickness of the perisarc 4·4 μ.

Hydrocaulus.—The stems bearing the hydranths are given off irregularly from the hydrorhiza, and very frequently they are unbranched. When branching occurs, it is irregular, as in text-fig. 1, *A*. Groups of irregular annulations are present at the base of the stems, and at the points of origin of the branches, and also at intermediate places. The diameter of the hydrocaulus is about 0·10 mm., and the thickness of the perisarc 4·4 μ.

Hydranth.—The polyp has the typical eudendrium-shape, and there are 15–18 tentacles in a single verticil.

In preserved specimens the trumpet-shaped hypostome measures about 0·09 mm. in height and 0·25 mm. in diameter. The body of the hydranth, measured from the verticil of tentacles to the base, has a height of about 0·39 mm., and its greatest breadth is about 0·32 mm.

Gonosome.—The male only has been found. The gonophores are carried in dense clusters on very short annulated stems, which spring direct from the hydrorhiza (text-fig. 1, *B*). Each cluster may be regarded as arising from an abortive polyp.

The gonophores are three-chambered (Pl. XLV, fig. 4); the proximal chamber is generally very small. There is sometimes a tendency for the development of a slight terminal tubercle, but no nematocysts have been seen in such.

The length of a gonophore is about 0·57 mm., and the diameter of the distal chamber 0·19 mm.

General histology.—There is a shallow groove running round the hydranth at about one third of the height of the polyp above the base (Pl. XLV, fig. 1, *t.pr.*). A thin continuation of the perisarc of the hydrocaulus is present over the base of the hydranth, and it terminates in this shallow groove (figs. 2 and 3, *t. pr.*). The ectoderm below the groove differs somewhat in character from the ectoderm above, and it ends in a line of especially large cells (*c. c.*), which have large nuclei and stain deeply. The perisarc of the hydrocaulus consists of an inner and outer layer (fig. 2, p_2 and p_1), and it is the latter (p_1) which is continued upwards over the base of the hydranth. Allman states that in Eudendrium vaginatum *Allman* "the body as far as the origin of the tentacles" is "enveloped in a loose corrugated membranous sheath, which loses itself below on the hydrocaulus."[1] The

[1] Allman, G. J., 'A Monograph of the Gymnoblastic or Tubularian Hydroids,' Part II, p. 339.

structure described in E. parvum is, doubtless, strictly homologous with the sheath of vaginatum, only in the former species it does not envelop the body to such an extent.

The nematocysts of the tentacles are somewhat small, and have a length of 4·8 μ, and breadth 2·1 μ.

The endoderm at the base of the hypostome consists of elongated cells with large granules (Pl. XLV, fig. 2, *gl. c.*). The endoderm of the vertical sides of the polyp is very thin, and it contains some flattened granular cells. Towards the base of the polyp the endoderm cells are conspicuously vacuolated (*v. c.*).

Systematic Position.—From the published descriptions of E. capillare *Alder*, it is not possible to identify the Natal hydroid with this species. The characters in which it differs are: the three-chambered condition of the male gonophore, the absence of a well-defined terminal tubercle to the gonophore, and the extension of the perisarc over the base of the polyp. In the last character, an approach is made to the condition seen in E. vaginatum. In Eudendrium insigne *Hincks* a shallow circular groove near the base of the hydranth is mentioned and figured by Allman, and doubtless it has the same structure as that described in E. parvum.

(3) Eudendrium angustum *sp. n.* (Pl. XLV, figs. 5, 6.)

This hydroid was dredged from a depth of 40 fathoms in the neighbourhood of Bird Island, off Algoa Bay. The specimen was torn from its attachment, and the hydrorhiza is unknown. It was about 3 inches in height, and of a dark brown colour.

Trophosome.—Hydrocaulus.—Monosiphonic, aborescent, irregularly branching; the stems which immediately carry the branches bearing the hydranths have occasional groups of annulations, and the branches are annulated at their origins, and have irregularly scattered groups of 2–10 rings. The perisarc is dark brown over the older portions of the colony, and paler over the younger parts.

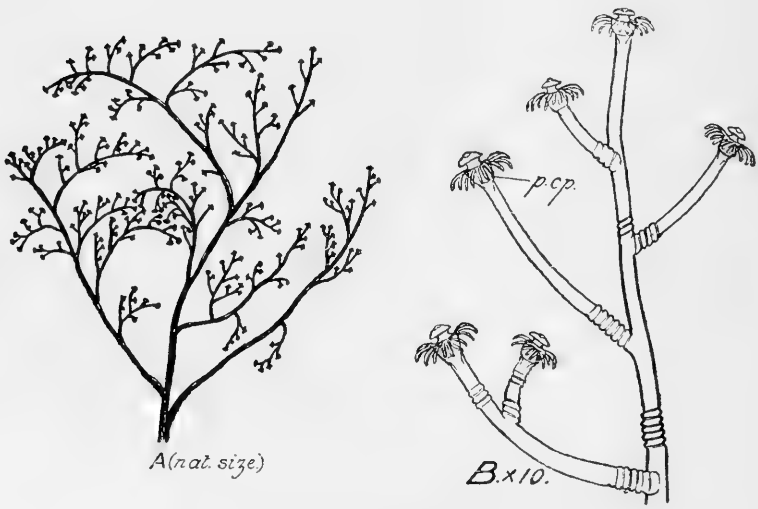
The main stems are nearly black; they may attain a diameter of 1 mm. or more.

The secondary stems, which carry the hydranth-bearing branches, measure about 0·38 mm. in diameter, thickness of perisarc 26·4 μ.

The diameter of the branches carrying the hydranths is about 0·19 mm., thickness of perisarc 6·1 μ.

Hydranth.—It has a superficial resemblance to a typical

TEXT-FIG. 2



Eudendrium angustum *sp. n.*

eudendrium polyp (Pl. XLV, fig. 5); there are 25–30 tentacles in a closely-set verticil.

In the preserved specimen the height of the hydranth from the base to the level of the verticil is about 0·31 mm., the breadth at the widest part 0·29 mm., and the height of the hypostome 0·16 mm.

GONOSOME.—Unknown.

General histology.—The general cell-structure of the hydranth is interesting and peculiar; it differs widely from that seen in E. capillare (cf. figs. 2 and 6, Pl. XLV).

The perisarc, terminating in a groove at the base of the polyp, is generally slightly inverted into a shallow cup (figs. 5 and 6, *p.cp.*), which is doubtless comparable to the sheath seen in E. vaginatum.

The ectoderm is provided with two kinds of nematocysts; the large measure about 23·3μ in length, and 10·4μ in breadth; the small variety 5μ and 2·2μ respectively. The small nematocysts occur chiefly on the tentacles, while the large are found on the body of the hydranth, and more especially around the edge of the reflexed ectoderm of the hypostome (fig. 6, *n.*).

The character of the endoderm is remarkable; there is practically no digestive cavity, and the mouth is blocked up by a plug of elongated endoderm cells, continuous with the digestive endoderm at the base of the polyp.

The upper surface of the hypostome consists of endoderm of two kinds—the central plug of digestive cells above mentioned (fig. 6, *e.p.*), and the outer reflexed epithelium (*r.e.*) continuous with the skeletal endoderm which runs up the tentacles. Between the elongated endoderm cells are wedged glandular cells (*v.c.*), which stain intensely with hæmatoxylin; the protoplasm is densely crowded with small, rounded vacuoles.

The plug of endoderm can directly ingest food; *i.f.*, in fig. 6, represents a cluster of copepod eggs. The exposed surface of endoderm is probably sticky during life, since small copepods and other organisms may frequently be found adhering to it.

This throwing out of digestive endoderm through the mouth, for the ingestion of food, is, as far as I am aware, unique among the hydroids.

Systematic Position.—The general character and branching of the hydrocaulus is distinctly that of an Eudendrium. The hypostome is also trumpet-shaped, although it has special peculiarities. It is remarkable that these peculiarities are present in the developing hydranth of Parawrightia robusta *Warren* ('Ann. Nat. Gov. Mus.,' vol. i, p. 192).

In the absence of the gonosome, however, the present hydroid can only provisionally be referred to the genus Eudendrium. The species is named angustum with reference to the narrow or almost obliterated digestive cavity.

(4) Clavatella multitentaculata *sp. n.* (Pl. XLV, figs. 7–9.)

A small clump of this species was found embedded in a white siliceous sponge at the edge of a small rock-pool full of corallines, and situated at some distance above the low-tide line (figs. 7 and 8).

This delicate little hydroid, reaching a height of about ½ inch, has a circle of numerous capitate tentacles, and the hypostome is richly coloured. Around the mouth there is an area of chalky white, below this there is a band of lemon yellow, and just above the circle of tentacles an irregular band of bright red.

Trophosome.—The hydrorhiza consists of a thin tube, which ramifies through the substance of the sponge. Diameter about 0·13 mm.; the perisarc is yellow and fairly stout, being about 17·8 μ.

Hydrocaulus.—Upright stems spring from the hydrorhiza and grow through the sponge to the upper surface. In comparison with the size of the hydranth, the hydrocaulus is slender, and it appears to be highly extensile.

Foreign bodies, such as minute particles of sand and diatoms, readily cling to the perisarc, and they may form a quite distinct coat.

Diameter of embedded portion about 0·13 mm., thickness of perisarc 13·1 μ; on emerging through the sponge the hydrocaulus has a greater diameter, being about 0·31 mm., while the perisarc becomes very thin and transparent, being about 4·4 μ thick.

Hydranth.—The polyp is relatively large (fig. 8), and looked at from above it is star-shaped. The hypostome is swollen and conical, with a small apical mouth (*mo.*), and is brightly coloured as above described. The tentacles are all capitate, and are arranged in one series at the base of the hypostome; they arise close together from the body of the hydranth, and they are too numerous to form a single verticil. There are some 28–35.

The following are the measurements of a preserved typical specimen. Total height of polyp 0·84 mm.; diameter, immediately above the verticil, 0·58 mm.; diameter of the capitulum of a tentacle 0·15 mm.

GONOSOME.—The reproductive bodies (fig. 8, *pl.*) are produced in clusters on short outgrowths from the body of the hydranth just above the circle of tentacles. These bodies are shown in section in fig. 9.

In none of the specimens collected were the reproductive bodies mature, and consequently it is not possible to state whether free medusæ are formed.

General histology.—The perisarc of the hydrocaulus dips into a groove at the base of the hydranth, and then extends for a short distance upwards over a modified band of ectoderm (fig. 9, *p.*). The capitulum of a tentacle possesses both large and small nematocysts; the former measure 19 μ in length and 11 μ in breadth, and the latter 9 μ and 4 μ respectively (*n.*).

The endoderm of the hypostome (*e.hy.*) is thick and compact, with numerous small nuclei, which have a special affinity for stains. Below the hypostome there are pendulous lobes of large cells (*gl.c.*) with large pigmented granules, and there are also a small number of oval cells (*ov.c.*) which stain readily and appear to consist of somewhat dense and homogeneous protoplasm. The usual vacuolated cells (*v.c.*) occur at the base of the hydranth, and skeletal septate endoderm runs up the tentacles.

SYSTEMATIC POSITION.—The present species is clearly closely allied to Clavatella prolifera *Hincks*[1] of the British coasts; it agrees with it in the tentacles being all capitate

[1] Hincks, T., 'A History of the British Hydroid Zoophytes,' 1868, p. 73.

and arranged at the base of the hypostome in a single series. It also agrees in the exceptionally delicate nature of the hydrocaulus. It differs from prolifera in possessing 28–35 tentacles instead of 8, and also in the place of origin of the reproductive bodies. In prolifera free medusæ are budded from short processes which spring from the base of the hydrocaulus, while in the present species such processes are budded by the hydranth itself. It is, of course, very probable that free medusæ are also formed by multitentaculata.

(5) Tubularia solitaria *Warren.*

TUBULARIA SOLITARIA *Warren*, 'Ann. Nat. Gov. Mus.,' vol. i, 1906, p. 83.

This species, which occurs embedded in siliceous sponges, has been fully described. It is a solitary form, and in the arrangement of the endodermal canals and in other ways it is allied to Corymorpha; but the occurrence of an actinula in development has caused it to be referred to Tubularia.

(6) Tubularia betheris *sp. n.* (Pl. XLV, figs. 10 and 11; Pl. XLVI, fig. 12.)

This graceful hydroid was found in a sheltered rock-pool near the Coast Quarry, between Park Rynie and Alexandra Junction. It was attached to the rock by a small hydrorhiza. The colony consisted of 4 individuals, and its height was about $1\frac{1}{4}$ inches (fig. 10).

The hydranths are translucent, and the hydrorhiza and hydrocaulus are a very pale brown.

TROPHOSOME.—The hydrorhiza is a branching stolon creeping over the surface of rocks or worm-tubes.

Diameter 0·34 mm., thickness of perisarc 20 μ.

Hydrocaulus.—It consists of upright stems springing irregularly from the hydrorhiza and bearing terminal polyps. The perisarc is irregularly ringed, especially towards the base.

Diameter 0·30 mm., thickness of perisarc 14 μ.

Hydranth.—The general shape is rather elongated and slender (fig. 11). At the base of the polyp there is a characteristic dilatation which is covered by a continuation of the perisarc of the hydrocaulus (fig. 12). The proximal or basal tentacles are of considerable length and are about 17 in number; the distal or oral tentacles are short and are about 14 in number.

The total height of the polyp, measured to the base of the dilatation, is about 2·51 mm., the greatest breadth, measured at the level of the basal tentacles, is about 1·21 mm. The height of the dilatation is about 0·55 mm., and its width 0·61 mm.

Gonosome.—The gonophores are budded in irregular clusters on semi-erect peduncles (*pd.*) or blastostyles, which spring from the hydranth just above the basal verticil of tentacles. The gonophores reach a high state of development; marginal tentacles, radial and circular canals, and a velum (*v.*) are present.

The gonophore figured (fig. 12) is a young male, but owing to the lack of material older stages have not been seen. A female gonophore has not been found, and consequently the nature of the actinula is undetermined.

General histology.—A vertical section of a hydranth is represented in fig. 12, Pl. XLVI. At the upper edge of the basal dilatation the ectoderm is conspicuously thickened, and on its under side there is a shallow groove (*p.g.*). The perisarc of the hydrocaulus is continued up into the groove, and then fades away on the rounded surface of the thickened ectoderm. The perisarc of the hydrocaulus consists of an inner and outer layer, the later being continued over the base of the hydranth.

The nematocysts in the ectoderm are mostly small and inconspicuous; they measure about 5·1 μ in length and 4 μ in breadth (*s.n.*). In the endoderm there is a larger variety (*l.n.*) measuring 8·3 μ and 7·9 μ respectively.

The endoderm around the mouth contains, as usual, numerous deeply staining nuclei; the oral or distal tentacles are provided with septate skeletal endoderm. The vertical sides of the hydranth have a very thin endoderm with a few vacuolated cells (*v.c.*), and also large nematocysts. The base of the hydranth is internally constricted by a large mass of cellular skeletal endoderm (*b.M.*), which constitutes the basal support of the proximal tentacles (*p.t.*). These are provided with cellular skeletal endoderm in place of the more usual septate structure, and it is continuous with the basal mass. Over the skeletal endoderm there is an epithelium (*e.ep.*) of ordinary endoderm with numerous vacuolated cells (*v.c.*).

The cavity of the basal dilatation (*b.d.*) is lined by elongated endoderm cells with large granules. This chamber is partially separated off from the rest of the digestive cavity of the hydranth by the projecting skeletal endoderm (*b.M.*), and the communication which is left tends to be more or less bridged across by a thin sheet of cells (*s.e.*) continuous with the endodermal epithelium.

Systematic Position.—The present species is characterised by the presence of the large dilatation at the base of the hydranth. In general aspect and in the erect position of the peduncles it resembles Tubularia attenuata *Allman*[1] and Tubularia humilis *Allman*[1] from the British and Irish coasts.

In a number of species of Tubularia the hydranth is supported on an annular expansion of the hydrocaulus. The dilatation at the base of the hydranth of betheris would naturally be directly compared with this annular expansion; but in betheris, at any rate, there is a distinct differentiation of the endoderm lining it (fig. 12), and doubtless it accomplishes some special physiological function. Without a detailed knowledge of the mode of development of the hydranth it is not possible to decide whether it should be regarded as a basal differentiated portion of the hydranth, or as an expansion of the upper end of the hydrocaulus.

(7) Pennaria australis *Bale*, var. cooperi *Warren*.

Pennaria australis *Bale*, 'Cat. of the Australian Hydroid Zoophytes,' 1884, p. 45.

In the 'Ann. Nat. Gov. Mus.,' vol. i, p. 73, the author

[1] Allman, G. T., op. cit., pp. 410–411.

has described under the name Halocordyle cooperi a hydroid which occurs along the Zululand and Natal coasts. It differs from the description of Pennaria australis *Bale* in the number, and arrangement in whorls, of the capitate tentacles. Definite variations in these characters were found to occur in different colonies of the Natal hydroid, and it is now seen that a series of gradations, leading to a symmetrical arrangement in whorls, occur in the different species of Pennaria.

The main character which distinguishes the genus Halocordyle from that of Pennaria is the verticillate arrangement in the former of the capitate tentacles; but an examination of the following table will show that it is scarcely necessary to retain the genus Halocordyle.

	Filiform tentacles.	Capitate tentacles.
Pennaria gibbosa *Agassiz*,[1] America .	12	32 scattered.
.. symmetrica *Clarke*,[2] America	14–18	30 ,,
.. cavolinii *Ehrenberg*,[1] Europe	12	20 ,,
.. australis *Bale*,[3] Australia .	7–12	9–14; 4, oral whorl; 5–10 scattered below
.. .. var. cooperi, Natal .	8–10, typically 8	8–13; typically 4 oral and 4 basal tentacles alternating.
.. adamsia *von Lendenfeld*,[4] Australia	24	4 oral and 4 basal alternating.
Halocordyle tiarella *Ayres*,[1] N. America	12?	6 oral, 6 basal.
.. australis *Bale*,[5] Australia	8–10	4–5, oral whorl, rest scattered.

[1] Allman, G. J., 'A Monograph of the Gymnoblastic Hydroids,' Part II, pp. 363–370.

[2] Bale, W. M., "On some New and Rare Hydroida in the Australian Museum Collection," 'Proc. Linn. Soc. N. S. Wales,' vol. iii, 1888, p. 747.

[3] Bale, W. M., 'Catalogue of the Australian Hydroid Zoophytes,' 1884, p. 45.

[4] Lendenfeld, R. von, "The Australian Hydromedusæ," Part V, 'Proc. Linn. Soc. N. S. Wales,' vol. v, 1884–5, p. 595.

[5] Bale, W. M., "Further Notes on Australian Hydroids," 'Proc. Roy. Soc. Victoria,' 1893, p. 94.

The variety cooperi has typically two alternating whorls of four capitate tentacles; but it exhibits marked variability in this character, and most of the arrangements above mentioned, as typical for the different species, occasionally occur in it. The matter has been discussed in the 'Ann. Nat. Gov. Mus.,' vol. i, p. 209.

From these considerations it would appear to be more satisfactory to regard the Natal hydroid as a variety, or perhaps as an incipient species, originating from P. australis.

(8) Cladocoryne floccosa *Rotch.*

Cladocoryne floccosa *Rotch.* 'Ann. Nat. Hist.,' March, 1871.

This unique hydroid with capitate pinnate tentacles was found originally at Herm, near Guernsey, and has been described and figured in Allman's monograph. I am not aware that the hydroid has been met with elsewhere; but it was found fairly abundantly at Isipingo and Scottburgh in the month of May, 1907. It occurred in rock-pools, and especially on old polychæt worm-tubes which had become covered with sea-weeds and polyzoa.

The colony consists of a running stolon which gives off short upright stems, from one quarter to half an inch high, which generally carry a single terminal polyp. Occasionally the stem may give off a short lateral branch.

The following measurements of an average preserved specimen are given, in order that a comparison may be made with the European hydroid.

Hydrorhiza; diameter 0·182 mm., thickness of perisarc 15·5 μ.

Hydrocaulus; diameter 0·152 mm., thickness of perisarc 8·9 μ.

Hydranth; total height about 0·9 mm., breadth about 0·5 mm. Diameter of capitulum of tentacle about 0·058 mm.

Nematocysts are at least of two kinds: the large measure 11·1 μ in length and 9·0 μ in breadth, and the small, 6·7 μ and 5·3 μ respectively.

The polyp has a chalky-white area around the mouth, and the body below is red. The perisarc is pale yellow, and in the hydrorhiza it is smooth, while in the hydrocaulus there may be a few irregular annulations.

Around the mouth there is a whorl of four to six simple short capitate tentacles. The number of pinnate tentacles is very variable, 10–18, and they appear to be irregularly scattered over the body, although a verticillate tendency is assigned to them by Allman.[1] The number of capitate ramuli on the tentacles varies from 6–14.

The whole length of the tentacle is occupied by a very regular septate endoderm.

All the material collected has been carefully searched for the gonosome, but it is regretted that none has been found. In the description given by Allman the gonosome is stated to be unknown.

(9) Asyncoryne ryniensis *g. e. sp. n.* (Pl. XLVI, figs. 13–17.)

Only two small colonies of this interesting hydroid have been found. They were obtained from Park Rynie, as the specific name implies, and were growing on the surface of polychæt worm-tubes. Although the polyps are large, being several millimetres in length, yet they were overlooked in the living condition, and only after fixation with corrosive sublimate were they detected. It is hence probable that they are exceedingly transparent when alive (Pl. XLVI, fig. 13).

Trophosome.—The hydrorhiza is a creeping stolon which appears to branch sparingly.

The diameter is about 0·24 mm. The perisarc is frequently remarkably inflated, being made up of thin layers more or less widely separated from one another. When not inflated it has a thickness of about 8·9 μ.

Hydrocaulus.—The hydrorhiza produces at irregular intervals very short upright stems bearing a single elongated

[1] Allman, G. J., 'A Monograph of the Gymnoblastic Hydroids,' 1872, Part II, p. 380.

hydranth. These stems gradually expand into the hydranth and are only separable from it by reason of the termination of the perisarc (fig. 15, *H*).

At times a branch of the hydrorhiza may turn upwards, and its growing apex may develop into a hydranth; and thus the growth of the branch is terminated. Such has occurred in the specimen shown in text-fig. 3, *A.*, *hy.*

Hydranth.—The general shape is that of an elongated spindle (Pl. XLVI, fig. 14). The hypostome region is not sharply distinguished on the outside. Around the mouth there are 4–6 short capitate tentacles; perhaps four is the typical number. Over the surface of the hydranth there are scattered some 25 moniliform tentacles. The longest of the tentacles are those situated at about one third of the length of the polyp from the mouth; those at the base are very short.

The hydranth in the preserved condition may have a length of 3 mm. or more. The diameter of the capitulum of an oral tentacle is 0·133 mm., and the diameter of the terminal swelling of a moniliform tentacle may be as much as 0·075 mm.

Gonosome.—Between the moniliform tentacles, and somewhat below the middle of the body, short outgrowths are produced, and from these are budded clusters of reproductive bodies. It is probable that they are planoblasts, and ultimately become free (Pl. XLVI, fig. 14, *pl.*); since in the most mature of the specimens marginal umbrella-tentacles are fully formed, and the body is practically a medusa, while the sexual elements are exceedingly immature.

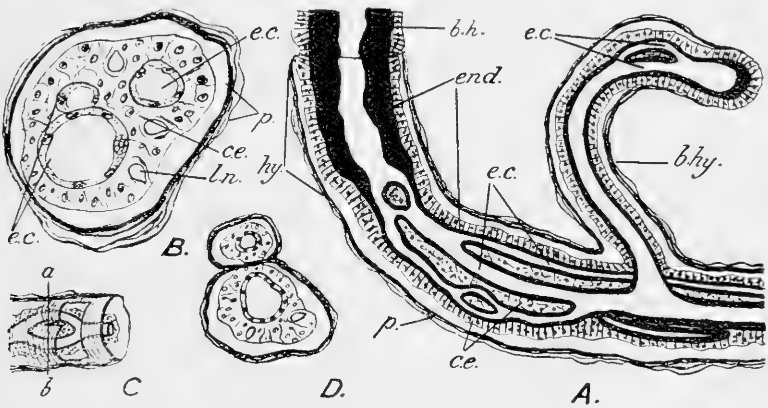
General histology.—The delicate perisarc of the hydrocaulus dips into a shallow groove of columnar cells at the base of the hydranth, and then fades away (Pl. XLVI, fig. 15, *p.g.*). The perisarc of the hydrorhiza, separated into distinct layers, is well seen in the figure (*p.*), also in text-fig. 3, *B.*, *p.*

The ectoderm is provided with two kinds of nematocysts. The large occur more especially in the capitula of the oral tentacles (fig. 17, *l.n.*), but they are found also in the general ectoderm of the hydranth and cœnosarc; they measure 27·0μ

in length and 19·5μ in breadth. The small nematocysts, measuring 10·0μ in length and 8·0μ in breadth, are abundant on the moniliform tentacles (fig. 16, *s.n.*).

The moniliform aspect of the tentacles is due to the presence of thickened rings or patches of ectoderm. The axis of septate endoderm takes no part in the production of the swellings, and, in fact, it seems sometimes to be somewhat constricted by them. The terminal swelling is more or less spherical, but it is much smaller than the capitulum of an oral

TEXT-FIG. 3.



Endodermal canals in Asyncoryne ryniensis, sp.n. *A* × 70; *B* × 150; *C* × 40; *D* × 80.

tentacle, and it appears never to possess large nematocysts. The small nematocysts tend to be crowded on the summits of the patches and thickened rings.

The endoderm of the hydranth consists of elongated cells with large vacuoles, and between them are wedged glandular cells (*gl.c.*), which stain deeply, and contain granules or numerous small vacuoles.

Cross-sections of the cœnosarc of the hydrorhiza may, in certain parts, exhibit two, three, or four tubes of endoderm, surrounded by a common ectoderm. This condition is shown in text-fig. 3, *A*, as it occurred in a branch of the hydrorhiza which happened to terminate in a hydrocaulus (*hy.*) and hydranth (*b.h.*). The layer shown solid (*end.*) is the endoderm, *e.c.* are the endodermal canals, *c.e.* the common ectoderm in which the canals are embedded, *b.hy.* is a branch coming off from the hydrorhiza, and it shows a fork in the endodermal canal at *e.c.*

Fig. *B* is a cross-section through the hydrorhiza, and shows three endodermal canals (*e.c.*), surrounded by a common ectoderm which contains three large nematocysts (*l.n.*). The perisarc (*p.*), consisting of loose laminæ, is well seen.

The endodermal canals do not seem to necessarily arise as direct tubular outpushings from a main canal, but sometimes, at any rate, they appear to originate as solid strings of endoderm cells, which split off from the main canal, and in which a cavity ultimately becomes hollowed out. Occasionally the perisarc dips down into the ectoderm between the forks, so that for a distance of $\frac{1}{4}$ mm. or so there may be two perisarc tubes (fig. *C*). A cross-section through *ab.* is shown at fig. *D.*

Systematic Position.—This hydroid appears to be unique in the nature of its tentacles. In Pennaria, Cladonema, and Stauridium the hydranth is provided with both capitate and filiform tentacles, but the latter are arranged in a definite basal verticil.

In Asyncoryne the filiform tentacles are scattered, and they also possess an unusual moniliform structure, and terminate in a kind of rudimentary capitulum. The structure of the tentacles recalls that of the marginal tentacles of the medusa of Cladonema and Syncoryne.

In the nature of the tentacles, Asyncoryne shows affinity to Cladocoryne. In Cladocoryne there is a verticil of simple capitate tentacles around the mouth, just as in Asyncoryne, while over the body there are arranged a number of pinnate capitate tentacles. The moniliform tentacle of Asyncoryne may perhaps be regarded as intermediate in nature between an ordinary filiform tentacle and a pinnate capitate one.

In Coryne and Syncoryne we have scattered capitate tentacles; and it would appear probable that both Asyncoryne and Cladocoryne are to be regarded as modifications of the Coryne type.

As the generic name implies the present hydroid is especially associated with Syncoryne, since the reproductive bodies are, with great probability, free-swimming medusæ. The general shape of the hydranth also recalls Syncoryne, although the habit of growth of the colony is simpler.

(10) Coryne pusilla *Gärtner.*

CORYNE PUSILLA *Gärtner.* Pallas, 'Spicil Zool,' fasc. x, p. 40; Allman, G. J., 'A Monograph of the Gymnoblastic Hydroids,' 1872, p. 266.

The identification of the Natal hydroid with Gärtner's pusilla is not made with any certainty; but without a detailed acquaintance of the variability and general growth-forms exhibited by pusilla it appears advisable to refer it to this species, as no obvious specific difference has been determined.

The hydroid appears to be very variable in size. There is a dwarf variety, about one quarter of an inch in height, which stretches over large areas of seaweed (text-fig. 4 *B*) exposed to the force of the waves, while in more sheltered places it grows to nearly double the size (*A*).

TROPHOSOME.—Hydrorhiza forms an irregular loose mesh-work on weeds or rocks. The perisarc is smooth, without annulations.

Diameter 0·162 mm., thickness of perisarc 26·3 μ. There is no marked difference in the size of the hydrorhiza in the dwarf and large varieties.

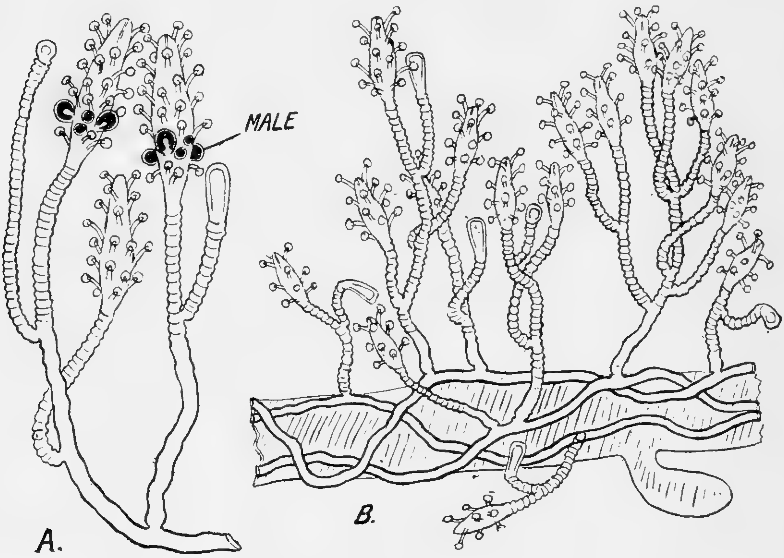
Hydrocaulus.—Straggling and irregularly branched; serpentine, blind-ending branches occur. The annulation o the perisarc is variable and irregular; it is generally most distinct for some distance below the hydranth; there are about 20 rings to the millimetre.

Diameter about 0·17 mm., and thickness of perisarc 15·1 μ; these dimensions are somewhat smaller in the dwarf variety.

Hydranth.—The perisarc of the hydrocaulus is not swollen into a loose sheath at the base of the polyp. The number of tentacles in the large variety varies from 20–30, and in the dwarf variety from 10–18.

The average length of the polyp in the large variety is

TEXT-FIG. 4.



Coryne pusilla *Gärtner*. *A*. Large form × 15. *B*. Small form × 15.

1·31 mm., and breadth 0·363 mm., in the small variety 0·80 mm. and 0·22 mm. respectively. The diameters of the capitula of the tentacles are about 0·13 mm. and 0·10 mm. in the two forms.

The nematocysts in the capitula are of two sizes: the large measure 16·7 μ in length and 11·2 μ in breadth; the small, 8·9 μ and 5·3 μ respectively. The sizes of the nematocysts in the two varieties appear to be about the same.

GONOSOME.—In the dwarf variety the reproductive bodies have not been met with, although they have been searched for in what appear to be old colonies, since they extended over considerable areas.

In the large variety the male reproductive bodies only have been found (text-fig. 4, *A*). It is clear that they are fixed gonophores, and they do not apparently differ from those described for pusilla.

Small errant polychæts and chætognaths appear to form the staple food of this hydroid.

(11) Sertularella polyzonias (*Lin.*). (Pl. XLVII, figs. 18–20.)

SERTULARELLA POLYZONIAS (*Lin.*) Syst; Hincks, T., 'A History of the British Hydroid Zoophytes,' 1868, p. 235; Bale, W. M., 'Cat. of the Australian Hydroid Zoophytes,' 1884, p. 104; Nutting, C. C., 'American Hydroids,' pt. ii, "Sertularidæ," 1904, p. 90.

It is scarcely possible to define this widely distributed species with any certainty. It is very variable, and the Natal hydroid is referred to it, as it is undesirable to found new species on characters (such as the presence or absence of internal knobs of chitin at the mouth of the hydrotheca) which are admittedly highly variable.

The hydroid is found on sea-weeds and worm-tubes, the colony is pale brown, and the stems may reach a height of three quarters of an inch.

TROPHOSOME.—Hydrorhiza has an irregular outline, and branches sparingly.

Diameter, about 0·242 mm., and thickness of perisarc, 23 μ.

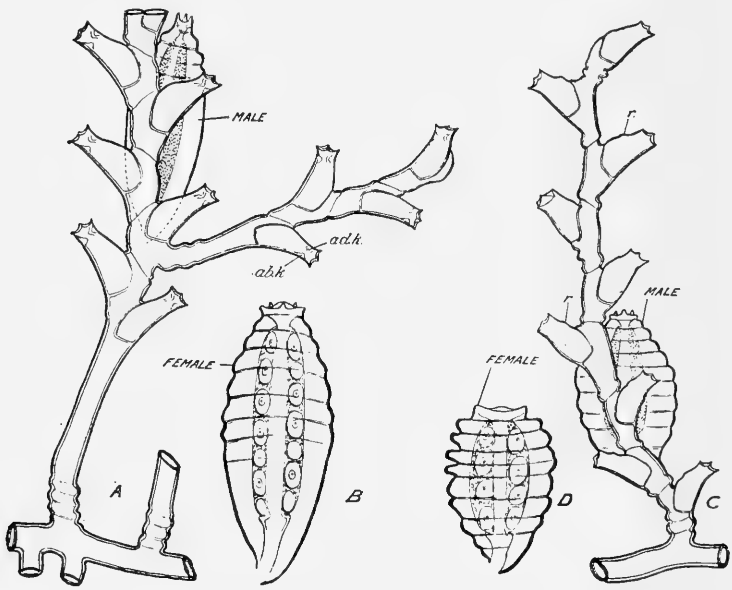
Hydrocaulus.—The hydrorhiza produces at irregular intervals upright stems bearing from 13–20 hydrothecæ. The stems are generally unbranched, but occasionally a lateral branch may be formed (text-fig. 5, *A*). The stem is divided into faintly-defined internodes by oblique divisions.

As a rule the stem is perfectly straight, and only rarely is it slightly zig-zag.

At the origins of the stems and branches there is frequently an annulation of 3–4 rings.

Diameter of stem, measured a short distance above its origin from the hydrorhiza, 0·278 mm; thickness of perisarc 38 μ.

TEXT-FIG. 5.



A and *B*. Sertularella polyzonias (*Lin.*), × 18. *C* and *D*. Sertularella fusiformis (*Hincks*). × 18.

Hydrotheca.—Alternate, ventricose below, contracted above, divergent, expanding mouth. About one half is sunk in the hydrocaulus. The mouth is quadrangular and provided with four teeth at the angles, two of which are lateral, one adcauline, and one abcauline.

Three internal knobs of chitin, constricting the size of the mouth, are usually developed near the edge; two are placed in the middle of the two sides of the square on the adcauline side (Pl. XLVII, figs. 18 and 19 k_1) and one below the abcauline tooth (k_2). Sometimes there are four knobs, the abcauline one being replaced by two in the middle of the abcauline sides of the square. There is an operculum of four flaps.

Length of hydrotheca, measured parallel to the abcauline surface, 0·55 mm ; greatest breadth, 0·26 mm.

Hydranth.—It has the typical sertularian structure with the dilatation of the cœlenteron on the outer side, and a sheet of ectoderm lining the upper portion of the inside of the hydrotheca. The hypostome is conical, and there is a verticil of about 25 tentacles. The nematocysts on the tentacles are small and narrow ; they measure about 6·2 μ in length and 1·8 μ in breadth.

Gonosome.—The gonangia are produced from the hydrocaulus just below a hydrotheca ; they are provided with three apical teeth. The male differs from the female in being narrower, and the apical teeth tend to be longer and closer together. The male gonangium (text-fig. 5, *A*) has 3 or 4 rings around the apical region, while it is smooth below : the female (*B*) has 5 or 6 rings.

The male gonangium has an average length of 2·28 mm. and greatest breadth 0·73 mm. The female measures 2·42 mm. and 0·97 mm. respectively. Thickness of perisarc about 17 μ.

Sometimes short lateral branches (Pl. XLVII, fig. 19, *b*) arise from the inside of a hydrotheca, thus recalling the mode of origin of the gonangia in the genus Synthecium. In one case a single hydrotheca, complete with operculum, issued from the old hydrotheca ; this was doubtless formed after the disintegration of the polyp and during its subsequent renewal.

Gall caused by a Pycnogonum.

Occasionally there may be seen springing from the inside of a hydrotheca a large fusiform body. This structure, which may be three times the length of a hydrotheca, is a gall produced by the presence of a parasitic larva of a Pycnogonum (Pl. XLVII, fig. 18, *g.*).

An egg of the Pycnogonum finds its way into the digestive cavity of a hydranth. It is, of course, quite possible that the parent may actually deposit its eggs in the polyp. The polyp contracts, loses its tentacles and the characteristic dilatation of the cœlenteron, and becomes in fact a closed sac (fig. 18, *c.hy.*); *y.e.* is the young developing embryo. The polyp-sac then elongates and projects out of the mouth of the hydrotheca (fig. 19, *d.g.*), and ultimately it grows and produces a large gall (fig. 18, *g.*) into which the embryo has passed.

The gall is remarkable for its structure: it is lined by a layer of ectoderm (fig. 20, *e.g.*) like a hydrotheca, and it generally terminates in four marginal teeth and a well-developed operculum (*op.*). The length of a gall is about 1·50 mm., and its greatest breadth 0·65 mm. Thickness of perisarc 20 μ. The stalk of the gall sometimes shows a tendency to be annulated.

The outgrowth of the original hydranth has a well-defined cœlenteron, lined by a regular endodermal epithelium, outside of which is a thin ectoderm. Sometimes the structure is surmounted by a set of well-developed tentacles (figs. 18 and 20, *te.*); but a definite mouth has not been observed. At other times the structure ends blindly without tentacles.

The embryo, lodged in the cœlenteron, grows, and there are developed two cheliceræ (fig. 18, *ch.*) ending in two little plates or lappets, which are perhaps of the nature of claws. In an older embryo two long curved claws may be found in this position (fig. 18, *cl.*).

In a longitudinal dorso-ventral section of the young embryo (fig. 20) there may be observed the following characters:

(1) The embryo surrounded by a cuticle (*c.*).

(2) The stomodæum (*St.*) dipping down towards the archenteron (*Ar.*) which is lined by elongated granular endoderm cells. These cells are placed remarkably separate from one another, and are frequently branched (*end.*).

(3) The loose mesoderm tissue (*m.*), and the ova (*o.*) which have already appeared on the ventral aspect, and extend into the base of the cheliceræ.

(4) The cheliceræ (*ch.*), which are inserted into the endoderm of the hydroid.

In an older embryo, represented in fig. 18, *o.l.*, clawed cheliceræ (*cl.*), the oral cone (*o.c.*), and paired, jointed appendages (*ap.*) may be seen.

The larva ultimately breaks out of the gall, and in fig. 19, *o.g.*, an empty broken gall is shown.

The peculiar interest of this example of parasitism is the very definite nature of the response which is made by the host to the stimulation caused by the presence of the developing embryo. Many animal galls and cysts are simple, rounded structures; but here a structure is formed which is practically an enormous hydrotheca and hydranth, the former being provided with marginal teeth and operculum, and the latter may even possess tentacles. There appears, however, to be no mouth, and very probably the operculum is never opened.

In this connection it may be noticed that the hydranth of this species exhibits a marked capacity for extended growth. Through some unknown stimulus a hydranth may round itself off and produce, as we have already seen, a short branch or a new hydrotheca, which thus springs from the mouth of the original hydrotheca (fig. 19, *b.*).

G. Hodge has already described a somewhat similar case, where a larval Pycnogonum forms galls on a campanularian hydroid. From a figure given by Karl Semper, in his 'Animal Life,' p. 332, it would appear, however, that these galls are simple, irregular structures, and cannot be compared with the definite structure occurring in Sertularella polyzonias.

(12) Sertularella fusiformis (*Hincks*). (Text-fig. 5, C and *D*).

SERTULARIA FUSIFORMIS *Hincks*, 'Ann. Mag. N.H.,' vol. viii, p. 253.

Sertularella fusiformis (*Hincks*), Hincks, T., 'A History of the British Hydroid Zoophytes,' p. 243; Hartlaub, Cl., 'Hydroiden aus dem Stillen Ocean Zool. Jahrbücher,' vol. xiv. Jena, 1901, p. 372; Nutting, C. C., 'American Hydroids,' pt. ii, "Sertularidæ," 1904, p. 89.

As in the case of the last species, the identification of the present species with S. fusiformis can only be regarded as provisional, until the limits of variability in fusiformis are more definitely known.

The Natal hydroid is found on sea-weeds or creeping on larger hydroids. It is considerably smaller than S. polyzonias, the stems not being more than about one quarter of an inch in height. It is pale-brown in colour.

Trophosome.—Hydrorhiza consists of an irregular, creeping stolon, sparingly branched.

Diameter about 0·15 mm.; thickness of perisarc 0·018 mm.

Hydrocaulus.—The stolon produces upright stems, which have never been found to branch, and they carry from 6 to 10 hydrothecæ.

The stem is distinctly zig-zag, and is divided by faint oblique divisions into internodes, each bearing a hydranth. The base of each internode is ridged by one, or by one and a half, spiral turns (text-fig. 5, *C*).

Diameter, measured close to the base, about 0·130 mm.; thickness of the perisarc 20μ.

Hydrotheca.—Alternate, ventricose, adnate for about half its length to the hydrocaulus. It is less divergent, and the quadrangular mouth is less expanding than in S. polyzonias. The adcauline free surface is sometimes slightly ridged (*r*).

There are four teeth, and the operculum consists of four flaps. There are no internal knobs of chitin constricting the mouth, as occur in the Natal specimens of S. polyzonias.

Length, measured parallel to abcauline surface, is about 0·420 mm., and greatest breadth 0·230 mm.

Hydranth.—It has the typical structure. Tentacles, about 24. Nematocysts are small and narrow; they tend to be especially abundant at the tips of the tentacles. Length 5·1 μ, and breadth 1·1 μ.

Gonosome.—Gonangia ovate, but smaller and less elongated than in S. polyzonias. The whole surface is generally ridged transversely by 7–8 rugæ. In the female (text-fig. 5, *D*) the opercular surface is wide and nearly flat, and there are no obvious teeth; in the male the neck is very narrow, and the teeth, of which there are three, are well developed.

Length of male gonangium about 1·25 mm., breadth 0·75 mm.; length of female 1·35 mm., breadth 0·69 mm.; thickness of perisarc 16 μ.

(13) Sertularella tumida *sp. n.*

A species of hydroid, very closely allied to Sertularella gayi (*Lamouroux*), was dredged from a depth of 40 fathoms about sixteen miles north-east of Bird Island, near Algoa Bay. In addition to these specimens there was picked up on the shore near Park Rynie, Natal, a loose stem of a hydroid which is regarded as the same as that from Bird Island, although there is a slight difference in the curvature of the free adcauline surface of the hydrotheca (text-fig. 6, *B* and *C*). The specimen from Park Rynie, which had doubtless been thrown up on shore from some depth, was richly supplied with gonangia, while there were none on the specimen from Bird Island.

The description given by C. C. Nutting[1] for S. gayi will apply with slight modification.

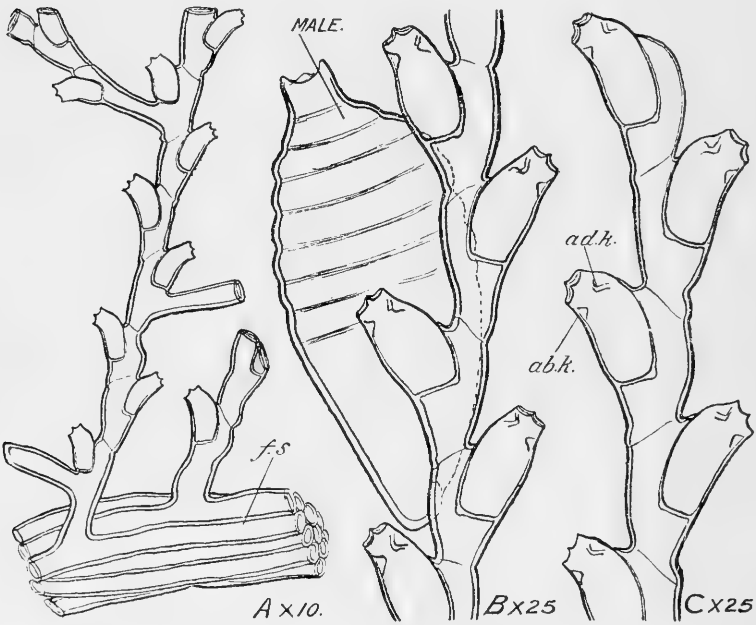
Trophosome.—Hydrorhiza unknown.

Hydrocaulus.—Colony straggling in habit, and attaining a height of about 4 inches. Stem fascicled (*f.s.*), being made

[1] Nutting, C. C., 'American Hydroids, Part II, "The Sertularidæ," 1904, p. 78.

up of intertwining tubes, which in the aggregate form a thick "woody" stem, 2–3 mm. in diameter, and bearing no trace of internodes or regularity of branching. The stems, which bear hydranths, give off branches more or less alternately with a pinnate tendency (text-fig. 6, *A*); but the arrangement may be very irregular and indefinite. The stems bearing hydranths,

TEXT-FIG. 6.



Sertularella tumida sp. n. *A* and *C*. Specimen from Bird Island. *B*. Specimen from Park Rynie.

and the branches, are divided by oblique nodes into regular internodes, each carrying a hydrotheca.

Diameter of terminal branch just below a hydrotheca is about 0·46 mm., and the thickness of the perisarc 35 μ. The hydrocaulus is generally considerably constricted in the region of the node.

Hydrotheca.—Ovate, divergent, distal end contracted, but slightly expanding immediately around the margin;

adnate for one-half to two-thirds of its length to hydrocaulus. Adcauline free surface smooth. The margin has four small equidistant teeth, of which the lateral pair are perhaps the best developed; there is an operculum of four flaps, two adcauline and two abcauline. Below the margin there are three internal knobs of chitin, two adcauline (*ad.k.*) and one on the opposite surface (*ab.k.*).

In the specimen from Park Rynie (*B*) the hydrotheca is sunk in the hydrocaulus to a less extent than in that from Bird Island (*C*).

The adcauline free surface of the hydrotheca is swollen, especially in the specimen from Bird Island, and it is perfectly smooth and not transversely ridged as in S. gayi.

Length 0·59 mm., greatest breadth 0·28 mm.

Hydranth.—Badly preserved, perhaps about 28 tentacles.

Gonosome.—The gonangia are known only from the Park Rynie specimen (text-fig. 6, *B*). The male gonangium is ovate, with a short tubular neck and three short apical teeth. Over the distal half there are about seven transverse rugæ; the proximal half is smooth.

Total length about 2·08 mm., breadth 0·87 mm.; thickness of perisarc 28 μ.

Systematic Position.—According to Professor Nutting S. gayi has not been found in the Pacific Ocean, and it is now a question whether the differences between the present hydroid and gayi are sufficient to warrant the formation of a new species. The only marked differences are: the complete absence of rugæ on the hydrotheca, and the amount to which the hydrotheca is sunk in the hydrocaulus. In S. gayi not more than one-half of the hydrotheca is adnate to the hydrocaulus, while in the hydroid from Bird Island two-thirds are generally adnate. This last character, however, is certainly variable, especially if there is justification in considering the specimens from Bird Island and Park Rynie as belonging to the same species (text-fig. 6, *cf.* *B* and *C*).

Only by a series of observations on the variability of S. gayi, with respect to the rugæ on the hydrotheca, would it be possible to arrive at any decision as to whether or not the Pacific hydroid should be regarded as the same as the Natal hydroid. In the meantime it has been considered advisable to give a new name to the present hydroid, and tumida has been chosen on account of the swollen condition of the hydrotheca.

(14) Sertularella campanulata *sp. n.* (Pl. XLVII, figs. 21 and 22.)

This minute but remarkable hydroid occurs creeping on sea-weeds, often in company with Pasythea quadridentata. It has been found at Scottburgh and Park Rynie, but is not particularly common. The habit of growth is more like that of a Campanularian than a Sertularian, and the species is clearly allied to Sertularella solitaria *Nutting,* from the Bahamas, and Calamphora parvula *Allman,* Bass Strait, Australia.

Trophosome.—Hydrorhiza consists of a creeping, somewhat flattened stolon branching sparingly or forming a loose reticulum.

Diameter 0·061 mm. On the surface attached to the seaweed the perisarc is very thin, while on the outer surface it has a moderate thickness, 8·2 μ (Pl. XLVII, fig. 22, *R.*).

Hydrocaulus.—Short stems, with 2–5 spiral turns, arise from the hydrorhiza and carry a terminal hydrotheca (fig. 22, *H.*). The stems appear always to arise at an angle of about 45° with the hydrorhiza, and they sometimes come off sloping alternately to the right and left sides of the hydrorhiza.

The diameter of the hydrocaulus (which is practically the peduncle of the hydrotheca) is 0·083 mm. and the average length 0·16 mm. The thickness of the perisarc is about 8·7μ.

Hydrotheca.—Barrel-shaped, set terminally on hydrocaulus, provided with 5–7 well-marked transverse rugæ; the proximal portion is sometimes smooth. The mouth is quadrangular and expanding, and has 4 pointed teeth, which appear to be arranged in a definite manner with respect to the origin of the hydrocaulus from the hydrorhiza, and the bilateral character of the perisarc of the hydrotheca; two of the teeth are lateral, one on the side facing the hydrorhiza, and one on the opposite side.

There is a four-flapped operculum, forming a four-sided pyramid.

The cavity of the hydrotheca is partially shut off from the cavity of the hydrocaulus by a diaphragm (*d.*), which resembles that seen in a Campanularian. The opening of the diaphragm is excentric, being nearer the side facing the hydrorhiza.

Length 0·40 mm., greatest breadth 0·26 mm. The thickness of the perisarc varies considerably on the two sides; on the side facing the hydrorhiza it is 4 μ and on the opposite side 10 μ (Pl. XLVII, fig. 22).

Hydranth.—The polyp has the typical sertularian structure. The hydrotheca is lined by a thin epithelium of ectoderm (fig. 22, *e.s.*) which generally joins the ectoderm of the hydranth near the diaphragm; but it appears not to be very constant in its place of junction. There is the usual dilatation of the cœlenteron (*C.D.*) which is on the side facing the hydrorhiza. The hypostome is more or less hemispherical. There is a single verticil of about twenty tentacles. The nematocysts are few and small; they measure about 3 μ in length and 0·7 μ in width.

The hypostome has a narrow endodermal epithelium; the outer side of the dilatation of the cœlenteron is lined by a comparatively flat undifferentiated endoderm (*u.e.*). The rest of the hydranth is lined by elongated vacuolated cells with granular cells (*gr.c.*) wedged between. At the base there are some clumps of special granular cells (*gl.c.*).

Gonosome.—Unknown.

Systematic Position.—The present hydroid is undoubtedly closely allied to Calamphora parvula[1] *Allman*, and Sertularella solitaria[2] *Nutting*. In the former the hydro-

[1] Allman, J. G., 'Challenger Reports,' vol. xxxiii, p. 29.

[2] Nutting, C. C., 'American Hydroids,' pt. ii "Sertularedæ," p. 89.

theca is practically sessile on a creeping stolon, and its height is about $\frac{1}{40}$ inch. It is transversely annulated with about twelve ridges, and the tetragonal mouth is stated to be inoperculate. The hydrotheca is rendered bilateral by the slope of the neck towards one side. It was found at a depth of thirty-eight fathoms.

In Surtularella solitaria, found in shallow water at the Bahamas, the hydrotheca is provided with a fairly long stalk with one or two annulations near the middle. Hydrotheca radially symmetrical, mouth quadrate, slightly everted, and four equidistant teeth. Body of hydrotheca annulated with about eleven transverse ridges. Operculum of four flaps.

In both cases the anatomy of the hydranth is not touched upon, but it is probable it is sertularian in nature as in S. campanulata. It is curious that Calamphora parvula is stated to be inoperculate; S. solitaria and campanulata are both obviously operculate.

It is interesting to note that, independently of the square neck and mouth, the hydrotheca in both C. parvula and S. campanulata exhibits a certain bilateral symmetry, thus still further emphasising the sertularian nature of the hydroids. In C. parvula the neck of the hydrotheca slopes towards one side and the mouth is consequently not terminal and radially symmetrical. In S. campanulata the peduncle of the hydrotheca arises at an angle of 45° to the hydrorhiza, and on the side facing the hydrorhiza the perisarc of the hydrotheca is less than one-half the thickness of that on the opposite side. The diaphragm, also, is excentrically perforated, the aperture being on the side having the thin perisarc.

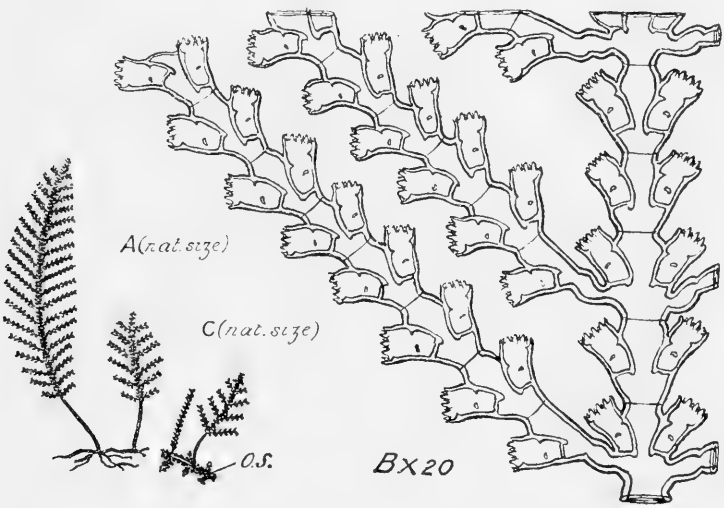
Allman expressed some doubt as to how his C. parvula should be classified, whether as a Sertularian or Campanularian. The general habit of growth and apparent radial symmetry of the three species would seem to place them among the Campanulariidæ; but the anatomy of the hydranth, the operculated, dentate, quadrate mouth, and the real bilateral symmetry, which exists under an exterior radial symmetry, unmistakably point to sertularian affinities.

(15) Sertularia acanthostoma *Bale*. (Pl. XLVI, figs. 23–26.)

SERTULARIA ACANTHOSTOMA *Bale*, 'Catalogue of the Australian Hydroid Zoophytes, 1884, p. 85.

There is probably little doubt that the Natal hydroid is Bale's acanthostoma; but, nevertheless, there are certain differences.

TEXT-FIG. 7.



Sertularia acanthostoma *Bale*.

The pinnate shoots reach a height of about 2 in.; the hydroid is straw-coloured, and grows attached to rocks near the low-water line. Two small colonies only have been found.

TROPHOSOME.—Hydrorhiza consists of a branching, loose reticulum.

Diameter 0·101 mm.; thickness of perisarc 10 μ.

Hydrocaulus.—Pinnate shoots, pinnæ slender at their origin, opposite. Typically there are three pairs of hydrothecæ on the main stem between every two pairs of pinnæ; but sometimes there are only two pairs, and occasionally only a single pair (text-fig. 7, *B*).

Diameter of main stem just below the proximal pair of pinnæ, 0·24 mm.; thickness of perisarc, 40 μ.

The specimen shown in text-fig. 7, *C* is peculiar, in that a young pinnate shoot is seen springing from the upper surface of the main stem of an old pinnate shoot (*o.s.*).

Hydrothecæ.—Opposite on main stem, subalternate on the pinnæ, usually one pair on every internode. Tubular in shape, expanding upwards; aperture oval with four outer marginal teeth alternating with four inner (*cf.* figs. 23 and 24, Pl. XLVI). In a vertical section (fig. 25) through the hydrotheca three projecting thickenings of chitin may be seen, one in the middle of the inner surface (*r.*), one near the margin of the outer surface (*plt.*), and a curved peg (*l.p.*) near the base on the outer surface.

Length of hydrotheca 0·38 mm., and greatest breadth 0·18 mm.

Bale[1] mentions and figures an oblique fold (intra-thecal ridge) extending across the hydrotheca from the process (*r.*) on the inner surface. In the Natal hydroid this fold is scarcely represented.

Hydranth.—Short conical hypostome and a verticil of 23 tentacles (fig. 25). There is the usual dilatation of the cœlenteron on the outer side (*C.D.*), and in the contracted condition of the polyp there is also an expansion on the inner side (*i.p.*). The outer dilatation is attached to the peg of perisarc at the base of the outer surface (*l.p.*); the endodermal epithelium on the outer side is flat and undifferentiated (*u.e.*). The rest of the endoderm consists of elongated cells with granular cells wedged between. The inner surface of the hydrotheca is lined by a thin layer of ectoderm (*e.s.*) which joins the ectoderm of the polyp at the extreme base. At the front outer edge of the hydrotheca there is a concave

[1] Bale, W. M., 'Catalogue of the Australian Hydroid Zoophytes,' 1884, p. 85.

depression (*plt.*) in which lies a thickening of the ectodermal epithelium (figs. 25, 26 *B.n.*). This thickening has very much the structure of a nematophore, it being provided with a battery of large nematocysts which resemble those occurring in the Plumulariidæ; they measure 22·7 μ in length and 4·2 μ in breadth.

In the specimens at my disposal it was not possible to decide whether there were ordinary nematocysts on the tentacles.

Gonosome.—Unknown.

This hydroid was very largely enveloped by a coralline alga (fig. 26, *C.W.*), which formed a perfectly regular layer over the greater part of the outer surface of the colony. It renders the colony very firm and strong, and in this way it may possibly be of some use to the hydroid.

The hydroid is, of course, peculiar among the Sertularians in the remarkable toothed condition of the margin of the hydrotheca, and it is further distinguished by possessing no trace of operculum.

(16) Sertularia operculata *Lin.*

Sertularia operculata *Lin.*, 'Syst.,' Hincks, T., 'Brit. Hyd. Zooph.,' p. 263; Bale, W. M., 'Cat. of Austr. Zooph.,' 1884, p. 67; Nutting, C. C., 'American Hydroids,' pt. ii "Sertulariidæ," 1904, p. 64.

Found attached to the surface of rocks; greenish-brown in colour. Height about 3 in.

Trophosome.—Hydrorhiza forms a feltwork, very firmly attached to the surface of the rock. Diameter 0·105 mm; thickness of perisarc 15 μ.

Hydrocaulus.—It branches dichotomously; a hydrotheca at each side of every axil and in contact with each other.

The internodes, bearing a pair of hydrothecæ, are distinguishable by the presence of nodes only on the terminal branches. In the older branches and main stems they are not present.

Diameter of main stem at the base 0·24 mm., thickness of perisarc 36 μ; terminal branch, diameter 0·20 mm.

Hydrotheca.—In pairs, opposite, not in contact, tubular, slightly divergent, adnate nearly up to the margin; two spine-like abcauline teeth, the back one being the larger and slightly incurved. Operculum two flaps.

Length of hydrotheca, measured along the outer edge, about 0·640 mm., greatest breadth 0·202 mm.

Hydranth.—About 18 tentacles.

Gonosome.—Gonangia, long, ovate, aperture operculate with a slightly elevated border.

In the male, length 1·414 mm., breath 0·505 mm., thickness of perisarc 7 μ.

The above description only differs from that given by Bale in connection with colour, absence of nodes in the older stems, and the mention of an operculum.

It may be noticed that in the figure given by Hincks[1] the nodes are not shown.

(17) Sertularia loculosa *Busk*. (Pl. XLVIII, fig. 37.)

Sertularia loculosa *Busk*, 'Voy. of Rattlesn.,' 1852; Bale, W. M., 'Cat. of Austr. Zooph.,' 1884, p. 91.

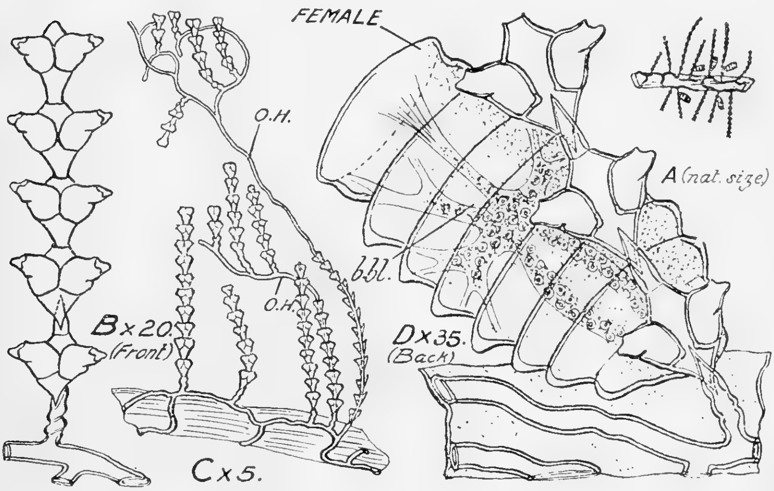
This is a common hydroid on the Natal coast; it occurs on coralline and other seaweeds. The colour of the colony is sometimes almost black, and at other times a pale brown. It is not certain whether the difference in colour is due to different physiological and histological conditions which may occur at different times in the same colony, or whether the two forms indicate two distinct varieties. There is no obvious difference in the ordinary specific characters in the two kinds. The height is about half an inch.

[1] Hincks, T., 'British Hydroid Zoophytes,' 1868, Pl. LIV, *b*.

Trophosome.—Hydrorhiza is a creeping stolon, irregularly branched. Diameter 0·152 mm., thickness of perisarc 18 μ.

Hydrocaulus.—Simple upright stems irregularly divided into hydranth-bearing and non hydranth-bearing internodes by transverse and oblique nodes. The base of the stem is provided with two spiral turns. The apex of a stem is capable of continued growth, and it may produce a stolon-like outgrowth, indistinguishable from the hydrorhiza, from which upright stems arise (text-fig. 8, *C*, *O.H.*). When the apex of

Text-fig. 8.



Sertularia loculosa *Busk.*

a stem comes into contact with a piece of weed or other object, it appears to be stimulated to grow in this way, as separate pieces of weed may be firmly bound together by outgrowths of the ends of the stems.

Length of hydranth-bearing internode, measured from a transverse joint to the opposite pointed extremity of an oblique articulation 0·50 mm.

Hydrotheca.—Short and broad, opposite; in contact in front (*B*), separate behind (*D*). Horizontal fold occurs about in the middle of the outer surface. Aperture somewhat contracted, directed outwards; two rounded abcauline teeth.

Length, measured along abcauline edge, 0·293 mm., greatest breadth 0·172 mm. Distance from mouth to mouth of a pair of hydrothecæ 0·570 mm.

Hydranth.—About 12–15 tentacles. Nematocysts, few, small, and inconspicuous, about 4·1 μ in length, and 1·2 μ in breadth.

Gonosome.—Gonangia ovate, upper surface flat or slightly convex; 7–9 prominent transverse annulations, aperture wide, operculate.

Length about 1·62 mm., breadth 0·847 mm. The enclosed blastostyle is branched.

The above description agrees with that given by Bale, except that the gonangium in the Australian hydroid appears to have 4–5 ridges in place of 7–9.

Histology.—In the black variety the endoderm is provided with dark brown, opaque, pear-shaped masses (Pl. XLVIII, fig. 37, *c.p.*). These are, doubtless, cells, but I have not with certainty detected the nucleus. The colouring matter may be very opaque and compact, but sometimes it is seen in the form of granules.

(18) Sertularia linealis *sp.n.*

The hydroid is characterised by running in longitudinal lines over the surface of ribbon-like sea-weeds. It is of a dark brown or black colour, and it does not appear to attain to a height of more than about one fifth of an inch. It was collected in the rock pools at Kosi Bay, Zululand.

Trophosome.—Hydrorhiza runs in longitudinal lines connected together by occasional cross-branches (text-fig. 9, *A*).

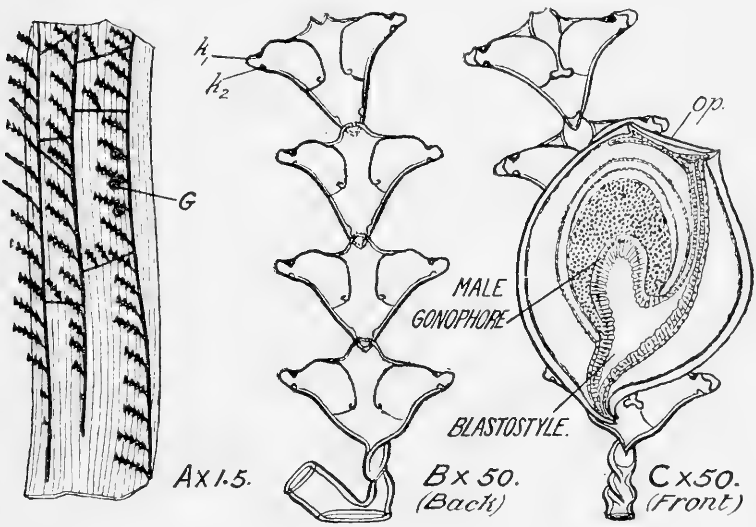
Diameter about 0·23 mm. The outer layers of the perisarc may become remarkably diffuse and swollen. The inner compact portion has a thickness of about 18 μ, and the diffuse outer portion 47 μ.

Hydrocaulus.—It consists of short upright stems divided by oblique joints into 5–6 regular internodes, each bearing a pair of opposite hydrothecæ. At the origin from the hydrorhiza the stem is spirally ridged by one or two turns.

Length of internode 0·30 mm. Width between the mouths of an opposite pair of hydrothecæ 0·48 mm.

Hydrotheca.—Tubular, divergent, mouth facing outwards and contracted. The hydrothecæ are nearly in contact in front (*C*), separate behind (*B*). Teeth lateral and very

TEXT-FIG. 9.



Sertularia linealis sp.n.

rounded and blunt, the back one being somewhat the wider. The mouth is internally constricted by perisarc; on the adcauline surface there is a deep pit on the outside, appearing as a peg on the inside (k_1); sometimes the pit may be more or less filled up with perisarc. On the abcauline inner surface there is a perisarc ridge which may be developed into one or sometimes two knobs (k_2). Two-flapped operculum.

Length of hydrotheca, measured parallel to abcauline edge, 0·211 mm.; breadth 0·163 mm.

Gonosome.—Male gonangium subglobular, smooth, with flat operculum. Blastostyle may develop two gonophores.

Length, including stalk, about 0·84 mm.; breadth 0·67 mm. Operculum 0·21 mm. in diameter. The perisarc has a thickness of 21 μ.

(19) Sertularia bidens *Bale.*

Sertularia bidens *Bale.* 'Cat. of the Australian Hydroid Zoophytes,' 1884, p. 70.

The Natal hydroid does not entirely agree with Bale's description of bidens; but the differences appear to be scarcely sufficient to warrant the formation of a new species. The colour is a very pale brown, not dark brown, and the height of the largest specimen found was only about 3 in.

Trophosome.—Hydrorhiza forms a loose feltwork. Diameter 0·172 mm., thickness of perisarc 22 μ.

Hydrocaulus.—Main stem bears pinnate stems irregularly placed (text-fig. 10, *A*). Just below the first pinna of the pinnate stem there is a conspicuous spiral groove running round the stem about twice (*C*). The portion of the stem bearing pinnæ is about half an inch in length. Pinnæ alternate. The stem is zig-zag, but the nodes are indistinguishable; between two pinnæ of one side there are three hydrothecæ, one in the axil and two above. On the pinnæ the nodes are few, the first internode carrying 4 or 5 pairs of hydrothecæ, while the remainder carry from 1 to 3.

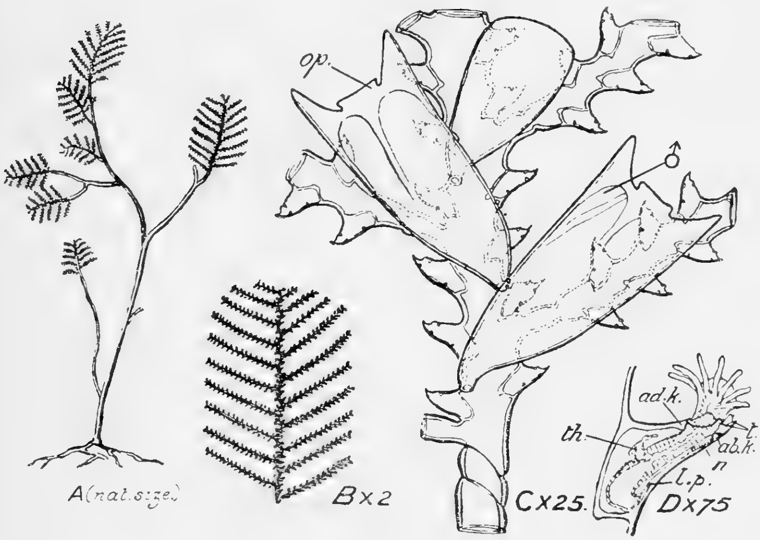
Diameter of a pinna, measured just below the base of a hydrotheca and about at the middle of its length, 0·152 mm.; thickness of perisarc, 5·1 μ.

Hydrotheca.—Subalternate, not in contact with each other, tubular, upper side horizontal, with the inner margin of the mouth rather widely separated from the hydrocaulus (text-fig. 10, *D*). Mouth horizontal, the outer margin provided with two pointed teeth (*t.*); on the inside of the inner margin there are usually developed two distinct knobs of chitin (*ad.k.*), and on the opposite side on the outer edge there are a similar pair (*ab.k.*). There is also occasionally a little peg of chitin on the outer wall a little above the base (*l.p.*).

Total length, measured parallel to the abcauline edge, 0·263 mm.; greatest breadth 0·105 mm. Operculum probably two flaps.

Hydranth.—Tentacles 13–14. The layer of ectoderm lining the hydrotheca is thickened along the outer margin (fig. D, *n.*), and it contains a row of vertically placed nematocysts,

TEXT-FIG. 10.



Sertularia bidens *Bale.*

measuring 6·6 μ in length and 1·4 μ in breadth. Nematocysts were not distinguished on the tentacles.

There is also a thickening of the hydrothecal ectoderm on the adcauline surface (D, *th.*).

GONOSOME.—Gonangia long, sub-tubular, with two sharp angles at the sides of the aperture. Aperture operculate, margin elevated and slightly everted. The gonangia originate from the stem just above the origins of the pinnæ, and they are regularly directed right and left.

Total length 1·70 mm., length of spines 0·39 mm., greatest breadth 0·59 mm.

Systematic Position.—The description of the Natal hydroid differs from that given for bidens from Australia in the following characters:

(1) The much greater size of the sharp angles of the gonangia.

(2) The relative shortness of the hydrotheca.

(3) The presence of internal knobs of perisarc near the margin of the mouth.

(4) The colony is pale brown.

Taking the characters altogether, the Natal hydroid appears somewhat intermediate between Bale's S. maplestonei and his S. bidens. The internal knobs of perisarc are not mentioned; but we know from other species that their presence or absence cannot be regarded of specific value. It is possible that the Natal hydroid, S. bidens and S. maplestonei are varieties of the same species; but a direct comparison of a series of specimens would be necessary for arriving at a definite conclusion.

(20) Pasythea quadridentata (*Ellis & Sol.*).

Sertularia quadridentata *Ellis and Sol.* 'Zooph.,' 1786, p. 57.
Pasythea quadridentata (*Ellis and Sol.*). Bale, W. M., 'Cat. of Australian Hydroid Zoophytes,' 1884, p. 112; Nutting, C.C., 'American Hydroids,' pt. ii, "The Sertularidæ," 1904, p. 75.

The hydroid grows on sea-weeds; it is yellowish-brown and about $\frac{1}{4}$ inch in height.

Trophosome.—Hydrorhiza forms a wide-meshed reticulum. It is characterised by possessing internal ribs of perisarc which project into the cavity from the vertical sides, and appear from above as pegs which extend internally for about one quarter to one third of the diameter of the hydrorhiza (text-fig. 11). The presence of these pegs renders the hydrorhiza readily distinguishable from the hydrorhizæ of other hydroids amongst which it may be living.

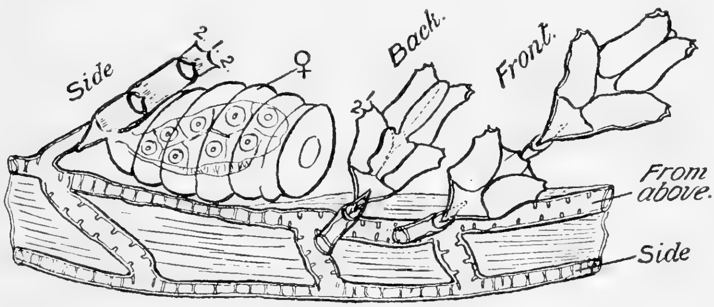
Diameter, from above, 0·121 mm.; thickness of perisarc 9 μ.

Hydrocaulus.—Consists of upright stems with no internal pegs. Divided by oblique nodes into regular internodes, bearing a pair of hydrothecæ, or two or three pairs in a closely compressed group.

Diameter of base of stem 0·081 mm., thickness of perisarc 15 μ, length of internode 0·798 mm.

Hydrotheca.—On the first internode there may be only a single opposite pair, in contact for about $\frac{1}{3}$–$\frac{1}{2}$ their height in

TEXT-FIG. 11.



Pasythea quadridentata (*Ellis and Sol*). × 30.

front, the distal part curving to a narrow tridentate mouth looking outwards. Two lateral teeth (fig. 11, 2, 2), one adcauline (1). Operculum of two flaps. Length of proximal hydrotheca, measured parallel to abcauline edge, 0·283 mm., greatest breadth 0·145 mm., thickness of perisarc 10 μ.

Hydranth.—13–15 tentacles.

GONOSOME.—Female gonangium borne at the base of the stem; ovate, with 5–6 transverse rugæ. Very broad aperture with flat operculum (text-fig. 11, ♀).

Length 0·808 mm., greatest breadth 0·412 mm.

The above description is practically the same as that given by Nutting. It is stated that "this species seems to be always found growing on floating sea-weed"; but the Natal hydroid grows plentifully on the sea-weeds of the rock-pools. It is also stated to be the rule for the lowest internode to bear only a single part of hydrothecæ; in the Natal hydroid this is the exception, as there are generally two pairs.

The presence of the characteristic pegs or ribs of perisarc extending into the hydrorhiza is not mentioned by Nutting, and it is possible that the Natal hydroid is peculiar in possessing them; and should such be the case the character is sufficient for founding a variety or even a new species.

(21) Thuiaria tubuliformis (*Marktanner-Turneretscher*).

DYNAMENA TUBULIFORMIS *Marktanner-Turneretscher*. 'Hydroid desk. k. natur. H. of Museums,' 1890, p. 238.

THUIARIA TUBULIFORMIS (*Marktanner-Turneretscher*). Nutting, C. C., 'American Hydroids,' pt. ii, "Sertulariidæ," 1904, p. 70.

This hydroid is one of the commonest on the Natal coast. It occurs on worm-tubes, and also attached to the vertical sides of rocks which are left bare during low-tide. Very probably, in deeper and quieter water, it has a more luxuriant habit; but in such positions as it has been found it rarely attains to more than an inch in height. It is of a pale yellowish-brown colour. The reproductive bodies are only rarely found.

The identification of the hydroid with T. tubuliformis has been made from Nutting's description.

TROPHOSOME.—Hydrorhiza, creeping stolon irregularly branched.

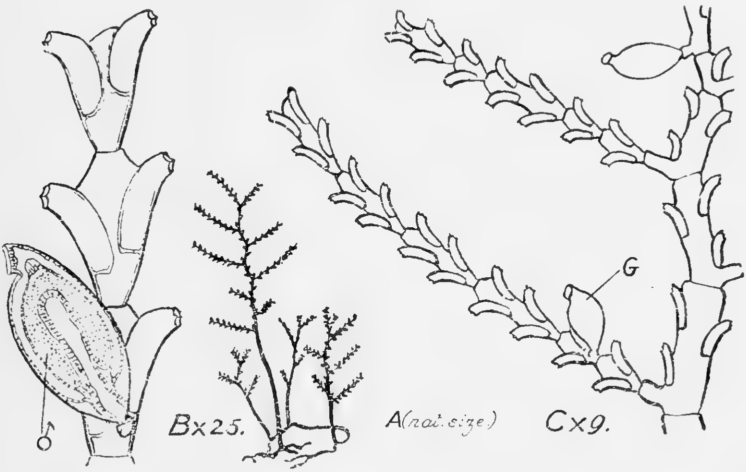
Diameter 0·263 mm., thickness of perisarc 18 μ.

Hydrocaulus.—Stems reach about 1 inch in height, ziz-zag, bearing alternating branches, divided into regular internodes, each bearing a branch and two hydrothecæ on one side, and a single hydrotheca on the other (text-fig. 12, *C*). Branches are divided into irregular internodes, and are constricted at their origins.

Diameter of main stem below the first branch 0·401 mm., thickness of perisarc 38 μ. Diameter of a branch about in the middle of its length, and measured just below a hydrothecæ and at the middle of an internode, 0·282 mm.

Hydrothecæ.—Sub-opposite, long, tubular, with the greater part of their adcauline edge parallel to the branch, and sunk in it, the upper portion being abruptly bent outwards and ending in two large, opposite, lateral teeth (text-fig. 12, *B*).

TEXT-FIG. 12.



Thuiaria tubuliformis (*M.—Turneretscher*).

Operculum two-valved. There is a distinct tendency for the hydrothecæ to arrange themselves in groups resembling those seen in Pasythea.

Length, measured parallel to abcauline edge, 0·667 mm., greatest breadth 0·182 mm.

Hydranth.—Tentacles about 19. Nematocysts at the tips of tentacles 5·2 μ in length, and 1·2 μ in breadth.

GONOSOME.—Gonangia originate from main stem or branches immediately below a hydrotheca. Ovate, with a constricted curved neck and round terminal aperture (*B*, ♂).

Greatest length 1·330 mm., and greatest breadth 0·646 mm.

Distribution.—There has been detected no character by which this hydroid can be distinguished from T. tubuliformis, described by Nutting. The distribution given is—"Dschidda (Dr. Billitzer); Bay of Bahia, Brazil (Rathbun); Florida, between Salt Pond and Stock Island (Dr. E. Palmer); Bahama Banks, 3–6 fathoms (Nutting)." The hydroid does not appear to have been described from elsewhere, and its occurrence on the coast of Natal gives to it a rather remarkable distribution.

(22) Plumularia tenuis *sp. n.*

This delicate hydroid is common on the Natal coast. It is exceedingly transparent and inconspicuous during life. It grows on sea-weeds near the low-water line, and attains a height of about $\frac{3}{4}$ inch.

Trophosome.—Hydrorhiza forms a reticulum with a strong tendency for branches to come off at right angles from the parent stolon. The perisarc may have an outer diffuse layer, nearly double the thickness of the inner compact layer.

Diameter of hydrorhiza about 0·162 mm.; thickness of perisarc, outer diffuse layer 13·3 μ, inner layer 8·9 μ.

Irregularly placed pegs of various shapes project into the cavity of the hydrorhiza from the vertical sides.

Hydrocaulus.—Stems divided by transverse joints into internodes, each of which bears a pinna on a process from its distal end. Pinnæ alternate; proximal internode very short, bearing no structures, the rest of the pinna divided by oblique nodes into hydrothecate internodes alternating with internodes bearing a nematophore only. Above and below the nodes there is an internal annulation.

Nematophores rather large, supra-calycine pair overtopping the hydrotheca, a mesial nematophore at the base of each hydrotheca, one at the proximal end of the intermediate internodes, one in the axil of the pinna and stem, and one at the basal end of each internode of main stem. Nematocysts of the nematophores, length 6·6 μ, breadth 2·5 μ.

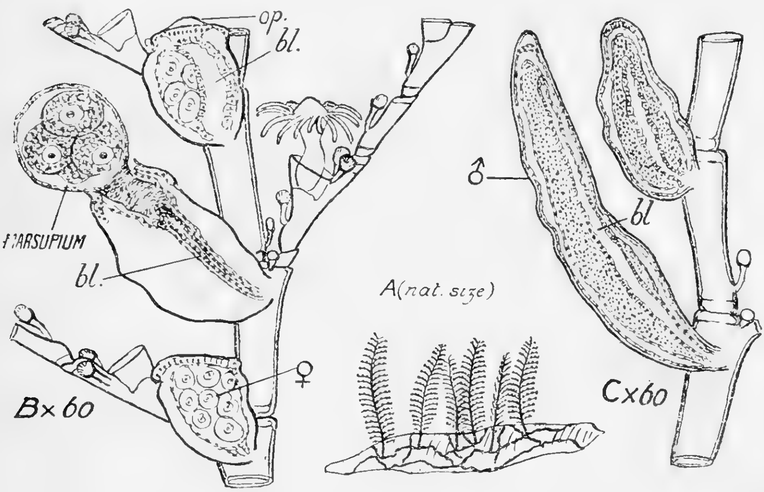
Diameter of stem, about at the middle and in the centre of an internode, 0·116 mm., thickness of perisarc 17 μ. Diameter at the middle of a pinna 0·042 mm.

Hydrotheca.—Cup-shaped, shallow, adnate by the whole adcauline surface.

Height 0·057 mm., breath 0·101 mm.

Hydranth.—18–20 tentacles. Nematocysts occur especially at the tips of the tentacles, 2·3 μ in length, and 0·7 μ in breadth.

TEXT-FIG. 13.



Plumularia tenuis *sp. n.*

GONOSOME.—The gonangia arise from the main stem, at the distal ends of the internodes just below the origins of the pinnæ. The male gonangia are very elongated, and when mature are generally ridged deeply and irregularly about the middle. The blastostyle does not form definite gonophores, but the spermatic tissue extends along its whole length (text-fig. 13, *C, bl.*).

Length of mature male gonangium about 0·827 mm., breadth 0·186 mm.

The female gonangia are more ovate; when immature they are provided with a sharply defined distal ridge and a flat or slightly convex upper surface (*op.*). The mature female gonangium is more elongated, and is irregularly ridged about the middle. As in the case of the male gonangium the blastostyle does not produce well-defined gonophores, but the ova may be seen in a cluster on one side (text-fig. 13, *B, bl.*). Ultimately the eggs or young planulæ are extruded into a kind of marsupial case, which appears to be formed by a secretion produced by the blastostyle at the base of the depression containing the egg-cluster (*B*). I am not aware that such a structure has been previously recorded among the Plumulariidæ.

Systematic Position.—This species is certainly very near to Plumularia setacea (*Ellis*) of Europe and America. The gonangia, however, appear to be sufficiently distinct to warrant the formation of a new species. The male gonangium in P. tenuis is much larger than the female, while the reverse is stated to be the case in setacea, also the occurrence of the marsupium-like structure in the female is characteristic.

(23) Antennella natalensis *sp. n.*

This exceedingly delicate hydroid grows on sea-weeds and worm-tubes. It does not appear to be very common on the Natal coast.

Trophosome.—Hydrorhiza, irregular reticulum, diameter 0·09 mm., thickness of perisarc 15 μ.

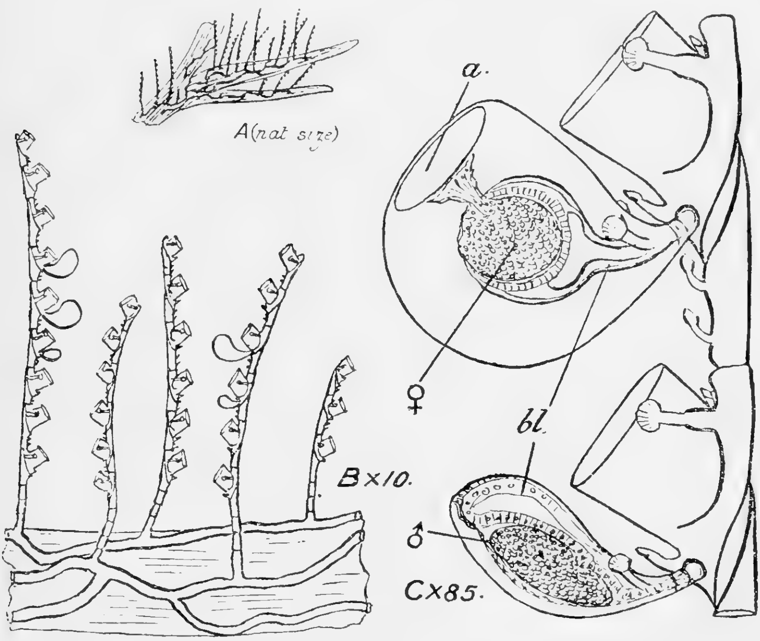
Hydrocaulus.—There is no main stem, the "pinnæ" or hydrocladia springing directly from the creeping stolon. The hydrocladia are regularly divided into internodes, alternate ones carrying hydrothecæ. The node immediately below a hydrotheca is exceedingly oblique, that above is transverse. Nematophores; a mesial one below each hydrotheca, a median nematophore with very thin-walled sarcotheca immediately above each hydrotheca, two supra-calycine nematophores borne on long processes from the internode, and two on each of the intervening internodes (text-fig. 14, *C*).

Nematocysts of the nematophores measure about 10·3 μ in length, and 4·4 μ in breadth.

Diameter about at the middle of hydrocaulus 0·068 mm., thickness of perisarc 5 μ.

Hydrotheca.—Cup-shaped, adnate to the hydrocaulus for

Text-fig. 14.



Antennella natalensis *sp. n.*

about one-third of the adcauline edge. Mouth facing outwards, its plane cutting the hydrocaulus at an angle of about 30°.

Height of hydrotheca about 0·177 mm., diameter of mouth about 0·253.

Hydranth.—About 18 tentacles; nematocysts very small; they measure about 2·4 μ in length and 0·8 μ in breadth.

Gonosome.—Both male and female gonangia may occur on the same stem.

Male gonangia ovate, spring from the internode just on one side of the mesial nematophore. The gonangium has a short jointed stalk or peduncle which is provided with two lateral nematophores (text-fig. 14, *C*, ♂).

The average size is 0·384 mm. in length and 0·253 mm. in breadth.

In the same figure a larger gonangium is seen, which is female. It would appear that the blastostyle has produced a second gonophore, since the operculum has opened, and a large, round, terminal aperture is present, through which, it is assumed, the products of the first gonophore have escaped.

Systematic Position. — This hydroid closely resembles Antennella gracilis *Allman*[1] and P. catharina *Johnston*, and especially the hydroid regarded by Hincks as a stemless variety of catharina. It agrees in having male and female gonangia on the same stem. It is, however, markedly different from catharina in the extreme obliquity of the nodes. Without an examination of a number of specimens of catharina from various localities, it is not possible to judge whether such a character should, or should not, be regarded as of specific value.

(24) Plumularia spinulosa *Bale*.

Plumularia spinulosa, *Bale*. 'Cat. of the Australian Hydroid Zoophytes,' 1884, p. 139.

This minute species has been found on one or two occasions at Park Rynie. It grows on sea-weeds or larger hydroids. About one-sixth of an inch in height.

Trophosome.—Hydrorhiza reticular; numerous pegs of perisarc project into the cavity from the vertical sides as in Pasythea.

[1] Nutting, C. C., 'American Hydroids,' Part I, "Plumularidæ,' 1900, p. 77.

Diameter 0·081 mm.; thickness of perisarc 6 μ.

Hydrocaulus.—Slender transparent stem divided into short internodes, each carrying a pinna on a process near the middle.

Pinnæ alternate, bearing a single hydrotheca; there are two internodes, a short proximal one, and a longer distal one carrying the hydrotheca and projecting beyond it as a sharp spine.

Diameter of stem, about at the middle, 0·040 mm.; thickness of perisarc 5·6 μ.

Hydrotheca.—Rounded at base, much compressed laterally, aperture at right angles to the pinna, margin somewhat everted. An intra-thecal ridge just below the aperture curves forwards and downwards nearly to the base of the hydrotheca. Nematophores bi-thalamic with slender bases, one below each hydrotheca, one at each side above it, one in each axil, and one at the lower part of each stem-internode.

Width, measured from aperture along a line parallel to the pinna, 0·113 mm.; height, measured at right angles to width measurement, 0·137 mm. Nematocysts of the nematophores, length 6·2 μ; breadth 1·5 μ.

Hydranth.—About 13 tentacles; nematocysts not distinguished.

Gonosomes.—Gonangia unknown.

Bale's hydroid was found at Queen's Cliff, S. Australia, and the Natal hydroid agrees in all respects with his description.

(25) Kirchenpaueria mirabilis (*Allman*).

Diplocheilus mirabilis, *Allman*. 'Challenger Reports.'

Kirchenpaueria mirabilis (*Allman*). Bale, W. M., "Further Notes on Australian Hydroids," 'Proc. R. S. Victoria,' 1893, p. 109.

This interesting hydroid, which in the juxtaposition of the hydrothecæ and in the absence of intervening internodes approaches the Statoplea, is quite common on the Natal coast, growing on sea-weeds and worm-tubes. It has not, however, been found in the reproductive stage.

Trophosome.—Hydrorhiza, creeping stolon irregularly branched.

Diameter 0·303 mm.; thickness of perisarc 26 μ.

Hydrocaulus.—Pinnate stems; main stem is divided into internodes by oblique joints. Each internode carries, as a rule, two pinnæ on projecting processes, one at the distal and one at the proximal end. Pinnæ alternate; consist of short internodes with oblique nodes; each internode bears a hydrotheca. Nematophores, one median above and one median below each hydrotheca, and one on the main stem in the axil of the pinna (text-fig. 15, *B*), and generally one on the front face of the internodes of the main stem at the distal ends in the middle line. The sarcotheca is very rudimentary. The sarcostyle above the hydrotheca is lodged in a depression with a delicate film of perisarc on each side; below the hydrotheca it lies in a kind of trough of perisarc (figs. *B* and *C*).

Nematocysts, length 13·4 μ, breadth 6·8 μ.

Diameter, about at the middle of main stem, 0·223 mm.; thickness of perisarc 18 μ.

Hydrotheca.—Distal portion curved towards the main stem; mouth circular, its plane cutting the pinna at an angle of about 30°. Abcauline wall deeply inflected, forming an intra-thecal ridge which extends half way across the cavity of the cell. This ridge is not completely filled in with solid perisarc as Bale describes in his account of the Australian specimen (*C*).

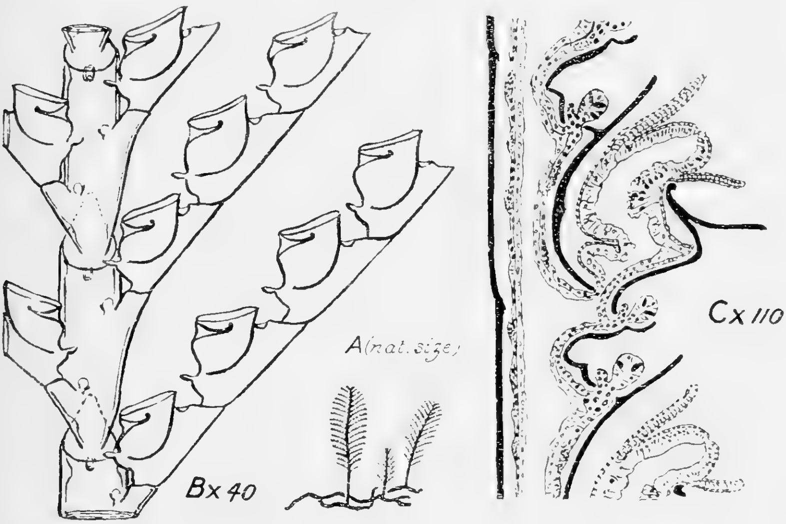
Diameter of mouth, measured in the plane of the long axis of the pinna, 0·222 mm.; height, measured at right angles to the plane of the mouth, 0·212 mm.

Hydranth.—About 18 tentacles.

Gonosome.—Not found, but described by Bale for the Australian specimens in the following terms: "Gonangia large, free, with rounded summit, and irregular, wide, transverse undulations; no distinct marginal ring or operculum; sporosacs, two."

SYSTEMATIC POSITION.—In the unjointed condition of the sarcothecæ, and in the absence of intervening internodes without hydrothecæ, the present hydroid diverges widely from the typical Eleutheroplea, and shows affinities with the Statoplea.

TEXT-FIG. 15.



Kirchenpaueria mirabilis *Allman.*

The Natal hydroid can scarcely be separated from Allman's Kirchenpaueria mirabilis, although the inflected wall of the hydrotheca leaves a sinus which is not filled up with homogeneous perisarc. In the absence of the gonophore, however, this determination cannot be more than provisional.

(26) Paragattya intermedia *g. e. sp. n.* (Pl. XLVII, fig. 27.)

This remarkable hydroid is somewhat common on the Natal coast, and it occurs on coralline and other sea-weeds. It is brown in colour and reaches a height of about one-quarter of an inch. The hydroid is interesting in a number of ways; it exhibits characters strikingly intermediate between those of the Eleutheroplea and the Statoplea, also, the same stem frequently bears both male and female gonangia, and when such is the case the male appear to be invariably placed at the distal end of the series.

Trophosome.—The hydrorhiza may form a very close meshwork; sometimes it is so close that there are practically no meshes and the whole constitutes a sheet composed of vermiform tubes more or less coalesced.

Average diameter 0·127 mm., thickness of perisarc 14 μ.

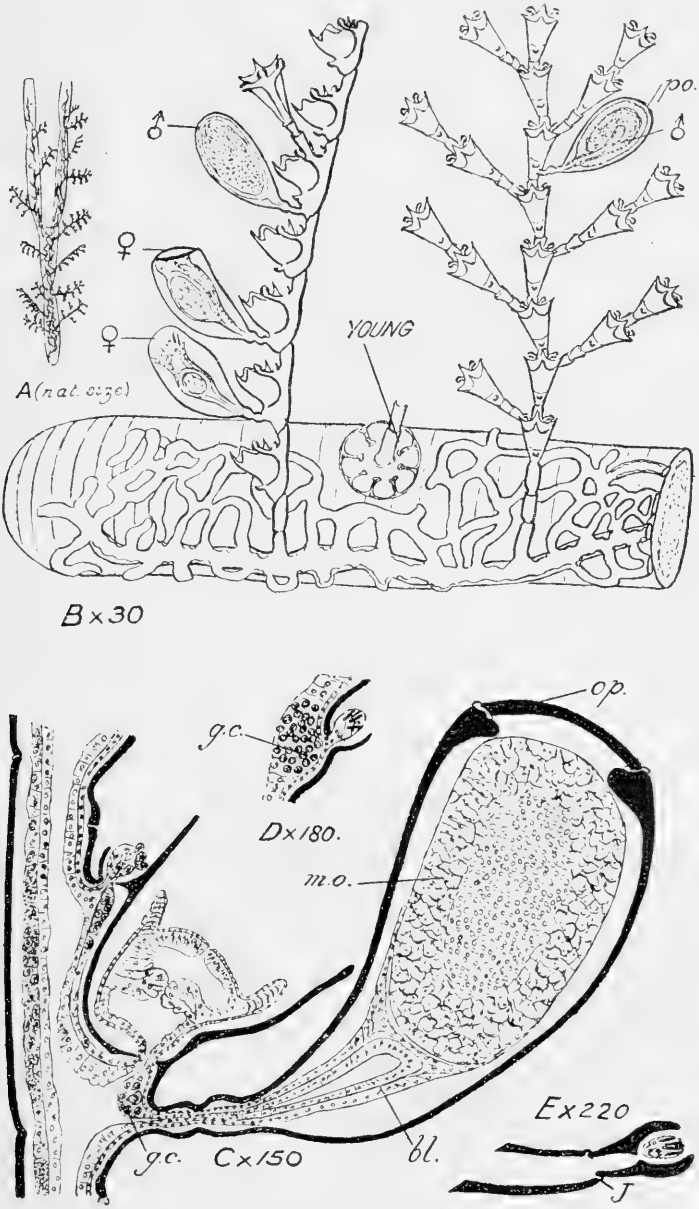
The hydrorhiza is frequently found attached to the same species of coralline alga as that which is so frequently attacked by a hydroid about to be described (Aglaophenia parasitica). This latter species sends suckers into the substance of the alga; but such is not the case with Paragattya intermedia, which, nevertheless, can fasten itself firmly to the smooth, hard surface of the coralline.

Hydrocaulus.—Pinnate stems spring from the hydrorhiza. The main stem consists of 2–5 basal joints, and above them it is divided into regular internodes by oblique nodes, and each bears a hydrotheca. It is somewhat zig-zag. The pinnæ are alternate, each internode of the main stem bearing one lateral branch, which springs from the process carrying the supracalycine nematophores (Pl. XLVII, fig. 27, *b*.). The two proximal internodes of a pinna carry no hydrothecæ; the remainder, of which there are generally only two or three, resemble those of the main stem.

Nematophores; one above (text-fig. 16, *C*) and one below (*D*) each hydrotheca in the middle-line, and two lateral or supracalycine nematophores (*E*).

The sarcostyle below the hydrotheca is lodged in a short trough-like sarcotheca; the one above the hydrotheca is contained in a fairly stout cup-shaped sarcotheca. The two lateral nematophores are set on processes from the distal ends of the stem-internodes, and they are distinctly jointed at their

TEXT-FIG. 16.



Paragattya intermedia *g. e. sp. n.*

place of origin (Pl. XLVII, fig. 27, and text-fig. 16 *E.*, *J*). The pinnæ or lateral branches spring from these processes.

Diameter of main stem, about at the middle of its length, 0·091 mm.; thickness of perisarc 17 μ.

Diameter of pinna in the middle 0·065 mm.; thickness of perisarc 10 μ. Nematocysts, 10·6 μ in length, 2·6 μ in breadth.

Hydrothecæ.—They occur on all the distal internodes of the main stem, and on all the internodes of the pinnæ, except on the short basal pair; there are no intervening internodes without hydrothecæ. The hydrothecæ are so inserted on the pinnæ that they face directly forwards (*B*), and not upwards as is generally the case in the Eleutheroplea.

The margin of the mouth is deeply notched or toothed. There are normally four teeth, a median back and front tooth, and two lateral. In one or two cases two pairs of lateral teeth have been seen (Pl. XLVII, fig. 27, 2 *a*); but the condition should probably be regarded as a freak, as there was no general tendency throughout the shoot for the development of six teeth.

This indented margin recalls the Statoplea rather than the Eleutheroplea.

The hydrothecæ measure 0·192 mm. in height, and 0·181 mm. in width.

Hydranth.—About 14 tentacles.

Gonosome.—The gonangia occur on the main stem; they arise laterally by the side of the mesial nematophore below the hydrotheca. A mass of germinal cells may generally be found in the endoderm just beneath a hydrotheca (text-fig. 16, *C* and *D*, *g.c.*).

Female gonangium ovate and provided with a large operculum (*C*, *op.*); the peduncle is transversely ridged and fairly long. One or more large eggs are carried on the side of the blastostyle and become pushed into an apical position (text-fig. 16, *C*, *m.o.*), and there segmentation takes place, and large planulæ are formed. The planula escapes, settles down and develops the usual rosette-structure (*B*, *young*).

Length 0·510 mm., breadth 0·223 mm.

Male: the general shape of the gonangium is the same as that of the female, it is provided with an apical pore (*B, po.*) in place of the large operculum; the spermatic tissue is carried on one side of the blastostyle without the formation of a well-defined gonophore.

Length 0·485 mm., breadth 0·223 mm.

As above remarked, both male and female gonangia arise on the same main stem; it is interesting to note that at the distal end of the stem, where the male gonangia occur, the accumulation of nutritive substances common to the colony must be in less quantity than lower down, where the female gonangia are found. It is conjectured that the determining cause of the observed arrangement of the male and female elements is the relative nutritive supply at the distal and proximal portions of the stem.

Systematic Position.—The present hydroid comes fairly near to Gattya humilis *Allman*,[1] with an unknown locality (possibly from the Cape). The former resembles the latter in the toothed margin of the hydrotheca, and in the jointed condition of the lateral nematophores; it differs from it in having a definite pinnate series of lateral branches, in the presence of a median nematophore above the hydrotheca, and in the general shape of the sarcothecæ.

Paragattya intermedia exhibits a remarkable mixture of characters typical of the Eleutheroplea and Statoplea.

The characters which it shares with the Eleutheroplea are:

(1) Presence of median nematophore above hydrotheca, seen also in Antennella natalensis, and in the aberrant Kirchenpaueria mirabilis.

(2) Lateral nematophores carried on processes from the stem and jointed, bi-thalamic.

(3) Mesial nematophore below hydrotheca not adnate to hydrotheca.

The characters which it shares with the Statoplea are:

[1] Allman, G. J., "Description of Australian, Cape, and other Hydroida," 'Linn. Soc. Journ. Zool.,' vol. xix, 1885, p. 156.

(1) Absence of intervening internodes not bearing hydrothecæ; seen also in the aberrant Kirchenpaueria.

(2) Hydrothecæ face towards the front, instead of being placed along the upper edge of the lateral branches.

(3) Toothed margin of the hydrotheca.

(4) The median nematophores above and below the hydrotheca are fixed; seen also in Kirchenpaueria.

(27) Halicornaria segmentata *sp. n.* (Pl. XLVIII, figs. 33–36.)

This hydroid grows in an arborescent manner; it is of a dark brown or black colour, and reaches a height of about 3 inches. Only one specimen has been found; it was attached to the surface of the rock at the bottom of a deep pool at some distance above the low-tide line.

Trophosome.—Hydrorhiza forms a felt-work on the surface of the rock, diameter very variable, average about 0·24 mm., thickness of perisarc about 32 μ.

Hydrocaulus.—Main stem shows a tendency to be fascicled, especially towards the base, where lateral tubes are given off, which grow downwards in contact with the parent stem, and on arriving at the base branch out into an ordinary hydrorhiza; irregularly branched with pinnate stems. The pinnate stems are faintly marked into internodes by indistinct nodes. Pinnæ alternate, and sharply divided into internodes by oblique nodes; on the posterior face of the pinnæ the internodes are prolonged forwards into a sharp ridge, which on side view makes the pinna very obviously segmented (Pl. XLVIII, fig. 33).

Nematophores: The mesial nematophore long and broad, adnate to the hydrotheca nearly to the marginal spine (fig. 33, *spi.*). Lateral or supra-calycine nematophores large and cylindrical. The pinnate stems are provided with cup-shaped nematophores, somewhat irregularly placed; there appear to be usually three around the base of the pinna, and there are also a certain number on the stem below the proximal pinnæ.

Nematocysts from mesial nematophore 45 μ in length, and 6·2 μ in breadth.

Diameter of main stem 0·50 mm., diameter of branch 0·263 mm., thickness of perisarc 34 μ, diameter in the region of the pinnæ 0·152 mm., diameter of pinna, front view, 0·071 mm., side view, 0·121 mm.

Hydrotheca.—Laterally compressed (fig. 34), viewed from the side ventricose (fig. 33). Margin with a broad angular lobe on each side, and a curved, spine-like tooth in front (*spi.*). Intra-thecal ridge situated low down towards the base.

Viewed from the side, height of hydrotheca 0·202 mm., width 0·223 mm. Viewed from the front, diameter of mouth 0·182 mm., diameter at the middle 0·131 mm.

Hydranth.—About 12–13 tentacles.

Gonosome.—Not known.

Histology.—The mesial nematophore in longitudinal vertical section is shown in Pl. XLVIII, fig. 35. A well-developed battery of nematocysts (*B.n.*) is present. At the base there is an aperture in the perisarc (figs. 33 and 34, *o.s.*) through which a sarcostyle (*s.*), without a sarcotheca, protrudes. At the base of this sarcostyle there can generally be found a large cell (*c.g.*) filled with very large refringent globules which have the general appearance of yolk. Similar cells can also be found in the general tissue of the cœnosarc.

The hydroid is characterised by its dark colour. The colour is due to the presence of cells containing numerous small globules of dark refringent substance (figs. 35 and 36, *c.p.*). These cells occur both in the ectoderm and endoderm (*ect.*, *end.*). In the case of S. loculosa, in addition to the black form, a colourless condition occurs. It is possible that such is also the case in H. segmentata.

Systematic Position.—The present hydroid is undoubtedly closely allied to Halicornaria mitrata *Allman*,[1] of un-

[1] Allman, G. J., "Description of Australian, Cape, and other Hydroida," 'Linn. Soc. Journ. Zool.,' vol. xix, 1885, p. 153.

known locality, and it is only with hesitation that I have separated them. The chief difference is the presence in the former of a forwardly-directed prolongation of the edge of the internode at the back of the pinna. This, in side view, gives the strongly marked segmented appearance to which the hydroid owes its specific name. Also, in segmentata the median spine at the front margin of the hydrotheca is relatively shorter than in mitrata, and the outline of the margin, although similar, does not appear to be identical in the two hydroids. The colour of mitrata is not stated.

Without, however, studying a series of specimens, it is not possible to judge with any certainty whether these differences are of specific value.

(28) Aglaophenia chalarocarpa *Allman.*

Aglaophenia chalarocarpa *Allman.* "Description of Australian, Cape, and other Hydroida," 'Linn. Soc. Journ. Zool.,' vol. xix, 1885, p. 150.

This is a very common hydroid and has been found in most of the localities that have been searched. It grows in clumps on sea-weeds and sponges, etc., and is of a pale straw colour. It may grow to the height of about one inch, but sometimes shoots with corbulæ do not attain a height of more than one-quarter of an inch.

It appears to agree with the Cape hydroid described by Allman.

Trophosome.—Hydrorhiza, creeping, irregularly branched, sometimes forming a loose reticulum. Diameter about 0·182 mm., thickness of perisarc 35 μ.

Hydrocaulus.—Simple pinnate shoots with stems of variable length. Sometimes the portion bearing the pinnæ is separated from the stalk by a very conspicuous oblique joint. The portion bearing the pinnæ is divided into regular internodes by transverse joints. Pinnæ alternate, carried on a process of the stem-internode placed rather above the middle. Pinnæ divided into regular internodes by transverse nodes.

Nematophores: mesial nematophore adnate to about three fourths of the height of the hydrotheca, and then terminating in a free portion which does not extend beyond the level of the hydrotheca margin; lateral nematophores strong, cylindrical, generally reaching the level of the hydrotheca margin. On the stem at the base of the pinnæ there are three cup-shaped nematophores, one on the process, one above, and one below it. The stem below the pinnate portion may bear an irregular number of nematophores.

Nematocysts of mesial nematophore about 15·5 μ in length and 2·5 μ in breadth.

Diameter of stem below pinnate portion 0·178 mm., thickness of perisarc 24·2 μ, diameter in the middle of the pinnate portion 0·152 mm., length of stem-internode 0·237 mm.

Diameter of hydrocaulus of pinna from the side 0·071 mm., from the front 0·064 mm.; thickness of perisarc 8 μ; length of internode of pinna 0·241 mm.

Hydrotheca.—Rather wide; margin with nine teeth, four lateral, one median; intra-thecal ridge distinct, situated at about one-quarter of the height of the hydrotheca from the base.

Measured from the side, height 0·174 mm., width 0·122 mm.; from the front, breadth at the middle 0·110 mm., diameter of mouth 0·155 mm.

Hydranth.—Tentacles muricated, about 11 or 12.

Gonosome.—Male corbula short, with about eight pairs of leaflets which are but slightly adherent to one another. The leaflets bear cylindrical nematophores along both edges. The rachis bears two rows of gonangia; the peduncle carries one hydrotheca.

Length of mature corbula about 1·92 mm., depth about 0·869 mm., width from above 0·687 mm.

(29) Aglaophenia parasitica *sp. n.* (Pl. XLVIII, figs. 28–32.)

This hydroid occurs very abundantly at Scottburgh among the large masses of red coralline sea-weed. It is of a dark brown colour, and the pinnate stems reach a height of about 1 inch.

Trophosome.—Hydrorhiza is a creeping stolon sparingly branched, it grows on the surface of the coralline weed, into which it sends suckers.

Diameter about 0·25 mm., thickness of perisarc 30 μ.

Hydrocaulus.—Simple pinnate shoots; the basal portion without pinnæ is short, and proximally is transversely jointed, while distally there may be two or three oblique joints. The portion bearing pinnæ is divided into regular short internodes by transverse or slightly oblique joints, each joint bearing a pinna on a short thick process. Pinnæ alternate, divided into internodes by transverse nodes.

Nematophores: mesial nematophore long and cylindrical, adnate for about half its length to the hydrotheca (Pl. XLVIII, fig. 28 *m.n.*), widely separated from the margin of the hydrotheca, and approximating to a horizontal position; lateral nematophores rather short, cylindrical, and extending to about the level of the margin; cauline nematophores cup-shaped, three in number, situated at the base of the pinnæ (text-fig. 17, *B*).

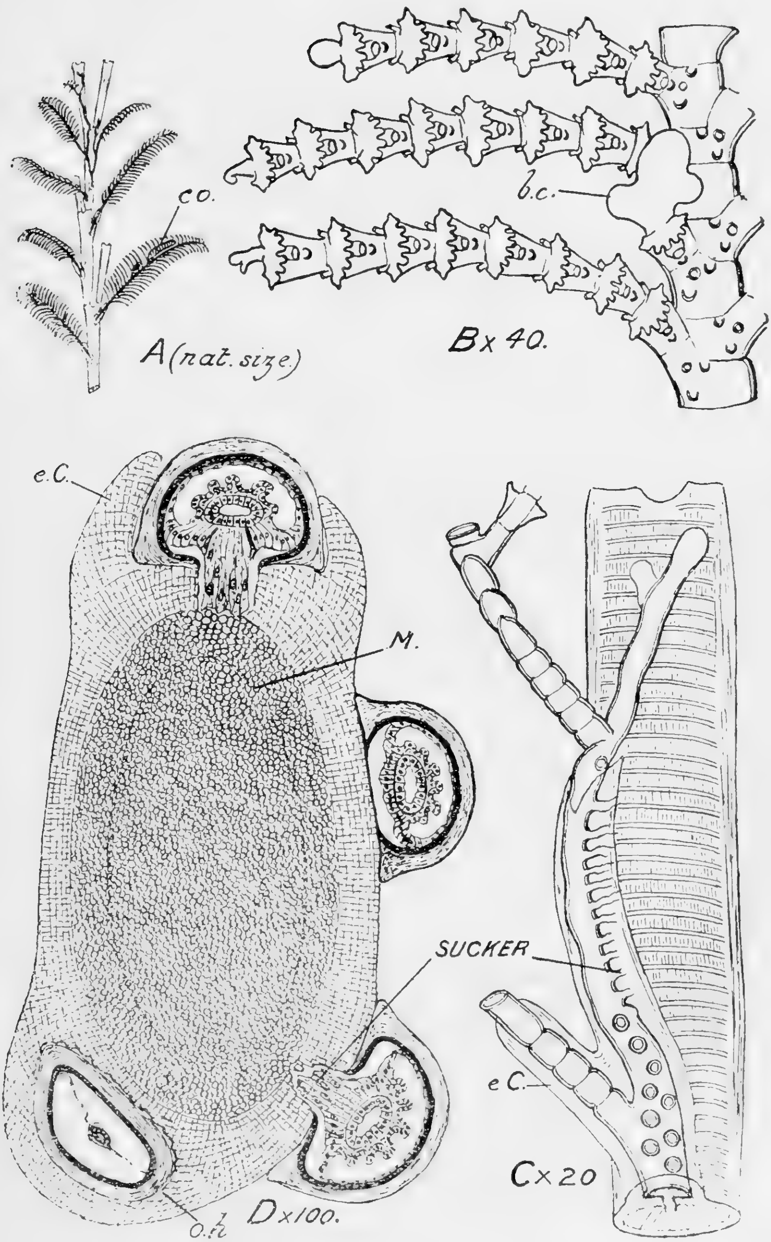
Nematocysts of mesial nematophore about 12·4 μ in length and 3·1 μ in breadth.

Diameter of stem below pinnate portion 0·23 mm., thickness of perisarc 48 μ; diameter in the middle of the pinnate portion 0·21 mm., length of stem-internode 0·182 mm.

Diameter of hydrocaulus of pinna from the side 0·113 mm., from the front 0·081 mm., thickness of perisarc 16 μ, length of internode of pinna 0·212 mm.

Hydrotheca.—Distal portion and mouth wide, proximal portion rather narrow. Margin provided with thirteen teeth, one median and six lateral; the third and fifth point inwards, and the second and fourth point outwards (fig. 29); the

TEXT-FIG. 17.



Aglaophenia parasitica *sp. n.*

median one is nearly vertical. The hydrotheca possesses a very long conspicuous spine (figs. 28, 29, *spi.*), which is curved upwards. The intra-thecal ridge is not very strongly developed; it occurs rather below the middle of the hydrotheca.

Measured from the side, height 0·226 mm., breadth 0·166 mm.; from the front, breadth at the middle, 0·123 mm.; diameter of mouth 0·253 mm. Length of spine (*i. e.* length of the arc) 0·166 mm.

Hydranth.—10–12 tentacles.

Gonosome.—Male and female corbulæ occur on different shoots and probably on different colonies; they differ considerably in shape, the male being much longer and thinner. The female corbula consists of about nine pairs of leaflets (fig. 31), which fuse together into a continuous sheet by their inner margins. The outer margins are provided with a close-set row of cylindrical nematophores. From the base of each leaflet there arises a lateral leaflet with a row of nematophores along each edge. The rhachis is divided into regular internodes. The gonangia are arranged in a single row.

In the male corbula there may be 13–15 leaflets (fig. 30); the lateral leaflets are relatively shorter than in the female, and almost disappear at the distal end.

Looked at from above the leaflets of the male corbula are less closely united together by a web than in the case of the female corbula; and this observation agrees with that of Torrey and Martin,[1] to the effect that a sexual dimorphism is exhibited in Aglaophenia by the male corbula being more or less open above, owing to the incomplete fusion of contiguous leaflets at their tips.

The peduncles of the corbulæ carry two hydrothecæ.

Length of female corbula 3–4 mm., depth 1·11 mm., width from above 0·82 mm.

Length of male 4–5 mm., depth 0·75 mm., width from above 0·71 mm.

[1] Torrey, H. B., and Martin, Ann, "Sexual Dimorphism in Aglaophenia," University of California Publications, 'Zoology,' vol. iii, No. 4, 1906, p. 50.

SYSTEMATIC POSITION.—The present species is rather close to Aglaophenia gracillima *Fewkes,* from Martinique (96 fathoms), and described and figured by Professor Nutting.[1] The general character of the hydrotheca strongly resembles that of parasitica; also, the corbula is described as being very long, and having expanded truncated processes springing from the base of the leaflets with a row of nematophores situated on the top. These "truncated processes" are undoubtedly homologous with the lateral leaflets above described in parasitica.

The parasitic habit.—This species is especially interesting on account of its close association with the coralline seaweed to which it is attached. The hydrorhiza creeps on the surface of the alga (text-fig. 17, *C*), and at some little distance behind the growing point of the stolon, sucker-like outgrowths are produced, which grow down into the tissue of the alga. These suckers are shown in section in fig. *D*, and also in Pl. XLVIII, fig. 32. The sucker is composed of a modified clump of ectoderm cells, which have become exceedingly elongated. The perisarc of the hydrorhiza is divided into an outer (p_1) and inner layer (p_2), and neither of these layers are generally continued down for any distance into the pit formed by the sucker, although occasionally such may be the case. Usually there are two rows of suckers on the under surface of the hydrorhiza (fig. *C*).

In fig. 32 of the plate it can be seen that the elongated, modified, ectoderm cells of the sucker are very granular, and they are shown perforating (*p.c.*) and entering the cells of the alga. Generally the sucker stretches down through the cortex (*C*) to the medulla (*M*) of the alga, and here the sucker-cells appear to retain a direct contact with the lining tissue of the alga without a layer of perisarc being formed. It is extremely probable that the hydroid extracts substances of use to it from the alga, and that the numerous suckers are not merely for

[1] Nutting, C. C., 'American Hydroids,' Part I, "The Plumulariidæ," 1900, p. 103.

the purpose of firmly fastening the hydroid to a support. If the suckers were for the sake of anchoring the hydroid, the purpose would be much more effectively acccomplished by the pits being lined by perisarc, but as a rule there is no perisarc towards the base of the pit.

In the immediate neighbourhood of the sucker, both in the ectoderm and endoderm, large rounded cells (fig. 32, *y.c.*) filled with yolk-like globules are found. It is possible that these represent the nutritive substances obtained from the alga. The tissue of the alga is very hard, being thoroughly impregnated with calcium carbonate, but the sucker can, in some way, eat into it. The tissue of the alga around the suckers is curiously stained for some depth, indicating that some substances are secreted by the hydroid and passed into the plant; perhaps some acid for dissolving the calcium carbonate is formed.

The cross-section of the cœnosarc shows an endodermal tube (*cœ.*), above which is a crumpled layer of ectoderm (*ect.*), from the edges of which a sheet of ectoderm passes round in contact with the perisarc (*e.s.*) and leaves a distinct cavity (*ec.c.*). In the spaces below the crumpled ectoderm (*ect.*) numerous loose granules (*gr.*) may often be seen.

The response of the plant to the stimulus, due to the penetration of the suckers, is an attempt to envelop the hydrorhiza and pinnate stems; the cortex of the alga grows up around them (text-fig. 17, *C* and *D*, *e.C.*), and may ultimately completely surround the hydrorhiza, as at *o.h.*

It would appear that the complete envelopment of the hydrorhiza by the tissues of the alga acts prejudiciously on the cœnosarc, since the ectoderm is found to have dwindled almost entirely away, and the endoderm tube is reduced to the smallest dimensions (vide fig. *D*, *o.h.*).

There is thus a struggle between the plant and the hydroid; the host attempts to smother the parasite by growing over it, and the spread of the hydroid must be considerably checked thereby.

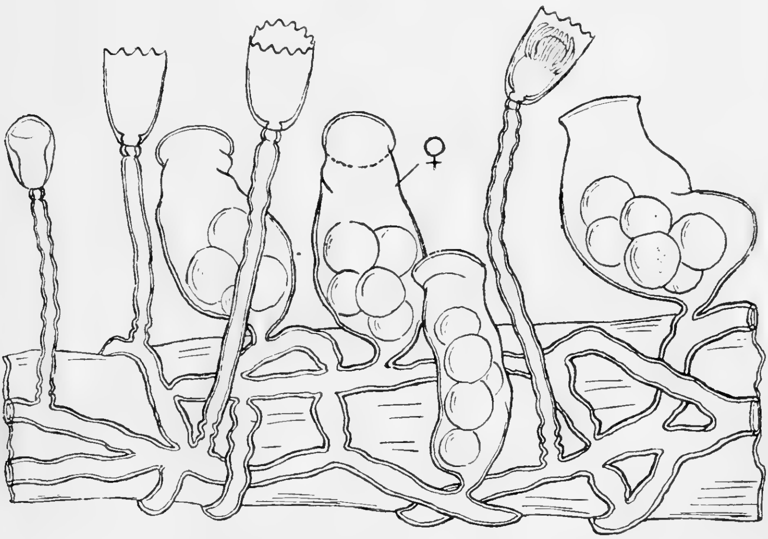
(30) Campanularia tincta *Hincks*.

CAMPANULARIA TINCTA *Hincks*. 'Ann. Nat. Hist.' April, 1861; Bale, W. M., 'Cat. of the Australian Hydroid Zoophytes,' 1884, p. 57.

This hydroid grows on sea-weeds and larger hydroids.

TROPHOSOME.—Hydrorhiza forms a reticulum.

TEXT-FIG. 18.



Campanularia tincta *Hincks*. × 30.

Diameter, 0·12 mm.; thickness of perisarc, 19 μ.

Hydrocaulus.—Simple upright stems, variable in height, with single terminal hydrotheca, wavy outline. Small, somewhat compressed spherule immediately below the base of the hydrotheca with a slightly smaller diameter than that of the stem.

Length of stem varies from about 0·4 mm. to 1·8 mm.; diameter 0·071 mm., thickness of perisarc 9·7 μ.

Hydrotheca.—Large, tubular, and sometimes slightly expanding; 10–12 crenations around the margin. Diaphragm close to base.

Length of hydrotheca about 0·47 mm., diameter at mouth 0·30 mm. Distance of upper edge of diaphragm from base 0·035 mm., diameter of opening in diaphragm 0·077 mm.

Hydranth.—About 25 tentacles. Nematocysts on tentacles, length about 5·2 μ and breadth 1·8 μ.

Gonosome.—Gonangia large, very variable in shape, subcordate to elongated and cylindrical; short peduncle.

Upper surface flat or slightly convex, edge somewhat everted.

Cylindrical form, length 0·95 mm., breadth 0·42 mm., diameter of flat opercular surface 0·32 mm. Subcordate form, length 0·82 mm., breadth 0·63 mm.

Systematic Position.—Compared with the Australian specimens the Natal hydroid tends to be small, and the length of the hydrotheca is shorter, but taking into account the highly variable nature of this species there appeared no sufficient reason to separate it.

(31) Campanularia caliculata *Hincks.*

Campanularia caliculata *Hincks.* 'A History of the British Hydr. Zoophytes,' 1868, p. 164; Bale, W. M., 'Proc. Linn. Soc. N. S. Wales,' vol. iii, 1888, p. 755.

Grows on sea-weeds and larger hydroids. As in the case of C. tincta the Natal specimens are smaller than those described by Bale from Australia.

Trophosome.—Hydrorhiza forms a reticulum.

Diameter 0·137 mm., thickness of perisarc 24 μ.

Hydrocaulus.—Simple stems of variable length, annulated, small spherule below the hydrotheca.

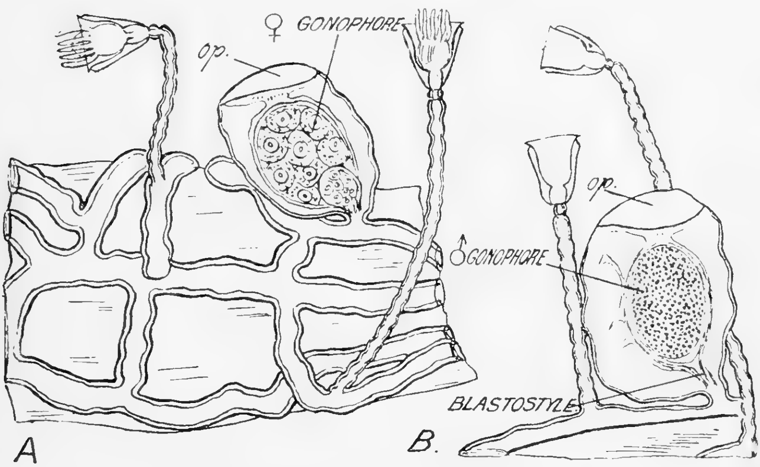
Length of stem varies from about 0·7 mm. to 2 mm., diameter 0·070 mm., thickness of perisarc 0·010 mm., diameter of spherule 0·051 mm.

Hydrotheca.—Cup-shaped and expanding; perisarc much thickened except along the margin, where an internal layer projects and is slightly everted. Diaphragm is separated somewhat widely from the base.

Length of hydrotheca about 0·251 mm., diameter at mouth 0·239 mm., thickness of perisarc 17 μ. Distance of upper edge of diaphragm from base 0·049 mm., diameter of opening in diaphragm 0·036 mm.

Hydranth.—Tentacles 25–28, muricated. Nematocysts, length about 4 μ, breadth about 1·7 μ.

TEXT-FIG. 19.



Campanularia caliculata *Hincks.* × 30.

GONOSOME.—Gonangium ovate, with a short peduncle and a wide convex operculum. Male and female similar in shape. The blastostyle of the female gonangium bears one or two gonophores (text-fig. 19, *A*).

Length of gonangium about 0·77 mm., and width 0·53 mm.

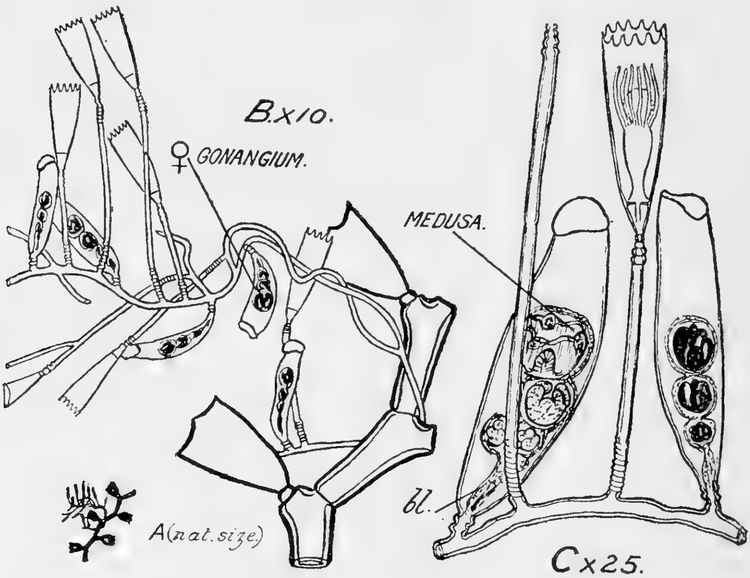
(32) Clytia elongata *sp. n.*

Only one specimen of this hydroid has been found; it occurred clinging to a species of Thyroscyphus dredged from a depth of forty fathoms in the neighbourhood of Bird Island, Algoa Bay.

Trophosome.—The hydrorhiza is apparently a creeping stolon from which simple stems and gonangia arise (text-fig. 20). In the specimen the hydrorhiza was not firmly attached to the Thyroscyphus along its whole length.

Diameter of stolon about 0·10 mm., thickness of perisarc 7·9 μ.

Text-fig. 20.



Clytia elongata *sp. n.*

Hydrocaulus.—Simple stems of variable height. At their origin from the stolon they are annulated with 9–12 rings, at the distal end there are 3–5 rings, and there is a terminal small spherule which is very variable in size; sometimes it is exceptionally small (0·05 mm. in diameter).

Height of stem 1·5–3 mm., diameter 0·092 mm., thickness of perisarc 8·9 μ.

Hydrotheca.—Long, cylindrical, sometimes expanding; margin with about twelve sharp teeth.

Length about 1·10 mm., greatest breadth 0·34 mm., height of teeth about 0·08 mm. Distance of upper edge of diaphragm from base 0·119 mm., diameter of opening in diaphragm 0·017 mm., diameter of diaphragm 0·128 mm.

Hydranth.—About 14–16 tentacles; nematocysts 4·6 μ in length and 1·4 μ in breadth.

Gonosome.—Gonangia long and cylindrical, arising from the stolon by short peduncles with 2–4 annulations. Opercular surface flat.

Length of gonangium 1·50 mm., breadth 0·31 mm., diameter of operculum 0·26 mm., length of peduncle about 0·32 mm.

Free-swimming medusæ are undoubtedly formed, and stages in their development can be observed in the various gonangia on the colony. It is not, however, possible with the available material to describe the general character of the medusa.

(33) Lafœa scandens *Bale.*

Lafœa scandens *Bale.* 'Proc. Linn. Soc. N. S. Wales,' vol. iii, 1888, p. 758, pl. xiii, figs. 16–19.

This hydroid has been found on two occasions growing on Thuiaria tubuliformis. The gonangium has not been seen, but the trophosome of the Natal hydroid does not appear to be separable from that of scandens from Port Stephens and Port Jackson, E. Australia, described by Bale.

Trophosome.—The hydrorhiza is a stolon creeping on the back of the hydrocaulus of the sertularian. Sometimes the stolon shows a tendency to be jointed.

Diameter 0·109 mm., thickness of perisarc 3·3 μ.

Hydrocaulus.—As distinct from the creeping stolon, it is represented merely by the pedicel of the hydrothecæ. This pedicel may or may not be jointed into two.

Diameter 0·067 mm., length 0·092 mm.; when jointed, proximal joint, 0·039 mm., distal joint 0·054.

Hydrothecæ.—Tubular, long, straight or slightly curved, margin somewhat everted. The hydrothecæ generally alternate right and left with the hydrothecæ of the sertularian.

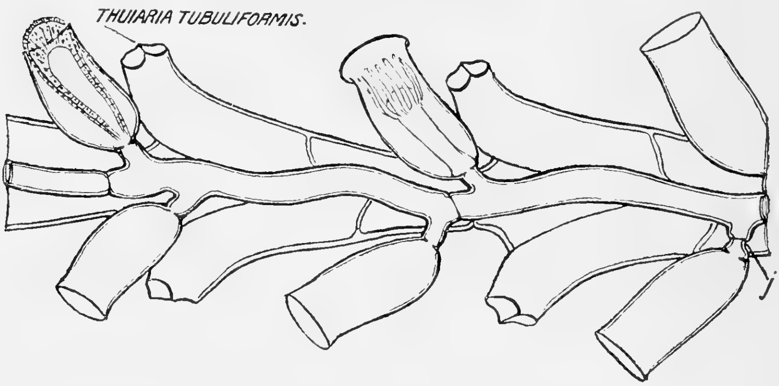
Length 0·48 mm., greatest breadth 0·22 mm. Diaphragm, diameter 0·075 mm., aperture 0·035 mm.

Hydranth.—About 13 tentacles. Nematocysts 4·1 μ in length, 1·2 μ in breadth.

In the figure given by Bale all the pedicels are jointed, whereas in the Natal hydroid the general rule is for the pedicels to be quite unjointed.

Gonosome.—Not found. The description given by Bale for the Australian hydroid is as follows: "Gonangia about double the length and diameter of the hydrothecæ, tapering down-

Text-fig. 21.



Lafœa scandens *Bale.* × 40.

wards in the lower half, with more or less distinct transverse undulations; margin with three or four shallow emarginations; summit of the blastostyle forming a trumpet-shaped expansion; gonophores two, both on the same sides of the blastostyle."

(34) Lafœa magna, *sp. n.*

This hydroid was found on sea-weeds and on larger hydroids. It occurred on a specimen of Thyroscyphus from Bird Island, Algoa Bay, on Aglaophenia segmentata from Park Rynie, also on sea-weeds from other parts of the Natal coast. The trophosome has some resemblance to that of Lafœa cylindrica *von Lendenfeld,*[1] from Bay of Islands, New Zealand; but the pedicel is much longer in the Natal hydroid.

TROPHOSOME.—The hydrorhiza is a creeping stolon.

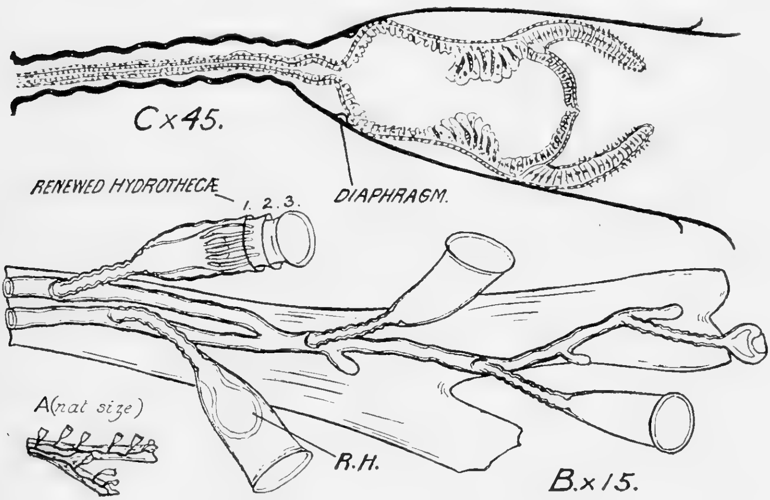
Diameter 0·15 mm., thickness of perisarc 12 μ.

Hydrocaulus.—Simple annulated stems of variable length (0·4–1·4 mm.).

Diameter about 0·14 mm., thickness of perisarc 18 μ.

Hydrotheca.—Tubular, straight or expanding, strongly

TEXT-FIG. 22.



Lafœa magna *sp. n.*

everted margin. Two or three renewed margins may sometimes be seen, marking the same number of regenerations of the polyp (text-fig. 22, *B* 1, 2, 3).

Height about 1·3 mm.; diameter, about at the middle, 0·58 mm.; diameter of mouth, 0·707 mm.; diameter in region of diaphragm, 0·282 mm.; diameter of aperture of diaphragm, 0·152 mm.

Hydranth.—About 22 tentacles; nematocysts, 7·0 μ in length, and 2·3 μ in breadth.

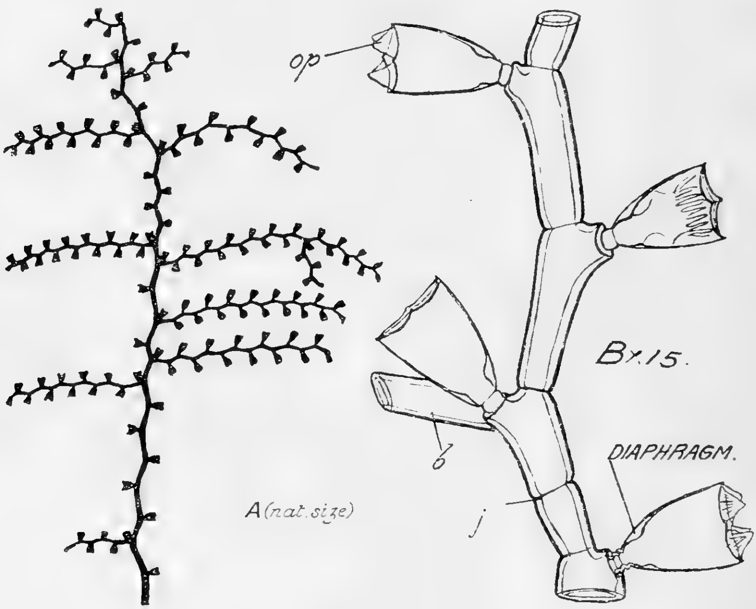
GONOSOME.—Unknown.

[1] Lendenfeld, R. von, 'Proc. Linn. Soc. N. S. Wales,' vol. ix, p. 912.

(35) Thyroscyphus æqualis *sp. n.* (Pl. XLVIII, figs. 38–40.)

This hydroid was dredged from Bird Island, Algoa Bay. It reaches a height of 4–5 inches. In the preserved condition it is yellowish white and is very opaque. The gonosome has not been found.

TEXT-FIG. 23.



Thyroscyphus æqualis *sp. n.*

TROPHOSOME.—Hydrorhiza unknown since the specimen was torn from its base.

Hydrocaulus.—Thick woody stem, monosiphonic, zigzag, divided into regular internodes which bear at their distal ends alternating hydrothecæ on short thick processes (text-fig. 23, *B*). Lateral branches are given off right and left in one plane; they arise from the internode of the main stem at the back of a hydrotheca (fig. *B*, *b*), and consequently the hydrotheca comes to lie, not exactly in the axil, but in front of it.

The lateral branches resemble the main stem in structure. Sometimes a joint appears in the middle of an internode (fig. *B. j.*).

Diameter of main stem about 1·3 mm.; diameter of lateral branch, 0·46 mm.; thickness of perisarc, 0·058; length of internode of branch about 1·8 mm.

Hydrotheca.—Set on a pedicel of 1–3 joints which is inserted on a blunt process at the distal end of the internode.

Hydrotheca tubular, rather short, expanding, with four equidistant and low teeth, and a four-flapped operculum, two of the flaps are adcauline and two abcauline. Diaphragm massive, situated not far from the base, and excentrically perforated, the aperture being nearer the abcauline side.

Length of hydrotheca about 1·18 mm.; breadth at mouth, 0·79 mm.; diameter at the level of upper edge of diaphragm, 0·28 mm.; diameter of aperture of diaphragm, 0·20 mm.; length of pedicel, 0·13 mm.; diameter 0·21 mm.

Hydranth.—About 32 tentacles; nematocysts on tentacles numerous; they measure about 7·2 μ in length and 2·7 μ in breadth.

Gonosome.—Unknown; large ova have been seen in the endoderm at the base of the pedicel in the blunt process of the internode (fig. 38, *O*).

Histology.—The hydrotheca is lined by a sheet of ectoderm (Pl. XLVIII, fig. 38, *e.s.*), and on the abcauline and adcauline sides the sheet is provided with two thickenings, bearing a series of very large nematocysts (*B.n.*) arranged horizontally with great regularity. Enlarged views of these nematocysts are given in figs. 39 and 40; length 30 μ, and breadth 9 μ. The cnidoblast (*cn.*) and nucleus (*nu.*) are shown. The nematocysts seem to be always placed so that the ends from which the thread (fig. 38, *Th.*) is discharged are pointed towards the perisarc cup. It is consequently not easy to see how they can be used; perhaps the cnidoblasts pass up to the edge (fig. 38), in a manner recalling the succession of teeth of sharks, and are only used at the free edge just below the operculum.

The hydrotheca is provided with an internal ridge (*rd.*) situated at about one third of the height of the hydrotheca from the base. Along this ridge the hydranth is attached to the sheet of ectoderm lining the hydrotheca.

The endoderm of the hydranth can be everted through the mouth (fig. 38, *e.e.*) for a considerable distance, thus recalling the condition seen in Eudendrium angustum.

Systematic Position.—The present hydroid is allied to Thyroscyphus simplex *Allman*,[1] from Somerset, Cape York, Torres Strait, in 8–12 fathoms of water, T. ramosus *Allman*[1] from Bahia, and Campanularia tor esii *Busk*[2] from Torres Strait. These three species exhibit a certain bilateral symmetry in that the hydrotheca is distinctly more ventricose on the adcauline than on the abcauline surface. In T. æqualis, as the specific name is intended to imply, the two surfaces are practically equal and symmetrical. Also the stem is much more zig-zag than in the other species.

In the present species, however, a bilateral symmetry is still evident by the excentric position of the opening of the diaphragm, it being situated nearer the abcauline side. From this it would seem probable, either that æqualis is reverting to a typical radial symmetry, or that it represents a stage in the development of the bilateral symmetry.

II.

Geographical Distribution of the Species.

There have now been described 35 species; 15 of these appear to be new, including two new genera.

Of the 35 species 32 were found on the Natal Coast and 4 were dredged off Algoa Bay, one occurring in both localities.

In the accompanying table the distribution of the species is shown as far as can be traced with the available literature. This list, notwithstanding its extreme incompleteness, exhibits certain points of interest and significance.

[1] Allman, G. J., 'Challenger Reports' "Zool.," V.

[2] Bale, W. M., 'Cat. of the Australian Hydroid Zoophytes,' 1884, p. 52.

Species.	Natal.	Cape.	Australasia.	Europe.	America.
Parawrightia robusta *Warren*	×				
Eudendrium parvum *sp. n.*	×				
,, augustum *sp. n.*		×[2]			
Clavatella multitentaculata *sp. n.*	×				
Tubularia solitaria *Warren*	×				
,, betheris *sp. n.*	×				
Pennaria australis *Bale*	×		×		
Cladocoryne floccosa *Rotch*	×			×	
Asyncoryne ryniensis *g. e. sp. n.*	×				
Coryne pusilla *Gärtner*	×			×	
Sertularella polyzonias (*Lin.*)	×	×	×	×	×
,, fusiformis *Hincks*	×		×	×	×
,, tumida *sp. n.*	×	×			
,, campanulata *sp. n.*	×				
,, acanthostoma *Bale*	×		×		
,, operculata *Linn.*	×	×[1]	×	×	×
,, loculosa *Busk*	×		×		
,, linealis *sp. n.*	×				
,, bidens *Bale*	×		×		
Pasythea quadridentata (*Ellis and Sol.*)	×	×	×		×
Thuiaria tubuliformis (*M.— Turner-etscher*)	×				×
Plumularia tenuis *sp. n.*	×				
,, spinulosa *Bale*	×		×		
Antennella natalensis *sp. n.*	×				
Kirchenpaueria mirabilis *Allman*	×		×		
Paragattya intermedia *g. e. sp. n.*	×				
Aglaophenia chalarocarpa *Allman*	×	×			
,, parasitica *sp. n.*	×				
Halicornaria segmentata *Allman*	×				
Campanularia tincta *Hincks*	×		×		
,, caliculata *Hincks*	×		×	×	×
Clytia elongata *sp. n.*		×[2]			
Lafœa scandens *Bale*	×		×		
,, magna *sp. n.*	×	×[2]			
Thyroscyphus æqualis *sp. n.*		×[2]			

[1] Hincks, T., 'A History of the British Hydroid Zoophytes,' 1868, p. 264, "South Africa (Busk)."

[2] Bird Island, Algoa Bay.

Out of the 32 Natal species 13 occur in Australia or New Zealand, 6 in the Cape, 6 in Europe, and 6 in America.

It is noteworthy that more Cape species have not been found in Natal. As far as I am aware no hydroid faunistic lists from the Cape coast have been published, but a considerable number of species have been described, and yet out of the 32 Natal hydroids collected only 6 Cape species have been found.

There is an obvious affinity between the Natal and Australian hydroid faunæ, and the list points to the view that this affinity may be stronger than that between the Natal and the Cape faunæ.

This apparent difference in the hydroid faunæ is perhaps associated with the course of the ocean currents. The warm south equatorial current flows westwards, and a part of it is deflected southwards as the Natal or Mozambique Current. This flows along the east coast of the Cape until it meets the cold Antarctic Current at the Agulhas Bank, when the greater part of it turns eastwards and flows back to Australia and then passes northwards up the west coast of the continent to be again caught up in the south Equatorial Current.

It is hence readily understood why there should be a marked difference between the marine fauna of the Natal coast and that of the Cape coast, especially the part west of the Angulhas Bank, since here the influence of the cold Antarctic Current is more strongly felt.

III.

Note on the Nematocysts.

After the measurements of the nematocysts in the various species were made, it was felt that there was some relationship in the shape of the nematocyst and the family to which the species belonged; in other words, that species of the same family tended to have nematocysts of similar shape.

In the accompanying table the second column gives the approximate length of the hydranth; the third, fifth, and seventh columns give respectively the length (L) and breadth

Species.	Approximate length of hydranth.	Small nematocysts in tentacles.		Large nematocysts.		Nematocysts in nematophores or ectodermal sheet.	
		L and B	$\frac{L}{B}100$	L and B	$\frac{L}{B}100$	L and B	$\frac{L}{B}100$
	m.	μ		μ		μ	
Parawrightia robusta	0·9	5·0×2·9	58				
Eudendrium parvum	0·5	4·8×2·1	44				
,, angustum	0·5	5·0×2·2	44	23·3×10·4	44		
Clavatella multitentaculata[1]	0·8	9·0×4·0	44	19·0×11·0	57		
Tubularia solitaria[1]	1·4	6·2×5·5	89	12·1×11·6	96		
,, betheris[1]	2·5	5·1×4·5	88	8·3×7·9	95		
Pennaria australis	0·8	11·2×5·4	48	38·7×17·0	41		
Cladocoryne floccosa	0·9	6·7×5·3	79	11·1×9·0	81		
Asyncoryne ryniensis	3·0	10·0×8·0	80	27·0×19·5	72		
Coryne pusilla	1·3	8·9×5·3	60	16·7×11·2	67		
Sertularella polyzonias	0·5	6·2×1·8	29				
,, fusiformis	0·4	5·1×1·1	22				
,, campanulata	0·4	3·0×0·7	23				
Sertularia acanthostoma	0·4					22·7×4·2	18
,, bidens	0·3					6·6×1·4	21
Thuiaria tubuliformis	0·7	5·2×1·2	24				
Plumularia tenuis	0·2	2·3×0·7	30			6·6×2·5	38
,, spinulosa						6·2×1·5	24
Antennella natalensis	0·2	2·4×0·8	33			10·4×4·4	42
Kirchenpaueria mirabilis	0·2					13·4×6·8	51
Paragattya intermedia	0·2					10·7×2·6	24
Aglaophenia chalarocarpa	0·2					15·5×2·5	16
Aglaophenia parasitica	0·2					12·4×3·1	25
Halicornaria segmentata	0·2					45·5×6·2	14
Campanularia tincta	0·5	5·2×1·8	34				
,, caliculata	0·3	4·0×1·7	42				
Clytia elongata	1·1	4·6×1·4	30				
Lafœa scandens	0·5	4·1×1·2	30				
,, magna	1·3	7·0×2·3	33				
Thyroscyphus æqualis	1·2	7·2×2·7	37			30·2×9·3	31

[1] In Clavatella and Tubularia there were more than two kinds of nematocysts; the size next to the largest was taken for the third column.

(B) measurements of the small nematocysts of the tentacles, the large nematocysts, and the specialised nematocysts from the nematophores and ectodermal-sheet lining the hydrotheca.

As an indication of the shape of the nematocyst the length-breadth index was calculated, $\frac{B}{L} \times 100$.

The following points can be noticed:

(1) A glance at the three columns of the table will show that among both the Gymnoblastica and Calyptoblastica a wide variability occurs, the length-breadth index ranging from 14–96; but that among the species and genera of well-defined families, *e.g.* the Eudendriidæ, Tubulariidæ, Sertulariidæ, and Campanulariidæ there is a distinct tendency for some uniformity. In the four species of the Sertulariidæ the index varies from 22–29, and the mean is 24; and in the six species of the Campanulariidæ it varies from 30–42 and the mean is 34. It may thus be said that in certain families, at any rate, the nematocysts have a characteristic shape, which may be expressed by the mean length-breadth index of the various species. As the table stands the family-index for the Sertulariidæ is 24 and for the Campanulariidæ 34; but, of course, a much longer series of species is required before these figures can be in any way accepted.

(2) Another feature to notice is that when nematocysts of two sizes occur in a hydroid the indices of the two sizes do not, as a rule, diverge from each other very widely, or in other words, the shapes of the large and small nematocysts tend to approach one another. The mean index of the small nematocysts, in the case of eight gymnoblastic hydroids, is 66, while the mean index in the same hydroids of the large nematocysts is 69.

(3) The absolute size of the nematocyst tends to be related to the size of the hydranth.

In 10 species with a hydranth not exceeding 0·5 mm. in length (mean 0·4 mm.), the mean length of the small nematocysts is 4·2 μ; and in 12 species with a hydranth exceeding

0·5 mm. in length (mean 1·3 mm.), the mean length of the nematocysts is 7·2 mm.

The relationship may be expressed mathematically in accordance with Professor Pearson's statistical methods; the constants calculated from the 22 species are: Mean length of hydranth 0·89 mm., mean length of nematocyst 5·93 μ. Standard deviation of hydranths 0·686 mm., standard deviation of nematocysts 1·565 μ. Coefficient of correlation 0·777; probable error of coefficient 0·057.

It is probable that a similar correlation would be found between the size of ordinary tissue cells and the general size of the hydranth.

(4) The nematocysts of the nematophores and of the ectodermal sheets lining the hydrothecæ tend to be elongated; the highest index seen is 51, and this belongs to the very aberrant genus Kirchenpaueria. The mean index of the 11 species given in the table is 28.

In correlation with the development of nematophores and specialised batteries on the sheets of ectoderm, the formation of ordinary nematocysts on the tentacles tends to be weak or almost completely absent.

EXPLANATION OF PLATES XLV—XLVIII.

Illustrating Dr. Ernest Warren's paper "On a Collection of Hydroids, mostly from the Natal Coast."

Fig. 1.—× 100. Side view of hydranth of Eudendrium parvum *sp. n.*, showing the base enveloped by a thin layer of perisarc, terminating at *t.p.*

Fig. 2.—× 260. Median longitudinal section of hydranth of E. parvum, showing general histology.

Fig. 3.—× 1100. Upper portion of the basal differentiated ectoderm of hydranth, showing modified terminal cells (*c.c.*).

Fig. 4.—× 75. Male gonophore of E. parvum, with three chambers and slight terminal knob.

Fig. 5.—× 75. Side view of hydranth of Eudendrium angustum

sp. n., showing the peculiar condition of the hypostome, and the plug of digestive endoderm (*e.p.*).

Fig. 6.—× 150. Median longitudinal section of hydranth of E. angustum, showing the general histology, the inverted perisarc-cup at base (*p.cp.*) and ingested food (*i.f.*) in endodermal plug.

Fig. 7.—Natural size. Small colony of Clavatella multitentaculata *sp. n.* on sponge (*sp.*).

Fig. 8.—× 35. Side view of C. multitentaculata, showing the hydrorhiza and the base of hydrocaulus embedded in sponge.

Fig. 9.—× 140. Vertical median section of the hydranth of C. multitentaculata, showing the histological structure and the origin of the planoblasts (*pl.*).

Fig. 10.—Natural size. Small colony of Tubularia betheris *sp. n.*

Fig. 11.—× 25. Side view of hydranth of T. betheris, showing the semi-erect peduncles or blastostyles bearing clusters of gonophores (*go.*).

Fig. 12.—× 70. Median longitudinal section of hydranth of T. betheris, showing basal dilatation (*b.d.*) with differentiated endoderm, basal mass of skeletal, "cellular" endoderm (*b.M.*), and blastostyle (*pd.*) with gonophores.

Fig. 13.—Natural size. Small colony of Asyncoryne ryniensis *sp. n.* growing on the surface of a polychæt tube.

Fig. 14.—× 35. Piece of colony of Asyn. ryniensis with short upright hydrocaulus (*H.*) carried by hydrorhiza (*R.*). The hydranth bears short peduncles with probable planoblasts (*pl.*).

Fig. 15.—× 70. Median longitudinal section of hydranth of Asyn. ryniensis, showing hydrocaulus (*H.*), perisarc groove (*p.g.*), and secondary endodermal canal (*S. E. C.*) in hydrorhiza.

Fig. 16.—× 225. Longitudinal median section of moniliform tentacle with the ectodermal swellings and small nematocysts (*s.n.*).

Fig. 17.—× 225. Longitudinal median section of capitate tentacle of Asyn. ryniensis with large (*l.n.*) and small (*s.n.*) nematocysts.

Fig. 18.—× 45. Stem of Sertularella polyzonias (*Lin.*) with infected hydranth (*c.hy.*) and with mature galls (*g.*) of a species of Pycnogonum.

Fig. 19.—× 45. Stem of S. polyzonias, with a lateral branch (*b.*) springing from the inside of a hydrotheca, a developing gall (*d.g.*), and an old empty and broken gall (*o.g.*).

Fig. 20.—× 130. Median longitudinal section through gall and hydrotheca of S. polyzonias. It shows a longitudinal dorso-ventral section of enclosed embryo of Pycnogonum. The gall is lined by an

ectodermal sheet (*e.g.*), it has a definite operculum (*op.*), and the modified hydranth has a clump of tentacles (*te.*).

Fig. 21.—× 48. Small piece of colony of Sertularella campanulata *sp. n.* creeping on weed.

Fig. 22.—× 220. Median longitudinal section through the hydranth, hydrocaulus, and hydrorhiza of S. campanulata. The opening in the diaphragm is excentric, the perisarc of the hydrotheca is much thinner on the side facing the hydrorhiza than on the opposite side, and the hydrocaulus is set at an angle of about 45° to the hydrorhiza.

Fig. 23.—× 180. Front view of hydrotheca of Sertularia acanthostoma *Bale*, showing four outer teeth and four inner teeth on each side.

Fig. 24.—× 180. Side view of hydrotheca of S. acanthostoma, showing the lower peg of chitin (*l.p.*).

Fig. 25.—× 300. Median longitudinal section of hydrotheca and hydranth of S. acanthostoma, showing sheet of ectoderm lining hydrotheca, with median thickening and battery of elongated nematocysts (*B.n.*) lying on special platform (*plt.*) of perisarc.

Fig. 26.—× 850. Median longitudinal section through edge of hydrotheca and ectoderm sheet of S. acanthostoma. The thickening of the sheet with the battery of elongated nematocysts (*B.n.*) and the outer clothing of coralline sea-weed (*C.W.*) are well seen.

Fig. 27.—× 200. Side view of piece of stem of Paragattya intermedia *sp. n.* The hydrothecæ usually possess one pair of large lateral teeth (2, 2), but occasionally there may be two pairs (2, 2; 2*a*, 2*a*). The nematophores should be specially noticed; the jointed lateral nematophores (*J.*), the median nematophore above the hydrotheca (*sup.n.*), and the mesial nematophore (*m.n.*), not adherent to the hydrotheca, which lies below.

Fig. 28.—× 80. Side view of small piece of pinna of Aglaophenia parasitica *sp. n.*

Fig. 29.—× 200. Front view of hydrotheca of A. parasitica, showing the arrangement of teeth.

Fig. 30.—× 30. Side view of male corbula of A. parasitica, showing the lateral prolongations (*l.l.*) of the leaflets.

Fig. 31.—× 30. Side view of female corbula.

Fig. 32.—× 350. Transverse section through the hydrorhiza of A. parasitica, showing the sucker penetrating into the coralline sea-weed. The sucker generally passes through the cortex down to the medulla of the plant. The sucker is formed of modified ectoderm. In the neighbouring ectoderm there are rounded cells (*y.c.*) filled with globules of homogeneous substance.

FIG. 33.—× 90. Side view of piece of pinna of Halicornaria segmentata sp. n.

FIG. 34.—× 90. Front view of piece of pinna of H. segmentata, showing hole (*o.S.*) at base of mesial nematophore (*m.n.*) for a sarcostyle.

FIG. 35.—× 500. Median longitudinal section of mesial nematophore of H. segmentata, showing sarcostyle (*S.*), battery of nematocysts (*B.n.*), and conspicuously large cell filled with globules (*c.g.*).

FIG. 36.—× 900. Small piece of body-wall of hydranth of H. segmentata, showing cells filled with dark globules (*c.p.*). They occur both in the ectoderm and endoderm.

FIG. 37.—× 900. Small piece of body-wall of the hydranth of the black variety of Sertularia loculosa *Busk*, showing cells, which are often pear-shaped, containing dark brown matter (*c.p.*). They appear to be confined to the endoderm.

FIG. 38.—× 90. Median longitudinal section through the hydrotheca and hydranth of Thyroscyphus æqualis *sp. n.* The diaphragm is excentrically perforated. The hydrotheca is lined by a sheet of ectoderm, which, at the upper region, is provided with two large batteries of elongated nematocysts (*B.n.*).

FIG. 39.—× 1000. Elongated discharged nematocyst of T. æqualis in cnidoblast.

FIG. 40.—× 1000. Undischarged nematocyst.

EXPLANATORY REFERENCES FOR PLATES AND TEXT-FIGURES.

a. Aperture. *a. b.* Line of section for fig. D. *ab. k.* Abcauline knob of perisarc. *ad. k.* Adcauline knobs of perisarc. *ap.* Appendage. *Ar.* Archenteron.

b. Branch. *b. bl.* Branched blastostyle. *b. c.* Budding corbula. *b. d.* Basal dilatation. *b. h.* Base of hydranth. *b. hy.* Branch of hydrorhiza. *b. M.* Basal mass of skeletal endoderm. *B. n.* Battery of nematocysts. *bl.* Blastostyle.

C. Cortex. *c.* Cuticle. *c. c.* Collar cell. *C. D.* Dilatation of cœlenteron. *c. e.* Common ectoderm. *c. g.* Cell filled with globules of yolk (?). *c. hy.* Contracted hydranth. *c. p.* Cell with "pigment." *c. t.* Capitate tentacles. *C. W.* Coralline sea-weed. *ch.* Cheliceræ. *cl.* Claw of chelicerӕ. *cn.* Cnidoblast. *co.* Corbula. *cœ.* Cœlenteron.

d. Diaphragm. *d. g.* Developing gall. *d. n.* Discharged nematocyst. *d. t.* Distal tentacles.

e. C. Enveloping cortex. *e. c.* Endoderm canal. *ec. c.* Ectodermal cavity. *e. e.* Everted endoderm. *e. ep.* Endodermal epithelium. *e. g.*

Ectoderm lining gall. *e. hy.* Endoderm of hypostome. *e. p.* Endodermal plug. *e. s.* Ectodermal sheet. *ect.* Ectoderm. *end.* Endoderm.

f. s. Fascicled stem.

G. Gonangium. *g.* Gall. *g. c.* Germinal cells. *gl. e.* Glandular endoderm cell. *g. o.* Gonophores. *gr.* Loose granules. *gr. c.* Granular cell.

H. Hydrocaulus. *h.* Hypostome. *Hy.* Hydrocaulus.

i. f. Ingested food (Copepod eggs). *i. p.* Inner expansion of cœlenteron.

J. Joint of lateral or supra-calycine nematophore. *j.* Joint.

k_1. Adcauline knobs of perisarc. k_2. Abcauline knob.

l. l. Lateral leaflet of corbula. *l. n.* Large nematocyst. *l. p.* Lower peg of perisarc.

M. Medulla of alga. *m.* Mesoderm. *m. n.* Mesial nematophore below hydrotheca. *m. o.* Mature ovum. *m. t.* Moniliform tentacle. *mo.* Mouth.

n. Nematocyst. *nu.* Nucleus.

O. Ovum. *o. c.* Oral cone. *o. g.* Old gall. *O. H.* Outgrowth of hydrocaulus. *o. h.* Old hydrorhiza. *o. l.* Older larva of Pycnogonum. *o. S.* Opening for sarcostyle. *o. s.* Old stem. *op.* Operculum. *ov. c.* Oval cell.

p. Perisarc. p_1. Outer layer of perisarc. p_2. Inner layer of perisarc. *p. c.* Process from sucker-cell entering cell of alga. *p. cp.* Perisarc-cup. *p. g.* Perisarc-groove. *p. t.* Proximal tentacle. *pd.* Peduncle or blastostyle. *ped.* Peduncle of hydrotheca. *pl.* Planoblast. *plt.* Platform for battery of nematocysts. *po.* Pore.

R. Hydrorhiza. *r.* Ridge. *r. e.* Reflexed endoderm. *R. H.* Rounded-off hydranth. *rd.* Ridge.

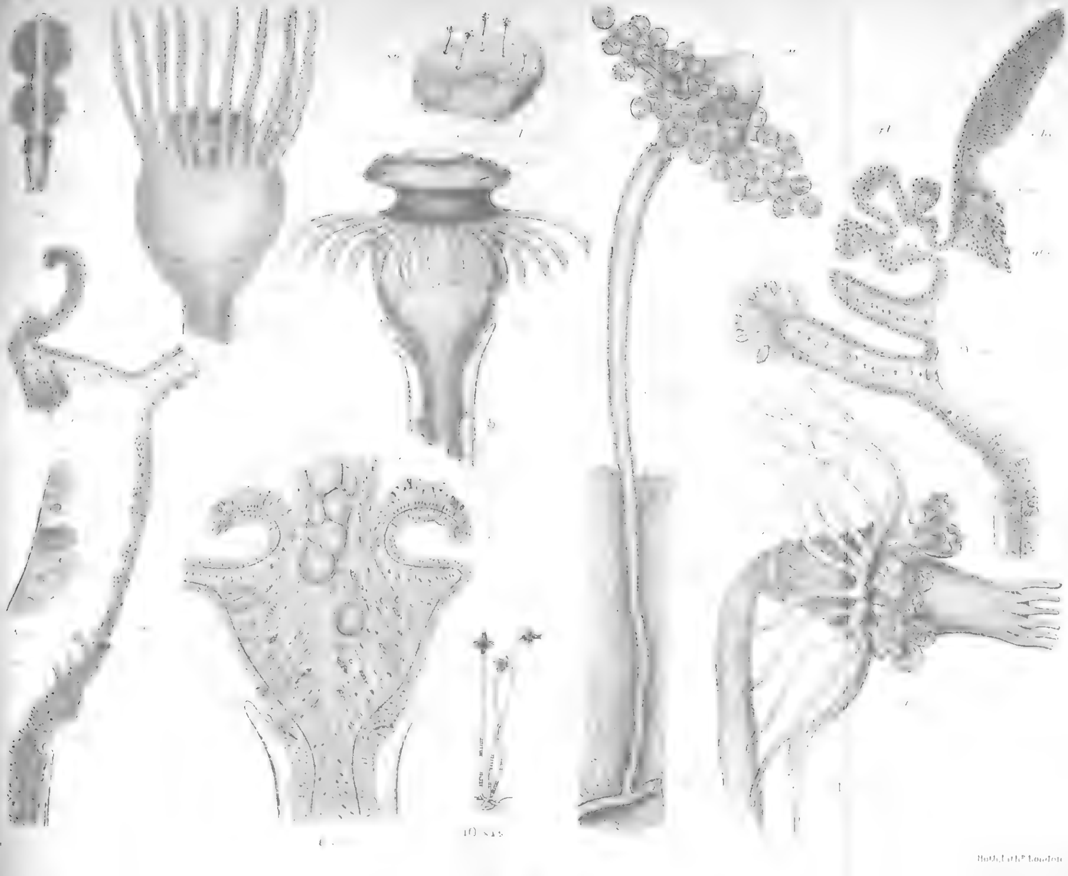
S. Sarcostyle. *s. e.* Sheet of endoderm. *S. E. C.* Secondary endoderm-canal. *s. n.* Small nematocyst. *sp.* Sponge. *spi.* Spine. *sp. t.* Spermatic tissue. *St.* Stomodæum. *sup.n.* Superior median nematophore.

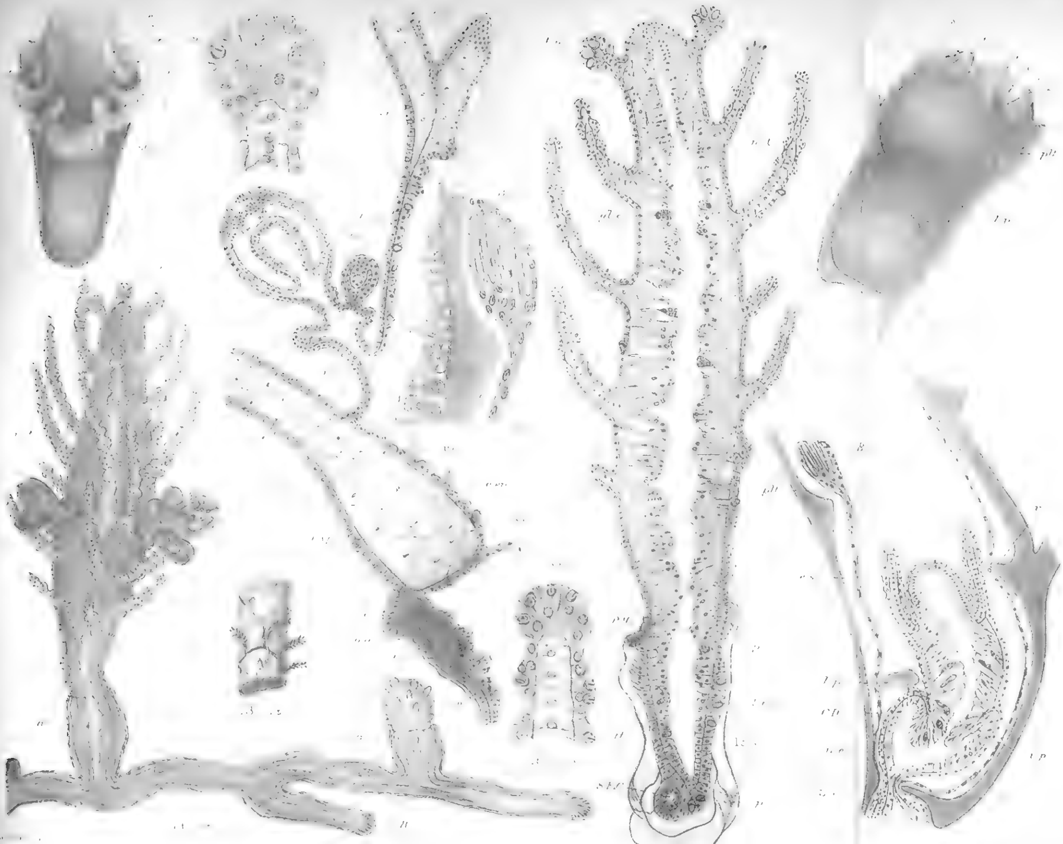
t. Tooth. *t. p.* Thin perisarc. *t. pr.* Termination of perisarc in perisarc-groove. *te.* tentacles. *th.* Thickening of ectodermal sheet on adcauline side. *Th.* Thread of nematocyst. *th. p.* Thick perisarc.

u. e. Undifferentiated endoderm.

v. Velum. *v. c.* Vacuolated endoderm cell.

y. c. Yolk-containing cell. *y.e.* Young embryo of Pycnogonum. *y. l.* Young larva.





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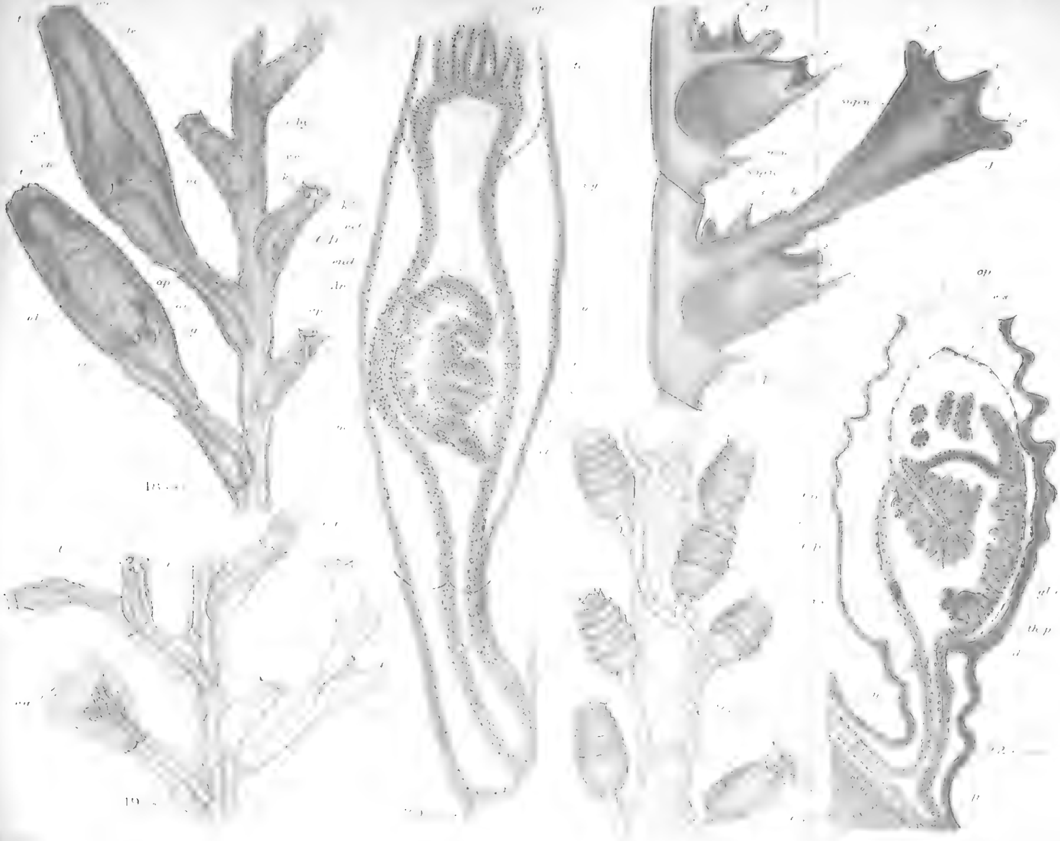

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ERRATA.

P. 21, 6th line from the top, *for* "Scapander" *read* Scaphander.
P. 33, 8th line from the bottom, *omit* "Mitra (Costellaria) dædala."
P. 52, 16th line from the top, *for* "E. aclis A. Adams" *read* E. aclis (*A. Adams*).
P. 78, 6th line from the bottom, *for* "ectoderm" *read* endoderm.
P. 80, 3rd line from the bottom, *for* "Halocodyle" *read* Halocordyle.
P. 117, 17th line from the bottom, *for* "barbirostis" *read* barbirostris.
P. 152, 5th line from the top, *for* "barbirostis" *read* barbirostris.
P. 189, 10th line from the top, *for* "Hinck's" *read* Hincks's.
P. 190, 5th line from the top, *for* "this layer" *read* the latter layer.
P. 196, 6th line from the bottom, *for* "Hinck's" *read* Hincks.
P. 196, 16th line from the bottom, *for* "Hinck's" *read* Hincks's.
P. 205, 5th line from the bottom, *for* "Leuconostc" *read* Leuconostoc.
P. 206, 2nd line from the top, *for* "Leuconostc" *read* Leuconostoc.
P. 212, 4th line from the top, *for* "vertical" *read* verticil.
P. 228, 13th line from top, *for* "semiannulus" *read* semiannulis.
P. 263, music of Song 1, "brace" *to be omitted.*
P. 264, music of Song 3, "braces" *to be added.*
P. 266, music of Song 7, "brace" *to be omitted.*
P. 267, music of Song 8, "braces" *to be omitted.*
Pl. XLIV, bottom line, *for* "Uugub" *read* Ugubu.
P. 345, 5th line from the top, *for* "0·058" *read* 0·058 mm.
P. 348, 14th line from the bottom, *for* "Angulhas" *read* Agulhas.
Pp. 270, 280, 282, 347, 349, 352, *for* "Tubularia betheris" *read* Tubularia bethæ.

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ANNALS

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