

PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

issued



by the

SMITHSONIAN INSTITUTION
U. S. NATIONAL MUSEUM

Vol. 84

Washington : 1937

No. 3010

OBSERVATIONS ON THE TREMATODE GENUS BRACHY- COELIUM DUJARDIN

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DURING the past five years I have examined many vertebrate animals, chiefly amphibians and reptiles, from various places over a portion of the Southeastern United States, mainly from two localities: New Orleans, La., and vicinity and Athens, Ga., and vicinity. These examinations have yielded a great variety of parasitic forms, many of which appear to be new to science.

Collections were made personally from the various places mentioned in the text, and all animals were brought into the laboratory before being examined. Except in instances in which only a very few animals were collected from any one given locality, the hosts were examined at various times after collections were made. By this method those parasites collected immediately after the hosts were brought into the laboratory could be checked against those parasites having had a longer time in which to mature. This procedure seemed advisable, since in a great many instances specific diagnosis of trematodes depends to a greater or lesser extent on the differences in dimensions of the various organs in the mature stage.

All parasites were studied first while living and then after being fixed. The worms considered in this paper were killed with cold

formalin, the fluid being drawn under the coverslip with filter paper. Worms were allowed to "set" in a somewhat flattened condition before being removed from the slide to a dish of formalin for preservation. All specimens were stained with Bullard's hematoxylin, dehydrated in alcohol, and cleared in cedar oil.

The present paper deals exclusively with members of the trematode genus *Brachycoelium* Dujardin, 1845.

I wish to express my appreciation to Dr. Maurice C. Hall, formerly chief of the zoological division, U. S. Bureau of Animal Industry, for the loan of paratype specimens of *Brachycoelium meridionalis* Harwood and *B. daviesi* Harwood; to Dr. Fred J. Holl, University of Buffalo, for the loan of slides carrying a serially sectioned specimen of *B. trituri* Holl; to Dr. M. C. Hall and Dr. E. W. Price, U. S. Bureau of Animal Industry, for reading the manuscript; and to James F. Denton for assistance in the technical work involved.

Genus BRACHYCOELIUM Dujardin, 1845

The genus *Brachycoelium* (as a subgenus of *Distoma*) was erected by Dujardin (1845) for the reception of the species *Brachycoelium crassicolle* (Rudolphi) (= *Distoma crassicolle* Rudolphi, 1809). Looss (1899) utilized the genus as the type around which to establish his subfamily Brachycoeliinae. Later S. J. Johnston (1912) elevated Looss' subfamily to the rank of family, Brachycoeliidae, which now includes the three well-known genera *Brachycoelium* Dujardin, 1845, *Glypthelmins* Stafford, 1905, and *Mesocoelium* Odhner, 1911. Faust (1929) included the family Brachycoeliidae in his superfamily Dicrocoelioidea.

The genus *Brachycoelium* is characterized as follows: Body elongated, more or less cylindrical; cuticle with or without (?) spines; suckers subequal; acetabulum at about equator of body; intestinal caeca short, diverging posterolaterally from bifurcation, ending short of level of acetabulum; ovary anterior (posterior in *B. lynchi*) to opposed testes, slightly smaller than male glands; genital pore ventral, in midline immediately in front of acetabulum; uterus sinuous, rather simple; ova small, thick-shelled, operculated; vitellaria follicular, anterior to level of acetabulum; excretory bladder Y-shaped, with short cornua; parasitic in intestine of amphibians and reptiles.

Since the erection of the genus for the inclusion of *B. crassicolle*, seven other species have been added as follows: By Stafford (1900), *B. hospitale*; by Nicoll (1914), *B. obesum*; by Holl (1928), *B. trituri*; by Harwood (1932), *B. storeriae*, *B. meridionalis*, and *B. daviesi*; and by Ingles (1936), *B. lynchi*. This paper adds five new species to the genus.

BRACHYCOELIUM CRASSICOLLE (Rudolphi, 1809)

I have no complete description of this species and am unable, from the descriptions and illustrations available, to assign any of the specimens in the present collection to it. *B. crassicolle* is referred to many times in the literature and appears to be the only member of the genus thus far recorded for continental Europe. In discussing the species, Stafford (1903) states that *B. hospitale* is very similar to *B. crassicolle*. "The internal organization, so far as it is known for both worms and so far as one can judge who has a practical acquaintance with only one of them, appears to be identical. . . . It would seem that *B. hospitale* is somewhat smaller and slenderer than *B. crassicolle*." Nicoll (1914) remarks: "At first sight they (*B. obesum*) appear to be identical with *B. salamandrae* (= *B. crassicolle*), but their exceedingly small size and the fact that even the smallest was fully matured, raised the suspicion that this could not be the case. . . . It was difficult, however, to obtain other grounds for regarding them as a distinct species."

BRACHYCOELIUM HOSPITALE Stafford, 1900

PLATE 8, FIGURE 1

This species of fluke was described by Stafford (1900) from the Canadian salamanders *Triturus viridescens* and *Plethodon erythronotus*. It has been reported recently by Harwood (1932) from the grass frog (*Rana sphenocephala*) from the vicinity of Houston, Tex. I assign to this species eight specimens taken from the duodenum of the salamanders *Ambystoma opacum* and *Plethodon glutinosus*, collected from the vicinity of Pearl River, La. In this material there are certain differences in anatomical details that may be noted. Most of the specimens fall within the range of the smallest forms described by Stafford. The acetabulum is consistently smaller than the figures given by Stafford would indicate, making the size ratio of the oral sucker and acetabulum approximately 8:5. The intestinal caeca terminate anterior to the level of the anterior margin of the acetabulum. The ova seem to be a few microns narrower than the dimensions given in the original description. The testes average about 0.18 mm long and 0.17 mm wide, being thus slightly larger than the ovary, which measures 0.11 mm long and 0.134 mm wide. Stafford states that the testes are slightly larger than the ovary. The cuticle very definitely bears spines as far posterior as the level of the testes.

BRACHYCOELIUM MESORCHIUM, new species

PLATE 8, FIGURES 2, 3

More than 30 specimens of this species were taken from the small intestine of the salamander *Desmognathus fuscus fuscus*, collected

from the vicinity of Athens, Ga. The specific designation is selected because of the medial position of the testes.

Description.—Body moderately large, elongated elliptical in outline, somewhat cylindrical in transsection; 1.3 mm to 2.7 mm long, averaging 1.7 mm; 0.42 mm to 0.69 mm wide, averaging 0.54 mm; widest at level of acetabulum. Cuticle relatively thin throughout, armed with moderately fine spines anteriorly to level of testes. Oral sucker subterminal, 0.165 mm in diameter. Acetabulum 0.116 mm in diameter, located about one-fourth body length, or 0.45 mm, from anterior end of body. Ratio of sizes of oral sucker and acetabulum, approximately 7:5. Prepharynx present, about 50μ long. Pharynx muscular, 0.04 mm long by 0.07 mm wide, surrounded by numerous rather small peripharyngeal gland cells. Caeca fairly large, 0.21 mm long, 0.09 mm in maximum width, lined internally by a membrane of tall epithelial cells, ending short of level of anterior margin of acetabulum. Ovary alternating from right to left side of midline, always partially dorsal to acetabulum, at level of equatorial plane of acetabulum or slightly in advance of that position, with margin entire, transversely oval, 0.096 mm long by 0.14 mm wide. Oviduct slender, sinuous, arising from medial end of ovary. Oötype at about posterior margin of ovarian side of acetabulum, lined internally by a ciliated membrane. Laurer's canal present. Seminal receptacle flask-shaped. Shell gland rather voluminous, entirely surrounding oötype. Uterus greatly convoluted, descending limb forming half loops on ovarian side, reaching to near posterior margin of body; ascending limb forming half loops in posterior body opposite descending limb, but forming complete loops across body just posterior to testes before passing between testes to make other complete transverse loops in front of testes, then passing to genital pore. Metraterm weakly developed. Ova numerous, thick-shelled, operculated, containing fully matured embryos when oviposited, measuring 27μ to 33μ by 45μ to 52μ . Vitellaria composed of rather large follicles, tending to form two or three clusters on each side of body, lateral in position, extending from level of posterior margin of acetabulum to level of bifurcation of caeca, overlying caeca to near bifurcation. Yolk ducts single on each side, uniting immediately posterior to shell gland and forming a small crescent-shaped yolk reservoir. Genital pore ventral, in midline just in front of acetabulum. Testes transversely oval, margins entire, with inner margins touching or overlapping midline, one slightly in advance of other, depending on position of ovary (right testis posterior in position when ovary is on right side), situated in area just posterior to acetabulum; right testis 0.112 mm long by 0.143 mm wide; left testis 0.104 mm long by 0.153 mm wide. Vasa efferentia delicate, uniting

on entering cirrus sac. Cirrus sac thin-walled, usually anterior to acetabulum, but sometimes extending posteriad over or around acetabulum to end short of posterior margin of sucker, containing an almost spherical vesicula seminalis, a club-shaped, muscular pars prostatica surrounded by gland cells, a short ductus ejaculatorius, and a weakly developed cirrus. Excretory system (pl. 8, fig. 3) characteristic. Bladder opening through a dorsoterminal pore guarded by a sphincter muscle; main stem of bladder Y-shaped, with short, often indistinct cornua, passing anteriad just under dorsal surface of body, ending near anterior margin of anterior testis. Common collecting tubules relatively long, sinuous, dividing into anterior and posterior collecting tubules and these giving rise to accessory tubules. Flame cells in groups, six groups in each side, each group containing three flame cells. Flame cell pattern of $2 \times 6 \times 3$ type.

Host.—*Desmognathus fuscus fuscus* (Rafinesque).

Habitat.—Small intestine.

Locality.—Athens, Ga.

Type specimen.—U.S.N.M. Helm. Coll. no. 9031.

Remarks.—*Brachycoelium mesorchium* shows a close relationship to *B. hospitale* but may be distinguished from that species, as well as from *B. obesum*, *B. trituri*, and *B. lynchi*, the other members of the genus with which it may be confused, by its more nearly equal suckers, the more medial position of the ovary and testes, the configuration and distribution of the vitellaria, and the pattern made by the uterus.

BRACHYCOELIUM GEORGIANIUM, new species

PLATE 8, FIGURE 4

Eight specimens of this species of worm were taken from the small intestine of the grass frog (*Rana sphenoccephala*) collected from the region about Athens, Ga.

Description.—Body spindle-shaped, bluntly pointed at both ends, or elongated oval with strongly rounded ends; averaging 1.326 mm long by 0.80 mm wide; widest at level of body equator. Cuticle relatively thin, thicker ventrally than dorsally; armed with spines to near posterior margin of body. Oral sucker subterminal, muscular, slightly elongated oval, 0.206 mm long by 0.191 mm wide. Acetabulum transversely oval, measuring only one-half as much as oral sucker, about one-third body length, or 0.474 mm, from anterior body margin. Ratio of sizes of oral sucker and acetabulum, 2:1. Prepharynx short, about 20μ long. Pharynx muscular, transversely oval, 0.055 mm long by 0.087 mm wide, surrounded by gland cells. Esophagus slightly longer than transverse diameter of pharynx, surrounded by gland cells. Caeca saclike, 0.175 mm long by 0.091 mm

in greatest width, lined internally by rather tall epithelial cells, ending well in front of acetabulum. Ovary transversely oval, lateral in position, alternating from right to left side of body and varying from a position on level with equatorial plane of acetabulum to a position slightly in front of acetabulum, measuring 0.096 mm long by 0.140 mm wide. Oviduct delicate, arising from medial end of ovary and extending posteromesad for a distance greater than transverse diameter of ovary before forming oötype. Ovarian complex typically that of *B. mesorchium*. Uterus a simple tube descending to near posterior margin of body before returning to genital pore. The entire pattern of the uterus has not been made out because of the numerous dark-brown ova contained in it. Distal end of uterus forming weakly developed metraterm. Ova 27μ to 33μ by 42μ to 45μ , dark brown in color, thick-shelled, operculated, containing fully developed embryos when oviposited. Vitellaria follicular, occupying a position just under dorsal and ventral surfaces of body, lateral to caeca, seldom overlapping caeca except marginally, extending from level of caudal end of caeca to level of equatorial plane of oral sucker. Yolk ducts single in each lateral field, uniting at level of shell gland and forming yolk reservoir. Genital pore ventral, in midline just in front of acetabulum. Testes elongated oval, with margins entire, in lateral fields opposite acetabulum, depending on position of ovary for exact location (when ovary is on right side, right testis is more posterior in position); right testis 0.223 mm long by 0.164 mm wide; left testis 0.241 mm long by 0.166 mm wide. Vasa efferentia uniting on entering cirrus sac. Cirrus sac club-shaped, usually entirely anterior to acetabulum, sometimes extending posteriad around or over acetabulum as far as its posterior margin, containing an almost spherical vesicula seminalis, a short, bulbous pars prostatica surrounded by gland cells, a short ductus ejaculatorius, and a weakly developed cirrus. Excretory system identical with that observed for *B. mesorchium* except anterior end of bladder always observed to end in short, bluntly rounded cornua.

Host.—*Rana sphenocephala* Cope.

Habitat.—Small intestine.

Locality.—Athens, Ga.

Type specimen.—U.S.N.M. Helm. Coll. no. 9030.

Remarks.—*Brachycoelium georgianum* probably shows a closer relationship to *B. mesorchium* than to any of the other members of the genus. It can be distinguished from that species, as well as from *B. hospitale*, *B. obesum*, *B. trituri*, and *B. lynchi*, the other members of the genus with which it might be confused, by the extent and configuration of the vitellaria, the position of the ovary, the size,

shape, and position of the testes, the pattern of the uterus, and the general outline of the body.

BRACHYCOELIUM OBESUM Nicoll, 1914

This species of fluke was described by Nicoll (1914) from the intestine of the summer snake (*Contia aestiva*) dying in the London Zoological Gardens. The exact geographical locality from which the snake came was not given in the author's paper. None of the present material came from snakes, and since none of the specimens show any close morphological relationship to the species, it is impossible to assign any specimens in the collection to this species. There are 18 specimens in the present collection that show a closer affinity to *B. obesum* than to any of the other members of the genus, and these are described herein as *B. ovale*.

BRACHYCOELIUM OVALE, new species

PLATE 9, FIGURE 1

Eighteen specimens of this species were taken from the intestine of the ground skink (*Leiolopisma laterale*) collected from the vicinity of New Orleans and Pearl River, La., and Calhoun Falls, S. C. The oval outline of the body suggests the specific designation.

Description.—Body quite small, elongated cylindrical when extended, almost spherical when contracted, slightly flattened ventrally but strongly arched dorsally; 0.90 mm long when slightly flattened by 0.61 mm wide; widest at level of acetabulum. Cuticle thin, about twice as thick anteriorly as posteriorly, slightly thinner dorsally than ventrally; armed with very fine spines to middle of posttesticular region of body. Oral sucker subterminal, weakly muscular, circular in outline, 0.184 mm in diameter. Acetabulum circular in outline, 0.09 mm in diameter, weakly muscular, lying 0.361 mm behind anterior margin of body. Ratio of sizes of oral sucker and acetabulum, approximately 2:1. Prepharynx long enough to allow transversely oval pharynx, measuring 0.037 mm long by 0.071 mm wide, to lie free behind caudal boundary of oral sucker. Esophagus nonmuscular, 0.07 mm long. Caeca pouchlike, 0.153 mm long by 0.094 mm wide, diverging almost directly laterad, lined internally by a rather low epithelium. Ovary transversely oval, 0.076 mm long by 0.104 mm wide, alternating from right to left side of midline, lateral to and slightly in advance of acetabulum, close behind end of caecum. Oviduct long, extending from inner margin of ovary to near midline at posterior margin of acetabulum before forming oötype. Laurer's canal, receptaculum seminis, and shell gland present. Uterus fairly simple, greatly convoluted, descending to near posterior margin of

body by a series of wavy loops on side of body opposite ovary, ascending through a similar course on opposite side of body to region of testes, here making complete transverse loops both posterior and anterior to testes before passing to genital pore. Metraterm weakly developed. Ova thick-shelled, operculated, containing fully developed embryos when oviposited, 27μ to 30μ by 39μ to 45μ . Vitellaria follicular, placed in superficial mesenchyme of lateral and dorsal regions of body, extending from level of anterior margin of ovary to anterior margin of oral sucker, not overlapping caeca. A single yolk duct from each side fusing with its neighbor in region just posterior to acetabulum to form yolk reservoir. Genital pore ventral, in mid-line just in front of acetabulum. Testes large, equal, 0.145 mm in diameter, at about level of equatorial plane of body, slightly behind level of acetabulum, one slightly in advance of other (when ovary is right, right testis is more posterior), or directly opposite. Vasa efferentia uniting on entering cirrus sac. Cirrus sac club-shaped, reaching to caudal margin of acetabulum, containing vesicula seminalis, pars prostatica with its gland cells, ductus ejaculatorius, and weakly developed cirrus. Excretory system typically that of the genus as described for *B. mesorchium*.

Host.—*Leiopisma laterale* (Say).

Habitat.—Small intestine.

Localities.—New Orleans and Pearl River, La., and Calhoun Falls, S. C.

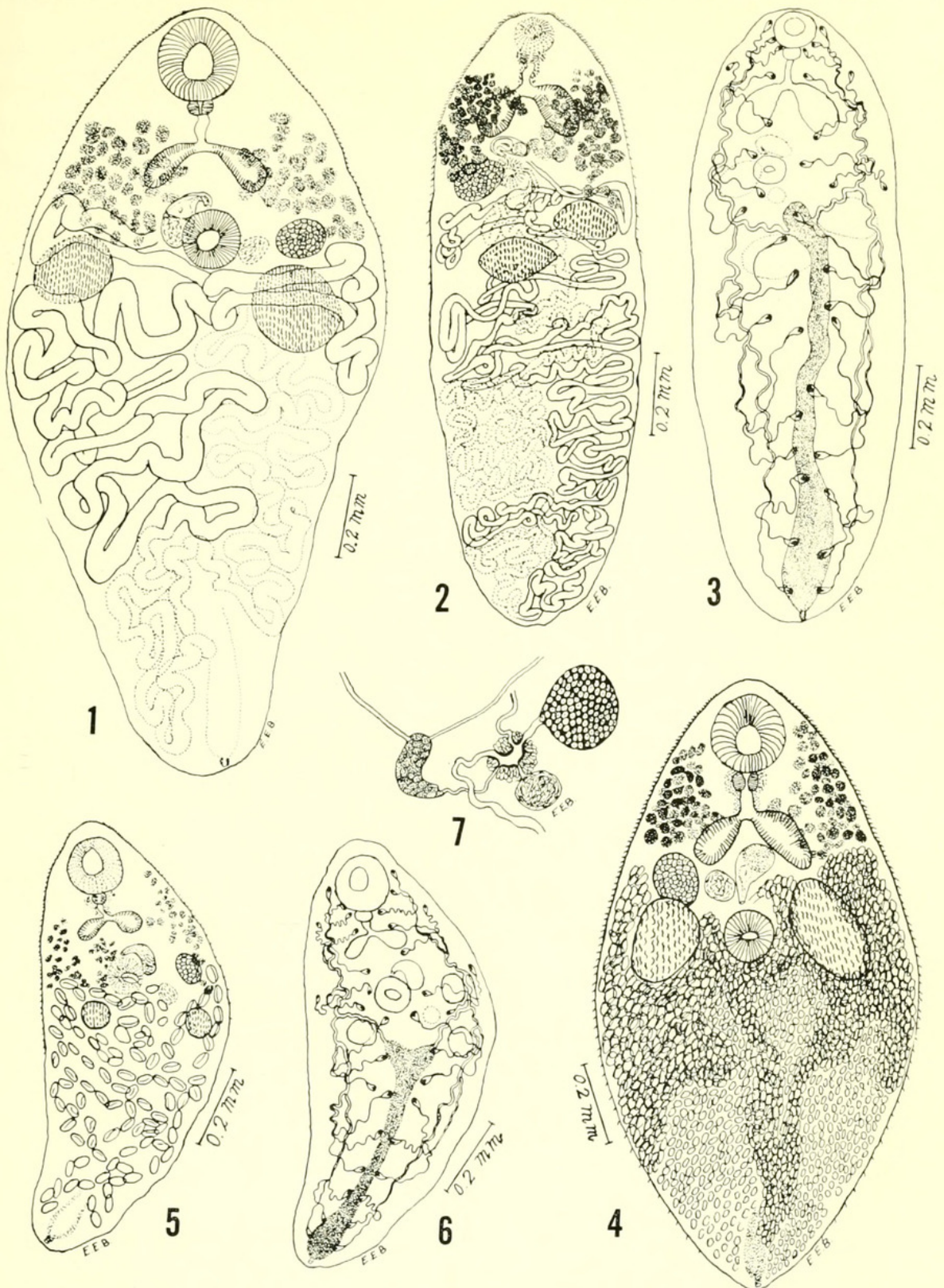
Type specimen.—U.S.N.M. Helm. Coll. no. 9028.

Remarks.—*Brachycoelium ovale* perhaps shows a closer relationship to *B. obesum* and *B. lynchi* than to any of the other members of the genus. The smaller size of the suckers, the general size and shape of the body, the smaller ova, the extent and distribution of the vitellaria, and the position and size of the reproductive glands are sufficient to separate it from its nearest relatives.

BRACHYCOELIUM TRITURI Holl, 1928

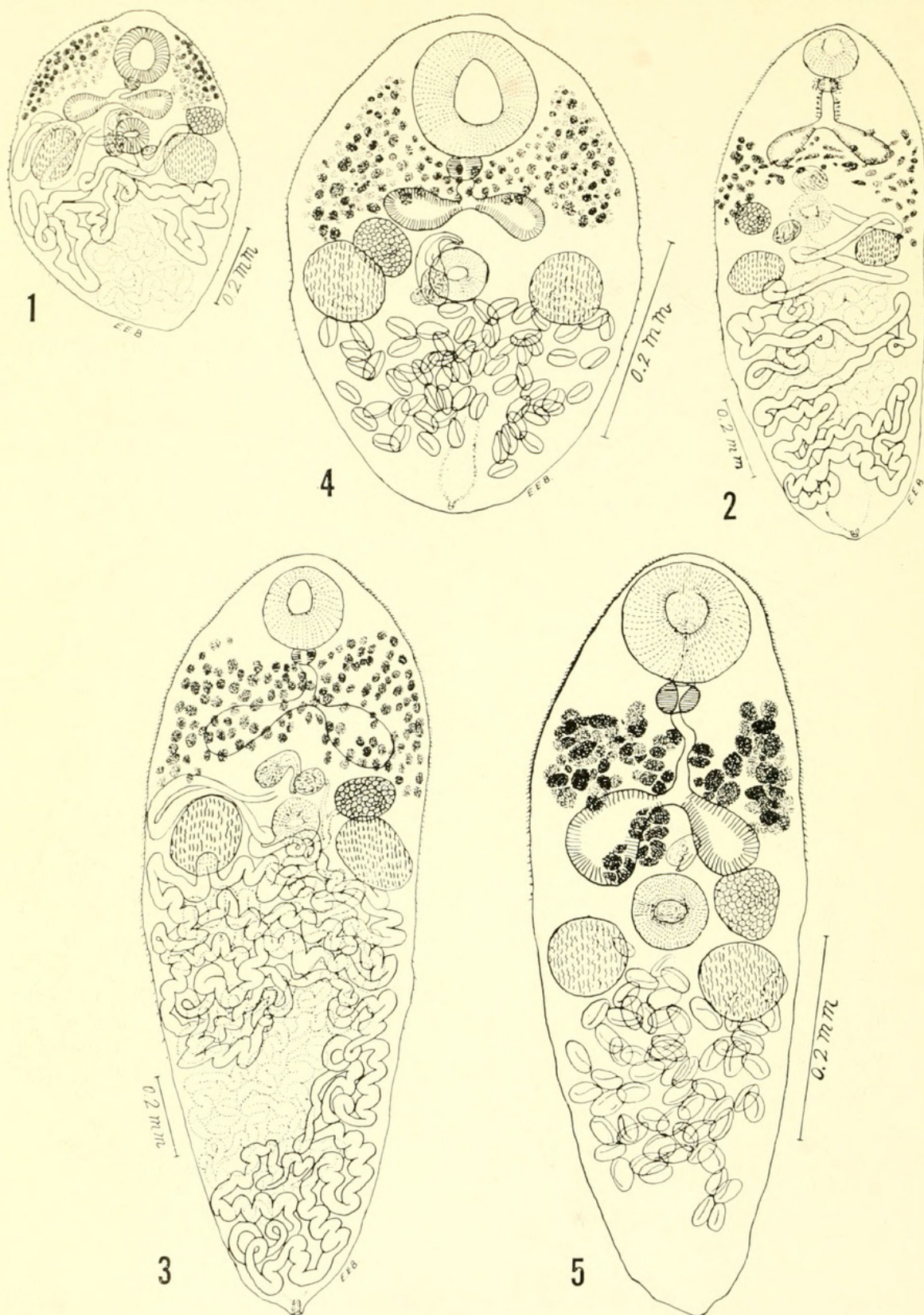
PLATE 8, FIGURES 5-7

Brachycoelium trituri was described by Holl (1928) from the intestine of the spotted newt (*Triturus viridescens*) collected at Durham, N. C. The form appears to be a valid species, although Holl's description was too brief to include morphological details, only measurements being given for the various organs. I am able, however, to assign to this species five specimens from the small intestine of the grass frog (*Rana sphenoccephala*) collected at Harvey, La., two specimens from the small intestine of *Pseudacris occidentalis* collected at Kenner, La., and five specimens from the small intestine of *Desmognathus fuscus fuscus* collected at Athens, Ga. Certain varia-



1. *Brachycoelium hospitale* Stafford: Ventral view of specimen from intestine of *Ambystoma opacum* $\times 23$.
 2, 3. *B. mesorchium*, new species: 2, Dorsal view, $\times 23$; 3, details of excretory system, outline, $\times 23$.
 4. *B. georgianum*, new species: Ventral view, $\times 23$.
 5-7. *B. trituri* Holl: 5, Dorsal view of specimen from *Rana sphenoccephala*, $\times 23$; 6, details of excretory system, outline, $\times 23$; 7, details of the ovarian complex, diagrammatic.

(All figures except 3, 6, and 7 were drawn with the aid of the camera lucida.)



1. *Brachycoelium ovale*, new species: Ventral view, $\times 23$.

2. *B. dorsale*, new species: Dorsal view, $\times 23$.

3. *B. louisianae*, new species: Dorsal view, $\times 23$.

4. *B. daviesi* Harwood: Dorsal view of specimen from intestine of *Leiolopisma laterale*, $\times 73$.

5. *B. meridionalis* Harwood: Dorsal view of paratype specimen (U. S. N. M. Helm. Coll. no. 30875), $\times 73$.

tions between these specimens and Holl's material should be noted. The body is slightly smaller; the suckers are more nearly equal, their sizes having a ratio of 8:5 rather than 2:1, as in Holl's specimens; acetabulum more cephalic in position; ovary more nearly rounded, slightly smaller; testes slightly larger; vitellaria more extensive. These differences are not deemed distinctive enough for the creation of a new species for the present material. The excretory system (pl. 8, fig. 6) and ovarian complex (pl. 8, fig. 7) are figured in detail for the species in question.

BRACHYCOELIUM LYNCHI Ingles, 1936

Brachycoelium lynchi was described by Ingles (1936) from the intestine of the frog *Rana aurora*, collected at Mount Shasta City (Siskiyou County), Calif. Ingles states that *B. lynchi* most closely approaches *B. daviesi* in relationship. It is my opinion that the continuous bridge of vitellaria over the dorsal portion of the anterior end of the body in *B. daviesi* is sufficient to separate the two species definitely, since in *B. lynchi* the vitellaria are confined to the lateral fields. The anterior position of the testes definitely separates this species from all my material.

BRACHYCOELIUM STORERIAE Harwood, 1932

This species of fluke was described by Harwood (1932) from a single specimen taken from the intestine of DeKay's snake (*Storeria dekayi*) collected from the vicinity of Houston, Tex., and represents the second species of the genus to be described from snakes. I feel that the species must be considered as valid until more material is available for study. None of the specimens in the present collection can be assigned to this species, although eight of the specimens show a close resemblance to it.

BRACHYCOELIUM DORSALE, new species

PLATE 9, FIGURE 2

Eight specimens of this species were taken from the intestine of the salamander *Ambystoma opacum*, collected from the vicinity of Pearl River, La. At first sight the flukes appeared to be identical with *B. storeriae*, but on closer examination they were found to represent a new species. The dorsal distribution of the vitellaria suggests the specific designation.

Description.—Body elongated, almost cylindrical, with parallel sides and gently rounded ends; 1.28 mm long by 0.49 mm wide. Cuticle thin, armed anteriorly with very delicate spines as far posterior as middle of posttesticular region of body. Oral sucker sub-

terminal, slightly more muscular than acetabulum, transversely oval, 0.15 mm long by 0.16 mm wide. Acetabulum 0.105 mm long by 0.122 mm wide, about one-third body length (0.423 mm) from anterior end. Ratio of sizes of oral sucker and acetabulum, approximately 3:2. Pharynx muscular, transversely oval, 0.033 mm long by 0.068 mm wide, connected with oral sucker by short prepharynx, surrounded by numerous peripharyngeal gland cells. Esophagus slightly longer than transverse diameter of pharynx, surrounded by periesophageal gland cells. Caeca saclike, rather long, 0.17 mm long by 0.074 mm wide, ending well in front of acetabulum, lined internally with rather low epithelial cells. Ovary almost spherical, 0.091 mm long by 0.10 mm wide, alternating from right to left side of acetabulum, usually about on same level as acetabulum. Oviduct delicate, long. Oötype at about level of equatorial plane of acetabulum. Laurer's canal present. Shell gland surrounding oötype. Receptaculum seminis spherical, large. Uterus a simple tube, descending to near posterior margin of body by a series of transverse loops, ascending by similar course to genital pore; loops almost completely crossing body in posttesticular region of body. Ova 27μ to 30μ by 39μ to 45μ , thick-shelled, operculated, fully embryonated when oviposited. Met-raterm weakly developed. Vitellaria sparse, follicles spindle-shaped, widely separated, forming a continuous bridge under dorsal surface just posterior to bifurcation of caeca; vitellaria in lateral fields, extending from anterior margin of ovary on one side and anterior margin of testis on other side to level of bifurcation of caeca. Yolk ducts converging near oötype to form small yolk reservoir. Testes transversely oval, behind level of acetabulum, opposite or slightly in tandem, depending on position of ovary for their exact location (when ovary is right, right testis more posterior); right testis 0.109 mm long by 0.141 mm wide; left testis 0.156 mm long by 0.153 mm wide. Vasa efferentia uniting on entering cirrus sac. Cirrus sac club-shaped, usually forming an inverted U just in front of acetabulum, but sometimes lying dorsal or lateral to acetabulum, rarely extending to posterior margin of sucker, containing spherical vesicula seminalis, bulbous pars prostatica with its gland cells, a short ductus, and a weakly developed cirrus. Excretory system identical with that of other members of the genus, with a flame cell pattern of the $2 \times 6 \times 3$ type.

Host.—*Ambystoma opacum* (Gravenhorst).

Habitat.—Small intestine.

Locality.—Pearl River, La.

Type specimen.—U.S.N.M. Helm. Coll. no. 9029.

Remarks.—*Brachycoelium dorsale* appears to be more closely related to *B. storeriae* than to any of the other members of the genus. It is separated from this species by the extent and configuration

of the vitellaria, the larger suckers, the larger ovary and testes, and the transverse looping of the uterus. From all other members of the genus thus far mentioned it is separated by the transverse bridge of vitellaria. The position and distribution of the vitellaria, the size and ratio of the suckers, and the uterine pattern serve to separate it from the remaining members of the genus.

BRACHYCOELIUM LOUISIANAE, new species

PLATE 9, FIGURE 3

This species of fluke is represented by five specimens taken from the small intestine of the salamander *Ambystoma opacum*, collected from the vicinity of Pearl River, La.

Description.—Body decidedly elongated, spatulated, being broadly rounded anteriorly and somewhat more pointed posteriorly, 2.04 mm to 3.1 mm long by 0.72 mm wide. Cuticle relatively thin, armed with fine spines anteriorly as far as middle of posttesticular portion of body. Oral sucker subterminal, circular, 0.20 mm in diameter. Acetabulum circular, 0.134 mm in diameter, well forward in anterior third of body, 0.496 mm behind anterior body margin. Ratio of sizes of oral sucker and acetabulum, approximately 3:2. Prepharynx present, short. Pharynx muscular, almost globular, 0.052 mm long by 0.069 mm wide. Esophagus nonmuscular, 0.17 mm long. Caeca flask-shaped, 0.29 mm long by 0.125 mm wide, diverging posterolaterad to end well in front of acetabulum, lined internally by a rather heavy epithelium. Ovary transversely oval, 0.128 mm long by 0.149 mm wide, usually left in position (right in one specimen observed), close behind end of caecum and slightly anterior to level of acetabulum. Oviduct long. Oötype at about level of equator of acetabulum. Laurer's canal, a spherical receptaculum seminis, and shell gland present. Uterus a simple tube, greatly convoluted, descending limb forming transverse and oblique loops to near posterior margin of body, ascending limb forming two or three transverse loops in posterior body, then passing forward by short loops on ovarian side to about middle of posttesticular region, here again forming a series of complete transverse loops before passing to genital pore. Metraterm weakly developed. Ova numerous, thick shelled, operculated, fully embryonated when oviposited, 30μ by 45μ . Vitellaria follicular, dispersed superficially just under dorsal surface, continuous from side to side, extending from level of anterior margin of ovary to posterior boundary of oral sucker, overlapping entire digestive tract. Yolk ducts converging just posterior to oötype, forming a small crescent-shaped yolk reservoir. Genital pore ventral, in midline just in front of acetabulum. Testes rather large, lateral, opposite acetabulum, testis on side of body opposite ovary

slightly more advanced; right testis closely apposed to ovary when ovary is right, 0.233 mm long by 0.227 mm wide; left testis closely opposed to ovary when ovary is left, 0.251 mm long by 0.240 mm wide. Vasa efferentia uniting on entering cirrus sac. Cirrus sac fairly large, club-shaped, usually entirely in front of acetabulum, sometimes extending laterad or dorsad to sucker, about one-third longer than diameter of acetabulum, containing a spherical vesicula seminalis, a bulbous pars prostatica with its gland cells, a short ductus, and a weakly developed cirrus. Excretory system of same general pattern observed for *B. mesorchium*; flame cell pattern of the $2 \times 6 \times 3$ type.

Host.—*Ambystoma opacum* (Gravenhorst).

Habitat.—Small intestine.

Locality.—Pearl River, La.

Type specimen.—U.S.N.M. Helm. Coll. no. 9027.

Remarks.—*Brachycoelium louisianae* shows a closer relationship to *B. storeriae* and *B. dorsale* than to any other member of the genus. The larger body, suckers, ovary, testes, and cirrus sac, and the distribution of the vitellaria, definitely distinguish it as a separate and distinct species.

BRACHYCOELIUM DAVIESI Harwood, 1932

PLATE 9, FIGURE 4

Brachycoelium daviesi was described by Harwood (1932) from the intestine of *Leiolopisma laterale*, *Pseudacris triseriata*, *Hyla cinerea*, and *Ambystoma microstomum*, collected at Houston, Tex. I am able to assign to this species eight specimens from the intestine of the ground skink (*Leiolopisma laterale*) collected at New Orleans, La., and five specimens from the same host collected at Pearl River, La. The material in the present collection shows: A smaller body; an armature of spines that extend to one-third the distance beyond the testes; more uniform suckers, although these structures show a size ratio of 2:1; and a smaller ovary and smaller testes. The excretory system is typically that observed for *B. mesorchium*.

SPECIES INQUIRENDA

BRACHYCOELIUM MERIDIONALIS Harwood, 1932

PLATE 9, FIGURE 5

This species was described by Harwood (1932) from the intestine of the spring lizard (*Triturus meridionalis*) collected from the vicinity of Houston, Tex. Through the courtesy of Dr. Maurice C. Hall, formerly chief of the zoological division, U. S. Bureau of

Animal Industry, I have been privileged to examine paratypes, slide no. 30875, of *B. meridionalis*. The slide carries two specimens of the species, one mounted in lateral view, the other in surface view. Observations on this material force me to the conclusion that there has been some mistake in the designation of paratypes, or that the species in question is to be considered as a synonym of *B. trituri*. In the specimen mounted in surface view, the only one of the specimens suitable for study, there is a decided break in the vitelline follicles just dorsal to the line of the esophagus, separating the glands into two lateral groups (pl. 9, fig. 5). Although these glands spread mesad almost to the midline, the esophagus lies fully exposed in the gap between the two groups. If in the future the same condition is found to be true for the type specimen, I suggest that *B. meridionalis* be suppressed in favor of *B. trituri*.

DISCUSSION

With the completion of the present study there are possibly 13 well-defined species belonging to the genus *Brachycoelium* Dujardin, 1845, as follows: *B. crassicolle*, *B. hospitale*, *B. obesum*, *B. trituri*, *B. storeriae*, *B. daviesi*, *B. meridionalis* (?), *B. lynchi*, *B. mesorchium*, *B. georgianium*, *B. ovale*, *B. dorsale*, and *B. louisianae*. The morphological characters of the members of the genus are strikingly similar in every detail except for certain constant variations that seem to warrant the creation of separate species. These variations are most noticeable with respect to the shape and size of the body, the presence or absence (?) of spines and their extent, the ratio of the sucker sizes, the shape and size of the ovary, testes, and eggs, and the distribution and configuration of the vitellaria. In regard to the last-named character there seem to be sufficient variations among the members of the genus to warrant the separation of the genus into two subgeneric groups. The establishment of these two groups is deferred, however, to some future date. It seems sufficient at this time to point out the major differences that tend to separate the species into two groups.

In the first group, containing the species *B. crassicolle*, *B. hospitale*, *B. obesum*, *B. trituri*, *B. lynchi*, *B. mesorchium*, *B. georgianium*, and *B. ovale*, the follicles of the vitellaria lie in the fields lateral to the intestinal tract and are placed in the superficial mesenchyme just under the ventral, lateral, and dorsal surfaces of the body. The species *B. hospitale* and *B. trituri* (?) offer the only exception to this distribution. In *B. hospitale* the vitellaria are described as being found in the mesenchyme lateral to the intestinal tract, but in the mesial plane of the sagittal section, and arranged along a longitudinal vitelline duct. It will be noted from the present study that the vitellaria in the specimens assigned to this species (pl. 8, fig. 1) show a marked tend-

ency to spread mesad and laterad in the areas of their extent. In the other exception, *B. trituri*, the vitellaria are said to be lateral to the intestinal rami, although nothing is said concerning their dorsal or ventral extension. In the figure accompanying the original description of the species, the vitellaria are represented by about seven follicles in each group. Here again (pl. 8, fig. 5) we see a tendency on the part of these glands to be more numerous than was originally figured and to conform more nearly to the pattern as outlined for the group. These two exceptions, when compared to the other members of the group, in no way alter the rule.

In the second group, containing the species *B. storeriae*, *B. daviesi*, *B. meridionalis*, *B. dorsale*, and *B. louisianae*, the follicles of the vitellaria spread from the superficial mesenchyme just under the ventral surface around the lateral margin of the body to the dorsal surface where they become confluent from side to side, thus forming a continuous bridge of follicles across the dorsal surface, overlying all genital structures and the digestive system throughout their extent.

The family Brachycoeliidae contains three well-defined genera, *Brachycoelium* Dujardin, 1845, *Glypthelmins* Stafford, 1905, and *Mesocoelium* Odhner, 1911, which, owing to the similarities of structures, especially of the excretory system, seem to justify their being included in the same family and tend to establish the family as a natural group. The justification of such a classification of these genera can be more definitely determined after the developmental history of the members is known. Faust (1929) placed the family Brachycoeliidae in his superfamily Dicrocoelioidea along with the families Dicrocoeliidae (Looss), Plagiorchidae Lühe, and Lissorchiidae Poche. Later, the same author (1932) added the family Allocreadiidae Stossich to the superfamily group. From a morphological standpoint the superfamily Dicrocoelioidea is based on the type of excretory system exhibited by the various individual family groups and on the similarities in developmental phenomena. The excretory system of the group is characterized by having a median, Y-shaped bladder, the main stem of which is rather long and which gives rise to two longer or shorter cornua anteriorly. The cornua in turn give rise to the common collecting tubules which give rise to the branches that form a basic pattern. The basic flame cell pattern, $2 [(1+1+1) + (1+1+1)]$, characteristic for the superfamily group, becomes expanded in various ways to give rise to the definitive pattern found in the separate families. In the family Brachycoeliidae this basic pattern becomes expanded into the definitive pattern of $2 [(3+3+3) + (3+3+3)]$ and is known for the following members of the family group: *Glypthelmins californiensis* (Cort, 1919), *Mesocoelium sociale* (Lühe, 1901) Sewell, 1920, and members of the

genus *Brachycoelium* as described above. The definitive flame cell pattern is known for all families now included in the superfamily Dicrocoelioidea except for the family Lissorchidae.

The members of the genus *Brachycoelium* show a marked uniformity in the characteristics of the definitive flame cell pattern. The main variation noted for the system is in the irregularity of the anterior end of the bladder stem. This end of the bladder may be observed to end blindly as a knoblike projection beyond the origins of the two common collecting tubules, or it may become somewhat broadened and slightly notched so as to resemble the flame of an oil lamp, at which times the common collecting tubules are given off from the anterolateral angles of the bladder, or again it may form short, bluntly rounded cornua, the tips of which give rise to the common collecting tubules. It is probable that these variations in the bladder stem are best explained by assuming that the bladder in *Brachycoelium* is derived from the I-shaped bladder and that the anterior end of this is more elastic and allows for considerable expansion. These variations in the stem of the bladder are of minor significance as compared with the influence of the fundamental plan of the excretory system.

KEY TO THE SPECIES OF THE GENUS BRACHYCOELIUM

1. Vitellaria in two groups, lateral to intestinal tract----- 2
 Vitellaria continuous from side to side in dorsal position, overlapping intestinal tract----- 9
2. Body averaging 1 mm or less in length----- 3
 Body averaging more than 1 mm in length----- 4
3. Testes anterior to ovary----- lynchi
 Testes posterior to ovary----- ovale
4. Body averaging 4 mm long by 1.2 mm wide; European----- crassicolle
 Body averaging less than 4 mm long; American----- 5
5. Vitellaria mediolateral, follicles united by a longitudinal vitelline duct; worm 2.25 mm long; ratio of sucker sizes, 4:3----- hospitale
 Vitellaria superficially placed, under ventral, lateral, or dorsal surface of body----- 6
6. Vitelline follicles few in number, dorsally placed; worm 1 mm to 1.4 mm long; ratio of sucker sizes, 2:1 to 8:5----- trituri
 Vitelline follicles numerous, ventrally, laterally, and dorsally placed----- 7
7. Testes transversely oval, medially placed, their inner margins overlapping midline; worm 1.7 mm long; ratio of sucker sizes, 7:5----- mesorchium
 Testes elongated oval, lateral in position----- 8
8. Testes large (more than 0.22 mm long); worm 1.3 mm long; ratio of sucker sizes, 2:1----- georgianium
 Testes less than 0.22 mm long; worm 0.75 to 1.4 mm long; ratio of sucker sizes, 5:3----- obesum



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