THE ANATOMY OF *TETRACOTYLE ITURBEI* FAUST, WITH A SYNOPSIS OF DESCRIBED TETRACOTYLIFORM LARVAE *

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Thru the courtesy of Professor Henry B. Ward, the writer has been enabled to examine specimens of *Planorbis guadelupensis* Sowerby infected with a new tetracotyle, to which the name *Tetracotyle iturbei* has been given (Faust 1918a). The material, for which I am greatly indebted to the kindness of Dr. Juan Iturbe, of Caracas, Venezuela, was at first considered to be "rediae" of *Schistosoma mansoni* (Iturbe and Gonzalez 1917). The infection occurs as cysts in the testicular cavities of the mullusk. As a result of the infection, these lumina are highly inflated, measuring two to three times normal size.

The material was examined by teasing out some of the worms and mounting as totos and by sectioning others *in situ.*

Description of *Tetracotyle iturbei* Faust 1918

Tetracotyle iturbei is a pear-shaped fluke measuring 0.42 mm. long, 0.33 mm. wide, and 0.3 mm. thick in the region of the primitive genital pore (Fig. 1). The oral sucker has a diameter of 52μ; the primitive genital pore, 42μ, and the acetabulum 95μ. Posterior to the middle of the oral sucker and lateral in position are the accessory suctorial grooves with their oval openings directed anteromesad. These organs are undoubtedly muscular and are deeply sunken in the tissue of the worm. The body as a whole is enclosed in a thin mucoid cyst capsule, fitting tightly around the tetracotyle everywhere except in the region of the ventral attachment organs. There is no armament anywhere on the integument. No inclusive suctorial cup, such as is described for *Cercaria flabelliformis* (Faust 1918), is found to surround the ventral attachment organs. In sagittal section the outline of the worm resembles a similar section of a trochophore larva.

From the deeply sunken oral sucker the alimentary tract leads dorsad. Immediately above the oral sucker is the flask-shaped pharynx, 16μ in trans-section. The ceca arise at the dorsal end of the pharynx and proceed posteriad after looping somewhat ventrad and then dorsad again to the plane which the posterior end of the pharynx occupies.

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The ceca describe a wide furculum. They end blindly in the region of the anterior ventral sucker, or at times extend to the margin of the posterior ventral sucker. These diverticula are composed of a single layer of granular cells surrounding a small lumen. They have no suggestion of muscular elements. The cells of the ceca are cuboidal, about 4 to 5μ thick, with spherical nuclei 2μ in diameter, located in the center of the cells.

Only the main trunks of the excretory system were made out, and those with great difficulty. The material which was available for study was preserved in formol, so that none of the ultimate traces of the system were left. The bladder is situated dorsal to the genital pouch; it is nonmuscular and inconspicuous. Emptying into it are two swollen trunks which occupy the greater part of the body lateral to the digestive ceca. As far as they can be made out they have no cellular lining, but are merely lumina within the parenchymatous complex of the worm. These trunks extend as far anteriad as the lateral suctorial grooves. They probably branch here, but the details cannot be followed. No excretory granules, such as are usually found in the Holostomidae, have been preserved in this specimen.

The nervous system of the holostomes has been remarkably altered, synchronously with the evolution of this group in other directions. The working out of this system was so difficult that Brandes (1891: 570) passed over its consideration in a brief paragraph, merely stating that he had observed nerve elements in the parenchyma of the suckers.

The present species has a nervous system similar in all essentials to that of *Cercaria ptychocheilus* (Faust 1918: 54, 55), but shows some interesting minor differences. In *Tetracotyle iturbei* the brain mass is large and is situated some distance dorsal to the pharynx (Fig. 4). There is a thick dorsal commissure. Anterior to it are dorsal and ventral trunks and perhaps traces of intermediate lateral trunks. From the posterior ventral angles of the brain are derived two paired trunks, dorsales and ventrales; and, in addition, a subesophageal commissure. The posterior dorsal trunk is fairly compact, cylindrical, and measures about 6μ in cross section. On the other hand, the posterior ventral trunk is very diffuse, being much larger than the dorsal ramus, in all some 9 or 10μ in cross section. The individual nerve fibers in this trunk can be easily distinguished. Given off from the ventral margin of the subesophageal commissure is a median fused trunk. In the plane of the lateral suckers it forks so that the branches of each fork surround the muscular region below the primitive genital pore. The muscular organ is the primitive vagina and the nerve is the genital nerve. In the region of the primitive genital pore the posterior dorsal trunks lie lateral and ventral to the ceca, while the large unsheathed ventrales lie in the plane of the pore, just lateral to it.

Branches of these two nerves form a dense mat between the parenchyma and muscle elements, ending in the body wall especially in the region of the acetabulum and lateral suckers. Prominent branches of the ventrales continue posteriad to the posterior genital pouch. The sensory nerve fibrillae (Fig. 3) pass in between the longitudinal and transverse nerve fibers and end in small papillae in the inner granular region of the integument.

The nerve cells are confined to the brain mass. No cell walls can be made out, but the nuclei are readily seen. They are oblong-ovate or reniform, and measure 1.5μ in short diameter and 4μ in long diameter.

The genital organs are differentiated early in holostomes. Midway between the acetabulum and the posterior genital pore is the ovarian cell mass, 25μ in transverse diameter. Dorsally, it opens thru the short oviduct into the ootype (Figs. 1, 5). The vitelline glands are long cylindrical cords, reaching cephalad as far as the primitive genital pore, and describing a broad H, with the anterior arms much the longer. At their anterior end the cords lie just ventral to the posterior limits of the ceca. Short transverse ducts connect them with the ootype. The vitellaria are composed of large granular cells with vesicular spherical nuclei. Posteriad, the ootype opens into a narrow cylindrical tube which continues caudad and opens to the exterior somewhat ventral to the excretory vesicle. There is no distinct enlargement into a genital pouch as has been described for various adult species and for the larvae, *Cercaria flabelliformis* and *C. ptychocheilus* (Faust 1918: 110-112). Nor is there a definite muscular wall here. There are, however, numerous muscular elements which have their insertion posterior to the ootype and are spread out in fan-shaped arrangement, ending in the posterior body wall, muscles which undoubtedly serve in the capacity of dilating the genital atrium.

Pyriform testes, 50μ in trans-section, are found lateral to the ovary and slightly anterior to it. Their efferent ducts run caudad separately and open into the genital atrium from the sides. The testicular elements consist of polygonal cells with many chromioles and no well defined nuclei.

The anterior of the two ventral suckers is of the highest significance in the phylogenetic history of the holosomes. In the literature this attachment organ has been referred to as the acetabulum by Moulinié (1856) and later workers. The posterior ventral sucker has been regarded as an accessory suctorial organ, which most investigators have considered a creation *de novo,* but which Ssinitzin (1910: 19-21) has thought to be the modified genital pore. The latter investigator has seen a resemblance between the suctorial organ of *Holostomum erraticum* Duj. of Brandes (1891: Taf. 41, Fig. 5) and the

penial organ of his own unusual distome larva, *Cercaria plicata*. A most serious difficulty prevents such a conclusion, namely, that the genital organ of distomes is usually anterior or lateral to the acetabulum and in only a few species posterior to that organ.

Of all the writers on holostome anatomy and phylogeny, Odhner (1913) alone considers the posterior ventral sucker to be the acetabulum; the anterior ventral sucker he regards as a phylogenetically new organ. *Tetracotyle iturbei* provides ample evidence in support of the view previously proposed by the writer (1918) that the anterior ventral sucker is the primitive genital pore, while the posterior ventral sucker is the acetabulum.

A median sagittal section of the tetracotyle (Fig. 5) shows three openings on the ventral side, the oral and the two ventral suckers. The posterior ventral sucker is muscular. The outer part is funicular and leads into a large deep pocket which ends blindly ventral and caudal to the ovary. Likewise the anterior ventral sucker has a funicular opening. Within it there is a narrow tube, walled with a single thick layer of elongate cells leading dorsocaudad. Near the dorsal wall it opens into a U-shaped tube of large diameter lined with cuboidal cells of granular structure. This tube in turn opens into two genital organs, the ovary, caudoventrad, and the vagina, anteroventrad. The latter organ is large and irregular in contour, 37μ in thickness and 64μ long. It is walled with several muscular layers and has only a small lumen.

Hence *Tetracotyle iturbei* has two genital canals leading to the outside, one opening anterior to the ovary and just in front of the acetabulum, and the other opening caudad below the excretory pore. The genital canal opening thru the anterior ventral sucker proves this sucker to be a modified genital pore. On the basis of this direct evidence this sucker is to be regarded as the primitive genital pore of all tetracotyle and diplostomulum larvae, even where the connection with the genital organs has been lost. Furthermore, the undeveloped muscular elements of the posterior genital atrium in this species, together with the clear connection between the ootype and the primitive genital pore, suggest that this species is phylogenetically a transition form between distome and holostome types. The vagina is an organ not usually found in the holostome group. No Laurer's canal has been made out with certainty, but it probably arises from the dorsal wall of the glandular region along the primitive genital canal.

The study of the genital system in this species, then, contributes important evidence in support of the distome relationship of the holostomes. It shows the direct homology between the anterior ventral sucker of the holostome and the distome genital pore. In confirmation of Odhner's view it homologizes the posterior ventral sucker of holostomes with the distome acetabulum.

The encysted animal is covered with a thin but firm capsule of mucoid material of a bluish-gray hue. Beneath this is the integument. There is no epidermis present. Directly beneath the cyst capsule is a firm, almost homogeneous non-cellular layer, in which minute refractory granules are brought out by a very bright illumination. An equally thick layer of the same material lies just beneath this covering. It differs from the outer layer in being more diffuse and in having larger granules. The sensory nerve fibrillae penetrate into this layer and end in delicate papillae (Fig. 3).

In many regions of the body the parenchyma is almost obliterated by muscle and nerve elements. It may be stated with considerable certainty that little if any undifferentiated parenchyma remains in the larva at this stage of development. In the deeper regions of the body it has been converted into connective tissue. In the region next to the body wall the cells have long aciculate processes which penetrate thru the muscle layers into the inner integumentary layer. These cells probably function in the secretion of the integument.

The holostome larva as illustrated by *T. iturbei* is a unique example of muscular development. The muscles function primarily in the attachment of the worm to the tissues of the host and not in locomotion. The body wall has two series of muscles, an outer single layer of transverse fibers and many layers of longitudinal fibers just within the transverse layer. No muscles have been found in connection with the digestive ceca. The glandular elements of the acetabulum make it possible for this organ to function as a digestive organ. There is a strong pharyngeal sphincter around the esophagus, directly above the oral sucker.

The suctorial organs of this species all contain muscular elements. In most tetracotyles the acetabulum is described as possessing glandular elements. For the accessory lateral suckers of *Tetracotyle echinata* Diesing (1858: 367) and *T. petromyzontis* Brown (1899: 493, Fig. 5) definite granular structures have been described, but the glandular nature of these organs is probably of secondary origin and not their primary function.

Important retractor muscles are situated in two regions of the body. In the anterior part (Fig. 6), dorsal to the origin of the digestive ceca, a heavy double muscle band has its insertion. One part runs ventrad to the left of the pharynx and the other runs ventrad to the right of the pharynx. Each part of the band spreads out in fan-shaped arrangement so that it occupies the entire lateral region between the oral sucker and the genital pore. With the contraction of these muscles the entire region between these suckers is converted into a vacuum, by means of which the worm is intimately attached to the host. Muscle strips inserted in the region of the uterus of the worm have their

ending in the posterior wall. They probably function in the dilatation and contraction of the functional genital pore.

The muscle cell nuclei are usually spherical, with a diameter of about 4.5μ. In the region of the primitive genital pore, however, some are stellate. These nuclei are all abundantly filled with chromidia, which in some cases, are massed into karysomes.

Only encysted individuals of *Tetracotyle iturbei* have been found. Like the distomes, the holostome larvae have been shown to be heterogenetic (Faust 1918). It is expected, therefore, that the cercariae of this species are produced parthenogenetically within a redia or sporocyst.

DISCUSSION

Tetracotyle iturbei is the first larval holostome to be described from South America. Records for North America have been made by Leidy, Rettger and Faust. These records, as well as those for *Tetracotyle typica* Europe are from molluscan hosts. Other tetracotyles are recorded from leeches, fish, amphibians, reptiles, birds and mammals. In every case except that of *Cercaria flabelliformis* the larvae have been found in the encysted or postencysted state. The doubtful case of *Tetracotyle hirudium* (Schomburgk 1844) gives the single record of an ectoparasite in the group.

No end of confusion in the systematology of holostome larvae has resulted from a disregard for the original diagnosis of the genera together with ignorance of the life-history processes of the group. The genera Diplostomulum, Tyrodelphys, and Tetracotyle have been recognized, but species of each of these have been placed in each of the other genera by overlooking items in the original description and by substituting incorrect descriptions for the genera to fit the cases in hand.

In 1832 von Nordmann proposed the name Diplostomum for the flat holostome larvae with two ventral suckers and no accessory lateral sucking organs. He recognized two subgenera with the type species *Diplostomum volvens* and *D. clavatum.* Unfortunately, he failed to name the subgenera. Diesing (1850: 304) removed the *clavatum* type to a new genus, for which he proposed the name Tylodelphys.

Tetracotyle typica was described by Steenstrup (1845: 129; Taf. 5, Fig. 3) as a "true distomata, *Distoma tarda.*" The accessory suctorial organs were considered to be excretory organs. In 1855 de Filippi found the same species in conjunction with sporocysts of *Cercaria furcata,* and, recognizing the lateral organs as suckers, proposed the name Tetracotyle for the group. The name for the species described by Steenstrup and de Filippi, as proposed by Diesing, is *Tetracotyle typica* (1858: 366). In as far as this larval group can be recognized as a genus, this species may well be considered the type species.

The work of the writers on the present species, *Tetracotyle iturbei,* together with that on *Cercaria flabelliformis* and *Tetracotyle pipientis,* makes it possible to define the genus more carefully, without in the least deviating from de Filippi's original conception of the genus.

Redescription of Tetracotyle.—Holostome larva, oval, pyriform or ovate-oblong in contour, with ventral compression. Attachment apparatus consists of an oral sucker, ventral sucker (acetabulum) often degenerate and glandular, a ventral muscular genital pore usually somewhat larger than the acetabulum, and a pair of lateral suckers to the right and left of the pharynx, at times muscular, but also glandular in some species—all of these usually included within a muscular attachment cup. Primitive genital pore with or without functional connections with the genital organs. Excretory system having framework of an inconspicuous bladder, a pair of long cornuate vesicular trunks and a prominent transverse vessel which shifts its position in various species. Genital organs well differentiated in the larvae: consisting of a pair of oval testes, a pair of vitelline chorda, a median ovary and a posterior genital pouch. Nervous system highly modified. Parthenogenetic generations occurring in the mollusk, intermediate stage passed in vertebrates, and possibly in the case of *T. hirudinum* in leeches, and the definitive stage in higher vertebrates. Adult stage thot in all cases to be the genus Strigea.

The genus Tetracotyle is differentiated from Diplostomulum and Tyrodelphys by the presence of lateral grooves, which are primitively muscular, but at times glandular. These grooves may be situated at the anterolateral margin of the worm or may be ventrally placed. *Monocerca heterobranchi* Wedl has chitinous grooves at the anterior margins. It may represent a transition from the Tetracotyle to the Tylodelphys type. Were the internal anatomy of all the species better known, a more fundamental basis for classification would be afforded.

Synopsis of Described Species of Tetracotyle

1. *Tetracotyle* (*Distoma*) *crystallina* (Rud.) 1819

Outline oval; length 0.4 to 0.6 mm.; width 0.25 to 0.45 mm.; oral sucker 130μ in diameter; primitive genital pore 140μ in diameter, median ventral; acetabulum glandular, auriculate; lateral suckers with small spines, opening forward. Excretory bladder rhomboidal, canals meandering, branching anterior to primitive genital pore.

Encysted in muscles of Rana, Bufo, and Pelias (Viperus). Europe.

2. *Tetracotyle* (*Heptastomum*) *hirudinum* (Schomburgk) 1844

Outline pyriform; length 0.62 mm.; remainder of description quoted directly from Diesing (1858:370): "Acetabula quattuor limbo ciliata, ventralia maximum subcentrale, alterum minus postpositum versus marginem posticum, transverse elliptica, et duo multo minore longe elliptica parallela, cum acetabulo marginale in triangulum disposita." Since Schomburgk figured his fluke up-side-down, his "versus marginem posticum" means toward the anterior end, and "aperturae genitales discretae antrosum sitae" should read "aperturae genitales discretae posticum." Two oval or reniform testes are figured behind the ovary. The main excretory trunk is median, extending to the region just behind the testes at which place the transverse canal is

formed. The lateral canals are given off near the base of the main trunk; they give rise to many tubules and capillaries laterally disposed.

Recorded as parasitic externally, also in the genital organs of *Nephelis vulgaris* and *Clepsine complanata*. Europe.

3. *Tetracotyle percae-fluviatilis* Moulinié 1856

Outline oval; length 0.38 to 0.88 mm.; width 0.3 to 0.5 mm.; oral sucker 60μ; primitive genital pore 80 to 100μ, in the posterior half of the body; acetabulum small, inconspicuous; lateral suckers 66 by 133μ, lateral to pharynx. Crura long, meandering to posterior part of the body. Bladder small, lateral excretory trunks filiform, transverse vessel just behind primitive genital pore, secondary laterals from transverse vessel coursing forward.

Encysted in region of heart, *Perca fluviatilis*. Europe.

This species is credited to von Linstow in Lühe (1909: 170).

4. *Tetracotyle typica* Diesing 1858

Outline ovate to pyriform; length 10 mm.; width 0.62 mm.; oral sucker 59μ in diameter; primitive genital pore 79μ in diameter; acetabulum glandular, very large; lateral suckers auricular, subequal to oral sucker. Esophagus long, crura with many lateral ceca. Bladder hemispherical, pore subterminal, excretory stems meandering, branching in region of primitive genital pore; no transverse canal described.

Found in Lymnaea, Planorbis and Paludina in Europe; reported from *Lymnaea catascopium* and *Physa heterostropha* by Leidy for North America.

5. *Tetracotyle echinata* Diesing 1858

Outline oval; length 0.62 mm.; lateral suctorial grooves glandular, sparingly covered with spines 3 to 4μ long; grooves subequal to oral sucker. Network of excretory granules.

Encysted in oval capsules 0.5 to 0.6 mm. thick, in peritoneum of *Leuciscus idus* and *Acerina cernua*. Europe.

6. *Tetracotyle foetorii* von Linstow 1876.

Top-shaped, with transverse constriction anterior to primitive genital pore; length 1 mm.; width 0.48 mm.; oral sucker 130μ in diameter; primitive genital pore 170μ in diameter; acetabulum large, irregular, glandular; lateral suckers small, auricular. Crura from base of pharynx to region of acetabulum; large genital cell mass behind acetabulum.

Encysted in neck muscles of *Mustela* (*Foetorius*) *putorius*. Europe.

7. *Tetracotyle colubri* von Linstow 1877

Anterior end elongate, posterior end elongate—cylindrical; few large spines with broad bases on surface of integument; length 0.54 mm.; width 0.3 mm.; oral sucker 78μ in diameter; primitive genital pore 120μ in diameter; acetabulum considerably larger than primitive genital pore; lateral suckers oval, lateral to oral sucker. Crura arising from base of pharynx, extending to posterior end of primitive genital pore.

In thick-walled capsules embedded in subcuticula, *Tripidonotus* (*Coluber*) *natrix* and *Pelias* (*Vulperus*) *berus*. Europe.

8. *Tetracotyle soricis* von Linstow 1877

Similar in most respects to *T. colubri*. In capsules 1.2 mm. by 0.54 mm.; oral sucker 66μ in diameter; primitive genital pore 110μ.

Embedded in connective tissue in a double capsule, *Sorex vulgaris*. Europe.

This description is inadequate to warrant the creation of this species, but future work on the species may show it to be well founded.

9. *Tetracotyle ovata* von Linstow 1877

Outline large oval; spines confined to suckers; length 0.84 mm.; width 0.57 mm.; oral sucker 98μ in diameter; primitive genital pore 130μ in diameter; acetabulum 160 to 210μ in diameter, opening backward ("larval anus" of von Linstow); lateral suckers elongate oval. Concentric rows of teeth on oral sucker and primitive genital pore.

Encysted in gut or peritoneum, or free capsules in body cavity, *Abramis (Blicca) bjoerkna, Osmerus eperlanus, Acerina cernua,* and *Abramis brama.* Europe.

10. *Tetracotyle lenticola* (von Linstow) 1878

Outline broadly pyriform; length 0.55 mm.; width 0.46 mm.; oral sucker 66μ in diameter; primitive genital pore 66μ in diameter; acetabuum about 60μ in diameter, with many radiating glands; lateral suckers at extreme anterolateral reaches, consisting of lenticular muscular grooves. Excretory bladder triangular, vesicular; lateral canals constricted, with racemose tubules thruout body. Digestive crura to region just anterior to excretory bladder.

In lens, *Abramis vimba.* Europe.

11. *Tetracotyle petromyzontis* Brown 1899

This species was first found by Müller in 1840 and described as a diplostome in the fourth brain ventricle of *Petromyzon fluviatilis.*

Synonymy:—Diplostomum of *Petromyzon fluviatilis* Müller 1840
Diplostomum petromyzi fluviatilis Diesing 1850
Tylodelphys petromyzontis fluviatilis Diesing 1858
Diplostomum mülleri Cobbold 1860.
Tylodelphys petromyci fluviatilis von Linstow 1878
Tetracotyle petromyzontis Brown 1899

Outline ovate, with oral end set off from body; length 0.42 mm.; oral sucker an ovoid cup; primitive genital pore slightly larger than oral sucker; acetabulum a longitudinal slit; lateral suckers auricular, multiglandular, just lateral to mouth. Pharynx powerful, ceca extending to subcaudal region. Genital cells consist of undifferentiated nuclear aggregates in region of primitive genital pore. Excretory bladder bicornuate, anterior tubules dendritic, posterior tubules prominently reflexed; transverse vessel split into two parts.

In fourth brain cavity of Ammocœtes. Europe.

Leydig arranged his species *Tylodelphys crainaria* with Henle's *T. rhachiaea* and Müller's Tetracotyle of *Petromyzon fluviatilis* since they possessed in common "calcareous granules" within the body tissues of the worms.

12. *Tetracotyle phoxini* nov. spec

Synonymy:—Tetracotyle from *Phoxinus laevis* Mataré 1910.

Outline pyriform, with constriction separating anterior and posterior parts of body; length 0.2 mm.; width 0.15 mm.; oral sucker and primitive genital pore subequal; acetabulum larger, midway between primitive genital pore and bladder; lateral suckers auricular lappets, to right and left of oral sucker. Pharynx well developed, embracing entire esophagus; ceca extending to acetabular region. Excretory bladder large, bicornuate; split longitudinal canals, with a transverse canal in region of primitive genital pore.

In brain and cranial cavity of *Phoxinus laevis.* Europe.

Mataré has brought together most of the true tetracotyles in his study, but he has also listed a number of diplostomula among these, as well as the agamodistoma of Wedl and of Leydig.

EXPLANATION OF PLATE

a, acetabulum
ad, anterior dorsalis nerve
av, anterior ventralis nerve
c, cirrus pouch
ce, cecum
cy, cyst capsule
g, posterior genital pore
ge, genital nerve
in, integument
l, lateral sucker
lm, longitudinal muscle
o, ovary
p, pharynx
pc, modified parenchymaa cell
pd, posterior dorsalis nerve
pg, primitive genital pore
pv, posterior ventralis nerve
s, subesophageal commissure
t, testis
tr, transverse muscles
v, vagina

Fig. 1. Ventral view of *Tetracotyle iturbei*, × 126. 2. Frontal section of fluke thru digestive ceca, × 260. 3. Region of integument and subintegumentary tissues, × 1500. 4. Oblique frontal view of nervous system, × 396. 5. Sagittal section of fluke, showing connection of vagina with primitive genital pore and posterior genital pore, × 260. 6. Sagittal section of worm in region of pharynx, showing relation of retractor muscles to pharynx, × 396.

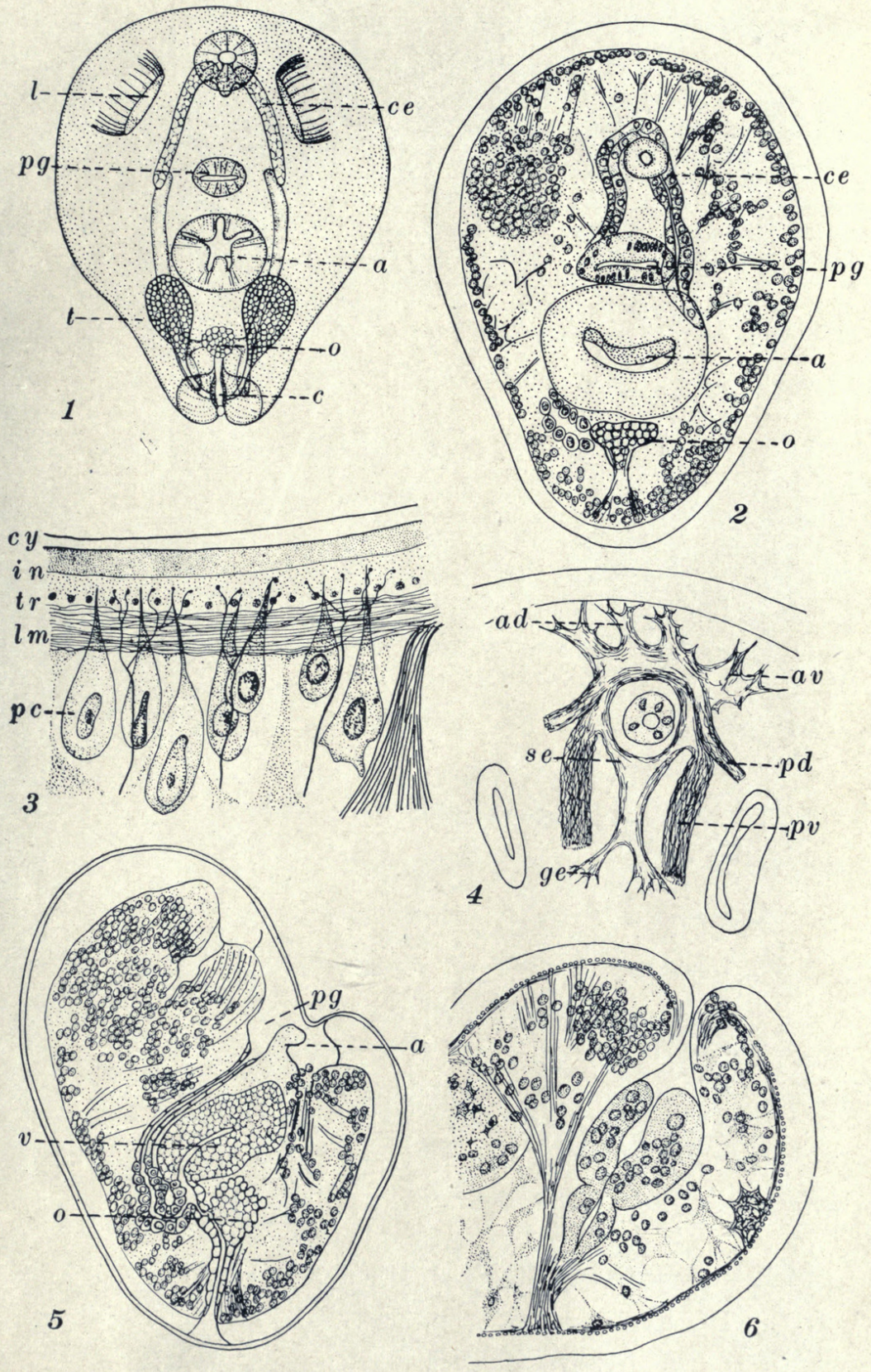

PLATE VI

13. *Cercaria* (*Tetracotyle*) *flabelliformis* Faust 1917

This is a tetracotyle in the pre-encysted stage. Its life history has been worked out thru the redia generation.

Outline ovate, with slight indication of caudal constriction; length 0.48 to 0.56 mm.; width 0.44 mm.; oral sucker 60μ in diameter; primitive genital pore 50μ in diameter; acetabulum confined to two transverse muscular lappets; lateral suckers oval in outline in young larva, wandering inward to sides of primitive genital pore and metamorphosing into lateral lappets in more mature larvae. Pharynx small; ceca sacculate, extending caudad two-thirds of body length. Excretory bladder inconspicuous; lateral canals with transverse vessel posterior to primitive genital pore; fan-shaped distribution of anterior tubules. Genital cell masses well defined, consisting of a club-shaped ovary, two vitellarian chorda, two testes posterior to ovary, and muscular genital cone.

In liver tissue, free or encysted, or in rediae, *Physa gyrina.* Corvallis, Montana.

14. *Tetracotyle pipientis* Faust 1918

Outline lyrate, with dense covering of spines; length 0.50 mm.; width 0.37 mm.; oral sucker 75μ in diameter; primitive genital pore 80μ in diameter, with a heavy crown of spines; acetabulum modified into a single transverse lappet; lateral suctorial organs elongate, obliquely placed, with large marginal spines. Pharynx small; ceca extending to center of primitive genital pore. Excretory bladder inconspicuous; lateral vessels, with transverse vessel far sephalad. Genital organs well defined, consisting of spherical ovary somewhat behind primitive genital pore, vitellaria in two diffuse chorda, two laterally disposed testes and ovoid genital cone.

Encysted in heavy capsules, mesentery and peritoneum, *Rana pipiens,* Chicago, Illinois.

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