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The Fauna and Geography of the Maldive and Laccadive Archipelagoes

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

Edited by

J. STANLEY GARDINER, M.A.

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

VOLUME I. PART III.

With Plates XIV—XVII and Text-Illustrations 41—75

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THE MARINE TURBELLARIA,

WITH AN ACCOUNT OF THE ANATOMY OF SOME OF THE SPECIES.

By Frank Fortescue Laidlaw, B.A. (Cantab.), *Demonstrator and Lecturer in the Owens College, Manchester.*

(With Plates XIV. and XV. and Text-Figures 61—73.)

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ACOTYLEA. I. Family Planoceridae.

1. *Planocera armata*, sp. n. (Pl. XV. figs. 10, 11, and 12).

One specimen from 40 fathoms, Suvadiva Atoll. Rubble and broken coral bottom.

Total length about 25 mm., total breadth about 15 mm. Tentacles from ant. margin 5 mm. Mouth aperture about 13 mm. behind anterior margin. Male gonopore about 5 mm. behind mouth. Female gonopore about 1 mm. behind male.

Colour white with small pigmented patches, scattered rather numerously near the dorsal surface. Tentacles about 2 mm. apart, bilobed at the tips; each with a dense cluster of eyes at its base. Brain compact, lying under a median branch of the gut. There is a cluster of eyes over the brain between the tentacles (Fig. 61).

The epidermis is composed of very small cells, crowded with a finely granular secretion. I can find no trace of rhabdites. The basal membrane is thick, and occasionally pierced by processes from gland-cells, lying beneath the integument. The muscle layers consist of a thin, outer, longitudinal layer, followed by two layers of diagonal fibres. These are succeeded by a circular layer which is much thicker on the ventral than on the dorsal side. Lastly on the ventral side only is an inner longitudinal layer.

The pharyngeal aperture is median. From the main gut some seven pairs of gut branches are given off. These again ramify into numerous smaller branches as they run outwards.

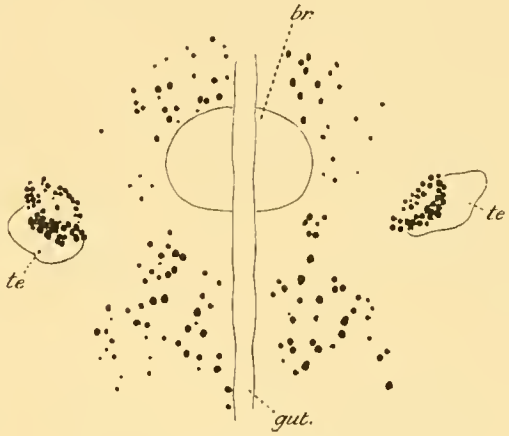


Fig. 61. Eye-spots of *Planocera armata*. *te.* tentacles, *br.* brain.

The small pigmented patches, referred to in the short account of the external characters given above, are found in section to be due to the presence of dark bodies in certain remarkable, dorsal diverticula given off from the gut branches (Pl. XV. fig. 10). The gut branches themselves are lined with very elongated columnar epithelial cells lying on a delicate basal membrane from which they are frequently, in my sections at least, torn away. The epithelium of the diverticula on the other hand, though similar in appearance, is structurally much reduced and obscured by the dark bodies referred to above.

These dark bodies are of three kinds. Firstly, there are numerous rather large, black, spherical bodies, which are evidently produced in the gut epithelium itself. With a high power different stages of the development of these bodies are readily distinguishable. They commence as small, lightly-staining masses, which increase in size, and at the same time take a deeper stain. Of their ultimate fate nothing can be said at present. They are scattered pretty regularly through the gut tissue and probably have but little or no share in giving the diverticula their characteristic appearance. Secondly, in and about the diverticula there are small masses of little rod-shaped bodies, probably bacteria. These do not occur generally throughout the gut, but only in the diverticula themselves or in their immediate neighbourhood; in the latter case they invariably have an appearance of streaming into the diverticula. Lastly, I have found in one or two diverticula only, a quantity of exceedingly fine, granular, pigment-like substances.

The significance of these bodies and of the diverticula themselves is obscure. The latter may be compared directly with the gut diverticula of such a form as *Thysanozoon brocchii*. Diverticula of a precisely similar character occur in a species of *Planocera*, as yet undescribed, collected by Mr Gardiner at Rotuma, whilst Lang's [9] figure of *Pl. villosa* suggests very strongly that a similar feature occurs in this species, though it is true that Lang appears to regard the pigment patches as merely epidermal.

Mention should be made here of the fact that von Plehn [10] has figured the occurrence of marginal pores opening from the gut in an undescribed Planoceroid. In the species described next the large spherical bodies of the gut epithelium are present, but there are no diverticula and neither of the other kinds of dark bodies.

Genital apparatus. The characters are shown somewhat diagrammatically in Pl. XV. fig. 11. In the female system the accessory vesicle (*a. v.*) of the vagina is thread-like and extends back as far as the level of the female aperture (♀). After receiving on its ventral side the common duct from the two uteri (*c. d.*), the vagus (*va.*) follows a winding course through the enormous shell glands (*s. g.*), and runs into a large bursa copulatrix (*b. c.*), whose lumen has many folded walls, appearing in part at any rate to be glandular. As in other typical members of the genus the terminal parts of the male apparatus are enclosed in an outer muscular sheath (*o. s.*), in which lie the penis and the prostate (*pr.*) as well as the duct. A remarkable feature of the penis, and one that separates this species sharply from other known *Planocera*, is the presence at the end of that organ of six large chitinous hooks (*c. h.*) and at its upper end of a chitinous ring or collar (*c. r.*). The lumen of the penis is lined by a very large number of small chitinous spines (*c. s.*). These vary from ·05 to ·07 mm. in length. The space between the penis and outer sheath is occupied by a very loose parenchymatous tissue.

Female organs. At its hinder end the accessory vesicle (*a. v.*) is difficult to trace owing to its extremely small size. The lining cells are not ciliated. As it passes forward it increases in size and a very few circular muscles appear about it. After receiving the short common duct (*c. d.*) from the uteri, which are also lined with non-ciliated epithelium, the vagina (*va.*), as it must now be called, continues to run forwards for some little distance. It then turns first ventralwards and then backwards. As it turns back it widens out so that its lumen is wide from side to side but narrow dorso-ventrally. In this part of its course it receives the secretion of the relatively enormous shell-glands (*s. g.*), which have a characteristic granular appearance and stain very lightly. The vagina continues to run backwards, passing right through the shell-glands until it lies right under the front end of the bursa. Here its lumen becomes circular in section. It now makes a Z-shaped turn upwards, and runs into the hinder end of the large bursa copulatrix (*b. c.*). As the vagina passes into the bursa its lining epithelium undergoes a marked change. Up to this point it consists of a fairly well-defined, cubical epithelium with deeply staining nuclei, apparently non-ciliated. As it passes into the bursa it becomes irregular and much folded; the protoplasm stains more deeply, and the nuclei can with difficulty be distinguished. From its proximal, anterior end the epithelium lining the bursa (*g. l.*) retains these characters almost to the gonopore, in the neighbourhood of which it merges into a columnar non-ciliated epithelium, continuous with the epithelium of the surface. The epithelium of the bursa is secreting very actively a remarkable 'glairy' substance, which occupies nearly the whole lumen of the bursa. Outside this epithelium the bursa is built up of a thick muscle layer of circular fibres. The folding of the wall lining the lumen of the bursa is no doubt, as Lang suggests, to permit of the distension of the organ. The secretory character of its wall is, so far as is known, confined to this species, and without homologue in the bursa of any Polyclad I am acquainted with. This peculiarity combined with the very remarkable nature of the penis indicates that this species is one of the most specialized in the whole order.

Male apparatus. The gonopore opens into an antrum masculinum whose walls closely resemble those figured by von Graff for his *Pl. simrothi* [6]. Little spherical masses of granular secretion given off from the cells lining the antrum lie scattered in its cavity. The outer sheath (Pl. XV. fig. 12, *o. s.*) is composed of two layers of muscle fibres, an outer longitudinal

and an inner circular layer. At its anterior proximal end it is pierced by the ductus ejaculatorius running into it from the small muscular vesicula seminalis (*v. s.*). At the same end lies the large prostate gland (*pr.*), whose duct joins the ductus ejaculatorius some way before entering the penis. Retractor muscles run from the upper end of the penis, and from the distal part of the ductus to join the outer sheath.

A transverse section through the distal lower limit of the penis is represented somewhat diagrammatically in fig. 13. The irregular lumen is seen to be lined with short chitinous spines (*c. s.*) and the section passes through the bases of the six large hook-like structures (*c. h.*). Outside the spines and hooks is a narrow layer of hyaline protoplasm, and beyond this the irregular, diagonal, intrinsic muscles of the penis (*p. m.*) in close contact with the muscles of the outer sheath, here rather feebly developed. The small cavities (*a. m.*) are parts of the antrum masculinum. The irregularity of the lumen is probably due to shrinkage. Further forward a transverse section shows the hyaline layer rather more clearly defined, and outside it is a broad muscle layer composed of diagonal fibres which are closely packed together on the inside, but loosely arranged to the outside, so that no very clear boundary can be distinguished between the muscles and the parenchyma, which have divided the intrinsic muscles of the penis from those of the outer sheath.

At the level of the chitinous 'collar-like' structure the sections have unavoidably been torn. Consequently I cannot be certain of the relationship of the collar to the penis or to the retractor muscles, but some of the latter seem to be attached to it. The collar itself, seen in the animal when cleared in oil of cloves before it was cut into sections, appeared as a ring of chitinous material, its upper, anterior end wider than the lower, and its outer surface decorated with a rectangular sculpturing. On account of the tearing of the sections it is also impossible to say whether the ductus ejaculatorius entered the penis by passing through the collar or to the outside of it.

In a transverse section in front of the penis but before the level of the prostate, the ductus ejaculatorius can be seen running through the middle of the section. It has a narrow lumen lined with ciliated epithelium. Outside this is a thin layer of circular muscle fibres followed by a longitudinal layer. From this longitudinal layer a number of bundles of retractor muscles are given off, exactly similar to those connected with the hinder end of the penis itself. In sections at this level many of them lie cut across obliquely amongst the parenchyma which here fills the wide space between the ductus and the outer sheath. The ductus runs nearly straight back to the prostate. Just before entering the latter it divides into a wider part running to the gland and a narrower part continuing to the vesicula seminalis, after piercing the wall of the outer sheath. It is interesting to find here a little peculiarity which evidently also occurs in *Pl. pellucida* (see von Graff's figure [6]), *i.e.* the duct from the vesicula does not open immediately into that from the prostate, but is actually prolonged for a short distance inside it. This prolongation is probably of the nature of a valve. Each of these two parts making up the ductus ejaculatorius is provided only with circular muscle fibres; but, whereas those of the prostatic part are few in number, those of the part running to the vesicula though few at first increase rapidly in number as the vesicula is approached.

The prostate (*pr.*) is a large gland, lying in close contact with the outer sheath at its anterior end; in fact the circular muscles of the sheath completely enfold it, and form a muscular wall for it. On the inside it is lined with a much-folded glandular epithelium. The vesicula

seminalis lies outside the outer sheath. It is small, with thick muscular walls composed of circular fibres. The vasa deferentia before joining it are much swollen and full of spermatozoa; they are lined with a cubical ciliated epithelium, and have no nuclei. The vesicula itself contains no spermatozoa.

2. *Planocera langii*, sp. n. (Pl. XIV. fig. 1, and Pl. XV. fig. 13).

One specimen from Minikoi. "White transparent form." Body flat, oval; margin folded.

Total length about 20 mm. Front margin to mouth opening 11 mm. Front margin to male aperture 13·5 mm. Male to female aperture about ·3 mm. Tentacles about 7 mm. from the anterior margin, and about 1·5 mm. apart.

Tentacular eyes numerous, small, lying at the base of either tentacle in a dense cluster. Tentacles slightly bilobed at their ends. Behind the tentacles is a single pair of small eyes, lying over the brain. Colour white, with a few small black chromatophores lying scattered round the pharynx region dorsally. There are in addition a number of exceedingly small black spots consisting apparently of pigment granules visible on the dorsal surface above the hinder part of the pharynx. These granules lie in the parenchyma, and are not of course comparable in any way to the diverticula described in the previous species. Similar granules occur in an undescribed species of *Planocera* from Rotuma.

Genital apparatus. An examination of the accompanying Figure 62 shows that the present species differs strikingly so far as these organs are concerned from *Pl. armata*. In fact it seems impossible to homologize the bursa copulatrix of the one with that of the other. The female aperture (♀) leads into a spacious antrum femininum into which the shell-glands (*sh. gl.*) open. From the antrum a short passage runs dorsalwards. It quickly divides to form the vagina which runs backwards, and the bursa copulatrix (*b. c.*) which extends forwards alongside the penis, lying at rather a higher level than the vagina (see fig. 13). The latter after a short distance bends ventralwards, and at the same time receives the separate openings of the uteri (*ut.*). Beyond this the character of its lining epithelium alters completely, and the organ is continued backwards as an elongated vesicle, which may be called the receptaculum seminis (*r. s.*), homologous with the accessory vesicle of *Pl. armata*. A remarkable feature of the male apparatus is the presence of a pair of vesiculae seminales, dilations of the terminal parts of the vasa deferentia with thick muscular walls. Compared with *Pl. armata*, this species has a long 'outer sheath' with feeble walls. The penis is long and twisted, without retractor muscles. The chitinous spines lining its lumen are relatively few, and there are neither chitinous hooks nor ring. The penis extends right back to the level of the prostate, which communicates with it by a short wide duct.

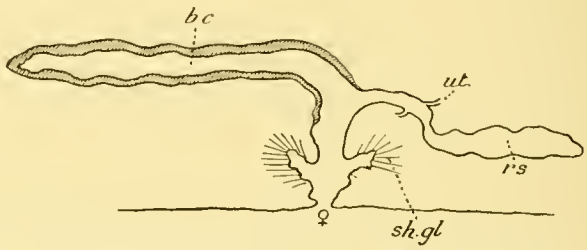


Fig. 62. Female apparatus of *Planocera langii* (diagrammatic). For explanation of lettering see text.

Female organs. The receptaculum seminis (= accessory vesicle) is lined by a regular, columnar, ciliated epithelium, resting on a fine, basal membrane. All the nuclei lie at the lower extremity of their cells, close to the membrane. They have a lightly staining ground-substance with scattered chromatin granules. The protoplasm is faintly granular. The receptaculum lies

rather near the ventral surface. As it approaches the vagina it makes a sharp turn up and the appearance of the epithelium changes; circular muscle fibres make their appearance, and, after receiving the uterine openings, the organ is continued forward as the vagina, the epithelium here consisting of a short, columnar, ciliated facies. The nuclei are homogeneous and darkly-staining; the protoplasm is hyaline. The bursa copulatrix extends forward as far as the front end of the male apparatus. Its inner walls are much folded and lined with cubical non-ciliated epithelium. Outside this it has moderately thick muscular walls composed of circular fibres. The undescribed species from Rotuma, to which I have already referred, bears a strong resemblance so far as the female apparatus is concerned to *Pl. langii*. In it the receptaculum seminis is crowded with spermatozoa.

Male apparatus. The outer sheath consists in this species of circular fibres only. From the antrum masculinum for about a quarter of its length, which is roughly a millimetre, it is continuous with the intrinsic muscular wall of the penis, and traversed by scattered, radial fibres running from the latter.

After this a split appears between it and the intrinsic muscles of the penis, leaving a space round the latter. At the upper anterior end the prostate as in the other *Planocera* lies in close contact with the outer sheath. The few muscle-fibres surrounding the prostate do not seem to be derived from the outer sheath. Lastly the sheath is pierced at two points by the ducts running to the penis from the vesiculae seminales.

The penis is approximately a millimetre in length. It is a cylindrical, tube-like organ, its lumen lined with chitinous spines, which are a little hooked and not very thickly set. The diameter is roughly equal throughout its entire length. The muscular wall consists of a well-defined, rather thick layer of circular fibres crossed by radial fibres. The penis is continued right up to the level of the prostate, which communicates with it by a short, wide, muscular duct, opening into it at the same point as do the ducts from the vesiculae.

At a point about one-third of the total length of the penis from the male aperture the chitinous spines are interrupted by the appearance of two curious folds of the inner wall (Pl. XV. Fig. 13, *pl.*). These folds are margined with chitinous material. It is possible that they may be to some extent comparable to the chitinous hooks or collar of *Pl. armata*, but their function is quite unknown to me. Behind them the spines are continued again up to the level of the opening of the prostate duct. As already stated each of the vasa deferentia is dilated before entering the outer sheath to form a vesicula seminalis, and the dilated part has muscular walls composed of circular fibres. The ducts running from the vesiculae to the penis are also muscular.

Before passing to consider the species belonging to the next family I may briefly notice the presence of a large Planoceroid represented by a single damaged specimen in the collection, which I am not able to describe. Its total length is probably about 45 mm. A pair of dorsal tentacles are visible. It is perhaps a *Stylochoplana*. I could only find indications of a single genital aperture, the genital organs being quite immature.

II. Family Leptoplanidae.

3. *Leptoplana pardalis*, sp. n. (Pl. XIV. fig. 9, and Pl. XV. fig. 14).

Several specimens from the reef, Goidu, Goifurfehendu Atoll, and from Minikoi, Laccadive Group.

Average length about 48 mm. Eyes distant 10 mm. from the anterior margin. Mouth opening about 20 mm. from the anterior margin. The male aperture lies about a millimetre in front of the female, the latter is about 15 mm. from the hinder end of the body.

The colour (in spirit specimens) is pale yellow. On the dorsal surface this is thickly studded with rosette-like clusters of brownish-black chromatophores. On the mid-dorsal line in the middle third of the back these chromatophores form a continuous band; near the margin the clusters are replaced to some extent by single chromatophores.

The eyes are arranged in two clusters of 'tentacle-eyes' of moderate size, each containing about a score of eyes. In front of them lie on either side about as many more eyes scattered irregularly. The gut branches anastomose.

This interesting species combines to some extent the characters of *Discocelis* with those of *Leptoplana*. The presence of a pair of receptacula seminis developed from the accessory vesicle of the vagina resembles the condition found in *Discocelis tigrina*, whilst the absence of marginal eyes and the widely separated gonopores forbid us to refer it to that genus. On the whole it is most conveniently placed in the genus *Leptoplana* as at present constituted, the male organs resembling those of other species of that genus.

Female apparatus. (See Figure 63.) The vagina (*va.*) runs back from the female aperture (♀) and receives the common duct (*c.d.*) from the uteri.

These latter extend forward from the short common duct, each being formed of two distinct sections. Firstly there is a duct-like part, consisting of a narrow tube lined with cubical, ciliated epithelium, surrounded by a few circular muscles (*u. d.*). This opens at about the level of the male aperture into a wide, irregular, glandular part, the pair extending forward on either side of the pharynx, and in one of the specimens, examined by sections, containing eggs. The walls of this glandular part (*u. gl.*) are much folded, and their epithelium is secreting actively and full of globules of a finely granular substance. Cell outlines are not visible.

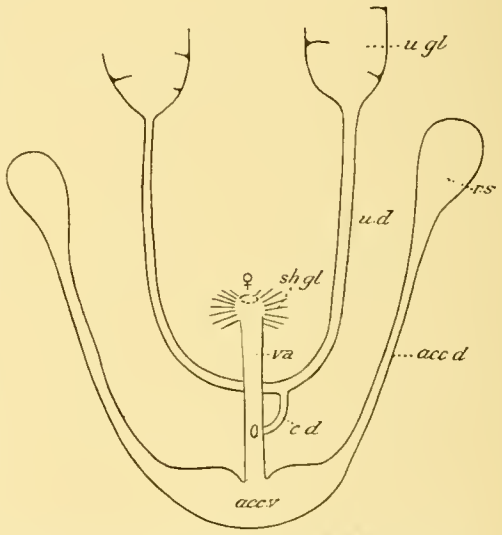


Fig. 63. Female apparatus of *Leptoplana pardalis* (diagrammatic). For explanation of lettering see text.

Behind the entrance of the common duct from the uteri the vagina, whose lumen is lined by cubical, ciliated epithelium surrounded by circular muscle fibres, runs back for a short distance, and finally opens into a crescentic accessory vesicle (*acc. v.*) with its horns directed forward. From either horn a narrow duct (*acc. d.*) runs forward, ending in a spherical dilatation (*r. s.*) which probably functions as a receptaculum seminis. The cubical epithelium, lining the accessory vesicle and the ducts opening into it, is not ciliated. In one specimen the receptacula are crowded with spermatozoa, surrounding a mass of what appears to be a granular secretion.

Considerable interest attaches to this species in that the walls of part of the uteri themselves are glandular. Glands in connection with the uteri are as a rule only present in certain Cotylea, such as *Diposthus*, *Pericelis* and various Euryleptidae, where they occur in

diverticula from the uterus. The accessory vesicle on the other hand only occurs in the Acotylea. In *Discocelis* it is glandular.

Male apparatus. The vasa deferentia dilate at their terminations to form a pair of moderately wide vesiculae seminales whose walls are surrounded by a thin layer of circular muscle-fibres. These vesiculae open into a short and narrow ductus ejaculatorius (Pl. XV. fig. 14, *d.e.*) lined with ciliated epithelium and provided with rather thick muscular walls. This duct narrows suddenly as it enters the muscular penis (*pe.*), which projects as a bluntly conical muscular mass into the antrum (*a.m.*). The antrum is lined with non-ciliated epithelium and its walls are muscular, forming the muscle sheath; I can find no trace of gland-cells in the epithelium.

Amongst the six specimens of this species collected at Minikoi is one which differs from the rest in coloration, being much darker. After a careful examination I have come to the conclusion that this difference is chiefly due to the expanded condition of its chromatophores, though they may be slightly more numerous. Unfortunately it is not possible to say whether this specimen was collected under different conditions from the others. Since examining these specimens I have received from Mr Gardiner three others, which I believe to be specifically identical with them, from Funafuti in the Pacific.

4. *Leptoplana*, sp.

One specimen from Minikoi. Damaged.

The arrangement of the eye-spots is that of a typical *Leptoplana*. There are a pair of small compact 'tentacle-eye'-groups, and in front of these the scattered brain-eyes.

Genital apparatus. The female aperture lies about two mm. behind the male, unfortunately the hinder part of the female apparatus is missing, but it bears a fairly close resemblance so far as can be determined to that of *L. vitrea* as figured by Lang. The shell-glands are very numerous, their secretion takes the form of enormous numbers of minute rhabdite-like bodies, similar to those found in *Pericelis* (see below). These rhabdites can be seen making their way into the lumen of the vagina. In the neighbourhood of the terminal parts of the genital apparatus the unripe shell-glands are so numerous as to give the tissue a characteristic appearance. They resemble closely those of *L. alcinoi* figured by Lang ([9] T. 14, Fig. 2), but in the latter species they are pyriform, whilst in the species under consideration they are spherical.

As they ripen and become filled with the small rhabdite-like bodies, the cell outlines become obscured, and finally the cells seem to disappear as though they had ruptured to permit of the escape of the contained rhabdites.

The walls of the vagina are lined with ciliated epithelium, and, as it passes back from the antrum, a fairly strong muscle layer developes about it. After running for a short distance backwards the vagina turns upwards and a little forwards and then finally backwards, receiving the separate openings of the uteri. Thence it continues back, first as a narrow tube, but further back appearing to open into a wide accessory vesicle; owing to the displacement of the organs at the hinder end of the body it is extremely difficult to follow. The uteri run forward, and for the first millimetre or so of their length have muscular walls, further on the muscles disappearing.

In the male apparatus the vasa deferentia open into a muscular vesicula seminalis, resembling in shape that of *L. vitrea*. From the front end of the vesicula the ductus ejaculatorius runs backwards and downwards for some distance; its lumen is rather wide and it is lined with glandular prostatic cells, outside which lies a layer of circular muscular fibres. This part of the apparatus resembles rather that of *L. pallida* than of *L. vitrea*. The rest of its structure is practically identical with that of *L. vitrea*. The duct narrows, and runs vertically upwards, then turns downwards and backwards again, extending parallel to the first part of its downward course. It is here very narrow, surrounded by a compact layer of circular fibres, outside which lie less compact, diagonal fibres. It opens finally into the antrum masculinum. These muscles form the penis.

As this specimen is in an imperfect condition I cannot describe it fully, though I believe it to be quite distinct from any named species.

III. Family Cestoplanidae.

5. *Cestoplana? maldivensis*, sp. n.

A single specimen from the reef of Minikoi, Laccadive group.

Total length about 15 mm., breadth 5 mm. Body flat, anterior end pointed, posterior end tapering a little. Colour (in spirit specimen) uniform dull brown. The hinder end of the body of the single specimen has unfortunately been so much damaged that it is impossible to determine the characters of the sexual organs.

The pharynx has the position typical for *Cestoplana*, and the mouth opening is about 4 mm. from the hinder end, whilst the male aperture is certainly not more than 2 mm. from the extremity.

From the two species of the genus previously known, viz. *C. rubrocincta* (Grube) and *C. faraglionensis* (Lang), the present species is separated by its relatively short and wide body. Another more striking difference is afforded by the arrangement of the eye-spots. In *C. maldivensis* there is a complete series of these round the margin of the body (see Fig. 64), on the posterior two-thirds of the body being few and distant, but on the anterior margin on either side as far back as the level of the brain thickly scattered. In addition to these in the apex of the triangular anterior end of the body lie a small number of eyes scattered over an area which stretches back for about half the distance from the apex to the brain; and further from the middle of the hinder end of this area two irregular parallel lines, each of a single row of eyes, extend back as far as the brain, which lies at about the end of the first sixth of the body.

The uteri can be traced forward through the hinder two-thirds of the body, and are crowded with eggs. Until it is possible to examine the genital apparatus of this species in a better-preserved specimen I prefer to leave it in the genus *Cestoplana*, although there can be no doubt that it differs strikingly from typical members of that genus.

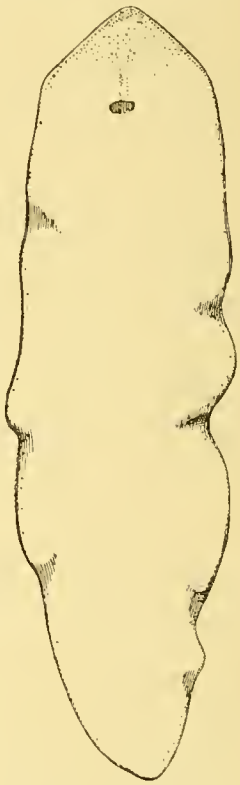


Fig. 64. *Cestoplana* (?) *maldivensis*. × 7.

COTYLEA. IV. Family Pericelidae, nov.

6. *Pericelis byerleyana* (Coll.) (Pl. XIV. fig. 6, & Pl. XV. fig. 15, 16, & 17).

Typhlolepta byerleyana. Collingwood, Trans. Linn. Soc. Lond. (2) i. p. 92; Lang, Naples Monogr. p. 616.

Five specimens from Minikoi.

Collingwood's description of this species is as follows:—"Length $\frac{3}{4}$ inch, breadth $\frac{3}{8}$ inch. Body smooth, thin, the lateral parts very ample and puckered. Upper surface beautifully marbled with light brown rings, including roundish spaces of a whitish colour, smaller rings being between the interstices of the larger; most crowded and darkest in colour along the median line, and more delicate towards the side. Under surface of a pale grey, the dendritic markings in the centre of an opaque white. Its movements were very contorted and it did not exhibit much activity. One specimen from under a piece of coral on Pulo Barundum off the west coast of Borneo."

In Mr Gardiner's collection are five specimens agreeing with this description so far as it goes, save that three of them are of considerably greater size. They are however provided with tentacles on the anterior margin, and with eyes; but I believe that Dr Collingwood may well have overlooked these owing to the extreme folding of the edge of the body.

Owing to the fact that this species possesses both eyes and tentacles it must be removed from the genus *Typhlolepta*. Its characters, moreover, are such as to distinguish it from all other Cotylea sufficiently to make it the type of a new genus and family[1].

The family *Pericelidae* may be defined as follows:—"Cotylea with small widely separated tentacles, with a complete series of marginal eyes; penis single; pharynx central; margin of the body excessively folded." Genus *Pericelis*.

The nearest ally of this interesting form is, I consider, *Anonymus*, the only other Cotylean Polyclad in which there is a complete series of marginal eyes. *Pericelis* further has the anterior margin notched in the middle line just as in *Anonymus*.

The most striking feature of the species, when viewed with the naked eye, is the extreme folding of the margin of the body. In one of the larger specimens the length of the body along the middle line is 35 mm., and the breadth at its middle about 32 mm., whilst the 'rim' of the body when spread out is not less than 230 mm. in length. In this same specimen the small tentacles lie not less than 9 mm. apart. They are crowded with eyes, and eyes are scattered completely round the margin inwards for a depth of about 5 mm. In the middle of the anterior margin is a well-marked notch or indentation, about 5 mm. behind this in the middle line is the elongated cluster of brain-eyes.

Other measurements are as follows:—mouth opening about 18 mm. behind the anterior margin. The male gonopore lies about 4 mm. behind the mouth. The female gonopore about 2·5 mm. behind the male. Sucker 1 mm. behind the female orifice.

To Collingwood's account of the coloration nothing need be added. I have ventured to give a coloured figure of one of Mr Gardiner's specimens to show the position of the tentacles and brain-eyes. It illustrates too the extraordinary amplification of the lateral parts of the body.

[1] The species is evidently a widely distributed one. I have received recently a sixth specimen of it from Mr Gardiner from Rotuma in the Pacific.

The body is characterized by its tenuity, its average thickness is only from ·3 to ·4 mm. Along the middle line there is of course a considerable thickening over the pharynx and genital apparatus, forming a ridge such as usually occurs in a Polyclad.

On the dorsal surface the epidermis contains large numbers of rhabdites about ·01 mm. in length. These are absent from the ventral surface. In addition to the rhabdites, pseudorhabdites occur numerously in both the dorsal and ventral epidermis. They are pellet-like bodies composed of a coarsely granular material, and are rather longer and at the same time thicker than the rhabdites. They are of sufficient size and number to give the whole surface of the body a granular appearance when viewed with a simple lens. On the dorsal surface of the tentacles the character of the epithelium differs markedly from that found elsewhere (see fig. 17). No rhabdites and only a very few small pseudorhabdites occur, and the whole epithelium has a very regular columnar arrangement, the nuclei all lie at the same level, viz. at about the middle of the cell. The cilia are not modified in any way, nor does there appear to be any special sensory apparatus. On the ventral surface of the tentacles the arrangement of the epidermal nuclei is quite irregular, and pseudorhabdites are fairly numerous, though not so abundant as over the general surface of the body.

The basal membrane lying below the epidermis is moderately thick; immediately below it lies the pigment, which to a great extent obscures the dorsal musculature. On the tentacles the pigment presents the appearance of being contained in chromatophores, whilst over the general dorsal surface of the body it is more diffuse and may be intercellular. In the flattened lateral parts of the body the inner longitudinal ventral muscle-layer is very strongly developed and extends dorsalwards for fully one-half of the thickness of the body. The muscles are but feebly developed in the tentacles; the space lying below the body-wall is almost entirely occupied with nerve-tissue. The "sucker" has its disc covered with a non-ciliated columnar epithelium; the nuclei are scarcely distinguishable, and the basal membrane very thin. Amongst the muscles below the basal membrane lie elongated gland-cells, full of a finely-granular secretion. Processes from these cells pierce the basal membrane and make their way through the epithelium to the surface. No pseudorhabdites are found in the epithelium of the disc. The pharynx is much folded and of considerable size, resembling in its arrangement that of *Anonymus viridis*.

Genital apparatus. In the two specimens from which sections were prepared the genital apparatus was well developed (Fig. 65). The vagina (*va.*) is of the type usually found in the Cotylea; that is to say, it runs upwards from the gonopore (♀), dilating at the point where it receives the shell-gland secretion (*sh. gl.*), further on narrowing again. It then turns back and downwards for a short distance, finally terminating in the uteri (*ut.*).

It is in connection with the uteri themselves that some of the most interesting characters of this species occur. In the first place there are a number of small rounded vesicles (*ut. v.*) each connected with the uteri by a short stalk-like duct. These vesicles in some cases contain quantities of spermatozoa, surrounding what appear to be fragments of eggs (cf. Woodworth [20], p. 66). In addition at intervals along the uteri are gaps in the walls, through which project into the lumen of the uteri cells, bearing a close resemblance to the yolk-cells of *Dendrocoelum lacteum* figured by Ijima [8] (see especially Pl. XXI. figs. 7–10, *loc. cit.*). This character is of importance, as hitherto no Polyclad possessing any organs comparable to the Triclad yolk-glands had been described.

The penis is muscular and directed backwards. It is conical in shape, and tapers to a fine point, which projects into a long and extremely narrow antrum masculinum (*a. m.*). At its anterior, proximal end the penis receives on either side the vasa deferentia (*d. e.*), crowded in the specimens with spermatozoa.

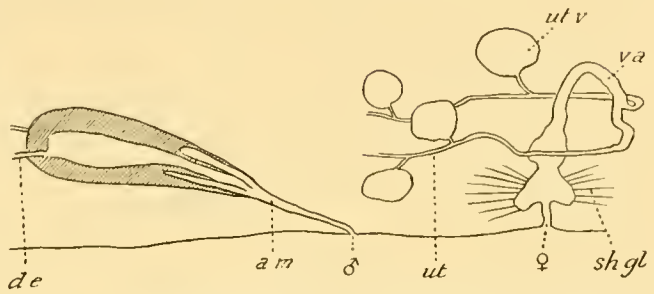


Fig. 65. Genital apparatus of *Pericelis byerleyana* (diagrammatic). For explanation of lettering see text.

Female apparatus. The shell-glands are large and extend for a considerable distance laterally. Their secretion is in the form of an immense number of minute, spindle-shaped, rhabdite-like bodies, which are each about a quarter of the size of the epidermal rhabdites. These are of peculiar interest as bearing on the morphology of the rhabdites of Turbellaria, and strongly supports the view taken by Woodworth [19] and others.

The vagina is narrow and lined with ciliated epithelium, surrounded by a very narrow layer of circular muscle-fibres, thicker at its hinder end, where it turns downward to receive the uteri the vagina has rather a thicker muscle layer. Outside the muscle-fibres lie a number of nuclei probably belonging to gland-cells. The epithelial lining of the uteri, if present, is so reduced that I have not been able to distinguish it. The walls of the uterus apparently consist of a ring of muscle-fibres surrounded as in the case of the vagina with gland-cells (see fig. 16). The uterine vesicles (see Fig. 65, *ut. v.*) are lined with a cubical, or somewhat columnar, non-ciliated, secretory epithelium. It rests on an extremely delicate basal membrane, and there is no muscular coat. The character of the lining epithelium of these vesicles recalls that of the receptaculum seminis of *Planocera langii*.

The vesicles are connected with the uteri by ducts of varying length, some so short that the vesicle is almost sessile on the uterus (fig. 15). They are similar in structure to the uteri themselves but smaller. The vesicles are fairly numerous, eleven opening into the uterus of one side between the level of the mouth opening and the vagina. So far as I can find they do not extend forward in front of the mouth. As already stated these vesicles frequently contain spermatozoa, surrounding a 'lump' of material, which appears to consist of small, round, hyaline cells with black nuclei, which do not resemble eggs. In the homologous vesicles of *Diposthus corallicola* Woodworth and in certain Euryleptidae spermatozoa are found surrounding fragments of what Woodworth and Lang suppose to be eggs, but in the present instance these 'lumps' are certainly not fragments of eggs. The ovaries contain ripe eggs. The oviducts themselves are indistinguishable.

Certain remarkable structures, as has already been stated, occur in connection with the uteri which bear a fairly close resemblance to the yolk-glands of certain Tricladida. The only structure with which they can be compared in the Polyclads are the 'rosette-like glands' of *Cycloporus papillosus*, described by Lang [9]. These differ firstly in that they open into the oviducts, and secondly in having the character of glandular diverticula from the oviducts. In *Pericelis* on the other hand there are numerous gaps in the walls of the uteri (Pl. XX. figs. 15 and 16), through which project deeply staining pyriform cells, which do not seem to be of a definite secretory or glandular character, with oval black nuclei. On the whole these organs of *Pericelis*

approximate more closely to the yolk-glands of the Triclads than to any structure previously known amongst the Polyclads. It is possible, however, that they are connected with the cell-like bodies found in the uterine vesicles as described above.

Male apparatus. The vasa deferentia are crowded with spermatozoa. They enter the walls of the penis some little distance behind its anterior end, narrowing as they do so. For the first third of its length its lumen is lined by glandular cells, and filled with a coarsely granular secretion (see Fig. 66). For the rest of its length it has a cubical ciliated epithelium, as also has the antrum masculinum. The wall of the penis is composed chiefly of circular fibres, interspersed with a few radial. The antrum becomes extremely narrow as it approaches the gonopore, and the latter is correspondingly minute.

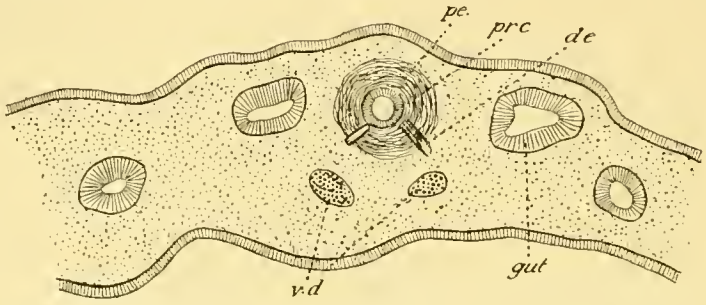


Fig. 66. Section across the base of the penis of *Pericelis byerleyana*.
pe. = penis, *pr. c.* = glandular cells, *v. d.* = vasa deferentia, *d. e.* = vas deferens entering penis.

Leaving the specialized *Prosthiostomum* out of account I believe that all other Cotylea save *Anonymus* have a special muscular prostatic organ connected with the penis by a short duct. Consequently *Pericelis* is more nearly related to *Anonymus* in the structure of the terminal parts of this organ than to the rest of the Cotylea.

V. Family Pseudoceridae.

7. *Thysanozoon plehni*, sp. n. (Pl. XIV. fig. 7, and Pl. XV. fig. 19).

Three specimens "from the reef-flat" Minikoi, with "brown to slate-black papillae."

Total length about 23 mm. Total breadth about 17 mm. 'Mouth opening' about 5 mm. behind the anterior margin. ♂ aperture 4 mm. behind the 'mouth.' ♀ aperture 1 mm. behind the male. Sucker 2 mm. behind the female aperture.

The ground-colour of the body in the spirit specimen is a dull pale yellow. On the dorsal surface lie a considerable number of black, rather pointed papillae; the small marginal tentacles are also black. Brain-eyes in a single small cluster; tentacle-eyes arranged along the anterior side of the tentacles (Fig. 67).

The muscle-layers of the body-wall are but feebly developed. The dorsal papillae contain no gut diverticula, only a loose parenchyma. Their epithelium is composed of very long, columnar cells, loosely connected with each other, containing clusters of rhabdites which vary in length from ·01 to ·0275 mm. In addition to the rhabdites the epithelium of the papillae secretes a small number of pseudorhabdites, bodies of about the same length as the larger rhabdites, but two or three times as broad and of a finely granular texture. They occur nowhere save on the papillae (Pl. XV. fig. 19). At the tip of each papilla is a small

'plug-like' mass of tissue derived in part from the parenchyma and in part from the epidermis, which differs from the tissue surrounding it in being denser and in staining more deeply. It occurs in every papilla through which my sections pass, but I cannot offer any suggestion as to its significance.

Fig. 67. Tentacles and eyes of *Thysanozoon plehni*.

Behind the level of the pharynx, which resembles that of other species of the genus, the main gut gives off numerous branches. *These do not all arise from it in the same plane,* but at the same time no branches are given off from the ventral side. Von Plehn [10] in describing two new species, which she calls *Thysanoplana indica* and *Thysanoplana marginata,* pointed out that a similar peculiarity occurs in those species, but to a much greater extent, for in them apparently the branches may in addition originate from the ventral side of the main gut. I have also found—from a careful examination of a series of sections in the Laboratory Cabinet of the Owens College Zoological Department—that in the neighbourhood of the male aperture of *Thysanozoon brocchii,* and for some little distance behind it, the gut branches do not all rise in exactly the same plane, though only from the lateral walls of the main gut. It is in the same neighbourhood, viz. in that part of the body where the main gut is largest, that this feature is most marked in von Plehn's species of *Thysanoplana* as well as in *Thysanozoon plehni.*

Genital organs. Excepting in detail these resemble very closely those of other species of the genus, and especially those of *Th. auropunctatus* (Coll.) as figured by von Stummer-Traunfels [14]. The terminal parts of the female ducts are in no way peculiar. The eggs, like those of other species of the genus, exhibit large centrosoma.

Male apparatus. The vasa deferentia unite to enter the vesicula seminalis by a short common duct ("gemeinschaftlicher Einmündungsgang" of von Stummer-Traunfels), which runs dorsalwards to open into the lower side of the vesicula near its hinder end. The vesicula extends forwards and a little downwards for the greater part of its length, but close to its anterior end it curves suddenly downwards and narrows into the duct to the penis. This duct is long, more than twice the length of the vesicula, and after a tortuous course enters the base of the penis, where it is joined by a very short duct running from the small prostate gland, which lies close above and behind the penis. It is lined with secretory epithelium, and has a compact muscular wall composed of diagonal fibres. The penis is armed with a short tubular chitinous stylet and projects into a cavity, whose walls form the penis-sheath. This cavity opens immediately below the penis into the antrum masculinum, which in turn opens to the exterior by the male gonopore.

It is of some interest to find that, whereas the gonopore is situated on the middle line, the penis with the penis-sheath lies very decidedly to one side of it, the right side. But the cavity of the antrum is extended fairly equally both to the right and to the left of the middle line. This peculiarity perhaps indicates that this species is descended from a form in which, as in many other species of *Thysanozoon,* the penis is paired, and that one of the pair, the left in this instance, has disappeared leaving the right penis to open unsymmetrically into the symmetrical antrum. In Lang's Monograph, T. 30, fig. 17, a diagrammatic figure is given of the terminal male apparatus of *Pseudoceros maximus*—a species belonging to a closely-allied genus—which possesses a pair of penes. If we picture one of these penes to be atrophied, the diagram would represent very closely the appearance seen in a section of the present species passing through the penis and antrum masculinum.

Thysanozoon plehni is on the whole most closely related to *Th. obscurum* described by von Stummer-Traunfels [14] from Amboina.

Genus *Pseudoceros*.

A. Forms with a pair of penes.

8. *Pseudoceros gardineri* sp. n. (Pl. XIV. fig. 4).

One specimen from Hulule, Male Atoll.

Total length about 35 mm., total breadth about 22 mm. Mouth opening 8 mm. behind the anterior margin. Female gonopore about 5 mm. behind the mouth. Sucker 7 mm. behind the female gonopore.

The margin is much folded. Body flat, oval with a prominent mid-dorsal longitudinal ridge. Colour: dorsal surface a delicate gray with scattered irregular black marks of varying size dotted over the surface; under surface grayish-white.

The marginal tentacles are sharply pointed, large and prominent. The eyes, which are exceedingly numerous, are grouped as follows. A large compact cluster containing about 200 eye-spots lies over the brain. This is circular in shape save for a slight notch in the middle of its hind margin. On the dorsal surface of either tentacle near the middle line and close to the anterior margin is a group of eyes, rather more scattered than those of the brain-cluster. On the outer side of each of these clusters is a second still more diffuse group. On the ventral surface of the tentacles, almost immediately under the more medially placed dorsal group, are two roughly square compact patches; from the outer side of each of these a small 'wing' runs on to the ventral side of the tentacles (Fig. 68). The projecting 'wing' is concealed by marginal folds.

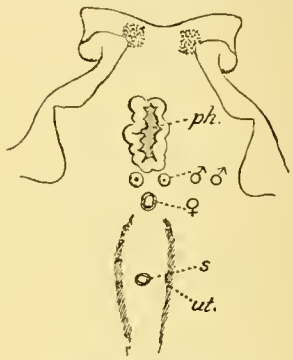


Fig. 68. Ventral surface of *Pseudoceros gardineri*. *ph.* = pharynx, *s.* = sucker, *ut.* = uterus, ♂ ♂ = penes, ♀ = female aperture.

9. *Pseudoceros punctatus* sp. n. (Pl. XIV. fig. 5).

One specimen from Hulule, Male Atoll.

Total length about 30 mm., breadth about 17 mm. Mouth about 5 mm. from anterior margin. Female gonopore 4 mm. behind mouth. Sucker 4 mm. behind female gonopore.

Body oval, flat, with well-marked, median, longitudinal ridge. Colour pale grayish-yellow, plentifully spotted on the dorsal surface with small black chromatophores.

The tentacles are pointed as in the preceding species.

The eyes over the brain form a very small cluster of some 25—34 minute eyes. At the base of each tentacle, on the dorsal side and close to the anterior margin, is a small, ill-defined cluster of eyes, and there are also a few scattered eyes on the outer sides of the tentacles. On the ventral side of the tentacles are a pair of small clusters near the middle line and a few scattered eye-spots along the tentacle fold.

The species is readily distinguished from the preceding by its possessing much more distinctly defined and more regular chromatophores, as well as by the relative fewness of its eyes. It yet resembles it especially in the shape of the tentacles, which are more like those found in certain Euryleptidae than those of most Pseudoceridae.

B. Forms with a single penis.

10. *Pseudoceros gamblei* sp. n. (Pl. XV. fig. 18).

Several specimens from Minikoi, Laccadive Group, 'milk-white' or 'transparent flesh colour' with purple or dark-blue rims.

Total length about 12 mm., breadth 6 mm. Mouth opening about 2 mm. behind the anterior margin. Female aperture about 1 mm. behind mouth. Sucker about 1 mm. behind the female aperture.

A small circular cluster of eye-spots lies over the brain about 1·2 mm. behind the anterior margin. There is a row of eyes along the margin of the tentacles both on the dorsal and ventral sides, which is continuous across the middle line (Fig. 69).

Sections were cut transversely through the anterior region of the body of a semi-adult specimen. Rhabdites appear to be absent in the epithelium, and the muscle layers of the body-wall are feebly developed. The testes lie, as is usually the case, on the ventral side of the gut, and the ovaries which are immature can be recognised on the dorsal side. The penis is that of a typical Pseudoceroid. The vasa deferentia before uniting to form the muscular ductus ejaculatorius are each dilated to form a vesicula, which is crowded with spermatozoa (Pl. XV. fig. 18).

A feature of the species is the curious shape of the pharynx, which has its hindmost folds produced backwards to form wing-like projections on either side, extending as far back as the level of the female aperture (Fig. 69).

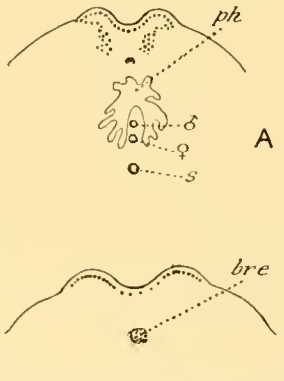


Fig. 69. Anterior end of *Pseudoceros gamblei*. A. from ventral; B. from the dorsal side.
ph. = pharynx, *br.e.* = 'brain-eyes,' *s.* = sucker, ♂ = penis, ♀ = female aperture.

11. *Pseudoceros tigrinus* sp. n. (Pl. XIV. fig. 3).

One specimen from Minikoi, Laccadive Group.

Total length about 17 mm., breadth 11 mm. Mouth aperture about 4 mm. from anterior margin. Male aperture about 5 mm. from anterior margin. Sucker about 3 mm. from male aperture.

Ground colour orange-pink, margin and tentacles black.

On the dorsal side, on either side of the middle line a black band runs from the anterior margin to within a short distance of the posterior margin. These two bands meet each other across the middle line at their anterior and posterior extremities. In addition to these black, triangular patches project inwards at intervals along the margin; these like the two median bands have on them a few rather large, circular, pink spots, and between these the black is thickly flecked with very small white spots.

The position of the eye-spots is completely concealed by the pigmentation of the body, which readily serves to distinguish the species.

The remaining specimens referable to this genus, some eighteen in number, are all very similar to one another in appearance, being of black colour with yellow margins. Two distinct

forms can be recognised. The first of these has a narrow pale yellow border and its ground colour is a greenish-black. The second has a broader orange border and its ground colour is rather a velvety-black.

Excepting for the above difference it is difficult to find any distinguishing characters. Measurements are of little value owing to the varying degrees of contraction of the several specimens, and the dense pigmentation makes it impossible to determine the arrangement of the eye-spots, especially those of the tentacles, with any degree of accuracy.

I believe the form with the pale narrow yellow margin is identical with *Proceros buskii* of Collingwood, found by him in Singapore Harbour. In his description [4] he gives the colour of the body as a rich velvety olive-green, but in his figure the body is shown rather as black. The appearance of the margin in his figure of *Proceros buskii* agrees with that of my specimens. I feel therefore justified in identifying them with Collingwood's species.

12. *Pseudoceros buskii* (Collingwood).

Proceros buskii Collingwood [4], p. 91, Pl. I. fig. vi.

Pseudoceros buskii Lang. Naples Monogr. p. 547.

Ten specimens from Hulule and Minikoi.

Length about 22 mm. Breadth about 12 mm. Mouth opening 5 mm. behind anterior margin. Sucker 8 mm. behind mouth.

Colour black or greenish-black with a narrow pale-yellow margin. Eyes on the tentacles and in a small cluster over the brain; only visible in sections.

The other eight specimens which have a broad orange margin are I think allied to *P. buskii* on the one hand and on the other to *P. velutinus* Lang, a species recorded from Ceylon. I think it advisable to refer them for the present at any rate to a new species under the name of *Pseudoceros flavomarginatus*.

13. *Pseudoceros flavomarginatus* n. sp.

Eight specimens from Minikoi, Laccadive Group.

Length about 25 mm. Breadth about 15 mm. Mouth aperture about 5 mm. behind the anterior margin. Sucker about 7 mm. behind the mouth.

Colour velvety-black with an orange margin about 1·5 mm. wide.

Eye-spots occur on the tentacles and over the brain.

It will be noticed that this species is a little longer than *P. buskii* and that perhaps the relative position of certain organs is different. But, as already remarked, much importance cannot be attached to measurements.

VI. Family Prosthiostomidae.

14. *Prosthiostomum elegans* sp. n. (Pl. XIV. fig. 8, Pl. XV. fig. 20).

A single specimen, dredged off hard sand, at 30 fathoms, in the lagoon of Suvadiva Atoll.

Length of body about 18 mm., breadth 4·5 mm. Anterior margin rounded, posterior end of the body pointed.

Colour, in the spirit-specimen, pale primrose-yellow. From immediately behind the level of the brain, on either side of the longitudinal mid-dorsal ridge, extends a row of chocolate-

brown chromatophores, about 12 in each row. In addition to these there is a single small chromatophore on either side of the brain (see Pl. XIV. fig. 8). Under surface entirely primrose-yellow.

A number of minute eyes are scattered round the anterior margin of the body. There are also two groups lying over the brain. These form a V-shaped cluster; the apex of the V is directed forwards, and each of its limbs, narrowing from behind forwards, is made up of some 15 eye-spots, which are rather larger than those of the margin[1].

The margin is not folded. In shape this species approaches *P. dohrni*, Lang, and its structure is closely similar to that of *P. siphunculus* (Delle Chiaji), fully described by Lang. It differs however sufficiently from both and from other species admitted by Lang in colour and in details of the arrangement of the eyes.

It was necessary to examine the specimen by serial sections. I append some details of its anatomy:—

Body-wall. The epidermis consists of a columnar ciliated epithelium, containing but few rhabdites. It rests on a moderately thick basal membrane. The musculature of the body-wall is more strongly developed on the ventral than on the dorsal side. Immediately within the basal membrane lies a thin layer of longitudinal muscle-fibres, next to these circular fibres followed by diagonal fibres. Lastly, on the ventral side only is an inner longitudinal layer.

Pharynx. The pharynx is of course tubular as throughout the family. My sections were only cut a little further forward than the proximal end of the pharynx, and at this end its lumen is triradiate in transverse section (Fig. 70, *A*). This triradial appearance occurs in other species of the genus). It shows some differences in detail from the proboscis of *P. siphunculus* described by Lang [9].

The outer and inner walls are lined with extremely flattened pharyngeal epithelium (Fig. 70, *B*, *o. e.* and *i. e.*). A large number of radial fibres (*ra. m.*) extend right across the wall from

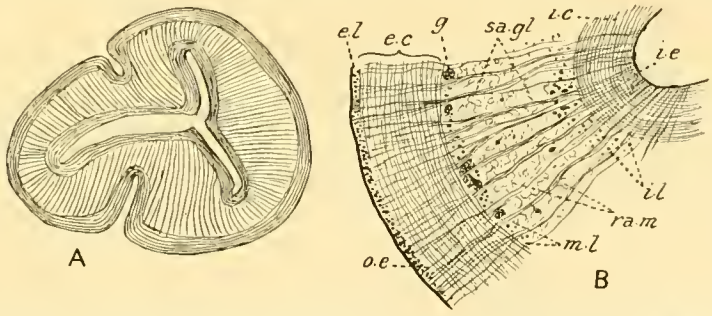


Fig. 70. Transverse section through the pharynx of *Prosthiostomum elegans*.
A. An entire section showing the triradiate lumen. B. Part of the same more highly magnified.
For explanation of lettering see text.

the inner to the outer epithelium. Immediately within the outer epithelium (*o. e.*) is a narrow layer of longitudinal muscle-fibres (*e. l.*), succeeded by a much wider circular layer (*e. c.*). In *P. siphunculus* this circular layer is succeeded by a longitudinal layer, which Lang calls the retractor muscle layer. This layer is present in *P. elegans*, but is only poorly developed (*m. l.*). Amongst the fibres composing it occur a certain number of ganglion cells (*g.*). Below

[1] In fig. 8 the marginal eyes are drawn proportionately too large.

the inner pharyngeal epithelium (*i. e.*) is a thick inner circular muscle layer (*i. c.*) followed by a narrower inner longitudinal layer (*i. l.*). Between this latter and the median longitudinal, or retractor muscle layer (*m. l.*) lie the salivary glands (*sa. gl.*), occupying fully one-half the width of the proboscis. Whilst passing through these the radial muscle-fibres are gathered up into more or less compact bundles.

Gut. The gut-diverticula are precisely similar in structure and arrangement to those of *P. siphunculus*. Their walls are crowded with exceedingly minute bacteria-like structures, which are entirely absent from other parts of the body. In the main-gut, however, I have found what appears to be a distinct kind of bacterial organism in various stages of growth (Fig. 71). The smallest, presumably the youngest stages, are rod-like; as the organism increases in size it gradually acquires a dumb-bell appearance, until finally it consists of two nearly equal sub-spherical masses united by a short stalk. Its subsequent fate I have not been able to trace.

Fig. 71. Bacteria-like organism from the gut of *Prosthiostomum elegans*.

Genital apparatus. Of the female organs only the vagina and shell-glands are developed; they are precisely similar to those of *P. siphunculus*, and in fact of most Cotylea. The male organs are in full functional activity. In this species the relative size of the terminal parts of the male apparatus is much greater than in *P. siphunculus*, otherwise they are very similar in the two species.

The two large vasa deferentia run inwards and forwards at their distal ends to open into the vesicula seminalis, a large sac with muscular walls, composed of circular fibres, lined on the inside with a flattened epithelium. The vasa deferentia do not open into the extreme hind end of the vesicula, but pass into its walls on either side a short way in front of its hinder extremity, and then run backwards in its walls for a short distance before opening into it. This arrangement may act as a valve to prevent 'regurgitation' of the sperm, when the vesicula is contracted suddenly. From the anterior end of the vesicle a ductus ejaculatorius runs forward to enter the penis. It is lined on the inside with a flattened non-ciliated epithelium, outside which is a very thin layer of circular fibres.

Immediately in front of the vesicula, lying side by side above the ductus, are two large spherical vesicles with thick muscular walls composed of circular fibres; outside the muscular layer is a sheath of specialized parenchyma, rather denser than the ordinary tissue. These vesicles are called by Lang 'accessory vesicles.' Their lumen, which is fairly spacious, is lined with a flattened epithelium, bearing a few cilia. Each is provided with a short duct —relatively much shorter than in *P. siphunculus*—which runs forwards, twisting greatly as it goes, lying for the most part dorsal to the ductus ejaculatorius. These accessory ducts, as they may be called, differ greatly from the latter. They are in the first place much narrower, they have a relatively thicker outside wall of circular fibres, and the epithelium through which they run is tubular, that is to say the ducts are intracellular. They pierce right through the muscular coats of the accessory vesicles. "Sie sind innen von einem verschwindend niedrigen Plattepithel ausgekleidet, in welchem die Zahl der einzelnen Epithelzellen andeutenden Kerne so gering ist, dass auf einen Querschnitt des Canales nie mehr als ein Kern zu liegen kommt, so dass man hier auch von durchbohrten Zellen sprechen kann." (Lang [9], p. 276.)

The ductus ejaculatorius (which for convenience I will simply call the ductus) as it approaches the base of the penis is joined by the two accessory ducts, which enter its walls and run forward in them for some distance, lying immediately to the outside of the epithelium of

the ductus itself. After entering the penis the two accessory ducts open into the ductus. The penis is curved downwards and a little backwards; it consists essentially of the end of the ductus, protected by a tapering chitinous tube or stylet, with a narrow lumen, projecting into the antrum masculinum. It can be protruded and withdrawn through the male gonopore by the action of muscle-fibres, attached to the base of the chitinous stylet.

The antrum consists of a small dorsal and a much larger ventral chamber separated from each other by a circular fold of its wall. The roof of the dorsal chamber is of course formed by the attachment of the basal part of the penis to the body. Its walls are lined with a flattened non-ciliated (?) epithelium, through which the secretion of a large number of gland-cells is being poured. These gland-cells lie beneath the epithelium, and may collectively be called the prostate glands. The walls of the dorsal chamber form the 'penis-sheath.' The ventral chamber of the prostate is lined with ciliated epithelium continuous with that of the surface of the body. Its walls have a muscular coat, consisting of an inner circular and an outer longitudinal layer of fibres.

The accessory vesicles are both full of the coarsely granular secretion (fig. 20, *s.*) of the gland-cells of the dorsal chamber of the antrum, and the same secretion is present in the accessory ducts. This secretion cannot be the product of the accessory vesicles themselves, and must reach them through their ducts. But it can only enter the ducts by passing from the antrum through the external opening of the penis stylet, and travelling up the penis to the opening of the accessory ducts into the ductus, and then turning down there. This Lang observes can come about in one of two ways. We may suppose that the secretion may be driven up the accessory ducts by contraction of the walls of the antrum, the male aperture and the ductus behind the openings of the accessory ducts being closed; or the secretion may be drawn into the accessory vesicles by a pumping action of the vesicles themselves. The latter is perhaps the more probable method[1].

The species appears to be most closely related to von Plehn's *P. nationalis* from the coast of Labrador [11].

15. *Prosthiostomum cooperi* sp. n. (Pl. XIV. fig. 2).

Two specimens, one semi-adult, the other immature, from Hulule, Male Atoll.

The larger individual is 17 mm. long and about 5·5 mm. broad.

Colour, milky white, margin of the body much folded. The adult has a series of fine black circular markings, arranged roughly in two parallel rows running down the middle of the back, from immediately behind the brain eyes, almost to the end of the body.

The anterior margin is rounded, the posterior pointed. The anterior marginal eyes are numerous and extend back along the margin considerably beyond the level of the brain eyes. These latter are arranged in two long, almost parallel series, which diverge slightly from each other at their ends.

Body-wall much as in *P. elegans,* but the rhabdites are much more numerous.

Genital apparatus. In both specimens the female organs are undeveloped. In the semi-adult the male apparatus is mature, but unfortunately rather displaced owing to the specimen having been damaged.

[1] An examination of Lang's diagram of the genital organs of *Prosthiostomum siphunculus* will enable the foregoing account to be much more easily followed, see Lang [9] T. 30, fig. 20.

The general arrangement of the terminal organs is similar to that in *P. elegans*, and the relative size of the parts is equally great. The vesicula seminalis lies transversely; this is probably owing to displacement. Its lumen, like that of the accessory vesicles, is relatively very small and the walls thick. The vasa deferentia unite before entering the vesicula, which lies transversely in the body possibly owing to displacement. The two accessory vesicles lie closely pressed together, and are bound up in a common sheath of specialized parenchyma. The glandular cells of the dorsal chamber of the antrum are well developed, but there is no secretion present either in the accessory vesicles or ducts.

The following table records the distribution of known species of this genus:—

	Mediterranean Sea	Atlantic Ocean		Indian Ocean[1]	Pacific Ocean		Polynesia
		English Channel	East Coast of North America	Maldives	Japan	Hong Kong	
1. P. siphunculus ...	*	*	...	...	...	...	...
2. P. dohrni	*	...	...	...	...	...	...
3. P. pellucidum[2] ...	*	...	...	...	...	...	...
4. P. sparsum	...	...	...	...	*	...	...
5. P. obscurum	...	...	...	...	...	*	...
6. P. tenebrosum ...	...	...	...	...	...	*	...
7. P. cribriarium ...	...	...	...	...	*	...	...
8. P. constipatum ...	...	...	...	...	*	...	...
9. P. elegans	...	...	...	*	...	...	...
10. P. cooperi	...	...	...	*	...	...	...
11. P. gracile	...	...	*	...	...	...	...
12. P. grande[3]	...	...	...	...	*	*	*
13. P. nationalis[4] ...	...	...	*	...	...	...	...

[NOTE. ON A SPECIMEN FROM CEYLON.

I take this opportunity of figuring and describing very briefly a typical *Cestoplana* obtained by Mr Stanley Gardiner off the Weligama reef, Ceylon.

Cestoplana ceylanica sp. n.

Very closely allied to *C. rubrocincta*.

Length about 65 mm., breadth 9 mm.

Anterior end of the body pointed. Colour (in the spirit specimen) dull gray with traces of a darker margin.

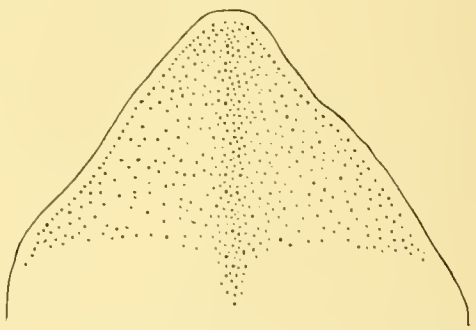


FIG. 72. Anterior end of *Cestoplana ceylanica*.

[1] Add an undescribed species from Ceylon.

[2] Doubtful species.

[3] It is possible that under this name more than one species is included by Lang, in fact different authors have described species from these three localities as distinct, but their descriptions are insufficient.

[4] See von Plehn [11].

Eye-spots (see Fig. 72) much as in *C. rubrocincta*, but the hinder margin of the eye-bearing area is straighter.]

II. NOTES AND CONCLUSIONS.

Most of the species described above have been examined by means of serial sections, the only satisfactory method of dealing with preserved specimens of this group. In some cases, however, I found it practicable to diagnose species sufficiently without having recourse to sections. This was especially the case with various specimens belonging to *Pseudoceros*.

I have not attempted to deal at all fully with the anatomy of any specimen described in the foregoing account, partly because space did not permit of my doing so and partly because Lang's Monograph has rendered it unnecessary. For fuller information concerning the anatomy of certain species of *Planocera* reference may be made to von Graff [6], and a very full account of the genus *Thysanozoon* has been given by von Stummer-Traunfels [14].

Planocera and a new Genus. Lang divides the genus Planocera as defined by him into two groups, A and B. These groups may briefly be defined as follows:—

A. Five to seven pairs of branches from the main gut. Penis cylindrical, its lumen lined with chitinous spines; lying in a muscular outer sheath. Female apparatus provided with a muscular bursa copulatrix.

B. Gut branches numerous. Penis styliform; no bursa copulatrix.

The really striking anatomical distinctions between the two groups argue equally marked physiological differences. That such exist is, I believe, shown by the fact that Wheeler [16] has proved that in *Pl. inquilina*, a species belonging to group B, hypodermic impregnation frequently occurs, in fact that in some cases the vagina may have no function other than that of a passage for the escape of fertilized eggs. A similar phenomenon may occur in other members of group B. On the other hand in group A the structure of the penis would preclude the possibility of hypodermic impregnation, whilst the presence of a large muscular bursa copulatrix indicates that fertilization is the result of a normal process of copulation. Such differences are quite sufficient to warrant the raising of the two groups to generic rank. The name *Planocera* must be retained for 'group A,' whilst for 'group B' I venture to suggest the name *Hoploplana*.

In Fig. 73 copied from Lang the arrangement of the genital organs of *Hoploplana insignis* is shown. If this figure be compared with Pl. XV. fig. 12, the difference between a true *Planocera*, such as *Pl. armata*, and *Hoploplana* will be apparent.

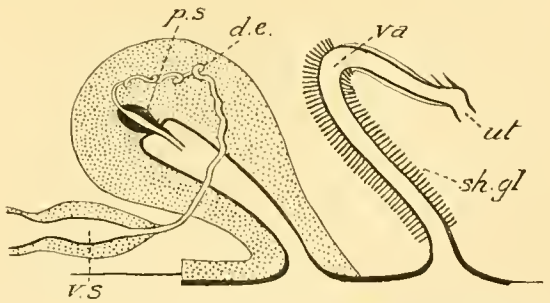


Fig. 73. Genital apparatus of *Hoploplana insignis* (after Lang). *va.* = vagina, *ut.* = uterus, *sh. gl.* = shell-gland, *v. s.* = vesicula seminalis, *p. s.* = penis, *d. e.* = ductus ejaculatorius.

The genus *Planocera* then as restricted may be defined in the same terms as group A is defined above, as Planoceroids with—Five to seven pairs of branches from the main gut. Penis cylindrical, its lumen lined with chitinous spines; lying in a muscular outer sheath. Female apparatus provided with a muscular bursa copulatrix.

It is obvious that *Pl. langii* differs more from any one of the other *Planocera* than they differ amongst themselves. The most pronounced differences are of course for the male apparatus the presence of paired vesiculae seminales, for the female the character of the bursa copulatrix, which appears to develope as an outgrowth from the vagina. I am inclined to suppose that an organ of a similar character occurs in Verrill's genus *Heterostylochus* [15]. In describing it he says of the female organs that, "a long narrow median duct runs far forward from the female orifice and expands into a flask-shaped seminal receptacle or spermatheca near the male organs; a swollen egg-duct also connects with the female orifice." The spermatheca may perhaps be the same organ that I have called the bursa copulatrix. Its true character may be judged from its appearance as shown in Pl. XV. fig. 13.

Thysanozoon and Thysanoplana. Von Stummer-Traunfels [14] has recently suggested a modified definition of the genus *Thysanozoon* Grübe: "Pseudoceriden mit spitzohrähnlichen faltenförmigen Randtentakeln, mit zottenförmigen dorsalen Anhängen in welche bisweilen Divertikel der Darmäste hineintreten, ohne jedoch daselbst auszumünden: mit einfach oder doppelten männlichen Begattungsapparate."

The genus is thus made to include a number of tropical species, several new species being described in an interesting review of the genus by this author, who has also given a series of beautiful figures of most of the species. He finds that of all the species known to him only one, viz. *Thysanozoon brocchii*, has the dorsal papillae invaded by gut-diverticula. *Thysanozoon brocchii* and about six other species have paired male apparatus. *Th. auropunctatus* (Kel. Coll.) and several others have an unpaired penis.

Von Plehn [10] has described a new genus, *Thysanoplana*, containing two species evidently closely allied to *Thysanozoon*. It is separated from this genus on the following grounds. Firstly, "Im Gegensatz zu *Thysanozoon* der männliche Apparat ist unpaar." Secondly, "Hauptdarm mit zahlreichen vielfach übereinander entspringenden Darmastwurzeln." The papillae are stated definitely to be invaded by gut-diverticula.

Now if we accept von Stummer-Traunfels' amended definition of the genus *Thysanozoon*, it is evident that the first of the characters, viz. the unpaired male apparatus, will not serve to distinguish *Thysanoplana* from *Thysanozoon*, and as to the second I have found that a similar peculiarity, though much less marked, occurs in *Thysanozoon plehni* (mihi), whilst traces of the same occur even in *Thysanozoon brocchii* (see above). Accordingly in this case the generic name *Thysanoplana* cannot, I think, be maintained.

On the other hand, if we do not accept the amended definition and retain *Thysanoplana*, it will be necessary to subdivide *Thysanozoon* into several genera as follows:—

A. Species with gut-diverticula in papillae.
   - *a.* Penis unpaired (*Thysanoplana*).
   - *b.* Penis paired (*Thysanozoon brocchii*).

B. Species without gut-diverticula.
   - *a.* Penis unpaired (*Thysanozoon plehni*, etc.).
   - *b.* Penis paired (*Thysanozoon*, sp.).

The mode of origin of the gut-diverticula cannot, I consider, be employed as a generic character. On the whole it is simplest at present to refer all the described species to the

genus *Thysanozoon*, and consequently *Thysanoplana* must be referred to the synonymy of that genus. When it becomes advantageous to divide up the genus, the best guide to a correct grouping of the species will probably be found in the presence or absence of gut-diverticula in the dorsal papillae.

Distribution in the Indian Ocean. Great interest attaches to Mr Stanley Gardiner's collection owing to the fact that it is not only the first made in the neighbourhood of the Maldive and Laccadive Archipelagoes, but also that it is one of the largest ever made in the Indian Ocean; certainly the largest since the publication of Lang's Monograph. It is not of course possible on our present knowledge of exotic forms to discuss the distribution of marine Turbellaria, yet a few points are worthy of remark in connection with these specimens.

Firstly, it will be noted that the Euryleptidae are entirely lacking in the collection. We must not assume therefore that they are altogether absent from the reefs of the Archipelago, but we are certainly justified in supposing them to be of considerable rarity in that neighbourhood. This is the more remarkable when we remember that the Euryleptidae are well represented on the coast of Ceylon, and are known to occur in most seas.

I quote here an extract from Mr Gardiner's notes: "I have no lists, nor can I find any account of the Turbellaria round continental tropical coasts, on which to base any comparisons as to the relative abundance of the group in the Maldives. From a limited examination of some reefs at Weligama and off the Jaffna coast of Ceylon I am inclined to think that they are very much less abundant in the Maldives, both in number and variety of species."

Secondly, the relatively high percentage of Pseudoceridae in the collection is striking. In addition to the five or six species of *Pseudoceros* given in the systematic part there are fragments of a specimen, which must I believe be referred to this genus, but is too much broken to describe.

Probably the Prosthiostomidae and Cestoplanidae will prove to be abundant over the whole of the Indian Ocean, and we may expect to find, especially in the latter family, forms of great interest. I have in my possession a collection of Turbellaria made by Mr Evans near Penang. This collection contains not less than two new Cestoplanoids, one of them a very remarkable creature with a complete series of marginal eyes which are much more numerous than those of *Cestoplana maldivensis*; its body also is relatively much longer.

Lastly, the occurrence of *Pericelis byerleyana* and of *Leptoplana pardalis* in the Tropical Pacific as well as in the Maldives' Archipelago is of interest. Two other widely distributed species, *Leptoplana tremellaris* and *Thysanozoon brocchii*, are known, but both of these occur in north temperate as well as in tropical seas.

Parasites. In none of the specimens in this collection, of which I have cut serial sections, have I found any gregarine parasite such as that which is found commonly in *Leptoplana tremellaris*[1]. On the other hand I would call special attention to the occurrence in two species, viz. *Planocera armata* and *Prosthiostomum elegans*, of bacteria or bacteria-like structures, which in both cases, but especially in the former, appear to occur only in certain definite situations.

Gut-Diverticula. Similar gut-diverticula to those found in *Planocera armata* occur also in other Planoceroids. Whilst morphologically they are not unlike the diverticula which invade

[1] I have not been able to identify this species. *Discocelis tigrina* is infested with *Ophiodina discocelidis* Mengazzini, which is probably closely allied to it.

the dorsal papillae of *Thysanozoon brocchii*, it may be questioned whether their function is similar. In *T. brocchii* on the one hand these diverticula may assist in the aeration of the tissues. In *Planocera armata* on the other hand it is difficult to suppose that they can have this function; I think it possible that they may rather be concerned in some way with nitrogenous secretion.

The function of the dorsal papillae of certain species of Thysanozoon, which contain no gut-diverticula, is also obscure. In *Thysanozoon plehni* the curious plug-like mass of tissue at the upper end of the diverticulum is to some extent suggestive of being connected with the function of excretion.

Relationships of the Cotylea. In dealing with *Pericelis*, *Thysanozoon* and *Prosthiostomum* in the systematic part of this paper I have given a fairly full account of the male genital apparatus of each, so that it is possible to compare and contrast the three chief forms that this organ assumes in the Cotylea. The arrangement of the eye-spots in *Cestoplana maldivensis* and *Pericelis byerleyana* completely round the margin of the body is so far as at present known only paralleled in *Anonymus virilis*, *Cryptocelis*, and perhaps in *Heteroplana newtoni*. I believe that this marginal distribution of the eye-spots is to be regarded as a primitive character derived from a radially symmetrical ancestor.

In the *Cotylea* other indications of a radial structure are most strongly developed in *Anonymus virilis*. Such indications are the sub-central mouth and the numerous male organs grouped around the single female aperture. The presence of organs in this species bearing a general resemblance to nematocysts is probably also an ancestral character, so that if we adopt the usual theory and assume that the Polycladida are derived from an ancestor possessed of radial symmetry we are justified in regarding *Anonymus* as nearer to this ancestral form in certain respects than are the other Cotylea.

Intermediate between *Anonymus* and the higher Cotylea stands *Pericelis byerleyana*, the most interesting type in Mr Gardiner's collection. This approaches *Anonymus* in having marginal eyes and a sub-central mouth. Like this genus too it has a median indentation of the anterior margin, whilst the structure of its penis approaches that of the latter more closely than that of other Cotylea. On the other hand the possession of tentacles, a single penis and uterine vesicles, ally it rather to the higher Cotylea, such as the *Pseudoceridae* and *Euryleptidae*, whilst the extreme folding of the margin, the wide separation of the small tentacles and the backward position of the genital apertures serve to distinguish it sharply from all its allies.

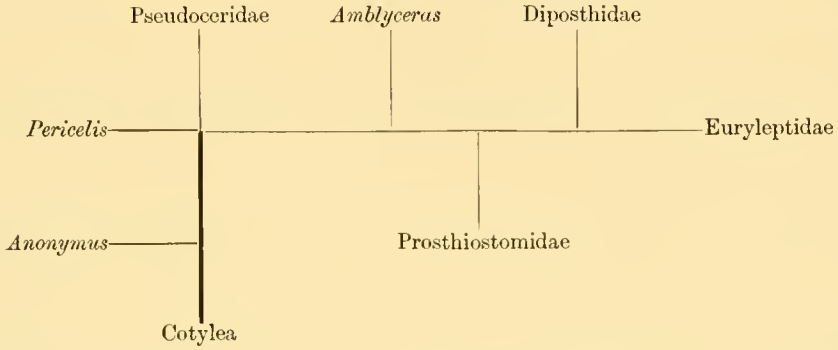
The marginal tentacles of *Pericelis* are of particular interest. They are of a simple and primitive character and indicate clearly the manner in which these organs have arisen in the Cotylea by the concentration of the marginal eyes on a pair of specialized folds of the margin. We can hardly doubt that this concentration has accompanied the acquisition of polarity in the organism in its development from a radially symmetrical ancestor. The fact that *Anonymus* has no tentacles, suggests the probability that this remarkable form is far more primitive than other Cotylea in that it has never acquired such organs.

A further development of the tentacles accompanied with the loss of the marginal eyes, save of such as have come into connection with the tentacles, gives us the condition found in the *Pseudoceridae* and *Euryleptidae*. The former family has a more primitive type of pharynx than the latter, in which it is tubular; in the *Pseudoceridae* it is not unlike that of *Anonymus* or *Pericelis*.

The *Prosthiostomidae* resemble the *Euryleptidae*, from which family they are probably derived, in possessing a tubular pharynx. They have no marginal tentacles, but the absence of these is probably secondary, perhaps a consequence of their elongated form. The structure of their male apparatus is very extraordinary, quite unlike that of other Polyclads.

Lastly, the family *Diposthidae* described by Woodworth [20] from the barrier reef of Australia is probably closely allied to the *Euryleptidae*, but unfortunately no account is given of the pharynx. *Amblyceras* is regarded by von Plehn [12] as intermediate between the *Pseudoceridae* and *Euryleptidae*.

The accompanying tree illustrates the presumed relationships of the Cotylea diagrammatically.



The characters of the terminal parts of the female apparatus give strong support to the view that the Cotylea constitute a perfectly natural group. In none of them is the vagina prolonged backwards beyond the point at which the uteri open into it to form an 'accessory vesicle' or receptaculum seminis; its walls are never developed to form a muscular 'bursa copulatrix,' and the shell-glands always open into it close to the gonopore. Whatever specialization of the female apparatus has been developed has occurred either in connection with the oviducts themselves as in *Oligocladus* or with the uteri as in *Pericelis* and *Diposthus*.

[The presence of an accessory vesicle in *Enantia*, as well as the arrangement of the eye-spots and the absence of a sucker form a combination of characters which forbid us to refer it, as Benham does [3], to Cotylea. In the possession of a gut anastomosis it does not by any means stand alone amongst the Acotylea, witness *Leptoplana pardalis*, *Planocera villosa*, *Eustylochus ellipticus*.]

Cotylea and Acotylea. The Acotylea can be distinguished broadly from the Cotylea by the fact that the former as a rule possess an accessory vesicle, a continuation of the vagina behind the point where it receives the uterine opening, though this is by no means invariably the case, *e.g.* the genus *Hoploplana*. But the most striking and most constant distinguishing feature (apart from the sucker) of the two divisions is afforded by the tentacles, when they are present. Those of the Cotylea have already been dealt with, and are of course universally marginal.

In the Acotylea marginal tentacles never occur; when they are present they lie dorsally immediately over the brain. In the *Leptoplanidae* and I believe in *Enantia* these tentacles, which in the *Planoceridae* always carry eye-spots, have been lost, the eye-spots connected with them have nevertheless been retained, at any rate in most cases. In the Cestoplanidæ so far as we know there are no traces of tentacles distinguishable (cf. the other elongated family,

Prosthiostomum). In speaking of the remarkable *Polypostia* Bergendal [1] remarks that 'tentacle eyes' can scarcely be distinguished. In passing we may notice that like *Anonymus*, *Polypostia* is provided with a number of male copulatory organs surrounding the female aperture. The fact is that some of the hinder pairs are not connected with the sperm-ducts. This is regarded by Lang as an indication that the penis in Polyclads is derived from glandular organs, which have only a secondary connection with the sperm-ducts. Whilst this is very probably true, it is possible that in *Polypostia* we have a stage in the disappearance of the multiple radially arranged penes that appear to be an ancestral character. In this connection reference may be made to the paired penes of certain *Pseudoceridae*.

Origin of Nuchal Tentacles. Of the origin of the tentacles of the Acotylea two views are held:—

(1) That adopted by Lang, who, following Chun, brings forward evidence for supposing the Polycladida to be derived from a Ctenophore-like ancestor; and homologizes the dorsal tentacles of the Planoceroids with the retractile tentacles of certain Ctenophores.

(2) That of Willey [17], who also derives the Polyclads from a radially symmetrical Ctenophore-like ancestor. He suggests that the dorsal tentacles of Polyclads are homologous with the sensory tentacles found in certain Ctenophores, and especially in Ctenoplana.

I here have to put forward a third suggestion, which differs completely from either of the preceding. Without questioning the probability of the origin of the Polyclads from a radial ancestral form, or the possibility of that form being also allied to a form ancestral to the Ctenophores, and avoiding any discussion as to the axial relationship of two groups, I consider that the tentacles of the Polyclads, whether marginal or nuchal,

(1) are a structure peculiar to the group;

(2) that they originated as marginal organs in connection with the eye-spots, somewhat in the way I have suggested above;

(3) that in the Cotylea they still retain this condition;

(4) that in the bulk of the Acotylea they have shifted back from the margin and come to lie dorsally.

This theory offers a more satisfactory explanation of the relationship of the Acotylea to the Cotylea than is possible on either of the two first. For, if we adopt either of these, we must suppose that the Cotylea are descended from forms which have lost all traces of the nuchal tentacles, and have in most cases acquired marginal tentacles. Now the *Leptoplanidae* have lost the dorsal or nuchal tentacles but have in almost every species retained evidence of their existence in the tentacle eye groups, whilst none of them have developed marginal tentacles, although some of them, *e.g. Discocelis*, have retained marginal eyes. On the other hand no Cotylean species ever exhibits any trace of a nuchal tentacle eye group.

On my theory there is no reason to regard the Cotylea as less primitive than the Acotylea; in fact the balance of evidence distinctly inclines to the opposite view. If we leave out of account the elongated, obviously highly specialized forms in either group, *i.e.* the *Prosthiostomidae* and *Cestoplanidae*, the Cotylea present far greater uniformity and less complexity of organization of the genital apparatus than we find in the Acotylea; whilst most

of the special features of the gut-branches of the Pseudoceridae (viz. dorsal diverticula of *Thysanozoon*, marginal pores of *Yungia*) are paralleled in the Planoceroids and in *Polyporus*.

Starting from a hypothetical, primitive, non-tentaculate form such as *Anonymus*, there is no difficulty in deriving both the Cotylea and Acotylea from it, if we admit that the tentacles in the two groups are homologous. There is no difficulty in supposing the margin of the body to have coalesced in front of the tentacles, and these latter to have moved back carrying their eyes with them, and come into connection with the dorsi-ventral muscles. As will be seen, this theory accounts readily for the presence of eye-spots in connection with nuchal tentacles.

There is a possibility that some of the more primitive Acotylea may be directly descended from forms that have never developed tentacles, but evidence on this point is lacking. On the whole I think that the balance of evidence inclines strongly to the view I have here advanced, which has the advantage of being better correlated with what is known of the anatomy of the group[1].

Natural History Notes. I append some interesting notes given me by Mr Gardiner:—

"All the forms were preserved with $HgCl_2$; but, however much they may be expanded, all contract when the corrosive sublimate solution is poured on them, hot or cold. Anaesthetization by cocaine was useless, for, without keeping the animal quiet and expanded, it caused the excretion of a large quantity of mucus and this prevented the fixing fluid from getting at the tissues. Usually in cocaine, too, the animal began to rot and break up before it was sufficiently quiet to be killed. Chloral hydrate seemed to have little effect and alcohol did not begin to act for some hours, and as soon as the animal became quiet it began to secrete mucus, a fatal difficulty. The best way to preserve would be, I believe, to drop specimens straight into a bottle of $HgCl_2$ on the reef itself or into strong—at least 10 per cent.—formaline, removing after 15—30 seconds into concentrated corrosive.

"It is almost impossible to get the *Thysanozoons* off the rocks, as they break up readily. With all forms the only really effective way is to tease them and make them project themselves into glass tubes. A large *Thysanozoon* (?) secreted an enormous amount of mucus, and broke up rapidly into separate pieces; its mucus collected a large amount of dirt, and killed the other animals in the bottle. It also extruded a quantity of faecal matter. The smooth-skinned forms do not secrete so much mucus, but really each form requires to be placed at once and killed in a separate vessel.

"I carefully examined for the food of these Platyhelminths and found them browsing on Tunicate colonies and sponges, whilst others had been eaten by them under the same stones. Weed was not generally touched, but dead animal-matter laid down under stones proved an attractive bait. They do not browse on *Cylicia*, *Coenopsammia*, nor any of the corals whose normal habitat is their own. Hydrozoa and Actinia too are not touched. Often at Hulule I turned over rocks which had Tunicate sponges and colonies of hydroids; but it was only the Tunicates that were generally attacked, the sponges being rarely touched.

"The Turbellaria live principally under stones and rock, especially where the latter is lying freely upon the reef. Sand is deleterious, and, if much of it is present, no forms will be found. When a rock is overturned the Planarians hurry off in all directions, some over

[1] I am aware that the embryological method lends no support so far as I know to this view, but neither does it make for either of the alternatives.

its edge, but the majority into any holes on its surface. If however the hand is placed over one, it will remain contented for some time in any damp spot and will not come into the light. That the latter in any strength is what the animals object to is clear, as in glass vessels they always get to the side away from it and hide under the lee of any stones which may be placed in the water.

"It is noteworthy that the Turbellaria do not generally occur on reefs or reef-patches within the lagoons, nor indeed where there is not an ample change of water. The animals are never found on growing coral, perhaps on account of the light.

"The colours are in no sense protective, nor do I think they can be warning. I have never seen, either on the reef or in basins, any free-living animals attack them, though I have expressly placed various species together in glass beakers for this purpose.

"I would suggest that the pigment is respiratory. It is, I believe, quite true for each species. Under any rock mass it is common to find many Tunicate colonies of one species, and one species only. This may be white, red, pink, blue, or purple, yet the Turbellaria did not appear to me to differ in colour under different masses of rocks."

In conclusion, my thanks are due to Mr Stanley Gardiner for giving me the opportunity of undertaking this work, and to Dr Gamble for much assistance with regard to literature. To both these gentlemen I am indebted for useful advice and suggestions. I have also to thank Professor Hickson, both for permission to carry out my examination of this collection in the Zoological Laboratory at Owens College and for the kind interest he has displayed in the work.

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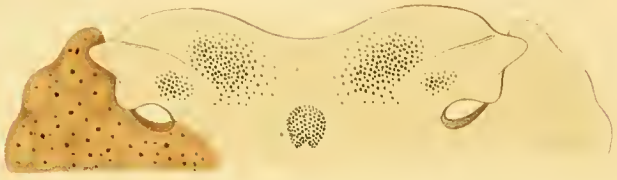

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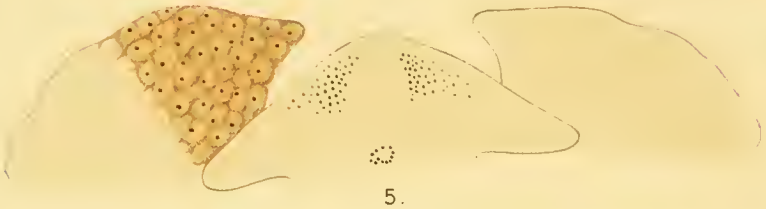

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F. Wilson, Cambridge.

EXPLANATION OF PLATES.

♂ = male aperture.
♀ = female aperture.
a.d. = accessory duct.
a.m. = antrum masculinum.
a.v. = accessory vesicle.
b.c. = bursa copulatrix.
c = chitinous stylet.
c.d. = common duct.
c.e. = columnar epithelium.
c.h. = chitinous hooks.
c.r. = chitinous ring.
c.s. = chitinous spines.
d = gut-diverticulum (of *Planocera armata*).
d.e. = ductus ejaculatorius.
e.t. = tentacle-eyes.
h = hyaline layer.
hy = hyaline secretory bodies.
n = nervous tissue
o.s. = outer sheath.
p = pigment.
p.g. = pigment granules.
p.m. = pigment mass.
pe = penis.
pl = fold of lining wall of the penis.
pr = prostate gland.
p.r. = pseudorhabdites.
p.m. = intrinsic muscles of the penis.
p.s. = penis sheath.
r = rod-like bodies or bacteria.
r.m. = retractor muscles.
rh = rhabdites.
s = secretion.
s.g. = shell-glands.
s.p. = dark secretory bodies.
u = uterus wall.
u.g. = glands on the uterus.
u.v. = uterine vesicle.
va = vagina.
v.s. = vesicula seminalis.
ves.d. = duct from the uterine vesicle.
y = cells resembling yolk-glands.
x = 'plug-like' tissue at the tip of a dorsal papilla.

PLATE XIV.

Fig. 1. *Planocera langii* n. sp.

Fig. 2. *Prosthiostomum cooperi* n. sp. Anterior third of adult specimen.

Fig. 3. *Pseudoceros tigrinus* n. sp.

Fig. 4. *Pseudoceros gardineri* n. sp. Tentacles, eye-spots of the dorsal surface and part of the anterior margin.

Fig. 5. *Pseudoceros punctatus* n. sp. for comparison with the preceding species.

Fig. 6. *Pericelis byerleyana* n. sp.

Fig. 7. *Thysanozoon plehni* n. sp.

Fig. 8. *Prosthiostomum elegans* n. sp.

Fig. 9. *Leptoplana pardalis* n. sp.

PLATE XV.

Fig. 10. *Planocera armata.* Transverse section across one of the gut branches, showing on its dorsal side a pouch-like diverticulum. × 500.

Fig. 11. Longitudinal median section through the genital apparatus of the same, reconstructed from transverse sections. Somewhat diagrammatic. × 60.

Fig. 12. Transverse section across the penis of the same at the level of the chitinous hooks. × 110.

Fig. 13. Transverse section of the penis of *Planocera langi* at the level of the pair of large folds projecting into the lumen. The section also passes through outer sheath and the 'receptaculum seminis.'

Fig. 14. Transverse section through the penis of *Leptoplana pardalis.*

Fig. 15. Longitudinal section through part of the oviduct of *Pericelis byerleyana*, passing also through one of the accessory uterine vesicles.

Fig. 16. Section passing transversely through part of the oviduct of the same.

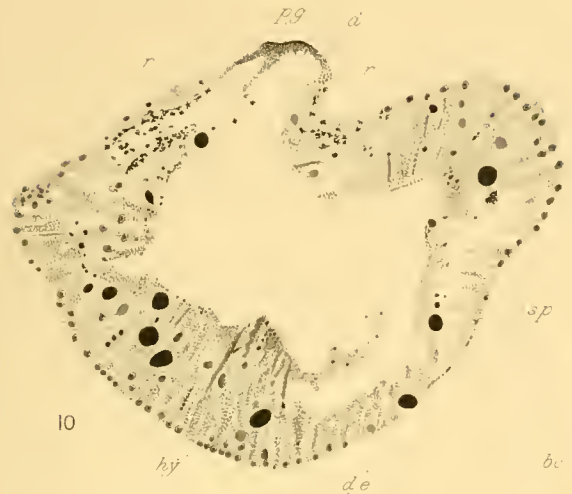
Fig. 17. Transverse section through a tentacle of the same showing the very regular columnar arrangement of the epithelium on the dorsal surface[1].

Fig. 18. Section through the penis of a specimen of *Pseudoceros gamblei.*

Fig. 19. Section through a dorsal papilla of *Thysanozoon plehni* showing the absence of any gut diverticulum; and the curious 'plug-like' mass of tissue (x) at the tip of the papilla.

Fig. 20. Section through the accessory vesicles of the penis and part of the antrum masculinum of *Prosthiostomum elegans.*

[1] Indicated by the lettering *c.e.*



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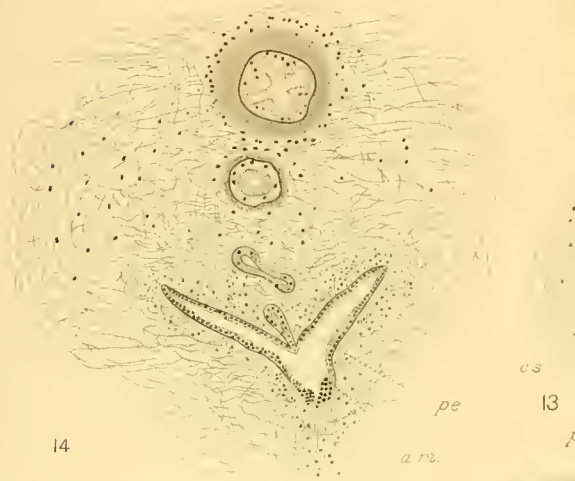

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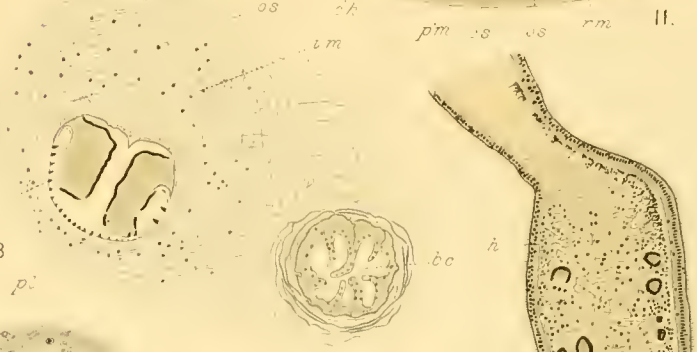

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