MICROPHALLUS PROGENETICUS, A NEW APHARYNGEATE PROGENETIC TREMATODE (MICROPHALLIDAE) FROM THE DWARF CRAYFISH, *CAMBARELLUS PUER*, IN LOUISIANA.[1]

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It is with great pleasure that I contribute this paper for the number honoring the memory of the late Percy Viosca, a noted Louisiana biologist who studied extensively the crayfishes of his native state.

In connection with studies of trematodes encysted in Louisiana crayfishes, specimens of a progenetic terematode were observed, through the shell of the affected crayfishes, moving about within the cephalothorax. The following is a preliminary report of this trematode.

Acknowledgements are extended to Dr. G. H. Penn for identification of some crayfish hosts and to Mr. Joseph Fitzpatrick, Mrs. Lucy McAlister Sogandares, and Miss Carol Winkler for technical assistance.

Unless otherwise specified all measurements are in millimeters.

Microphallus progeneticus, sp. nov.
(Figures 1-8)

Host.—*Cambarellus puer* Hobbs, 1945; dwarf crayfish; family Astacidae.

Incidence of infection and numbers.—In 4 of 4: 4, 30, 33, 43.

Location.—On surface of viscera in cephalothorax.

Locality.—Maringuoin, Iberville Parish, Louisiana.

Holotype.—U. S. Nat. Mus. Helm. Coll. No. 59649.

Diagnosis (based on thirty specimens).—*Microphallus.* Body pyriform with posterior notch, 1.150 to 1.750 long by 0.630 to 1.225 wide. Forebody 0.329 to 0.445 long. Cuticle completely spined. Oral sucker subterminal, 0.053 to 0.095 long by 0.053 to 0.106 wide. Muscular pharynx absent, instead pharyngeal gland cells surrounding small area of anterior 1/2 to 3/4 esophagus. Esophagus extending from oral sucker to approximately anterior 1/4 body. Cecae two, rudimentary, extending short distance from cecal bifurcation at posterior end of esophagus. Acetabulum unornamented, preequatorial, mesial, 0.074 to 0.127 long by 0.085 to 0.106 wide. Sucker ratio 1:0.81 to 1.65. Genital pore at left anterior border of acetabulum, followed by genital atrium approximately ¾ diameter of acetabulum. Testes two, side by side, approximately in posterior ¾ body, edges smooth, oval in shape; dextral testis 0.170 to 0.226 long by 0.085 to 0.170 wide; sinistral testis 0.150 to 0.226 long by 0.106 to 0.91 wide. Seminal vesicle preacetabular, transverse to longitudinal axis of body; connecting with intratrial unornamental muscular genital lobe perforated by sperm duct. Prostate cells surrounding tip of seminal vesicle adjacent to genital lobe. Genital lobe varying from almost ball-like (Fig. 3) to club-like (Figs. 4-6) in shape. Ovary dextral, dorsally overlapping acetabulum on right side; oblong in shape, edges sometimes notched; 0.170 to 0.212 long by 0.074 to 0.212 wide. Uterus descending from posterior mesial border of ovary, forming double-loop *receptaculum seminis uterinum* short distance from ovary, extending posteriorly to mid-dextral testis, ascending on ventral right border of dextral testis to level of ovary, descending to posterior border of dextral testis, transversing body to posterior level of sinistral testis, descending to halfway between posterior border of sinistral testis and posterior end of body, ascending along left border of sinistral testis to perforate posterior border of genital atirum through short metraterm surrounded by gland cells. Vitellaria composed of coarse follicles, extending on each side of body from level of acetabulum to posterior 1/5 body. Uterine eggs with an antiopercular spine (Fig. 8), containing fully developed miracidia, 20 to 29 microns long by 11 to 17 microns wide. Excretory vesicle short Y-shaped; mainstem extending anteriorly from mesial excretory pore at apex of posterior body notch, forking at level of posterior border of testis; anterior extent of collect-

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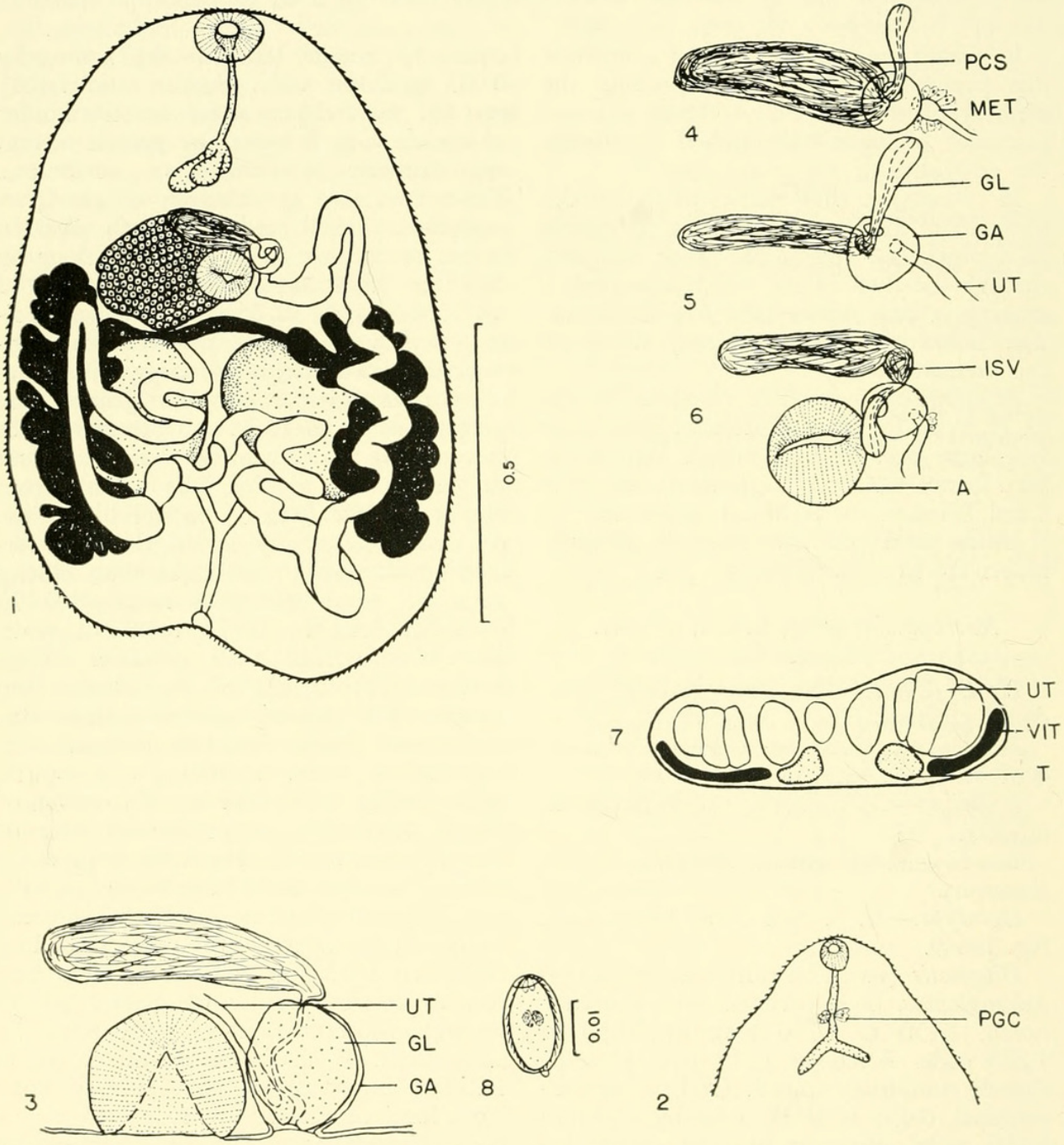
ing ducts of excretory vesicle disappearing at level of acetabulum in serial cross section. Flame cell pattern 2 [(2+2) + (2+2)]=16.

Discussion: — *Microphallus progeneticus* is closely related to *M. opacus* (Ward, 1894) Ward, 1901, (type species of *Microphallus)* originally described from the bowfin, *Amia calva* Linn., in North America. Now *M. opacus* is known to be a polyxenous trematode. Experimentally it is capable of developing to maturity in several verte-



Figures 1-8. **1.** *Microphallus progeneticus,* ventral view of young adult specimen. **2.** Same, sketch of ventral view of anterior end of body showing variation in shape of ceca, and pharyngeal gland cells. **3.** Same, composite sketch of terminal genitalia from serial cross sections. **4-6.** Same, sketches of ventral views of terminal genitalia showing various shapes assumed by male genital lobe. **7.** Same, sketch of cross section showing relation of vitellaria to uterus and testes in a specimen swollen by large numbers of eggs in the uterus. **8.** Same, uterine egg showing antiopercular spine and miracidium inside. Unless otherwise specified drawings were made with the aid of a camera lucida and the projected scales have the value indicated in millimeters. Abbreviations used: A, acetabulum; GA, genital atrium; GL, genital lobe; ISV, internal seminal vesicle; MET, metraterm; PCS, pseudo-cirrus sac; PGS, pharyngeal gland cells; T, testis; UT, uterus; and VIT, vitellaria.

brates of widely differing classes (Rausch, 1947). *M. progeneticus* differs from *M. M. opacus* by consistently lacking a pharynx, and by its progenetic nature.

Ward (1901) redescribed the genital terminalia of *M. opacus* and Wright (1912) supplemented Ward's description. Strandine (1943) studied the morphological variation of *M. ovatus* Osborn, 1919 and concluded that, at best, this species could be regarded as a variety of *M. opacus*. Rausch (1947) reported the host relationships of *M. opacus* and supported Strandine's view that *M. opacus* and *M. ovatus* are conspecific. He did not report egg production by metacercariae of *M. opacus* encysted in crayfishes. To my knowledge none of the published studies of adult *M. opacus* report the absence of a pharynx. However, Fantham and Porter (1948) pictured (Plate III, Figure 12), but did not describe, an apharyngeate species of *Microphallus* from *Perca flavescens* Mitchell in Lake Memphremagog, Canada. These authors apparently were not sure of their identification because on page 623 they stated, "and *Microphallus* sp. near *opacus* (Plate III, Fig. 12) in one female fish." However, on page 626 they observed: "The only member of the Microphallinae [represented in the collection] was *Microphallus opacus,*" (Plate III, Fig. 12), and in the explanation of figures for Plate III (Page 649) they stated, "*Microphallus opacus* (or near)." In any event their figure of this species does not show a pharynx. Dr. Allen McIntosh (personal communication) informed me that he has studied Ward's (1849) material of *M. opacus* and stated, "in his material the pharynx at best is very small and in one specimen I could not be certain that it had a pharynx." There is little doubt that most morphological characters of adult *M. opacus* from vertebrate hosts may overlap those of adult *M. progeneticus* from the crayfish. There is, however, doubt about the physiological requirements of the two species. None of the published studies on *M. opacus* remotely suggest that this species is progenetic, living unencysted in crayfishes. When two species are isolated from each other, for example, as *M. opacus* and *M. progeneticus* are in their respective hosts, no gene flow could occur between the two populations even if the species existed together in the same locality. In exceptional circumstances the two species might accidentally come together in a vertebrate intestine.

Mechanically excysted metacercariae of *M. opacus,* of small size and still bearing a stylet, had an anlagen of cells which could be identified as the precursor of the pharynx. This pharyngeal anlagen could not be observed in several live immature specimens of the smallest *M. progeneticus* collected. The encysted Metacercariae of *M. opacus* were found in many *Procambarus clarki* from localities where *M. progeneticus* was collected.

Three mechanically excysted *M. opacus* metacercariae kept in 0.7% NaCl at 27°C produced abnormal eggs after 24 hours. In another trial two recently mechanically excysted large metacercariae of *M. opacus* were introduced into an oxalted suspension of human erythrocytes (1:1:1-0.85% NaCl, potassium monohydrogen phosphate/potassium dihydrogen phosphate buffer at pH 7.6, 66.7% oxalted whole blood) kindly supplied by my assistant, Mr. R. D. Lumsden. One worm produced eggs which appeared normal after 36 hours at room temperature (27°C). The other worm appeared to be dead (flame cells not beating), lacked sperm in the seminal vesicle and had produced no eggs.

Despite the fact that *M. progeneticus* lacks a pharynx, and the larval stages are unknown, the species resembles members of the genus *Microphallus* in certain structural details: (1) spined cuticle; (2) short Y-shaped excretory vesicle, and a flame cell pattern of 2[(2+2) + (2+2)]; (3) testes side by side and posterior to the acetabulum; (4) lack of a true seminal receptacle; (5) presence of an unornamented muscular genital lobe perforated by the sperm duct which connects with a free seminal vesicle; (6) metraterm opening separately into genital atrium which also contains the male genital lobe; (7) vitellaria in region of testes and composed of coarse follicles; and (8) short ceca.

The absence of a muscular pharynx in *M. progeneticus* is not particularly surprising since cercariae of the "Ubiquita" type are sometimes apharyngeate and also lack an acetabulum. Both structures usually become well developed in the metacercariae. Cable *et al.* (1960) suggested that the development of the acetabulum in microphallids is

delayed until the metacercarial stage, ". . . perhaps in adaptation to the modifications of the copulatory apparatus adjacent to that sucker." There is possibly an encystment dependent factor triggering the full development of a pharynx in microphallids with no pharynx or a rudimentary structure in the cercarial stages. *M. progeneticus* has a prominent acetabulum but lacks a pharynx. One explanation may be that *M. progeneticus* does not pass through an encysted metacercarial stage or does so for a relatively short period of time, not allowing development of a pharynx. Serial cross and longitudinal sections of *M. progeneticus* show that a cluster of cells similar to those observed surrounding the pharynx of many different trematode species apparently replaces the muscular pharynx. Since *M. progeneticus* is progenetic, perhaps the acetabulum is developed, as Cable *et al.* (1960) suggest, in adaptation to the modifications of the copulatory apparatus adjacent to that sucker.

One dwarf crayfish was kept alive in the laboratory for a period of three months after collecting. *M. progeneticus* from this crayfish were examined alive under the microscope, but no pharynx was visible except for the pharynngeal gland cells mentioned in the description and discussion above. This observation suggests that the species is permanently apharyngeate after attaining maturity in its crayfish host.

The following Louisiana crayfishes have been examined but found uninfected with *Microphallus progeneticus: Cambarellus shufeldti* (Faxon, 1884); *Orconectes clypeatus* (Hay, 1899); *Orconectes lancifer* (Hagen, 1870); *Procambarus blandingi acutus* (Girard, 1852); *Procambarus clarki* (Girard, 1852); *Procambarus penni* (Hobbs, 1951). Eleven specimens of *Orconectes lancifer* and one specimen of *Procambarus clarkii* found with the infected *Cambarellus puer* were not infected with *Microphallus progeneticus.*

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Abstract

Microphallus progeneticus, new species, (Trematoda: Microphallidae) is described from an astacid decapod, *Cambarellus puer* Hobbs, 1945, in Louisiana. *M. progeneticus* differs from other microphallids by its progenetic nature, by lacking a discrete muscular pharynx and by possessing eggs with an antiopercular spine. It is probably a sibling species of *Microphallus opacus* (Ward, 1894). The following astacid decapods from Louisiana were examined and found uninfected with *M. progeneticus: Cambarellus shufeldti* (Faxon, 1884); *Orconectes clypeatus* (Hay, 1899); *Orconectes lancifer* (Hagen, 1870); *Procambarus blandingi acutus* (Girard, 1852); *Procambarus clarki* (Girard, 1852); and *Procambarus penni* (Hobbs, 1951). Metacercariae of *M. opacus* were found in *Procambarus clarki* from localities in which *M. progeneticus* was collected.