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THE ENTEROPNEUSTA OF FUNAFUTI.

PART II.

By JAS. P. HILL,

Demonstrator of Biology in the University of Sydney.

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[Plates XIX.–XXII.]

INTERNAL ANATOMY OF *Ptychodera hedleyi.*

Proboscis.—In the larger specimens examined the epidermis of the proboscis has a thickness of about ·13 mm. Below the two-layered limiting membrane is the thin circular muscular layer, with a thickness of ·017 mm., *i.e.*, slightly thicker than the same layer in *P. minuta.**

Anterior to the central proboscis organs the longitudinal musculature almost entirely fills up the cavity of the proboscis; only a small circular space filled up by spongy connective tissue is left towards the centre of the latter. Below this space the centrally situated longitudinal fibres form an interlacing bundle which posteriorly, shortly in front of the central organs, divides into two portions. These pass back laterally to the central organs to take their origin with the more peripherally situated fibres from the posterior wall of the proboscis. The longitudinal musculature is not divided into radial masses.

In this species the fibres of the dorso-ventral muscle-plate are very strongly developed, with which fact is to be correlated the flattened tongue-like form of the proboscis in preserved specimens. In respect to the degree of development of the dorso-ventral muscle-plate, *P. hedleyi* may be best compared with *Balano-glossus kupfferi.†*

In my preparations of this species it can be clearly seen that numbers of the fibres of this dorso-ventral plate are inserted directly into the limiting membrane of the anterior end of the "notochord," which here is not covered by the glomerulus (fig. 6, *dsc.*). Arising in the dorso-median line the fibres of this system

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* J. W. Spengel—Die Entropneusten des Golfes von. Neapel, etc. Fauna u. Flora des Golfes von Neapel, 1893, p. 17, etc. See *ante* p. 207.

† Spengel—*loc. cit.*, pl. xiv., fig. 2.

extend on to the lateral walls of the heart-bladder, and also in front of the heart-bladder form a vertical sheet, the fibres of which converge to be inserted directly into the limiting membrane of the apex of the "notochord" (Plate xix., fig. 6, *dsc.*). From here also fibres arise which diverge downwards and forwards on each side of the ventral septum. The ventral septum, accompanied by fibres of the muscle plate, passes obliquely downwards and forwards from the anterior end of the "notochord," its most anterior ventral point of affix being a considerable distance in front of the apex of the "notochord." Behind the apex of the "notochord," the ventral fibres of the plate are inserted into the limiting membrane on its ventral surface, on each side of the attachment of the ventral septum (fig. 1, *vps.* and *dsc.*). The splanchnic epithelium of the proboscis cœlom (fig. 1, *sp.*) has the usual relations. As in *P. minuta* and *P. australiensis*, the splanchnic epithelium is covered by a layer of spongy tissue representing the inner limiting layer of the connective tissue of the proboscis.

As in other species, a free space representing the proboscis cœlom is present round the central organs. The ventral septum (fig. 1, *vps.*) has oblique anterior and posterior free edges (fig. 2, *vps.*). Behind its posterior free edge there is an unpaired ventral pocket (fig. 3, *vp.*) which ends blindly in what appears to be simply the thickened basement membrane of the epidermis below the anterior portion of the proboscis skeleton (fig. 4, *vp.*).

The dorsal proboscis pockets (figs. 2 and 3, *dp.*) separated by the heart-bladder, pass backwards, and, on a level with the posterior end of the unpaired ventral pocket, each becomes constricted to form a small and short ventral canal (fig. 4, *dp'.*) which ends blindly, and a much larger dorsal canal, the proboscis canal (*pc.*) The two proboscis canals may either open into each other, thus forming a single canal which opens to the exterior by a single median proboscis pore, or the canals may remain separate and open independently to the exterior, thus forming two proboscis pores, one on each side of the median line (fig. 5, *p.*).

"*Notochord.*"—The "notochord" has the usual Ptychoderan shape. Anteriorly it appears, in section, of an oval outline, with a large central lumen. In the region of the ventral blind sac, it is markedly extended transversely and somewhat dorso-ventrally compressed (fig. 2). From the lumen of the blind sac there pass forwards two short lateral horns (fig. 2, *lb.*) as in *P. australiensis*. In the posterior portion of the proboscis neck, the "notochord" is also dorso-ventrally flattened. Its dorsal wall is here much thicker than the ventral, and provided with numerous glands. The ventral wall shortly in front of the opening of the "notochordal" lumen into the throat becomes reduced to a low layer of columnar or cubical cells resting on the proboscis skeleton.

As in other species, the "notochord" possesses a continuous wide lumen, crossed here and there by cellular bridges, and reaching to near its apex.   Numerous glands open into the lumen along its whole extent, but are specially abundant in the dorsal wall of the neck of the "notochord."

Proboscis Skeleton.—The "end plate" (fig. 3, *eps.*) closely invests ventro-laterally the posterior portion of the blind sac, which here is somewhat quadrangular in outline (fig. 3, *lbs.*)   Behind, the end plate narrows and passes over into the body of the proboscis skeleton, overlying the posterior portion of the unpaired ventral proboscis pocket.   The body is at first convex below and provided with short nearly vertical wings investing the "notochord" laterally.   Posteriorly the ventral surface of the body soon looses its convex form, and behind the posterior end of the ventral proboscis pocket is distinctly keeled.   In sections just behind the ventral proboscis pocket the entire skeleton is found to consist of a dorsal flattened portion prolonged on each side into short almost horizontal wings, below which is a blunt triangular keel-like projection.   In the dorsal portion, the lines of stratification correspond with the ventral wall of the "notochord"; it thus represents the "body" of the skeleton.   In the ventral projection the lines correspond in direction with the adjacent epidermis : it thus represents the "keel" of the skeleton.

In this species the "keel" is not separated from the "body" by "chondroid tissue," and it is not provided with distinct lateral outgrowths or wings.   Posteriorly the keel gradually becomes blunter and thicker and at the same time decreases in height, until, at the level of the proboscis pores, the entire skeleton has the shape shown in fig. 5.   The skeleton (*vps.*) is here in section again convex below, slightly concave above and provided with two short ventrally curved wings.   The skeleton continues in this condition up to the point of union of the proboscis neck with the inner face of the collar.   Here the "nuclei" of the "legs" appear, separating the now thin "body" from the ventral part of the skeleton, the continuation of the "keel."   Posteriorly the "nuclei" eventually separate from each other to form the diverging "legs" of the skeleton, which end considerably in front of the mid-region of the collar.

The "chondroid tissue" of the proboscis neck (figs. 2-4, *ch.*) is, as in other species of the genus, not very strongly developed. The cell strands penetrating it are derived mainly from the ventral proboscis pocket, and also in lesser degree from the dorsal pockets.

Heart-bladder.—The heart-bladder has the usual relations.   Anteriorly (fig. 1, *h.*) it is prolonged down on each side of the "notochord" so as to enclose about the upper three-fourths of the latter. It does not extend quite to the extreme apex of the "notochord."

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Posteriorly the cavity of the heart-bladder is occupied by cellular tissue crossed dorsally by transverse fibres passing between its lateral walls. As in other species its ventral wall (fig. 1, *vw.*) is provided with a layer of transverse muscular fibres.

Proboscis Vessels.—The glomerulus is shown in transverse section in fig. 1 (*gl.*). It does not cover the anterior end of the "notochord" as in *P. minuta* and *P. australiensis*, its two halves being separated by the fibres of the dorso-ventral muscle plate inserted into the apex of the "notochord." The central blood space (figs. 1 and 6, *cbs.*) opens freely on each side into the glomerulus sinus on the lower portion of the lateral walls of the heart-bladder. The efferent proboscis vessels (figs. 2 – 5, *epv.*) only become distinct at the posterior end of the glomerulus. They are not joined by a connecting vessel in the proboscis neck as in *P. australiensis*.

The afferent (figs. 2 – 4, *av.*) and efferent vessels of the subepidermic network have the usual relations.

Along the mid-ventral line of the proboscis there runs a small vessel internal to the circular musculature, which stands at intervals in connection with the subepidermic capillary net, the circular muscular layer being interrupted at these points. When the ventral septum appears this vessel apparently passes up along its anterior edge.

Collar.—The five zones of the epidermis (*cf.* Part I.*) are distinct in longitudinal section. The first zone, including slightly more than the anterior free rim of the collar, and the fifth zone, forming the posterior rim of the collar, stain similarly and not very deeply. The second and fourth zones stain deeply, while the third zone stains less deeply. The collar musculature has the usual relations.

The perihæmal spaces, as in *P. sarniensis, aperta,* and *australiensis,* enclose about the ventral half of the collar nerve cord (Plate xx., fig. 7, *phs.*).

As may occur in *P. australiensis,* the dorsal septum of the collar appears as a free fold in front of the first root and reaches the epidermis along with the latter. From here it extends to the posterior end of the collar. The ventral vessel consists of a single fold. It unites either near the mid-region of the collar or nearer its posterior end, with a median subepidermic vessel to form the ventral septum of the collar. The dorsal vessel in the collar occupies the whole of the mesentery between the perihæmal spaces.

The collar canals (fig. 8, *ccl.*) have the usual shape and are relatively short. Each runs obliquely backwards and downwards to become continuous with the anterior wall of the first gill-pocket.

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* *Ante,* p. 207.

The outer opening of the canal is expanded and provided with thick out-turned lips. In this species the first and second gill pockets have a common efferent portion into which the collar canal opens (fig. 8, *g.c.* 1 and 2).

Nerve Cord of Collar.—The collar nerve cord is dorso-ventrally flattened and band-like in shape, convex above and concave in its mid-region below (fig. 7, *cnc.*). As in *P. sarniensis*,* a continuous axial canal (fig. 7, *cnl.*) opening both anteriorly and posteriorly is present in the cellular part of the cord. The axial canal is wide and dorso-ventrally compressed like the cord itself. Towards its anterior end, it narrows to open to the exterior by the small anterior neuropore (fig. 6, *an.*), the posterior neuropore is a slightly larger opening. The canal is lined by a cuticular layer, and there open into it numerous gland cells, especially abundant and large in the ventral wall of the canal. The ventral wall is very much thicker than the dorsal. As in other species of the genus, the cellular part of the cord is completely invested by the fibrous layer, but here the layer of fibres on the dorsal surface of the cord is a very thin one.

Dorsal Roots.—As in *P. australiensis*, the first root may arise from the collar nerve cord quite near its anterior end. The roots are quite irregular, both in size, number, course, and disposition. They vary in number from one to two roots, situated in the anterior half of the cord, to four, seven or eight, in four specimens examined. The axial canal of the cord is not prolonged into any of the roots. They all possess a solid cellular core surrounded by a thin fibrous layer, and are invested by the usual basement membrane carrying blood. Where they join the epidermis, they cause no interruption of the cells of the latter such as occurs in *P. minuta* and in, at least, the most anterior of the roots in *P. australiensis*.

Trunk.—Except for a thin layer of circular muscles below the epidermis at the extreme posterior end of the body, forming the anal sphincter, a circular muscular layer is absent below the epidermis of the trunk, as occurs in no other described species of the genus *Ptychodera*.

Branchial Region.—Owing to the absence of both genital pleura and cushions in this region, it has in transverse section a dorso-ventrally compressed ovalish outline (Plate xix., fig. 2). The dorsal nerve (Plate xxi., fig. 9, *dn.*) lies at the bottom of a deep median groove, wider below and narrow above. The epidermis forming the lateral walls of the wider ventral part of this groove contains numerous gland cells and stains very deeply (fig. 9). Gland cells are also present in small numbers

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* Spengel—*loc. cit.*

in the cellular part of the dorsal nerve, while they are almost entirely absent in the cellular part of the ventral nerve. The course of the ventral nerve (fig. 9, *vn.*) is marked by a very shallow median groove.

Laterally to the dorsal median groove, there is on each side a shallower branchial groove, the epidermis forming the lateral walls of which also contains numerous gland cells and stains deeply (fig. 9, *brg.*).

The longitudinal musculature (fig. 9, *lmt.*) follows immediately on the basement membrane of the epidermis. It is interrupted dorsally and ventrally by the dorsal and ventral vessels, and also along the sub-median lines situated close to the base of the lateral wall of the branchial grooves (fig. 9). Numbers of radial fibres pass inwards from the limiting membrane of the epidermis to be inserted into the walls of the œsophagus and gill pockets. The cœlom is here completely subdivided into two, above by the dorsal mesentery and below by the ventral vessel. In mature specimens the lateral halves of the cœlom are almost completely occupied by the gonads.

The alimentary canal is, as in other species of the genus, divided into a dorsal branchial canal (fig. 9, *gg.*) and a ventral œsophageal canal (*œ.*). The line of separation between the two is marked by two projecting longitudinal ridges, the limiting ridges (fig. 9, *lc.*), but in this species these two ridges are widely separated from each other so that the branchial and œsophageal canals are in open communication (fig. 9).

The epibranchial band (fig. 9, *epb.*) along the mid-dorsal line of the branchial canal is composed of long narrow cells, and stains only slightly. It contains small gland cells in no great abundance and with no definite arrangement.

The gill pockets have the same general structure as in *P. minuta*. The synapticulæ of the gill skeleton (fig. 9, *sn.*) do not exceed thirteen or fourteen in number, those more dorsally situated being usually wider apart than the more ventral ones. The gill pores open into the branchial grooves just mesial to the sub-median lines as in *P. minuta*, and, as in that form, oblique slips of the longitudinal musculature pass between successive pores.

In the non-ciliated epithelium of the outer, the anterior and posterior walls of the efferent portions of the gill pockets, as well as in that of the outer walls of the gill tongues ("tongue bottom") there occur numbers of gland cells (figs. 9 and 10). The outer wall of the gill tongue ("tongue bottom") is not enfolded into the cavity of the tongue (fig. 10) as is found to be the case in sections through the gills of *P. minuta* and *P. australiensis*.

The inner concave wall of the gill tongue ("tongue back") is composed of the usual high epithelium, in the anterior and posterior faces of which small flask-shaped gland cells occur (fig. 10, *gtb.*).

The first gill pocket lies under cover of the posterior end of the collar, and as has already been mentioned, the first and second pockets have a common efferent portion which opens to the exterior between the collar and trunk by a narrow slit-like canal (Plate xx., fig. 8, *gp. 1* and *2*).

The gills in one of the larger specimens of this species with a gill area measuring 3 cm. in length, would number considerably over one hundred pairs.

The usual septa and gill tongue vessels are present (Plate xxi., fig. 10). The dorsal vessel in this region occupies only the dorsal half of the dorsal mesentery, and the afferent gill vessels diverge about opposite the gill tongues outwards and downwards from its ventral side as in *P. minuta*. As Spengel describes, each afferent vessel stands in direct connection with the two vessels in the gill tongue lying one on each side just within the tongue bars of the gill skeleton, and also in connection with a septal vessel, apparently in this species with either the septal vessel of the septum in front of, or behind the corresponding tongue. The capillary system of the gill tongues also appears to stand in connection with the septal vessels by connecting branches running round the dorsal ends of the gills.

In this species these leave the ventral side of the dorsal vessel, not only the afferent branchial vessels, but also branches which pass to the mesial wall of the efferent portions of the gill pockets (fig. 9).

Towards the posterior end of the branchial region the median dorsal groove becomes much shallower, while the branchial grooves become markedly wider and deeper. The median dorsal portion of the body in the region of the developing gill pockets thus forms a prominent longitudinal projection in which the branchial canal is situated, while the dorso-lateral portions of the body stand out as thick free wings. The gill pores here open near the middle of the mesial wall of the widened branchial groove, while the genital pores open on its lateral wall, about on a level with the gill pores.

Genital Region.—In the anterior portion of this region, just behind the last developing gill pockets, the alimentary canal of *P. hedleyi* exhibits a noteworthy differentiation into two portions similar to and perhaps even more marked than that described by Spengel for the corresponding portion of the intestine in *P. erythræa* and *P. bahamensis.*

Plate xxii., fig. 11, represents a section taken shortly behind the last pair of gill pockets, and it will be seen that we have here the same general external form of the body as was described above for the posterior portion of the branchial region.   In other words, the median dorsal projection there found continues back into the anterior portion of the genital region, and is bounded laterally by deep grooves, the continuations of the branchial grooves, now, however, much deeper and narrower below. Beneath these grooves, the longitudinal musculature is absent.

Just as the median dorsal projection in the posterior branchial region lodged the branchial canal, so here it lodges a remarkable thick-walled dorsal division of the alimentary canal (fig. 11, *idv.*) which is joined by a short, laterally compressed stalk, to a ventral division of the intestine, lined by ordinary intestinal epithelial cells (fig. 11, *i.*).   The dorsal division possesses a small lumen which opens by a narrow slit-like cleft in the connecting stalk, into the broad and dorso-ventrally compressed lumen of the ventral division.

At its anterior end the dorsal diverticulum projects forwards over the last pair of gill pockets as a very short, free, blindly-ending tube, the lumen of the diverticulum opening below into that of the branchial canal. The lumen of the ventral division of the intestine is the direct continuation of the œsophageal canal of the branchial region.

Posteriorly the slit-like canal of communication between the dorsal and ventral divisions of the intestine gradually widens out, and at the same time the dorso-lateral corners of the ventral division of the gut extend inwards mesially, giving rise to two prominent folds, one on each side of the opening between the two divisions.   These two folds eventually become free and end shortly behind the point of complete merging of the dorsal division into the ordinary gut.   It has also to be mentioned that posteriorly the branchial grooves by the fusion of the mid-portions of their opposite walls, form two very short and blindly-ending canals which pass back one on each side in the trunk cœlom, alongside the dorsal diverticulum.

This dorsal division of the gut is lined by a very deeply staining and slightly folded epithelium measuring up to ·25 mm. in thickness.   The epithelium is composed of long, narrow cells closely packed together, with small rod- or spindle-shaped nuclei.   The cell-protoplasm contains large numbers of small granules staining a dull red with eosin.   Below the thin cuticular covering of the epithelium there occur very numerous gland cells, which open freely into the lumen of the diverticulum.

As has already been mentioned, Spengel has described the occurrence of a similar subdivision of the gut canal just behind

the branchial region, in the two members of the sub-genus *Chlamy-dothorax* (*P. erythræa* and *P. bahamensis*) examined by him. Of *P. erythræa* he says :—" Der Darm (of the part of the genital region immediately following on the branchial region) durch zwei seitlich einspringende Falten in zwei Halbcanäle, einen dorsalen und einen ventralen, geschieden erschient.   Ersterer stellt eine tiefe Rinne dar, die von einem mächtigen, drüsenreichen Epithel ausgekleidet ist ; letzterer dagegen ist breit und niedrig, seine Wand verhältnissmässig dünn.   Der Querschnitt des Darms ist entsprechend etwa ankerförmig."*

In *P. hedleyi* this dorsal diverticulum of the gut appears to be more markedly separated from the ventral division than in *P. erythræa* (*cf.* fig. 11 with Spengel's fig. O, page 182).   In both cases the dorsal division is lined by a very thick epithelium with numerous glands.

In *P. bahamensis*, according to Spengel, the same features are found, but not in such noteworthy proportions as in *P. erythræa*.

In *P. flava* which, as Willey† has shown, also belongs to the sub-genus *Chlamydothorax*, I find in the portion of the gut in question a similar subdivision into dorsal and ventral portions. The dorsal division is small and lined by a moderately thick epithelium, in which, however, glands are not specially developed. This dorsal division is connected with the large thin-walled ventral division by a laterally compressed stalk, with a very narrow lumen.   Gland cells are especially abundant in the thick epithelium of the stalk.   Altogether in *P. flava* this dorsal division of the gut is a much smaller and much less prominent structure than in *P. hedleyi*.

Neither in *P. hedleyi* nor in *P. flava* is there any differentiation of muscular layers in connection with this part of the gut, such as Spengel describes for *P. erythræa* and *P. bahamensis*. In *P. hedleyi* the above described dorsal diverticulum of the intestine is such a well defined structure that we cannot but regard it as possessing some definite function.   Without doubt it is a mucus-secreting organ, but the presence of granules in the protoplasm of its epithelial cells suggests also that it has some other function, probably digestive.   In this connection it may be mentioned that in one out of three specimens sectionised, the lumen of the diverticulum contained what appeared to be partially disorganised animal remains.

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* Spengel—*Loc. cit.*, p. 182.

† A. Willey—On *Ptychodera flava*, Esch.   Qt. Journ. Micro. Sci., xl., 1, 1897, p. 165.

Behind the intestinal diverticulum of the anterior portion of the genital region, the genital cushions gradually become more prominent until about the middle of the genital region proper they form marked thick lateral projections (fig. 12, *gnc.*) into which the dorso-lateral portions of the gut pass. Posteriorly the genital cushions gradually fade away as the hepatic region is approached.

The cœlom in the genital region is completely divided into two lateral halves, above by the high dorsal mesentery, and below by the ventral vessel. The dorsal vessel (fig. 12, *dv.*) occupies only a small portion of the dorsal half of the dorsal mesentery. The lateral septa have the usual relations: they extend into the posterior portion of the branchial region.

Gonads.—In the branchial region, gonads exist only laterally to the gill pores. They are much branched sacs, occupying in mature individuals the greater part of the cœlom in that region. In *P. minuta* and *P. sarniensis*, according to Spengel, the gonads in the branchial region are simple unbranched sacs. The genital pores open in the submedian lines close to the base of the lateral wall of each branchial groove. Towards the hinder end of the branchial region, the submedian lines shift upwards, so that the genital pores on each side open into the branchial groove about the middle of its lateral wall. Posteriorly the submedian lines pass still more dorsally, and, in the genital region proper, the genital pores open close to the free margin of the genital cushions on their mesial sides (fig. 12, *gap.*).

In the genital region the gonads consist each of two main subdivisions (1) a lateral division situated on the outer side of the lateral septum (fig. 12, *glt.*) and (2) a mesial division situated on the inner side of the septum and extending mesially towards the dorsal mesentery (fig. 12, *gm.*). Both these main subdivisions are again irregularly branched.

Post-genital Region.—The hepatic region in its general features corresponds with that of *P. minuta.* The intestinal and hepatic epithelial cells contain numbers of greenish granules.

The hind body calls for no detailed consideration. The two ciliated grooves of the intestine are related essentially as in *P. australiensis.* The intestine is provided with a long and high keel-like process, the slightly enlarged ventral edge of which overlies the minute ventral vessel. The dorsal and ventral vessels, the keel-like process of the intestine, and the dorsal nerve disappear shortly in front of the posterior end of the body. The ventral nerve can be traced to the extreme posterior end. The radial fibres passing between the limiting membrane of the epidermis and that of the intestine are well developed.

Round the terminal portion of the body there is below the limiting membrane of the epidermis a thin layer of circular muscles which, with the delicate circular muscles round the terminal part of the intestine, form a sphincter round the anus.

SUMMARY.

(1) The Pacific species, *P. hedleyi*, is to be associated with the two European species *P. minuta* and *P. sarniensis* in the sub-genus *Ptychodera (sensu stricto)*, especially characterised by the rudimentary character of the genital pleura.

(2) In the possession of a continuous axial canal in the dorsal nerve cord, opening both anteriorly and posteriorly, *P. hedleyi* agrees with *P. sarniensis*, while in the possession of two longitudinal epidermal stripes overlying the two ciliated grooves of the intestine, it agrees with *P. australiensis*.

(3) *P. hedleyi* exhibits affinities with the members of the sub-genus *Chlamydothorax (P. erythræa, P. bahamensis*, and *P. flava)* in the possession of a dorsal thick-walled glandular division of the intestine just behind the branchial region. It is suggested that this dorsal diverticulum may, in *P. hedleyi*, have some digestive function.

(4) As regards the degree of development of the dorso-ventral muscle plate, *P. hedleyi* may be best compared with *Balanoglossus kupfferi*.

(5) *P. hedleyi* differs from all hitherto described species of the genus *Ptychodera*, and agrees with the members of the genus *Balanoglossus* in the absence of a circular musculature in the trunk.

REFERENCE LETTERS.

an. Anterior neuropore.
av. Afferent vessels of subepidermic capillaries of proboscis.
bps. Body of proboscis skeleton.
brg. Branchial groove.
cbs. Central blood-space of proboscis.
ccl. Collar canal.
ccp. Prolongations of collar cœlom into the proboscis neck.
cfw. Circular musculature of outer wall of anterior rim of collar.
ch. "Chondroid tissue."
cl. Cleft into which dorsal vessel opens.
cm. Circular musculature of proboscis.
cnc. Collar nerve cord.
cnl. Axial canal of collar nerve cord.
cœ. Collar cœlom.
cœ'. Part of collar cœlom into which the collar canal opens.
div. "Notochord."

dn. Dorsal nerve of trunk.
dp. Dorsal proboscis pockets.
dp'. Blindly ending ventral portions of dorsal proboscis pockets.
dsc. Fibres of dorso-ventral muscle plate.
ds. Dorsal septum of collar.
dv. Dorsal vessel.
ep. Epidermis.
epb. Epibranchial strand.
eps. " End plate " of proboscis skeleton.
epth. Epithelium of throat.
epv. Efferent proboscis vessels.
g. Gonads.
gap. Genital aperture.
gc. Gill pocket.
gg. Branchial canal.
gl. Glomerulus.
glt. Lateral gonad branch.
gm. Mesial gonad branch.
gnc. Genital cushion.
gp. Gill pore.
gs. Gill septum.
gt. Gill tongue.
gtb. Epithelium of " gill tongue back."
gtc. Cavity of gill tongue.
h. Heart-bladder.
i. Intestine.
idv. Intestinal diverticulum, just behind branchial region.
ifw. Musculature of fore wall of anterior rim of collar.
ies. Low cubical epithelium covering the inner edge of the septal bar and the surfaces of the tongue bars.
lb. Anterior horn of lumen of the " notochordal " blind sac.
lbs. Ventral blind sac of " notochord."
lc. Limiting cushions between branchial canal and œsophagus.
lfw. Longitudinal musculature of outer wall of anterior rim of collar.
lm. Longitudinal musculature of proboscis.
lmt. Longitudinal musculature of trunk.
ls. Lateral septa of trunk.
nf. Nerve fibre layer.
ngr. Nerve fibre ring of proboscis neck.
ntr. Nerve ring at posterior end of collar.
œ. Œsophagus.
ol. Opening of lumen of " notochord " into the throat.
p. Proboscis pore.
pc. Proboscis canal.
phs. Perihæmal spaces.
pps. Peripharyngeal space.
ps. Proboscis skeleton.
rf. Radial fibres between fore and outer walls of anterior rim of collar.
sn. Synapticulæ.
sp. Splanchnic epithelium of proboscis cœlom.
spr. Septal bar of gill skeleton.
tpr. Tongue bars of gill skeleton.
vgs. Septal vessel.
vn. Ventral nerve.
vp. Ventral proboscis pockets.
vps. Ventral septum of proboscis.
vv. Ventral vessel.
vw. Ventral wall of heart-bladder.

EXPLANATION OF PLATE XIX.

Ptychodera hedleyi, sp. nov.

Fig. 1. Transverse section through the anterior region of the central
     proboscis organs. × 65.

,, 2. Transverse section at the level of the " notochordal " blind
     sac. × 65.

,, 3. Transverse section passing through the " end plate " of the
     proboscis skeleton. × 65.

,, 4. Transverse section of proboscis neck just in front of the posterior
     end of the ventral proboscis pocket (*vp.*). × 65.

,, 5. Transverse section passing through the proboscis pores (*p.*) × 65.

,, 6. Nearly median sagittal section through the proboscis neck and
     anterior portion of collar. × 50.

[For Reference Letters see pages 345-6.]
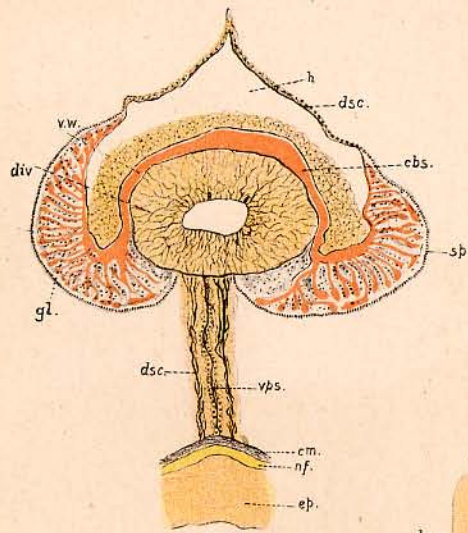
PLATE XIX.

Fig. 1.
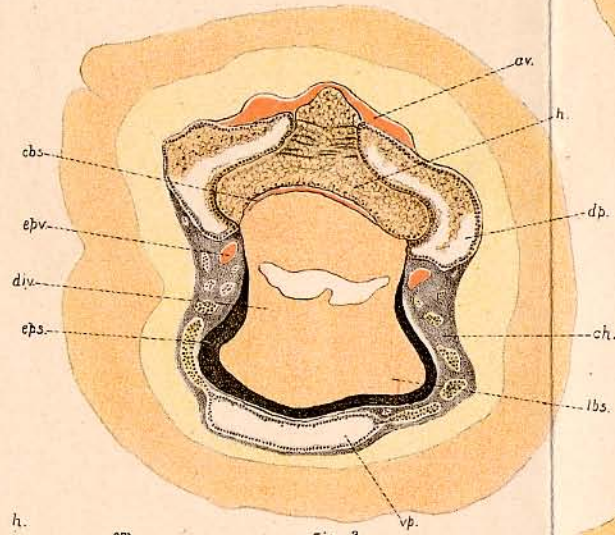
Fig 2.

Fig 3.
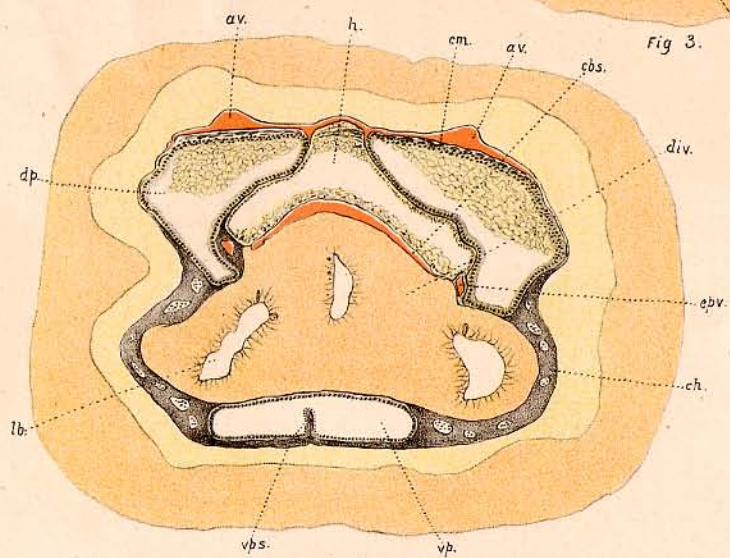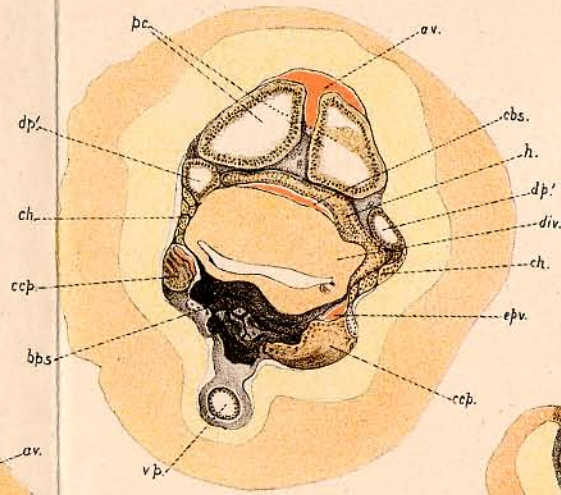
Fig 4.
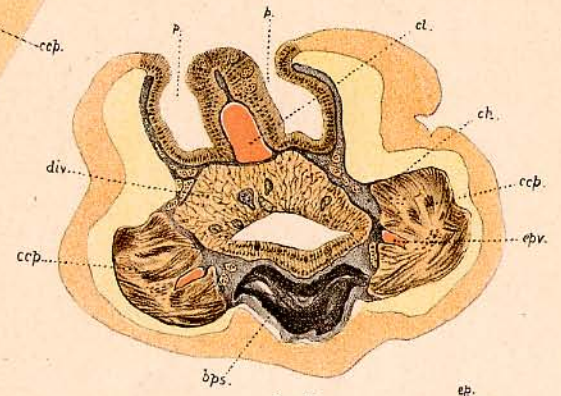
Fig 5.
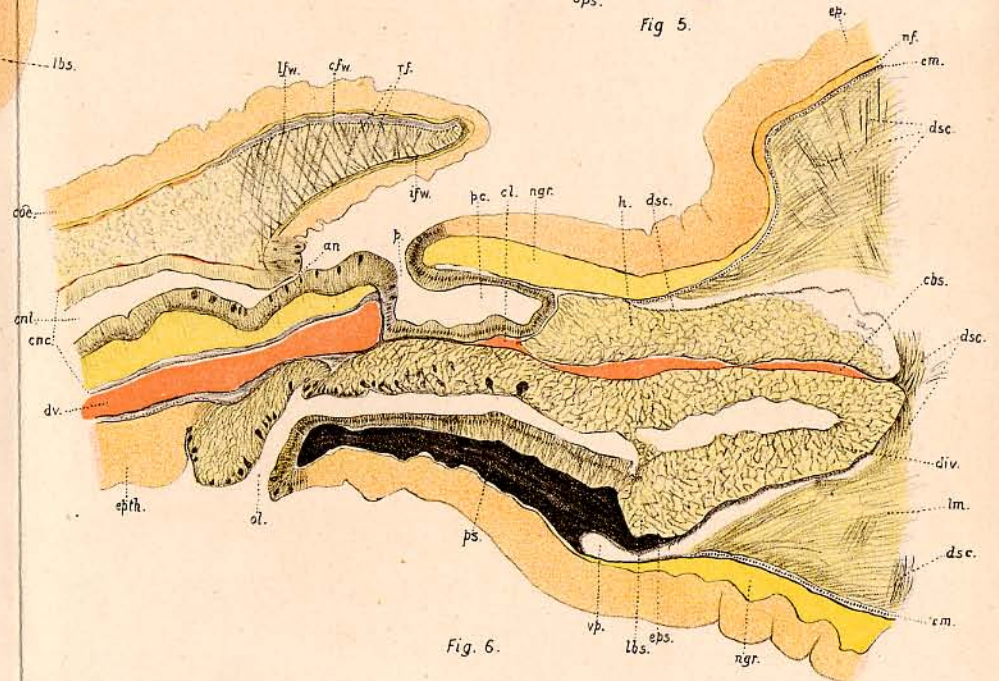
Fig. 6.

EXPLANATION OF PLATE XX.

Ptychodera hedleñi, sp. nov.

Fig. 7. Transverse section through the collar nerve cord. x 125.

,. 8. Sagittal section through the collar canal (*ccl.*) of one side and
the first and second gill pockets (*gc. 1* and *2*). *gp. 1* and *2*:
Common opening of the first and second gill sockets. *spr. 1*:
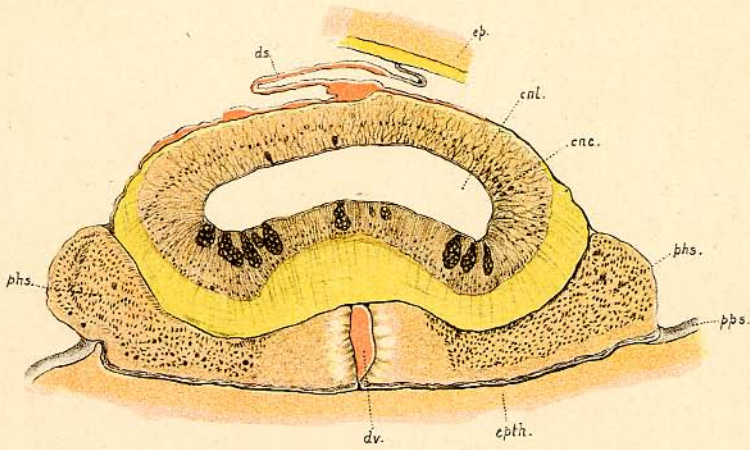First septal bar of gill skeleton. x 80.

Fig. 7.
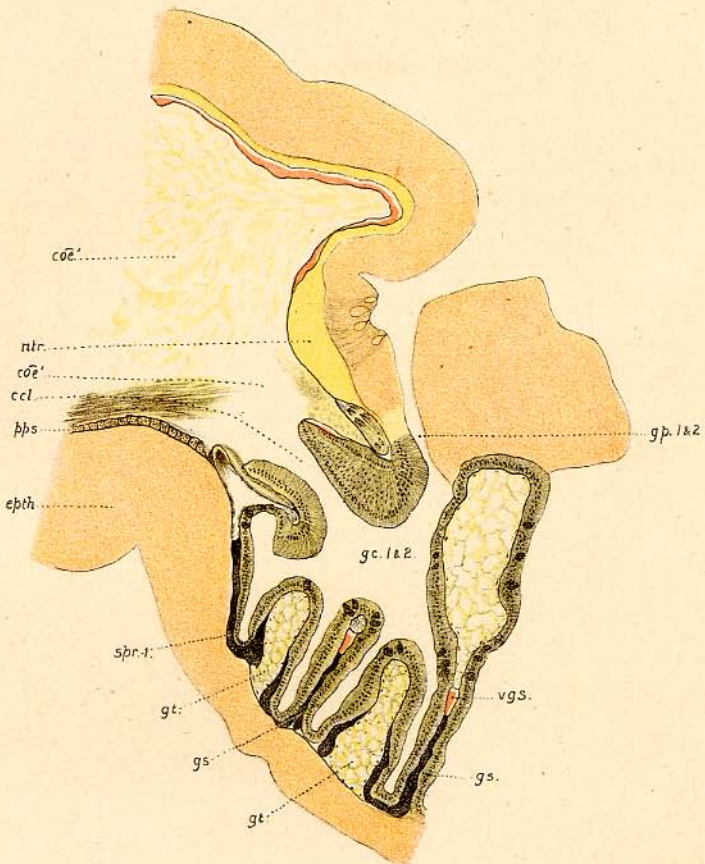
Fig. 8.

EXPLANATION OF PLATE XXI.

Ptychodera hedleyi, sp. nov.

Fig. 9. Transverse section through the branchial region; on the left side
a gill septum (*gs.*) is shown, and on the right a gill tongue
(*gt.*) x 30.

,, 10. Sagittal section through two gill septa and the gill tongue
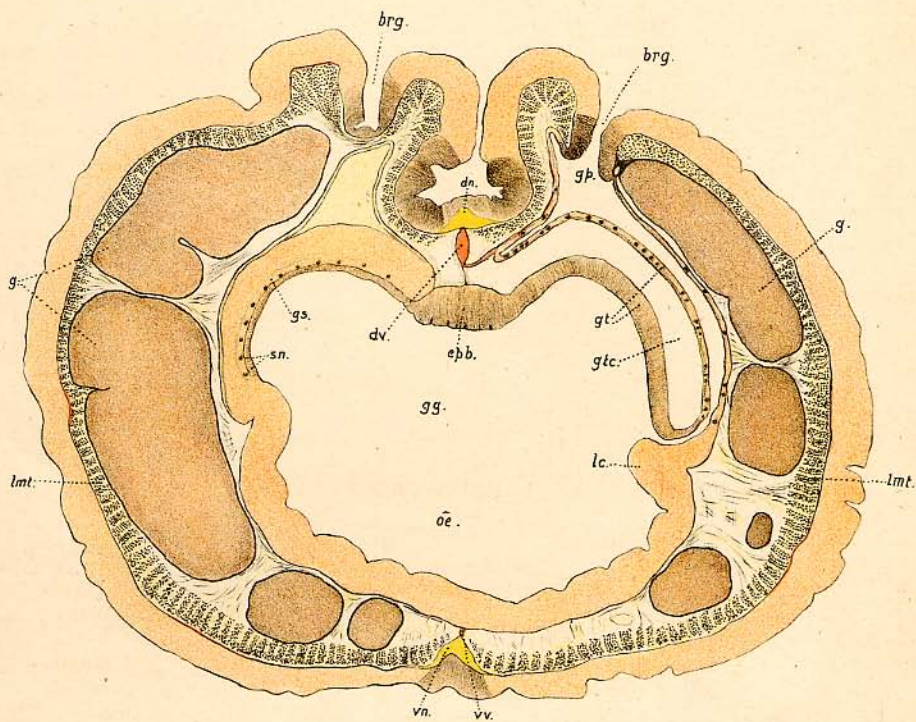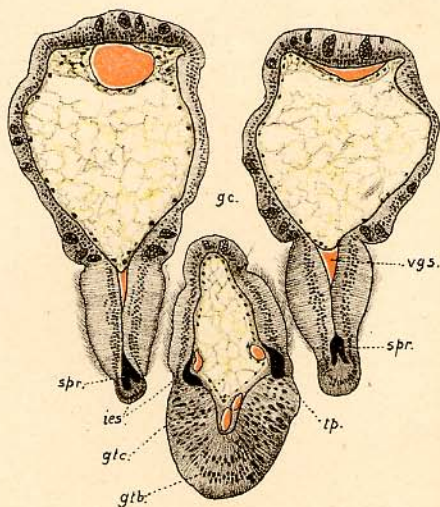between. x 135.

[For Reference Letters see pages 345-6.

Fig. 9.

Fig. 10.

EXPLANATION OF PLATE XXII.

Ptychodera hedleyi, sp. nov.

Fig. 11. Transverse section through the anterior portion of the genital
region to show the thick walled intestinal diverticulum (*idv.*)
x 24.

„ 12. Transverse section through the middle of the genital region.
The genital cushions (*gnc.*) are in this section more approxi-
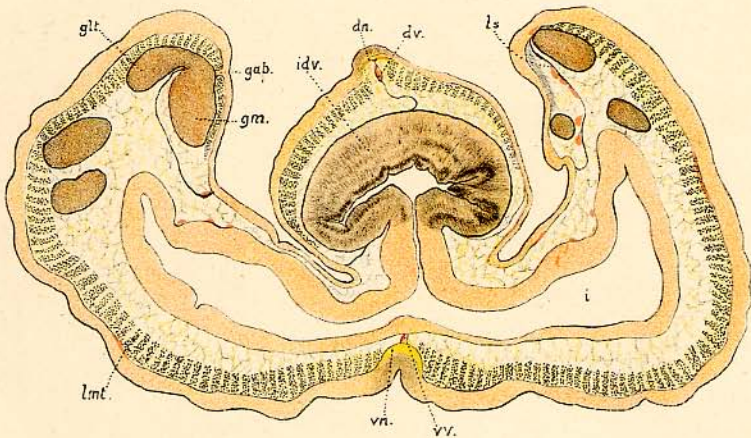mated than is normal.   x 24.

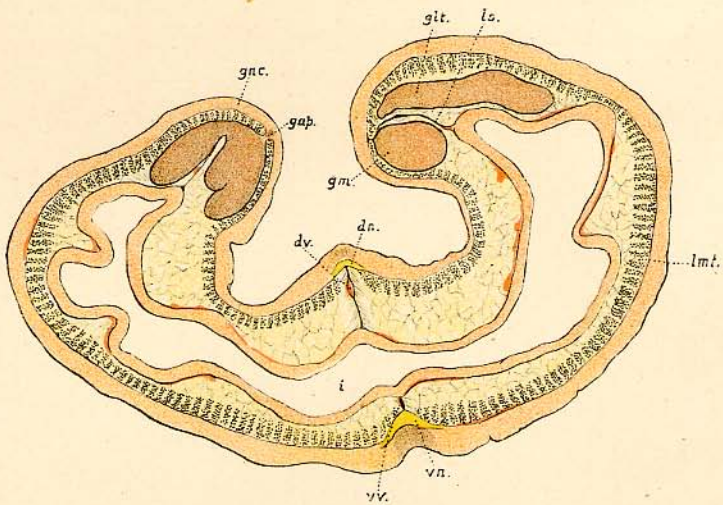[For Reference Letters see pages 345-6.]

Fig. II.

Fig. 12.