On Cephalogonimus vesicaudus n. sp.

By

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With Plate 8.

The genus *Cephalogonimus* was established by Poirier (1886) for the reception of a species of trematode obtained from a Senegal turtle (*Tetrathyra*) and whose most striking peculiarity is, as the name suggests, the location of the genital aperture at the extreme anterior end of the body in front of the oral sucker. To this type form he gave the specific name *lenoiri*. A second species has been referred to this genus by Stafford (1902) under the specific name *americanus*. Stafford found this species in the intestine of American frogs (*Rana virescens* and *Rana clamata*). A third form which may be put in the same genus is found abundantly in the intestine of the soft shelled river-turtles *Aspidonectes* and *Amyda*. It first came to my attention in 1899 while I was upon the houseboat Megalops maintained by the Minnesota Natural History Survey for the investigation of the fauna of the Mississippi and its tributaries. Subsequent observations have shown that it is almost invariably present in turtles of these two genera. For this species I have used in manuscript the name *vesicaudus* and Pratt (1902) has referred to it by that name in his Synopsis of North American Trematodes. No detailed description has been published. The new form agrees however in almost every respect with the definition of the genus

Cephalogonimus given by Looss (1899) and is unquestionably closely related to the members of that genus already known.

Cephalogonimus vesicaudus is a rather small worm the average length of preserved specimens being from $1^1/_2$ to 2 mm and the width 0,8—1 mm. The greatest length which I have recorded is 3,5 mm and the maximum width 1,3 mm. The smallest specimen that I have measured was $1^1/_4$ mm in length. The posterior end is broader and rounded, the anterior somewhat tapering giving an ovoidal outline as in Fig. 6. Preserved specimens nearly always have a strong ventral curvature due to contraction of the longitudinal muscle-fibers which are developed more strongly than elsewhere in two lateral bands upon the ventral side of the body. The acetabulum is a little larger than the oral sucker and is situated about $^2/_5$ of the length of the animal from its anterior end. The diameters of the two suckers are respectively about 0,27 and 0,22 mm. My maximum and minimum measures recorded are for the acetabulum 314 and 222 μ for the oral sucker 260 and 204 μ. These measurements were made upon preserved specimens.

The whole ventral surface is thickly set with scales arranged in the usual oblique rows. In the mid-ventral region they are broad and flat with the lateral edges parallel and abruptly rounded ends giving an outline which may be compared to that of the blade of a round pointed shovel. The larger ones measure 14—16 μ in length by 10—12 μ in breadth. Toward the ends of the body and the lateral margins they become narrower and more claw shaped. Upon the dorsal surface the spines are absent except upon the most anterior part; they are here very small and become progressively more minute backward until they entirely disappear not farther back than over the pharynx. Fischer (1884) describes *Opisthotrema* as having spines on the ventral but lacking them on the dorsal surface, but so far as I know this peculiarity of distribution of spines is not common in trematodes.

The condition of the digestive system agrees with that of the two other species except in the absence of an esophagus. The pharynx which measures about 60 μ in length by 100 μ in transverse diameter follows immediately upon the oral sucker and frequently shows a four-lobed condition at its anterior end. The intestinal coeca begin immediately back of the pharynx, there being no intervening esophagus, and terminate a little less than one fourth of the worm's length from its posterior end. The other two species

C. lenoiri and *C. americanus* are described as having esophagi respectively 150 μ and 125 μ in length.

The reproductive systems agree very closely with those described by Stafford for *C. americanus*. The relations and positions of the organs are shown in Fig. 1. The testes occupy the central portion of the body back of the acetabulum and are elongated transversely, the ratio of the transverse to the longitudinal diameter being about 3:2. The posterior testis is median in position, the anterior one lying wholly to the left of the middle line. The penis sack with its contents, seminal vesicle and prostate gland begins as a large fusiform structure just in front of the ovary upon the right side and extends obliquely across the body between acetabulum and pharynx; after crossing the left coecum it diminishes in size and as the ductus ejaculatorius (Looss) or prostatic duct (Poirier) continues forward as a slender tube having a somewhat tortuous course over the oral sucker or along its left margin in company with the vagina to the genital sinus. The seminal vesicle is elongated and folds upon itself to occupy nearly the first half of the fusiform enlargement of the penis sack, the remaining portion being taken up by the enormously developed prostate gland. The ovary is placed opposite the posterior border of the acetabulum and always upon the right side. The receptaculum seminis is large and at the right end of the anterior testis. The shell gland surrounding the ootype lies just in front of the mesial end of the anterior testis between it and the acetabulum. Laurer's canal opens dorsally in the middle line between anterior testis and the receptaculum seminis (Fig. 1 u. 2 *L. c.*).

The uterus extends from the ootype backward on the right side and its egg-filled coils occupy most of the space back of the posterior testis. Its terminal portion passes forward on the left side near the intestinal coecum and terminal part of the penis sack to the genital sinus.

The vitellaria are placed along either side mostly lateral to the intestinal coeca but overlapping them in the middle region. They extend forward to a transverse line halfway between the oral sucker and the acetabulum. Posteriorly they reach a little beyond the posterior border of the posterior testis. Poirier describes the testes in *C. lenoiri* as being one behind the other in the median line whereas in both of the American species the line joining the testes is an oblique line and the anterior testis is placed on that side of

the body which does not contain the ovary. The sexual amphitypy which Stafford finds in *C. americanus* I have not observed in *C. vesicaudus*. 21 specimens examined with respect to this factor showed the ovary in every case on the right side and the anterior testis on the left side. If it occurs at all it is certainly much less common than in his form.

The ova of *C. vesicaudus* measure 38—40×17—21 μ.

The excretory system is the one which presents the most interesting conditions. In its main features it agrees with the descriptions of Poirier and Stafford but differs from the systems which they described in the possession of a rounded chamber interposed between the excretory vesicle and the excretory pore which they neither mention nor figure and which is unlike any structure which I have seen described in other trematodes. I shall refer to this as the caudal vesicle. It was with reference to this unique morphological feature that the name *vesicaudus* was chosen. The extent of the excretory vesicle is shown in Fig. 6. Its main stem is formed by the union of two chief branches which begin far forward beside the oral sucker and extend backward near the lateral margins of the body to the region of the testes. In this part of their course they receive from both sides numerous short dendritic branches. Near the testes they bend sharply inward and meet in the middle line back of the posterior testis to form the main trunk of the system which extends directly back to open into the peculiar rounded chamber already mentioned. This main stem also receives about 3 pairs of lateral branches whose dendrites extend out to near the lateral and posterior margins of the body. The larger branches of this system are of about the same caliber as the intestinal coeca as shown in Fig. 2. They are lined thruout by an irregularly columnar epithelium which is low in the smaller branches and correspondingly higher in the larger ones. In the latter the distal parts of the cells stand up independently of one another in a manner suggesting an amoeboid activity during life.

The relations of the terminal portion of the excretory vesicle, the caudal vesicle and the excretory pore are shown in Figs. 3, 4, 5, 6 and 7. Figs. 3 and 4 are adjacent sections from a transverse series. Owing to the strong ventral flexure of the caudal portion of the worm however the sections in the latter part of the series from which these came are made to run obliquely ventrad and caudad as indicated in the small sketch Fig. 8 *x—y*. Fig. 3 shows

the openings of the last pair of lateral branches into the main stem of the excretory vesicle and the connection of this with the caudal vesicle. Fig. 4 is from an adjacent section which passes obliquely thru the caudal vesicle and its pore to the exterior and just above the opening from excretory into caudal vesicle. Fig. 5 represents part of a section which cuts this vesicle transversely. It may be seen from these four figures that the caudal vesicle has a general form which is approximately spherical or spheroidal but which is modified by the presence of a number of longitudinal infoldings of its wall (Fig. 5) which subdivide its cavity into a corresponding number of pockets. These open laterally from the central cavity which is continuous from the mouth of the main excretory trunk to the excretory pore or caudal foramen. The longitudinal infoldings of the wall may be compared to the septae of an actinian and the cavity of the caudal vesicle has therefore a shape not dissimilar to that portion of the gastrovascular cavity of the actinian below the gullet. The infolded wall consists of a thin structureless membrane continuous at the edges of the excretory pore with the outer covering of the body and at the junction of the excretory trunk with the vesicle, continuous with the basement membrane beneath the epithelial lining of the excretory vesicle. Within the caudal vesicle, lining its wall and covering all of the infoldings, is a layer of finely granular material of indifferent staining power. Its thickness is fairly uniform and about equal to that of the epithelial lining of the larger excretory trunks, but no nuclei, cell boundaries nor other definite evidence of cellular structure can be made out. The transition from the condition of the lining of the excretory trunk to that of the vesicle is sharp. In regard to the actual character of the lining of the vesicle I have not succeeded in obtaining any conclusive evidence. It has the same character in the youngest specimen that I have studied as in older and larger ones.

Around the wall of the vesicle is a layer of large pyriform cells represented in Fig. 7. They have prominent nuclei containing four or five rather large clumps of chromatin. The cytoplasm is clear non granular. It is possible that these are glandular in function and that the granular appearing material lining the caudal vesicle is a product of the activity of these cells. Corresponding cells are not present about the wall of the excretory vesicle but similar smaller cells are present in the subcuticular layer in many regions. Embedded in the otherwise structureless wall of the

vesicle are delicate circularly arranged fibers brought out as black lines or dots by the iron haematoxylin stain. From these characters it appears that the wall of the caudal vesicle is structurally much more like the external body covering than like the excretory vesicle.

The septa seen in cross section under high magnification present an appearance very feather like, the axis (or shaft) being made of a double layer of basement membrane from which stand out on each side long slender columnar processes side by side like the barbs of a feather. These barb like processes are a little too broad and blunt at the ends to be cilia and have a vagueness of outline which makes it impossible to say just how distinct from one another they are. They show no trace of nuclear structure. As seen under low magnification they appear as zones of finely granular material rather broad on the sides of the septa and thinner on the walls of the vesicle between the bases of the different septa as indicated in a part of Fig. 5. It is impossible to say with perfect assurance what the nature of this material is, but the impression which it gives when studied with high powers is that of a degenerated epithelium in spite of the absence of any trace of nuclei and the quite unequal thickness in the different portions. If it be regarded as a degenerated epithelium the condition offers an interesting comparison with that found by Pratt (1898) in the uneverted caudal appendage of *Apoblema*. This interpretation also is in harmony with the view that the cuticular body covering of the trematode has the morphological relations of a hypertrophied basement membrane of an epithelium which has disappeared in embryonic stages.

It is seen from the foregoing description that *C. vesicaudus* differs anatomically from the type species *C. lenoiri* in three respecta, viz. the possession of the caudal vesicle, the absence of an esophagus and the oblique position of the testes. These differences would perhaps justify the creation for it of a new genus. Stafford's species *C. americanus* stands intermediate between the other two, agreeing with *C. vesicaudus* in the oblique position of the testes and with *C. lenoiri* in the possession of an esophagus and the lack of caudal vesicle. If a new genus were created it would therefore has based

upon the presence of a caudal vesicle and the lack of an esophagus. In view however of the close resemblance of the three forms in all other respects it has seemed to me not necessary to separate them and I have preferred to refer my species to Poirier's genus.

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Literature.

Looss, A., 1899, Weitere Beiträge zur Kenntniss der Trematoden-Fauna Aegyptens etc., in: Zool. Jahrb., Vol. 12, Syst., p. 521.

Pratt, H. S., 1898, A contribution to the life-history and anatomy of the Appendiculate Distomes, ibid. 11, Anat.

—, 1902, Synopses of N. American Invertebrates XII. The Trematodes, in: Amer. Naturalist, Vol. 36, p. 959.

Poirier, J., 1886, Trématodes nouveaux ou peu connus, in: Bull. Soc. philom. Paris, Vol. 10.

Stafford, Jos., 1902, Cephalogonimus americanus n. sp., in: Ctrbl. Bakteriol., Vol. 32, p. 719.

Explanation of Plates.

ac acetabulum
c. v caudal vesicle
ex excretory vesicle
g. p genital pore
in intestine
L. c Laurer's canal
o. s oral sucker
ov ovary
ph pharynx
pr prostate
r. s receptaculum seminis
tes testis
ut uterus
v. gl vitelline gland

Plate 8.

Fig. 1. Drawing of entire worm as seen from the dorsal side. This specimen was fixed while flattened under a compressor and the anterior portion is thus made a little too broad. The outline in Fig. 6 is more normal.

Fig. 2. A transverse section thru the middle region of the body.

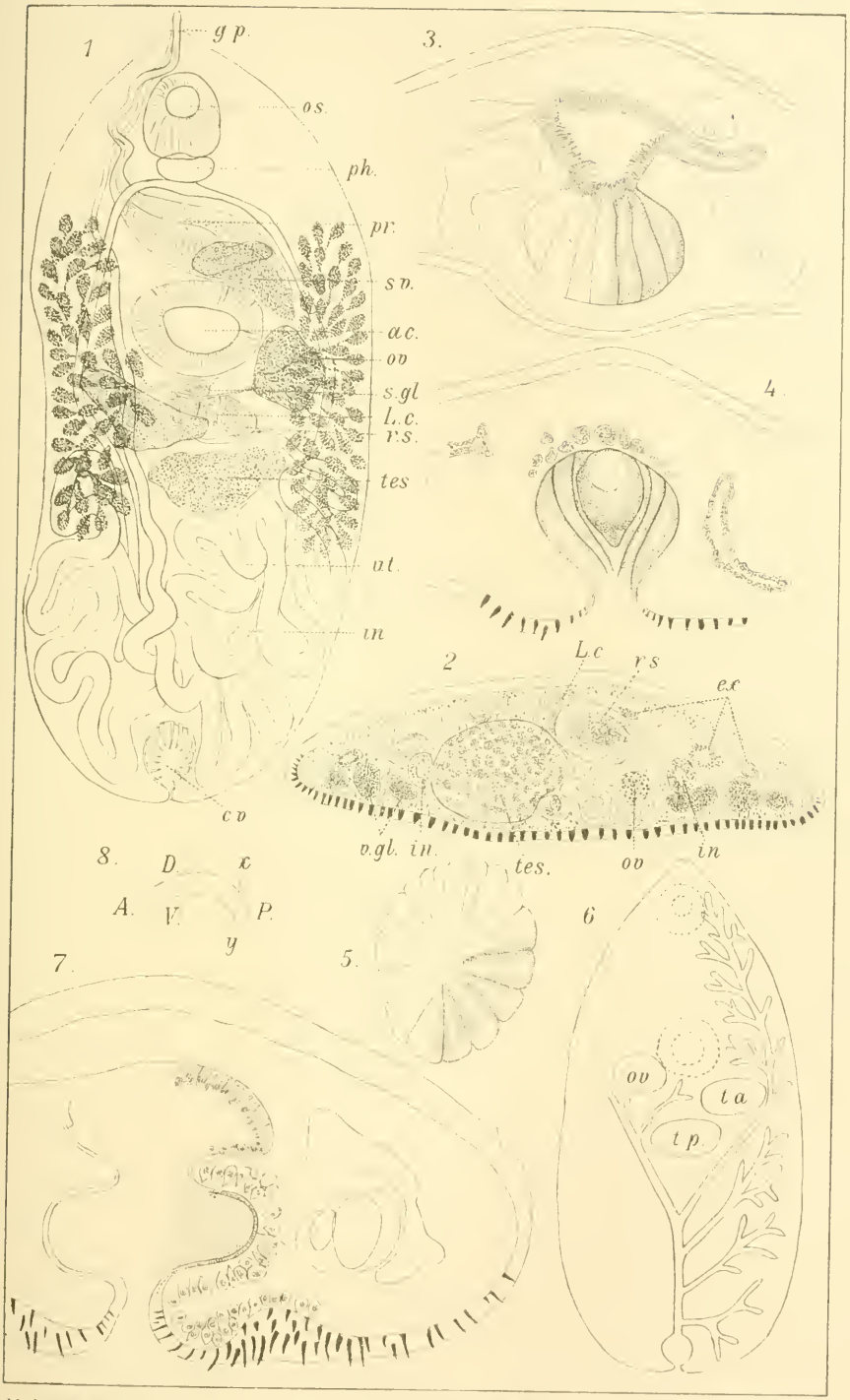
Figs. 3 and 4. Portions of adjacent sections thru posterior end in direction indicated by the line *x*—*y* in Fig. 8. Fig. 3 shows the connection between the excretory and the caudal vesicles; Fig. 4 shows the opening of the caudal vesicle to the exterior.

Fig. 5. Part of a section passing transversely thru the caudal vesicle; the lining layer is represented in only a part of the drawing.

Fig. 6. Freehand reconstruction of the excretory system of the right half of the worm.

Fig. 7. Section thru the posterior part of the excretory vesicle, the caudal vesicle and the excretory pore, showing the relations of the structures forming their walls.

Fig. 8. Sketch to show the direction of the plane of section of Figs. 3 and 4.



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