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MEMOIRS AND PROCEEDINGS

OF THE

MANCHESTER

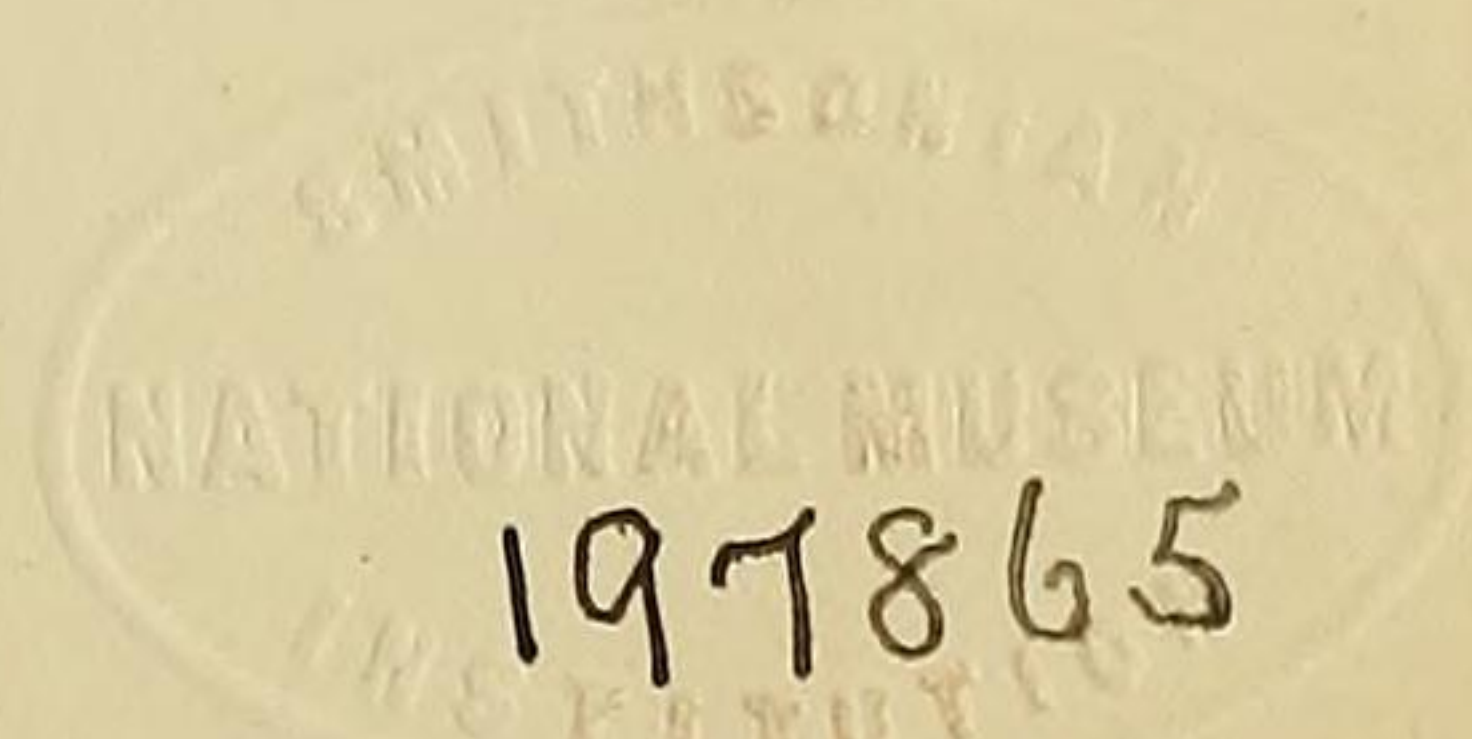
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IV. Suggestions for a Revision of the Classification of the Polyclad Turbellaria.

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I. INTRODUCTION.

In dealing with the various genera and species of the Acotylean Polyclads which I have been able to examine, I have in most cases given more attention to the structure of the terminal parts of the genital ducts than to that of the other organs of the body, because I believe that they afford the readiest means by which any species may be referred to its proper genus, and at the same time they give a safe indication of the affinities of the various genera.

An examination of these organs in a considerable number of genera shows that there is much less variation in the plan on which the vagina is constructed than in the case of the male organs. In fact, the vagina of almost any Polyclad may be referred to one or other of two types; the only exception that I am acquainted with being found in the case of the specialized genus *Paraplanocera*¹. Leaving the consideration of this genus for the present, and confining our attention to the two 'normal' types, we may take as the first that in which the vagina ends directly, at its proximal end, in the two large egg-ducts which will be spoken of as the uteri.

THE VAGINA OF THIS FIRST TYPE² is a perfectly simple duct, which often widens near its outer end, at the point where the shell-glands pass their secretion into it. This is the condition found in the Cotylea. In those

¹See Note A.

²See Fig. 1, p. 7.

Acotylea where a vagina of this type occurs, it is usually of nearly equal calibre throughout, and the shell-glands lie along a considerable part of its length, instead of being grouped about one level. *Cestoplana*, however, amongst the Acotylea, rather recalls the Cotylean condition of the shell-glands. Any accessory organs, whether vesicular or glandular, which may occur in connection with this type of vagina are, I believe, invariably developed on the uteri.

All Cotylea are provided with a vagina of the first type, and also certain Acotylean genera: such are

Alloioplana,
Cestoplana,
Stylochus,
Hoploplana,
etc., etc.

Certain species also, belonging to genera in the majority of whose species the second type of vagina occurs, possess a vagina of this first type. Such a species is *Stylochoplana nationalis* v. Plehn ('96a).

THE SECOND TYPE OF VAGINA is confined to the Acotylea, though not found universally in that group. Here the vagina, after receiving the openings of the two uteri (which almost invariably combine just before they enter the vagina to form a short, median, common duct) is continued back to form what is spoken of as the accessory part of the vagina. This accessory part may be simply a vesicle opening into the vagina immediately behind the uterine opening, or it may be divided into two parts, viz.:— a long duct-like part which opens at its (morphologically) hinder end into a vesicular part; this vesicular part is usually median, but in some cases it is practically bilaterally symmetrical, of a crescentic shape with its horns directed forward, as for example in *Discocelis tigrina*.

The accessory vesicle has glandular walls, and doubtless correlated with its presence is the fact that uterine vesicles, such as are found so commonly in the Cotylea, are never found developed in connection with a vagina of the second type; *Stylochoplana nationalis*¹, mentioned above which has a vagina of the first type, supplies an interesting example of this correlation. It is the only Acotylean species possessing uterine vesicles with which I am acquainted.

It is conceivable that the accessory vesicles may disappear altogether, and that a vagina of the first type may be produced secondarily. This reduction seems to be in progress in the genus *Leptoplana*.

The lower part of the vagina of the second type is sometimes very muscular, and may form a well-developed bursa copulatrix as in *Planocera* and some species of *Leptoplana*.

The uteri invariably open into this type of vagina from below and on its morphologically posterior side.

Turning now to the male apparatus it is found to consist normally of a muscular vesicula seminalis; of a muscular conical penis which may be armed with a stylet, which communicates with the vesicula seminalis by means of a ductus ejaculatorius or vesicular duct, and projects into a chamber opening to the exterior, called the antrum masculinum; and lastly of a prostate gland with muscular walls. Here again it is possible to distinguish two types of the normal apparatus, to one or other of which the majority of genera may be referred. The means used to distinguish these two types are found in the characters presented by the prostate gland.

IN THE FIRST TYPE² the prostate is distinct from the vesicular duct, and has a duct of its own, which

¹ This species should perhaps be made the type of a new genus.

² See Fig. 2, p. 7.

joins the former usually at the base of the penis. This type of apparatus is found in the majority of the Cotylea, and in many Acotylea.

IN THE SECOND TYPE¹ the prostate lies about the vesicular duct, between the vesicula seminalis and the penis, and passes its secretion into that duct. This arrangement is found in many genera of the Acotylea, e.g., *Stylochoplana*, *Cestoplana*; but in the Cotylea it occurs only in *Pericelis* (:02 p. 292) and there in a modified form.

As already stated the variations presented by these two types are much greater than those found in connection with the vagina. Thus the shape of the penis differs greatly in different genera. It reaches its greatest specialization in *Planocera* and its immediate allies, and in *Cryptocelis*. In *Discocelis* and related genera it is large and blunt, in *Enantia* it is a rounded vesicle-like body. A good idea of the differences in form exhibited by this organ may be obtained by a study of Plate 30 of Lang's monograph ('84).

The vesicula seminalis is found usually immediately beyond the union of the two vasa differentia. It is, in fact, a widened part of the ductus ejaculatorius, provided with muscular walls. It is occasionally absent altogether as in *Discocelis tigrina*, *Phylloplana lactea*, etc. In some such cases its place is taken by the terminal parts of the vasa differentia, which become swollen and provided with muscular walls at their distal ends. This condition is found in *Phylloplana lactea*, and also in the Latocestidæ, where we must suppose it to have arisen independently. In this latter case it is carried so far that there is a well defined pair of secondary vesicles. Such are found, too, and again quite independently, in the genus *Paraplanocera*.

¹See Fig. 4, p. 8.

The prostate gland like the vesicula is usually provided with well-developed muscular walls. In some genera it is lost completely. Interesting stages in its reduction can be traced in the genus *Leptoplana*, whilst it has altogether disappeared in *Discocelis*, *Planctoplana* ('92) and in other genera of the Acotylea, and in the Diposthiidæ and Diplopharyngeatidæ amongst Cotylean forms. In some cases *e.g.*, *Discocelis*, the prostate is replaced by glands of a prostatic character which appear on the walls of the antrum. These glands in *Thalamoplana*¹ are situated at the ends of definite muscular projections from the walls of the antrum masculinum, which are of great interest, since they show how the extraordinary 'intromittent prostate' of the Diposthiidæ may have originated. In most of the Cotylea the walls of the antrum masculinum are folded so as to form a special *penis sheath*. Amongst the Acotylea this sheath occurs only in the Cestoplanidæ.

The characters discussed above, taken in conjunction with others of importance, such as the position of the tentacles or tentacle eye-groups, the presence or absence of marginal eye-spots, and the characters of the pharynx, have enabled me to draw up the following diagnostic table of the majority of the genera included in the division Acotylea. In order to make the table more complete, I have included in it the Cotylean families.

I have omitted altogether the genera *Cryptocelides* ('93), *Polypostia* ('93), and *Bergendalia* (:03a) because, whilst their peculiarities enable them to be readily distinguished, they make it impossible to define their relation-

¹A detailed account of this new genus will be published in Prof. Herdman's Report on the Pearl fisheries of Ceylon, now in the press. The genus may very briefly be defined as follows:—A genus closely allied to *Discocelis*, but with the genital apertures separated. The prostatic glands are carried on muscular projections from the walls of the antrum masculinum. Accessory vesicle crescentic.

ship to other Polyclads on our present knowledge of the group. Certain other genera, such as *Imogene*, *Diplonchus* ('84), are not sufficiently well known, and are also left out of consideration. *Polyporus* ('98), described from an immature specimen, is not included in the list, but is perhaps allied to the Stylochidæ.

I offer this revision with some diffidence, the more so that my grouping of the genera does not coincide with that given by Lang in his monograph ('84). The genera most affected belong, however, to his two families Planoceridæ and Leptoplanidæ, and, as I have already hinted (:03*b*), the discovery of such a genus as *Disparoplana* must needs modify the definition of these families. As the most important character used in my diagnosis, I have taken the condition of the prostate gland; whether provided with a duct of its own, or merely surrounding the vesicular duct, or absent altogether. The last condition is, I think, obviously a secondary one. Which of the first two is the more primitive condition it is hard to say, though the fact that the prostate with its own duct is found in the Acotylea, in practically all the Cotylea, and in such a genus as *Bergendalia*, indicates that it is, at any rate, an ancient character.

EXPLANATION OF LETTERING IN THE FIGURES.

<i>a.m.</i>	antrum masculinum.	<i>pr.c.</i>	cavity of prostate.
<i>c.</i>	chitinous spines.	<i>pr.gl.</i>	prostatic glands.
<i>d.e.</i>	ductus ejaculatorius.	<i>sh.gl.</i>	shell-glands.
<i>m.pr.</i>	muscular wall of the prostate.	<i>st.</i>	stylet of penis.
<i>o.s.</i>	outer muscular sheath.	<i>ut.</i>	uterus.
<i>p.</i>	penis.	<i>va.</i>	vagina.
<i>p.s.</i>	penis sheath.	<i>v.d.</i>	vas differens.
<i>pr.</i>	prostate.	<i>v.s.</i>	vesicula seminalis.

FIG. 1.

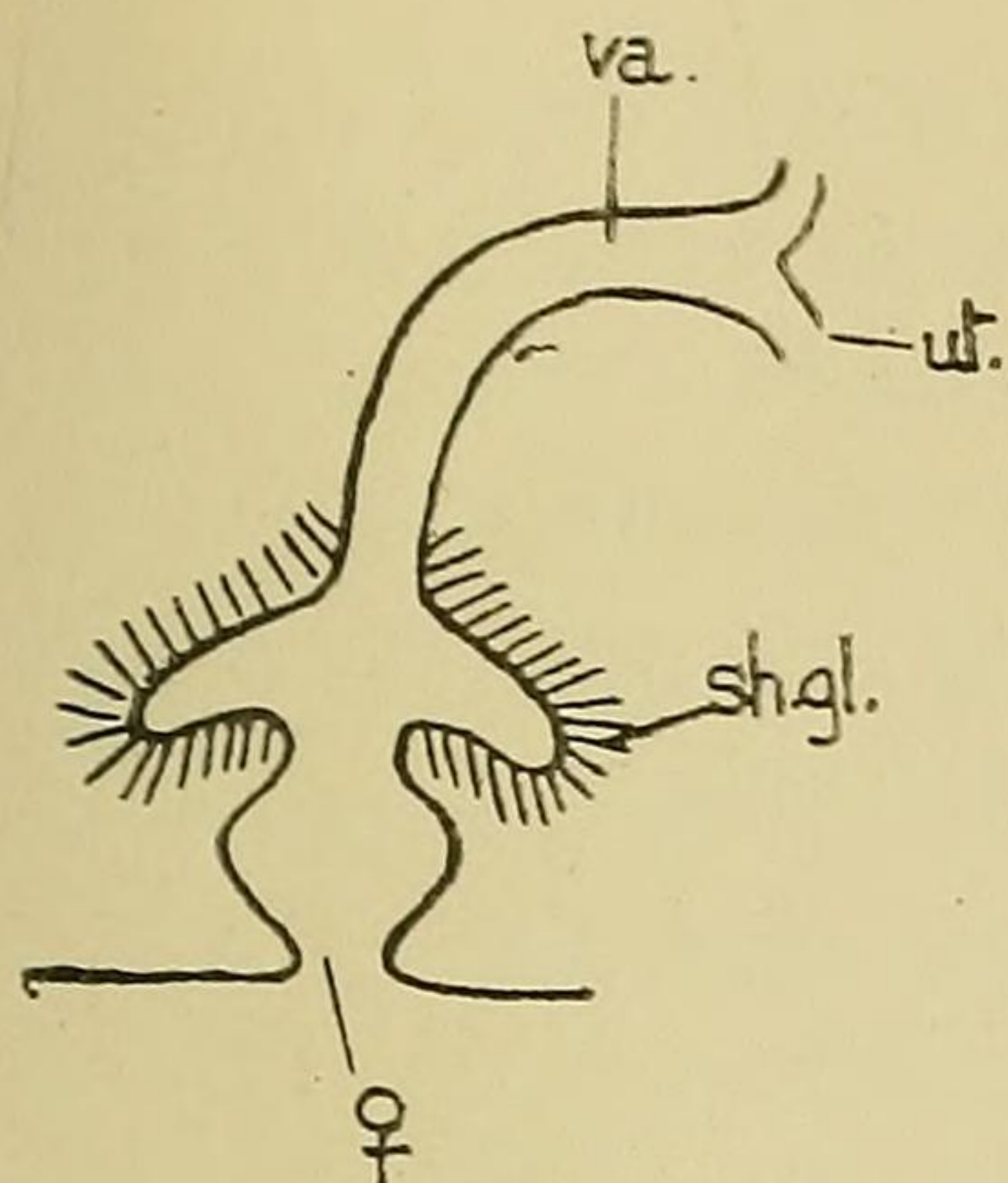


FIG. 2.

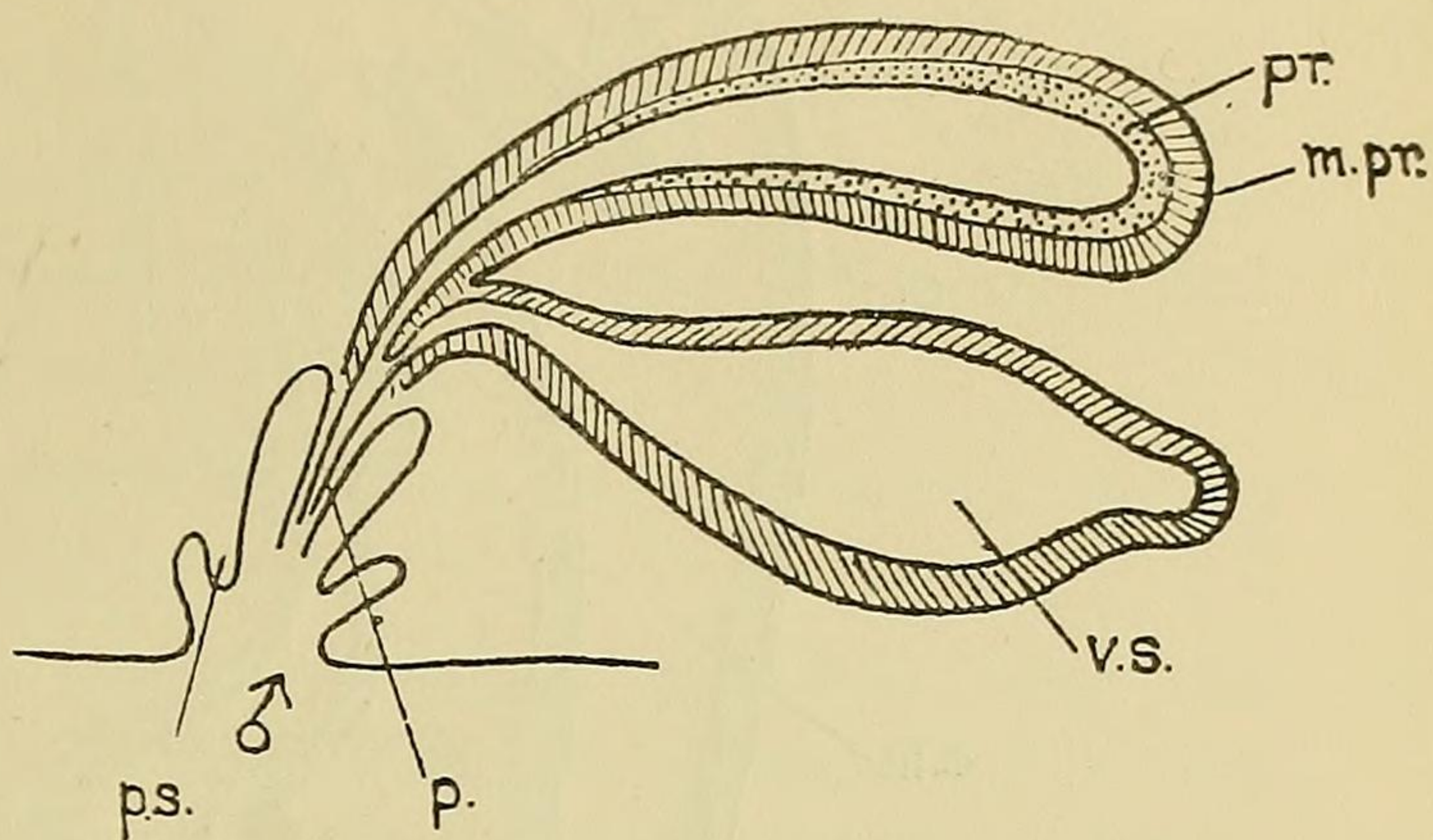


FIG. 3.

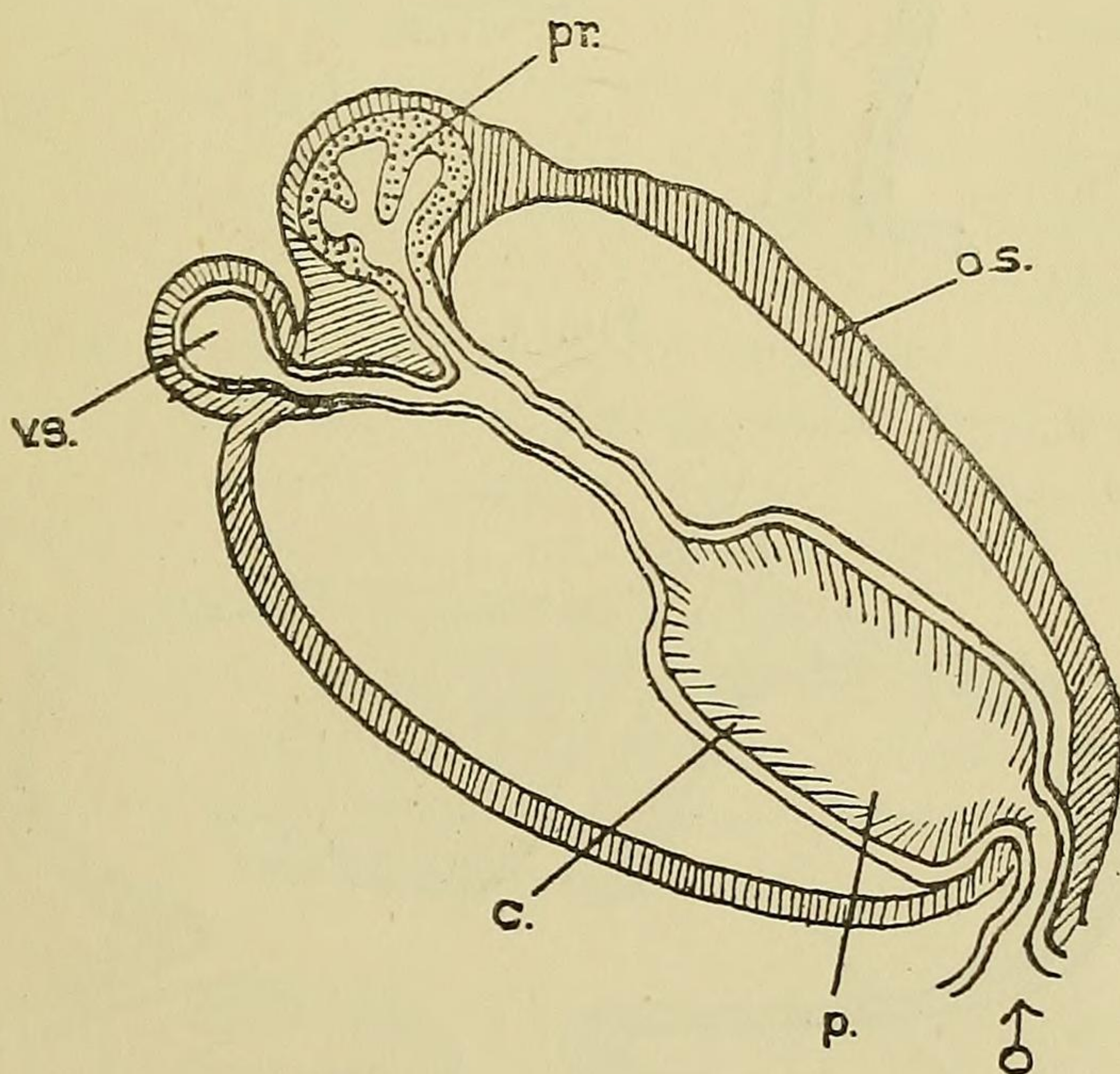


FIG. 1. Vagina of *Eurylepta cornuta* (slightly modified after Lang).

FIG. 2. Male apparatus of the same species " "

FIG. 3. " " of *Planocera simrothi* (modified after Graff).

FIG. 4.

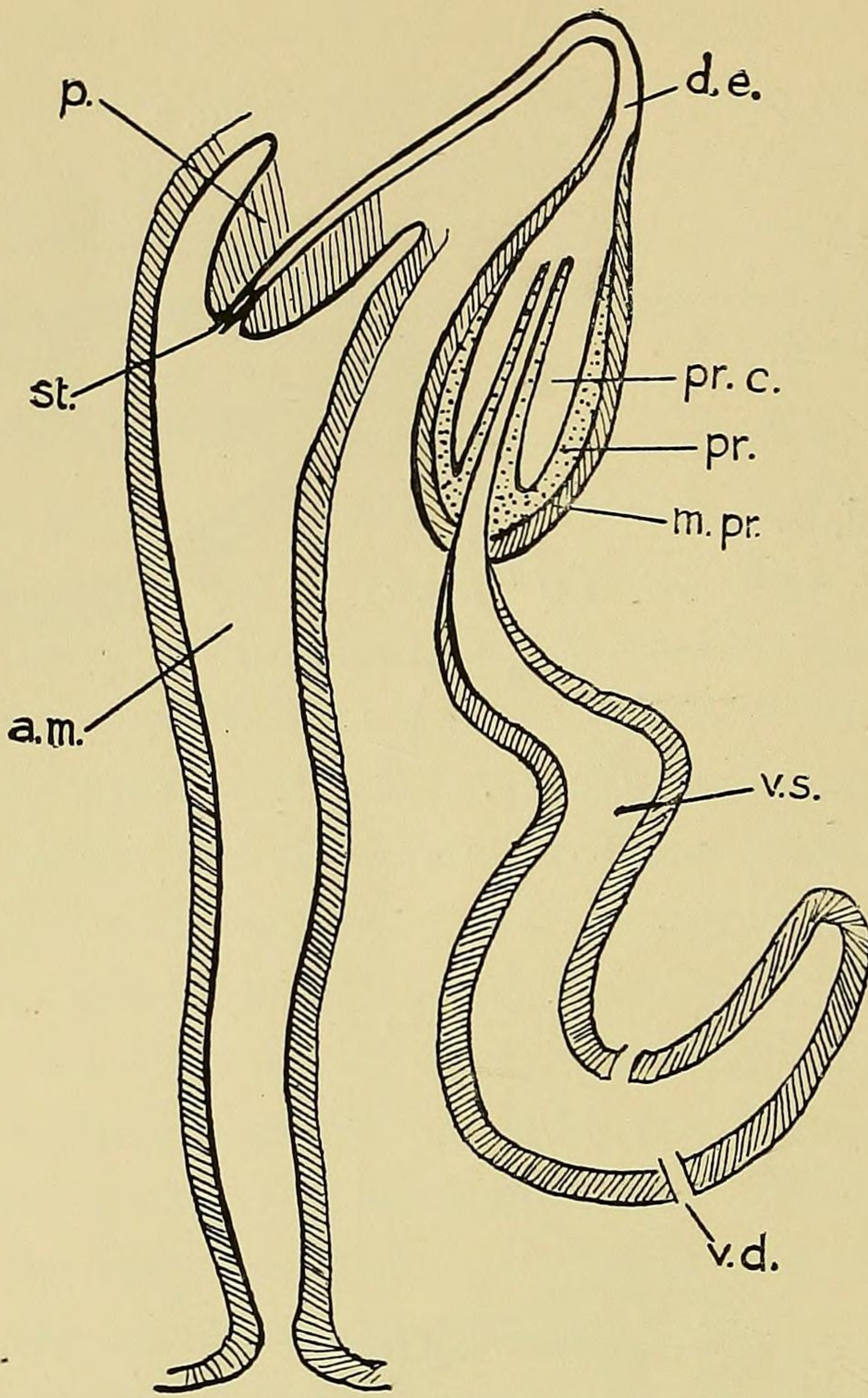


FIG. 5.

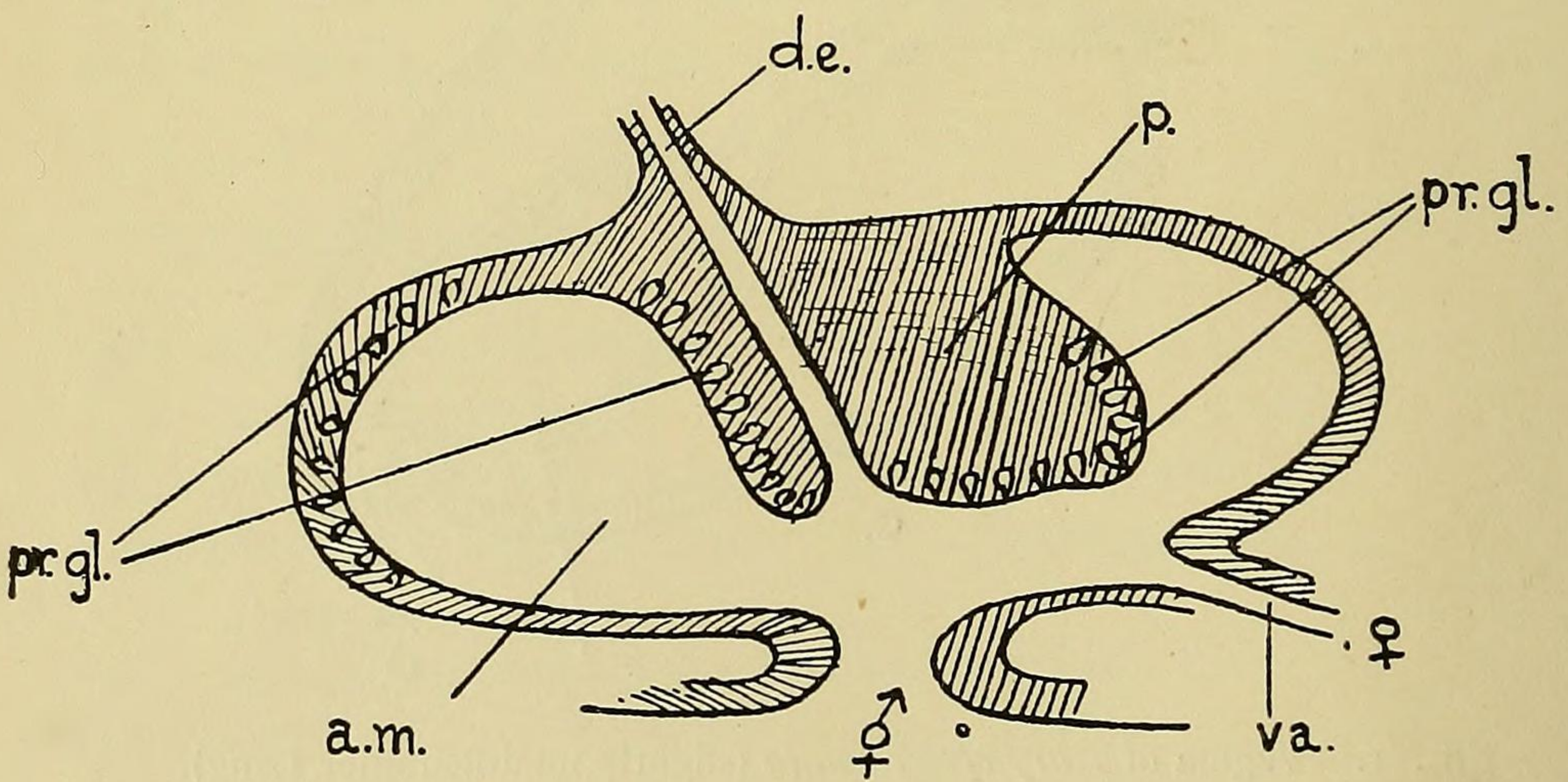


FIG. 4. Male apparatus of *Notoplana evansii* (after Laidlaw), *P.Z.S.*, 1903, i. p. 304, Fig. 51.

FIG. 5. Genital antrum of *Discocelis tigrina* showing the penis and prostatic glands (slightly modified after Lang).

II. DIAGNOSTIC TABLE.

ACOTYLEA.

No sucker immediately behind the female gonopore. Tentacles or tentacle eye-groups, if present, never marginal. Pharynx usually sub-central. Vagina often provided with an accessory vesicle.

I. Prostate separated from the ductus ejaculatorius and provided with a duct of its own.

A. Penis large, tubular, eversible; its lumen lined with chitinous spines. With the prostate and usually the vesicula seminalis it lies in an outer muscular sheath. No marginal eyes.

a. Nuchal tentacles present, body rounded, gut-branches few.

1. Vesicula seminalis single, lying within the outer sheath. Lower part of the vagina with thick muscular walls forming a bursa copulatrix.

Planocera (:02)¹

2. A pair of vesiculae seminales, lying outside the outer sheath. Lower part of the vagina with a muscular, forwardly directed diverticulum.

*Paraplanocera*² (:03)

b. Body elongate, no nuchal tentacles.

1. Vesicula seminalis single, within the outer sheath, no bursa copulatrix.

*Disparoplana*² (:03b)

B. Penis small conical, prostate large, its duct short, vesicula seminalis single.

a. Nuchal tentacles and marginal eyes present. Body rounded or rather elongate. (Penis without stylet?)³

1. Vagina without accessory vesicle, sexual openings near to each other and to the end of the body.

Stylochus.

2. Vagina and its accessory parts of great length.

Where no reference is given to a genus it will be found fully described in Lang's Monograph ('84).

See note A.

See note B.

(α) Prostatic duct and vesicular duct opening independently, body rather long.

Idioplana ('97).

(β) Prostatic duct and vesicular duct unite at base of the penis, body round. *Woodworthia*.¹

b. No nuchal tentacles or marginal eyes, body elongate.

1. No accessory vesicle. Penis with stylet.

*Stylochocestus*¹

c. No nuchal tentacles, body elongate, accessory part of the vagina opening to the exterior. *Trigonoporus*²

C. Penis small, conical; a pair of vesiculæ seminales present.

1. Body rounded, pharynx sub-central, no eye-spots.

Acelis ('96)

2. Body elongate, pharynx lying far back, eye-spots numerous.

Latocestus ('96)

II. Prostate lying about the course of the vesicular duct (ductus ejaculatorius).

A. Tentacles or tentacle eye-groups present. Pharynx sub-central, penis without a penis sheath.

a. Nuchal tentacles, no marginal eye-spots. Penis small conical, with stylet.

1. A common genital atrium.

Stylochoplana.

2. Gonopores separated.

a. Prostate chambered.

† Antrum masculinum very long. Pharynx normal, accessory vesicle present.

Notoplana (:03a)

†† Antrum masculinum not very long, pharynx transversely elongate, no accessory vesicle.

Plagiotata ('96).

β Prostate not chambered, no accessory vesicle.

* Prostate very long, gonopores close together.

Alloiplana ('96).

** Prostate small, lying close about the base of the penis, antrum masculinum large and muscular.

Hoploplana (:02).

¹ *Woodworthia*, a new genus closely allied to *Idioplana*, and *Stylochocestus*, will be described in Prof. Herdman's forthcoming report on the Ceylon Pearl-fisheries.

² See note C.

- γ. Prostate absent. *Planctoplana* ('92).
- b. No nuchal tentacles, no marginal eye-spots. Penis small conical.
1. Vesicula seminalis normal. *Leptoplana*.¹
2. Vesicula seminalis paired, prostate reduced. *Phylloplana* (:03^b).
- B. Pharynx sub-central, no tentacles, marginal eye-spots present. Penis and prostate very large. *Cryptocelis*.
- C. Pharynx behind the centre of the body, a penis sheath present, no tentacle eye-groups. Penis small.
- a. Body very long, no accessory vesicle. *Cestoplana*.
- b. Body rounded, accessory vesicle present, dorsal surface with numerous papillæ. *Ommatoplana* (:03).
Dorsal surface smooth (penis sheath?).
Microcelis ('99).
- III. No internal prostate glands.
- A. Pharynx sub-central, no nuchal tentacles, marginal eyes present, penis large, blunt and without a stylet.
1. External prostatic glands developed on the walls of the antrum masculinum.
- a. A common genital atrium. *Discocelis*.
- b. Genital apertures distinct. *Thalamoplana*².
2. No external prostatic glands, a common genital atrium. *Semonia* ('96).
- B. Pharynx in the anterior half of the body, no nuchal tentacles, no marginal eye-spots. The penis which lies close behind the pharynx is a rounded vesicular body, opening through a minute antrum to the exterior.
1. Pharynx large, folded, a vesicula seminalis present, four uterine openings into the vagina. *Enantia* ('89).
2. Pharynx of a very simple type, no vesicula seminalis present, only one pair of uterine openings into the vagina. *Haploplana*³ (:03^b).

¹ See note D.

² See footnote, p. 5.

³ See note E.

I propose to group the Acotylean genera included in the above table into families as follows :—

<p>I. PLANOCERIDÆ. <i>Planocera.</i> <i>Paraplanocera.</i> <i>Disparoplana.</i></p>	<p>IV. LEPTOPLANIDÆ. <i>Stylochoplana.</i> <i>Notoplana.</i> <i>Alloioiplana.</i> <i>Plagiotata.</i> <i>Hoploplana.</i> <i>Planctoplana.</i> <i>Leptoplana.</i> <i>Phylloplana.</i></p>
<p>II. STYLOCHIDÆ. Stylochinæ. <i>Stylochus.</i> <i>Idioplana.</i> <i>Woodworthia.</i> (<i>Eustylochus</i>). (<i>Planoceropsis</i>). (<i>Shelfordia?</i>). Stylochocestinæ. <i>Stylochocestus.</i> Trigonoporinæ. <i>Trigonoporus.</i></p>	<p>V. CRYPTOCELIDÆ. <i>Cryptocelis.</i></p> <p>VI. CESTOPLANIDÆ. <i>Cestoplana.</i> <i>Ommatoplana.</i></p> <p>VII. DISCOCELIDÆ. <i>Discocelis.</i> <i>Thalamoplana.</i> <i>Semonia.</i></p>
<p>III. LATOCESTIDÆ. <i>Acelis.</i> <i>Latocestus.</i></p>	<p>VIII. ENANTIIDÆ. <i>Enantia.</i> <i>Haploplana</i></p>

COTYLEA.

A sucker behind the female gonopore. Tentacles or tentacle eye-groups, if present, marginal. Vagina without accessory vesicle.

I. Pharynx sub-central.

A. Marginal eye-spots present.

a. Penes numerous, radial, no tentacles. *Anonymidæ.*

b. Penis single, a pair of small widely separated tentacles.
Pericelidæ (:02).

B. No marginal eye-spots.

a. Prostate developed on the walls of the antrum.

Diposthiidæ ('97).

II. Pharynx in front of the middle of the body.

A. Pharynx folded.

Pseudoceridæ.

B. Pharynx tubular.

a. Tentacles usually present, prostate as in *Pseudoceridæ*.

Euryleptidæ.

b. No tentacles, a pair of prostatic vesicles.

Prosthiostomidæ.

C. Pharynx reduplicated, body very long and narrow (no sucker?)

Diplopharyngeatidæ ('96).

III.—NOTES ON THE TABLES.

Note A.—The remarkable diverticulum of the vagina found in *Paraplanocera*, which I have figured elsewhere (:02, *fig.* 63), is quite without a parallel in any other known genus. Verrill ('88) in describing his new genus *Eustylochus* speaks of a long median duct which opens at the female orifice and runs forward to end in a flask-shaped vesicle. With this he compares a structure found in *Stylochoplana maculata*.

A careful examination of de Quatrefages' beautiful figure of this species ('45, *pl.* vi., *fig.* 2) has, however, convinced me that in this species at any rate, this median duct is nothing more than the anteriorly directed vagina (the uteri are shown opening into it) continued forward into the accessory vesicle. The fact that de Quatrefages has figured the narrow forwardly directed part of the vagina opening at the female orifice and not into the upper end of the wide distal part of the vagina is, I think, readily to be accounted for by the difficulty of determining the precise course of a duct bent upon itself, by means of optical sections only. I have not been able to examine sections of *Stylochoplana maculata*, but I feel convinced that when the genital organs of this species are so studied they will be found to resemble in detail those of *Stylochoplana agilis* as figured by Lang ('84, *pl.* 30, *fig.* 13).

In dealing with *Eustylochus*, Verrill for the same reason has not, I believe, determined the real course of the vagina, which probably differs from that of such a form as *Stylochoplana agilis* chiefly in having the uterine opening placed at a different, that is a posterior, level.

In my account of *Paraplanocera langi* I find I was in error in describing the shell-glands as lying close above the female aperture. A careful re-examination of my sections has shown that there are no shell-glands in that position in any of the three species of the genus at present known, and that the tissue which I supposed to be shell-glands, in the case of *P. langi*, though in a bad state of preservation, is probably muscular. The receptaculum seminis, as described in my account of that species, is lined with secretory epithelium. This may be held to account for the unique position of the shell-glands in *Disparoplana*, namely behind the uterine opening.

Note B.—Verrill's two genera *Eustylochus* and *Planoceropsis* are to be referred to this division ('88). *Eustylochus* appears most closely allied to *Idioplana* from the structure of its genital organs, the exact affinities of *Planoceropsis* are more doubtful. It will be noticed that both these genera are provided with nuchal tentacles and marginal eye-spots.

A recently described new genus *Shelfordia* v. Stummer-Traunfels (:02a) with one species, from Borneo, interesting as being the only known fresh-water Polyclad, would appear also to be related here. It has no tentacles but possesses marginal eyes. The long narrow prostate is described as ending blindly, and is said to be wound round the conical vesicula seminalis.

Note C.—The American species referred to *Trigonoporus* by Verrill ('88) can hardly remain in the genus if it is to be clearly defined. I am inclined to believe from Verrill's figure of the genital apparatus of his species (*T. folium*) that they may ultimately be found to have some affinity with *Planocera*. Certainly his figures ('88, pl. XLIV., figs. 4-7) show indications of an outer

muscular sheath, whilst the backward prolongation of the vagina, save that it appears to open to the exterior, distinctly recalls the receptaculum seminis of *Paraplanocera*.

Note D.—The genus *Leptoplana* as at present constituted contains, as I have pointed out elsewhere (:03a), three very distinct groups. The first of these includes only *L. tremellaris*, which is unfortunately the type of the genus; the second also contains at present only one species, *L. subviridis*. The numerous remaining species form the third group which agrees much more closely with other genera of the Leptoplanidæ, in so far as the structure of the male organs is concerned, than do either of the first two groups.

Note E.—The “very small median vesicle” into which the vasa differentia of *Haploplana ellioti* open (:03) is precisely similar to the penis of *Enantia spinifera* as figured by von Graff ('89). This similarity combined with a further agreement in the position of the pharynx, which lies relatively much nearer the anterior margin than in any other Acotylean genus, are sufficient to indicate a relationship between these two genera.

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